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FROM THE EDITOR



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In this issue we have a number of papers from the region. A paper from Libya looked at a case report of Brown Recluse Spider Bites. The author stressed that spider bite is a special skin incident encountered. She pointed out that severe envenomation by the black widow variants are associated with involuntary muscular spasm, diaphoresis, and hypertension which can be mistaken for an acute abdomen or myocardial infarction.

Prof Md. Abdul Goni looked at Fertility Decline-the Role of Non-Government Organizations (NGOs) in Bangladesh. The author indicated that recent statistics suggest that despite continued increase in contraceptive use and the functioning of NGO activities the fertility decline has stalled. He stressed that in order to achieve further decline in fertility, therefore, the policy makers should emphasize those policies that actively enhance women's status through education, more access to mass media as well as getting them involved in the workforce in the country and the need to encourage others NGOs to include family planning and education programs.

A paper from Bangladesh looked at primary data on 250 arsenicosis patients from the arsenic affected districts Nawabganj, Bangladesh. The data indicates that most of the patients are young, illiterate, low socioeconomic background and are suffering from

various diseases such as diabetes, blood pressure, asthma and heart diseases. The finding also shows that arsenicosis disease has changed the socioeconomic status of the patients and women are divorced due to arsenicosis. The multivariate analysis suggests that source of drinking water is the most important factor for arsenicosis. Proper initiatives should be taken immediately for the welfare of mankind.

A paper from Nigeria looked at domestic energy and the health problems of man and animals. The authors stressed that pollutants produced by several types of domestic energy could have adverse effects on the health of living things especially that of man and animals. The health problems found in human beings were that of chronic cough, eye irritation, headache, and others. These were common in individuals exposed to pollutants from coal and firewood. Similar health problems also occur in animals in environments where domestic energy is used. The paper recommends a systematic collection of data on the health problems of living things exposed to chemical residues from different sources of domestic energy in Nigeria.

A second paper from Bangladesh looked at Covariates of Early Childbearing in Bangladeshi Mothers: An Analysis of Teenage Women. The authors present the results of logistic regression analysis of early childbearing. Out of 11 variables, 8 variables influences early childbearing and they are: education of women, place of residence, religion, age at first marriage, father's education, marital duration, women's work status and contraceptive use.

BROWN RECLUSE SPIDER BITES; A CASE REPORT

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ABSTRACT

Spider bite is a special skin incident encountered. However there are more than 100,000 species of spiders, but most of them are not dangerous due to their delicate mouthparts, and if they bite, they cause local irritation, redness with swelling, pain, and itching which can last from a few hours to a few days. Those symptoms can be treated by over-the counter analgesics and antihistamines. Systemic symptoms are unusual. However, severe envenomations by the black widow variant are associated with involuntary muscular spasm, diaphoresis, and hypertension, which can be mistaken for an acute abdomen or myocardial infarction.

Key Words: Spider bite, Brown recluse spider, envenomation, tissue necrosis, necrotic arachnidism, skin necrosis, spiders

Case Report

A young healthy 36 year-old, white Libyan lady, five months pregnant (G2, P1+0) presented over the course of two days to the OPD with a wound lesion characteristic of a necrotic brown recluse spider bite, which had arisen accidentally when she woke-up in the morning. She presented complaining of pain, severe itching and swelling since two days. She came to us on the 4th day of her illness. Clinically the lesion was located on her lower right leg on the anterior ankle area and dorsal aspect of the right foot (as can be seen in Figure1), about 5 x 7 cm, with a central bluish-purple discolouration, and had three ulcerations at the base of the lesion, surrounded by an erythematous border, and swelling, O/E; hot and tender on palpation, associated with some fluid oozing. Patient does not have any chronic ailments.

Investigations requested were complete blood picture, liver function test, kidney function test, and routine urine analysis, and all were within normal range.

Patient came after a week for the first follow up, and she was much better as the lesion started to subside and close up gradually. Also the swelling decreased slightly; however the patient was still not satisfied and wanted a speedy recovery.

Background

There are more than 100,000 genuses of spiders, but two notable exceptions worth mentioning; are the black widow spider (*Latrodectus* species), and the brown recluse spider

(*Loxosceles* species). Most spiders are not dangerous to humans and do not require a spider bite treatment, but can be deleterious to babies, children and elderly due to their venom (toxin) when injected at the bite site¹. The black spider is a small dark black spider with a red hourglass mark on its belly, and found frequently in low-lying webs in garages, around swimming pools, and in wood piles and their bite occurs between April and October defensively, and is more venomous², while the brown spider is a long spider with a violin mark on its upper back, and lives in hot, dry abandoned areas such as woods, rocks and bed linen. A bite from a widow spider (mostly female black widow) results in sharp pain followed by swelling and erythema at the site of bite, which is characterised by two small fang marks at the bite site, then muscle spasms and rigidity starting at the bite site within 30 minutes to two hours, with chills, fever, and acute abdomen pain. While the brown recluse bites occur early in the morning because it is only active at night³, and its bite is painless, it won't be noticed at the start by the patient, but then a red skin area develops followed by a blister at the bite site, then pain with itching occurs for 2-8 hours post bite. These bites usually progress to ulcerating dermo-necrosis at the bite site within a few hours (Necrotic arachnidism) with necrosis which takes months to heal^{2,3}. Some generalised symptoms might be seen due to systemic reactions such as haemolytic anaemia fever, chills, and joint pain.

Usually a spider bite victim is unaware of the bite until some hours later. Spiders can cause severe envenoming, with either neurotoxic

effects or necrotic ulcers³. Though spider bites can produce necrotic skin lesion, the differential diagnosis of such lesions is extensive; mostly Community-Acquired Methicillin-Resistant *Staphylococcus aureus*; CA-MRSA, pyoderma gangrenosum, cutaneous anthrax and many more⁴.

Treatment is usually supportive; washing the site with water and soap, ice pack, elevation of the affected part to minimise inflammation and swelling, analgesics for the pain and antihistamine for the itching, and complete avoidance of any strenuous work. Any debridement or local steroid injection is forbidden completely as it might extend the extent of dermo-necrosis.

Discussion

The patient gave a classical history of spider bite, as she hadn't noticed, felt, or realised that she had been bitten in the first place, and that is well-documented in the literature that the spider is seldom ever seen by the patient. Ulcerating lesions of unclear aetiology always raise the suspicion of a spider bite. Diagnosis is made based on patient description and on clinical examination. Our patient woke-up in the morning and noticed her right foot was swelling, and associated with pain and severe itching though she slept in the night before and was perfectly fine. During these few days before she sought a medical consultation, she applied some local steroid ointment, but without any improvement. Patient did not give history of bulla formation, and this can be attributed to the associated severe itching and scratching. The ulcerative lesion over her right foot developed within the first two days, and can be explained to be the site of the bite by the spider as can be seen in the Figure-1 (double fang mark). The Brown recluse is the finest-known species of spiders belonging to the genus *Loxosceles*. These spiders are well-known because of their characteristic markings. They have a dark, violin-shaped marking on the cephalo-thorax part. They are also referred to as "fiddle back" spiders. Research speculated these spider's venom is responsible for the patho-physiological features of the bite (necrotic ulcer). When the spider

bites, it injects cytotoxic venom, which is composed of many potent enzymes; alkalinephosphatase, 5-ribonucleotide phosphohydrolase, lipase, protease, esterase, hyaluronidase, and the most important and active enzyme is sphingo-myelinase-D which was postulated a long time ago by Forrester et al in 1978. It was believed that sphingo-myelinase enzyme was the sole cause for haemolysis, plus cutaneous and systemic reactions, as was explored by Forrester et al⁵. Later on, this venom was projected to be the cause the dermo-necrosis by Patel et al. (1994)⁶. This was explained by initiating a reaction in the vascular endothelium, which would attract the neutrophil, and later would attach to endothelium and induce a reaction by releasing its granules. This mechanism starts by inducing the release of E-selectin, which causes release of cytokines; namely interleukin-8 and granulocyte macrophage colony-stimulating factor, both of which act as key mediators in the attraction and activation of neutrophils, whereby the neutrophils bind to E-selectin, then degranulate and cause tissue destruction. Our case illustrated a minimal route of cutaneous loxoscelism (skin necrosis), and that can be explained because the affected location has few fat cells.

A literature review indicates and assures that the brown recluse spider bite is a frequent and sometimes can be a serious clinical entity⁷. Furthermore literature review acknowledged only a few reported cases of loxoscelism involving the dorsum of a foot as our case is. Those cases mentioned in the literature illustrated lesions consistent with bites caused by the bite of a Brown recluse spider, but none supplied definitive proof for the causation by the brown recluse spider.

Each case expresses early morning swelling, with redness and pain leading to significant oedema without noticing the spider at the first place⁸. The lesions became necrotic in the first day, formed black eschar and resulted in some degree of scarring when healed. All cases passed through similar stages and within the same time. Later on the outcomes were satisfactory to each

affected case.

Management decisions stipulate cautious consideration of exact location of the bite, degree of envenomation, age and general circumstances of the patient's health. Though Anderson & Wasserman, noted in 1997 the infrequency of severe systemic reactions^{9,10}, Wilson and King indicated in 1990 that complications occur more frequently with bites to the eyelids, hands and feet¹¹. Conservative approach was suggested as there is no observed support for various treatment modalities¹². The old modality of treatment involved dapsone, topical nitroglycerin and hyperbaric oxygen, as dapsone was thought to limit tissue destruction by the suppression of neutrophils but evidence supporting their use is lacking¹². Furthermore a current controlled study using New Zealand white rabbits failed to indicate benefit of either of these modalities^{14,15}.

An additional area of research involves the use of anti-venom. Rees et al. reported the benefit of administering anti-venom in limiting the extent of dermo-necrosis if it was given within the first 24 hours¹⁶. Regrettably anti-venom is not readily accessible and must be administered early following injury.

Although the management of this case is not presented as a therapeutic model, we believe the potentially dangerous location of the bite and the severe clinical presentation justified aggressive treatment, because they are available, and can be administered in a cautiously controlled scenery. To conclude it is always impossible to foresee what the clinical outcome would be, but in our case we approached her more conservatively¹⁷.

Lastly to the best of our knowledge, no such case report has been reported yet in the literature, and this would add it to the literature.

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Table 1. Comparison of Widow Spider and Recluse Spider Bites

Bite species	Widow spider (Latrodectus) bites	Recluse spider (Loxosceles) bites
early bite symptoms	Moderately to severely painful; little or no surrounding inflammation	Painless or minimally painful; localized inflammation that afterwards spreads
mechanism of envenomation	neurotoxic	cytotoxic
main toxin	alpha-Latrotoxin	Sphingomyelinase D
expected for systemic toxicity	Present	rare
Incubation period from bite to systemic toxicity	Rapid (30 minutes - 2 hours)	Delayed (3-7 days)
systemic toxicity signs	Muscular spasm, rigidity mimicking acute abdomen	Arthralgias, fever, chills, maculopapular rash, nausea
Other possible signs	Arthralgias, diaphoresis, fever, hypertension	Fever, chills, hemoglobinuria, myoglobinuria, acute renal failure
Outcomes of most bites	Resolution of all manifestations over 2-3 days; death rarely occurs	Most necrotizing ulcers will heal over 1-8 weeks with a 10 -15 % incidence of major scarring.

COVARIATES OF EARLY CHILDBEARING IN BANGLADESHI MOTHERS: AN ANALYSIS OF TEENAGE WOMEN

Md. Roshidul Islam¹, Md. Nurul Islam¹, Samad Abedin² and Golam Hossain¹

ABSTRACT

Early pregnancy is a critical issue in safe motherhood. Childbearing in Bangladesh is characterized by early start of motherhood, quick progress till the peak age of reproduction and slow progress till the end of the childbearing period. This article presents the results of logistic regression analysis of early childbearing concerns. Out of 11 variables, 8 variables influencing early childbearing are: education of women, place of residence, religion, age at first marriage, father's education, marital duration, women's work status and contraceptive use. The study will utilize data from the 2004 Bangladesh Demographic and Health Survey (BDHS) and we have employed a nationally representative, two-stage sample that was selected from the master sample maintained by the Bangladesh Bureau of Statistics (BBS) for the implementation of surveys.

Key Words: Covariate. Early Childbearing. Teenage Women. Bangladesh. Logistic Regression.

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Introduction

Fertility in Bangladesh is high even by the standards of developing countries. Recent evidence suggests that fertility has started to decline in Bangladesh (Amin and others, 1993). The total fertility rate has declined from nearly seven births per woman in 1975 to 3.4 births per woman in 1996 (BFS, 1975; BDHS, 1993-1994). A number of demographers have argued that the mechanism of this steep fertility decline was achieved primarily due to successful family planning (Amin et al., 1990; Cleland et al., 1994; Cleland, 1993; Islam et al., 1998), that succeeded in raising the contraceptive prevalence rate (CPR) from a low level of 8 percent in 1975 to as high as 53 percent in 2004. However, from 1993-1994 the level of fertility appears to be unchanged at a level of 3.3, as indicated by the last three surveys (BDHSs) in Bangladesh in 1996-1997, 1999-2000 and 2004. About half of the population of Bangladesh is female and most live in rural areas with low status in the family, as well as in society. Fertility in Bangladesh is high even by the standards of developing countries. Early childbearing may have a risk of a poor or tragic outcome among those who have already had many births (Haaga). High parity is associated with increased risk of maternal mortality where mothers may be less able to meet the physiological demands of repeated pregnancy (Koenig and others, 1987). In many developing countries about 50 percent of pregnancy terminations occur among

the high-risk mothers (Rinehart and Kols, 1984) and the wide choice of family planning methods now available allow health programmes to offer an appropriate technique to avoid each type of early pregnancy. Every early pregnant woman faces risk - high or low, during her childbearing period. In the following section an effort is made to identify the factors that have an influence on early childbearing according to teenage women. A woman's teenage fertility is considered as a dependent variable. The aim should be in identifying the variables, which have a significant influence on the dependent variables. Logistic regression analysis identifies the variables, which influence early childbearing. The analysis of teenage is of interest in this context since it can provide further insights into the mechanisms underlying fertility change (Njogu and Martin, 1991). Early childbearing in the human population is a complex phenomenon. Analysis of early childbearing is even more complex since a number of biological, behavioral and cultural factors are associated with it. In the context of Bangladesh, only a few studies, not all of them nationally representative, have been carried out to examine the effects of various factors on childbearing performance (Islam et al., 1995; Islam, 1999). Therefore, the purpose of the present paper is to identify the factors influencing early childbearing in the context of teenage years of Bangladeshi women, employing the technique of logistic regression analysis.

Materials and Method

In this study, early childbearing had the demographic characteristics such as teenage. The study will utilize data from the 2004 Bangladesh Demographic and Health Survey (BDHS) which employed a nationally representative, two-stage sample that was selected from the master sample maintained by the Bangladesh Bureau of Statistics (BBS) for the implementation of surveys. A total of 10,811 households were selected for the sample; 10,523 were occupied of which 10,500 were successfully interviewed. The shortfall is primarily due to dwellings that were vacant or destroyed or in which the inhabitants had left for an extended period at the time the interviewing teams visited them. Of the households occupied, 99.8% were successfully interviewed. In these households, 11,601 women were identified as eligible for the individual interview (i.e. ever-married and age 10-49) and interviews were completed for 11,440 or 98.6% of them. The multivariate logistic regression analysis provides a powerful statistical technique for identifying early childbearing with respect to several socio-economic and demographic variables, simultaneously.

The explanatory variables considered in this model are discussed in the following table:

Adolescent Fertility

Adolescent fertility is a major social and health concern. Teenage mothers are more likely to suffer from severe complications during delivery, which result in higher morbidity and mortality for both themselves and their children. In addition, young mothers may not be sufficiently emotionally mature to bear the burden of childbearing and rearing. Every entry into reproduction denies them the opportunity to pursue academic goals. This is detrimental to their prospects for good careers, which often lowers their status in society.

Table 2 shows that one-third of adolescents age 15-19 have begun childbearing. Twenty-eight percent of these teenagers in Bangladesh have given birth, and another five percent are pregnant with their first child. As expected, the proportion of women age

15-19 who have begun childbearing rises rapidly with age. Early childbearing among teenagers is more prominent in rural areas, compared with urban areas, and in Rajshahi and Khulna divisions, compared with other divisions. Childbearing begins later in Sylhet, compared with the rest of the divisions, mainly because of relatively late marriage in Sylhet. Delayed childbearing is strongly related to education among women age 15-19. Only 16 percent of the teenagers who had completed secondary education had begun childbearing, compared with almost half of those with primary incomplete or no education.

Logistic Regression Model

The logit of the multiple logistic regression models is given by the equation

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p \quad \text{----- (i)}$$

In which case

$$P_i = \frac{e^{g(x)}}{1 + e^{g(x)}} \quad \text{----- (ii)}$$

And $1 - P_i = \Pr(Y = 0 / x_{i1}, x_{i2}, x_{i3}, \dots)$

$$x_{ip} = \frac{e^{g(x)}}{1 + e^{g(x)}} \quad \text{----- (iii)}$$

Equations (ii) and (iii) look complicated, however, the logarithm of the ratio of P_i and $1 - P_i$ is a simple linear function of x_{ij}

$$\text{Let } \lambda_i = \log_i = \beta' x \quad \text{----- (iv)}$$

Which express the log odds of occurrence on an event (i.e. independent variable) as a linear function of the independent variables. The logit is thus the logarithm of the odds of success, that is, the logarithm of the ratio of the probability of success to the probability of failure. It is also called the logit transformation of P_i and equation (iv) is linear logistic model. It has several nice properties; P_i is bounded only between 0 and 1. If $\mathcal{L}(Y) < 0.5$, logit P_i is negative; while if $P_i > 0.5$, logit P_i is positive.

Results of Logistic Regression Analysis

The result of logistic regression

analysis is shown in Table 3. The regression coefficients in the model are also shown in the table. The variables are education of women (x_5), religion (x_8) and age at first marriage (x_2) are 1% level of significance, the variables place of residence (x_9), marital duration (x_3) and contraceptive use (x_{10}) are 5% level of significance and the variables father's education (x_6) and women's work status (x_7) are 10% level of significance. The sixth column of the Table 1.3 shows the odds ratios. For example, the odds ratio of mother's education (x_5) is 1.116 indicates that early childbearing will be 1.116 times higher for those mothers who have no education than those mothers who have education. Also, the odds ratio of place of residence (x_9) is 1.355 which indicates that early childbearing will be 1.355 times higher for those mothers who live in rural areas than those mothers who live in urban areas. The odds ratio of religion (x_8) is 1.934 and indicates that early childbearing will be 1.934 times higher for those mothers who are Muslim than those mothers who are non-Muslim. The odds ratio of age at first marriage (x_2) is 1.235 indicates that early childbearing will be 1.235 times higher i.e. for those mothers whose age at first marriage is less than 16 years than those mothers whose age at first marriage is 16 or more years. Similarly the variables on fathers education (x_6) is 0.769 times higher, women work status (x_7) is 2.964 times higher, marital duration (x_3) is 0.241 times higher and the variable contraceptive use (x_{10}) is 0.711 times higher for their categories. Therefore, the most important significant variables that influence early childbearing mothers are place of residence, religion, age at first marriage, women's work status, mother's education, father's education, contraceptive use and marital duration. The most significant variable is education and the next significant variable is place of residence and so on.

The logistic regression equations for early childbearing becomes

$$Z_0 = 2.077 + 0.132x_2 + 6.552x_3 +$$

$$0.110x_5 + 0.214x_6 + 0.483x_7 + 0.660x_8 + 0.340x_9 - 0.342x_{10}$$

Conclusion and Policy Implication

The present study is a modest attempt to categorize the variables into two ways and to analyze the early childbearing pattern in context of prevailing socio-economic conditions. There is no doubt about the contributions of early childbearing patterns in regulating population growth of the country. Reasonably and hopefully it is believed that in the light of findings of the study, policy makers and planners will show a congenial and judicious path for the development of Bangladesh.

Higher socio-economic status of women will contribute to change the pattern of early childbearing. Education of women and employment opportunities, particularly in rural areas will contribute to depress the level of early childbearing performance.

Education may provide better employment opportunities outside home and providing education to females, especially at the secondary and higher levels can increase age at marriage and age at first birth. Delaying the start of childbearing at young ages would save many women's lives.

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Table 1 List of explanatory variables of logistic regression model for early childbearing pattern (Codes and Categories)

Characteristics	Variable Level	Codes and Categories
Current age of women	x_1	0 = Less than 16 years 1 = 16-19 years
Age at first marriage	x_2	0 = Less than 16 years 1 = 16 or above
Marital duration	x_3	0 = 0-4 years 1 = 5-9 years
Children ever born	x_4	0 = Less than 2 1 = 2 or more
Education of women	x_5	0 = No education 1 = Primary or more
Father's education	x_6	0 = No education 1 = Primary or more
Women's work status	x_7	0 = Never working 1 = Ever working
Religion	x_8	0 = Muslim 1 = Non-Muslim
Place of residence	x_9	0 = Rural 1 = Urban
Contraceptive use	x_{10}	0 = Never use 1 = Ever use
Husband's occupation	x_{11}	0 = Unemployed 1 = Employed

Table 2. Percentage of mothers age 15-19 with their first child and background characteristics

Background characteristic	Percentage who are:		Percentage who have begun child-bearing	Number of women
	Mothers	Pregnant with first child		
Age				
15	7.5	4.0	11.5	778
16	18.3	3.9	22.2	706
17	30.8	6.4	37.2	660
18	36.9	5.9	42.8	629
19	54.8	4.0	58.8	563
Residence				
Urban	21.9	4.3	26.1	758
Rural	29.7	5.0	34.7	2576
Division				
Barisal	25.9	3.6	29.5	215
Chittagong	23.7	4.0	27.7	725
Dhaka	27.2	4.2	31.5	956
Khulna	21.2	6.4	37.7	367
Rajshahi	35.7	6.6	42.3	797
Sylhet	16.2	2.8	19.0	271
Education				
No education	42.5	4.0	46.5	435
Primary incomplete	40.2	5.6	45.8	541
Primary complete	32.8	4.3	37.1	334
Secon. incomplete	22.3	5.0	27.2	1760
Secon. complete or higher	10.9	4.6	15.5	253
Wealth index				
Lowest	37.7	3.2	40.9	559
Second	33.7	5.6	39.2	665
Middle	21.7	3.6	25.2	1006
Fourth	17.4	4.5	21.9	949
Highest	23.0	5.6	28.5	492
Total	27.9	4.8	32.7	3337

Source: BDHS- 2004.

Table 3: Odds ratios, regression coefficients and their significance level of logistic regression models

Variables	Coefficients	S.E	p-value	Wald statistic	Odds ratio
Education of women (X_9)					
No education	0.110	0.194	0.000	0.323	1.116
Primary or more					
Place of residence (X_9)					
Rural	0.304	0.140	0.030	4.709	1.355
Urban					
Religion (X_8)					
Muslim	0.660	0.253	0.009	6.779	1.934
Non-Muslim					
Father's education (X_6)					
No education	0.214	0.148	0.075	3.174	0.769
Primary or more					
Age at first marriage (X_2)					
Less than 16 years	0.132	0.196	0.006	61.241	1.235
16 or more					
Women work status (X_7)					
Never working	0.483	0.052	0.059	6.489	2.964
Ever working					
Marital duration (X_3)					
0-4 years	6.552	0.231	0.023	1.226	0.241
5-9 years					
Contraceptive use (X_{10})					
Never use	-0.342	0.138	0.014	6.097	0.711
Ever use					
Constant	2.077	0.470	0.000	19.562	7.983

DOMESTIC ENERGY AND THE HEALTH PROBLEMS OF MAN AND ANIMALS

ABSTRACT

Pollutants produced by several types of domestic energy could have adverse effects on the health of living things especially that of man and animals. The health problems found in human beings were that of chronic cough, eye irritation, headache, and others. These were common in individuals exposed to pollutants from coal and firewood. Similar health problems also occur in animals in environments where domestic energy is used. Common health problems found among animals were loss of ciliated epithelium in the upper respiratory tract, lysis of erythrocyte within alveolar capillaries and breakdown of capillary endothelium and others. However, one problem of this study is the dearth of literature on the health problems of living things exposed to domestic energy in Nigeria. There was little or no literature available for review at the time of study.

The paper recommends a systematic collection of data on the health problems of living things exposed to chemical residues from different sources of domestic energy in Nigeria. This is necessary because research has shown that exposure to sources of domestic energy such as coal, kerosene, firewood, gas, sawdust and others, has adverse effects not only on the health of human beings but also on that of animals.

Key Words: Exposure to domestic energy, erythrocyte, epithelium, Nigeria.

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Introduction

Domestic energy in this paper refers to substances such as coal, kerosene, firewood, gas, electricity, sawdust and others that are used for generating energy in homes. The paper documents the various pollutants these sources of energy emit and the resultant health problems on living things especially on man and animals. Studies by Coffin and Gardner, (1972) and Graedal, (1978) have shown that domestic sources of energy also produce chemical residues, which destroy plant growth. Plants produce oxygen for respiration (Coffin and Gardner 1972). The destruction of plants causes depletion of the levels of oxygen in the atmosphere. This depletion of the levels of oxygen in the atmosphere the studies uphold, adversely affect the respiratory systems of both man and animals (Goran, 1995, Radim, 1966 and Yoko (1974). The studies further showed that gases emitted from domestic energy directly or indirectly affect the health of women more than that of other users. The studies argued that the gender roles women take on; expose them to the hazards of different sources of domestic energy more than men. As such, women more than men are at risk of the effects of the pollutants emitted by domestic sources of energy. Studies by Goldberg (1996) and Spin et. al. (1993) confirm the findings of Gorna (1995) and Yoko (1974) that the gender roles women take on expose them to the hazards of different sources of domestic energy more than men. For instance, the findings of Spin et.al. (1993) Dejmek, et al. (1995) and Goldberg et al. (1996) maintain that some gases transverse the mammary gland

especially that of nursing mothers and contaminate the breast milk thereby endanger the life of breastfeeding babies. Among the pollutants or chemical residues identified by these authors include sulfur oxide, carbon monoxide, oxides of nitrogen and volatile organic compounds. These pollutants were found to accumulate in the body systems to form toxic levels (Rasmussen 1992). The studies by Rasmussen (1992) and Nakazawa (1990) argue that individuals exposed to smoke from coal and firewood are particularly more at risk than others of developing nasal discharge, tachycardia (excessive rapid heart beat), asthma (asphyxia due to contraction of the airways) and phlegm (mucus secreted by the mucosa of the air passages).

Further evidence from Ko (1996) and Yoko (1974), showed that nitrogen oxide constitutes pollutants that adversely affect health by producing photochemical and other chemical agents that affect the respiratory system of man and animals. In man, nitrogen oxide causes fibrosis of the lungs, phlegm, chronic cough, breathlessness, ataxia, confusion, pneumonia, eye irritation, tachycardia, and arrhythmias. In animals, nitrogen oxide causes increase in the frequency of respiration, decrease in tidal volume as well as inflammation of cells in the tonsil. The findings of Klassen (1980) Nakazawa (1990), Romm and Ervin (1996) argue that indoor cooking with kerosene and gas stoves, produce pollutants that affect the health of living things as much as other indoor activities like cigarette smoking, using ultraviolet lamps, electrostatic precipitators, photocopying machines and odour

control equipment. The findings of Nakazawa (1990) specifically confirm that while the pollutants produced by indoor cooking with kerosene and gas stoves are more of nitric oxide, and ozone, these indoor activities such as cigarette smoking, using ultraviolet lamps, electrostatic precipitators, photocopying machines and odour control equipment produce more of ozone, carbon monoxide, sulfur dioxide and nitrogen oxide than other gases. Evidence from Fetner (1962), Selevan (1995), White (1976), Stephen (1973) and Freeman (1973) confirm that the primary targets of ozone are the respiratory tract especially the pulmonary parenchyma and the reproductive system.

Exposure to ozone has various effects on living things. For instance, several findings reveal that in man, exposure to ozone causes metaplasia and fibrosis of bronchiolar epithelium (White 1976) as well as breakage of chromosomes (Fetner 1962). In rats, it causes pulmonary oedema, while in dogs it results in haemorrhage and death (Stephen 1973). Generally, ozone causes a reduction in the number of alveolar cells especially those that synthesize deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) (Selevan (1995). In guinea pigs, ozone causes increase in respiration as well as a decrease in tidal volume while in rabbits, exposure to ozone causes inflammation of the cells of the tonsil Freeman et.al. (1973). Also the studies by Yoko (1974) and Coffin (1972) reported that other gases like nitrogen dioxide and sulfur dioxide also have effects on other laboratory animals. For instance, in cats, nitrogen dioxide caused erythrocyte lysis in alveolar capillaries and a breakdown of capillary endothelium (Yoko 1974).

In cats, exposure to sulphur dioxide results in swelling of type I alveolar cells as well as loss of ciliated epithelium while in rabbits, exposure to sulfur dioxide causes inflammation of the cells in the tonsil (Coffin 1972). Generally, the researchers observed that animals exposed to a mixture of nitrogen oxide and sulfur dioxide had loss of phagocytic and macrophagic properties of the pulmonary alveolar cells as well as a complete loss of motor activities and that such animals

suffered decrease in resistance to bacterial infections (Coffin 1972 and Yoko (1974).

On the effects of exposure to carbon monoxide poisoning, the findings of Radim (1966) stressed that it produces carboxyhaemoglobin (irreversible combination with hemoglobin) as well as pneumonia, asthma, cardiovascular diseases, chronic cough, confusion, eye irritation, and non-productive cough. The aim of this paper is to highlight the health problems of man and animals, that are exposed to pollutants from various sources of domestic energy.

Domestic energy in this paper refers to substances such as coal, kerosene, firewood, gas, electricity, sawdust and others that are used for generating energy in homes. The paper documents the various pollutants these sources of energy emit and the resultant health problems on living things especially on man and animals. Studies by Coffin and Gardner, (1972) and Graedal, (1978) have shown that domestic sources of energy also produce chemical residues, which destroy plant growth. Plants produce oxygen for respiration (Coffin and Gardner 1972). The destruction of plants causes depletion of the levels of oxygen in the atmosphere. This depletion of the levels of oxygen in the atmosphere the studies uphold, adversely affect the respiratory systems of both man and animals (Goran, 1995, Radim, 1966 and Yoko (1974). The studies further showed that gases emitted from domestic energy directly or indirectly affect the health of women more than that of other users. The studies argued that the gender roles women take on; expose them to the hazards of different sources of domestic energy more than men. As such, women more than men are at risk of the effects of the pollutants emitted by domestic sources of energy. Studies by Goldberg (1996) and Spin et. al. (1993) confirm the findings of Gorna (1995) and Yoko (1974) that the gender roles women take on expose them to the hazards of different sources of domestic energy more than men. For instance, the findings of Spin et.al. (1993) Dejmek, et al. (1995) and Goldberg et al. (1996) maintain that some

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pollutants from various sources of domestic energy.

Methods

Documents were reviewed in this study. In this review, the effects of exposure to various sources of domestic energy on the health of living things especially on man and animals were examined. In doing this, extensive review of relevant literature was done. This helped to unravel the specific health problems encountered by human beings and animals exposed to pollutants, emitted from various sources of domestic energy. In addition, the frequencies of the health problems as noted in the review were computed so as to give an overview of the magnitude of the problems in society.

These frequencies represent the compilation of various health problems of individuals reported in the literature reviewed.

These frequencies represent the compilation of health problems of experimental animals reported in the literature reviewed

Analysis of Results

The finding showed that exposure to pollutants from coal, firewood, gas, and kerosene stoves produced several health problems including influenza epidemics, pneumonia, asthma, lung cancer, cardiovascular diseases, chronic cough, wheezing, breathlessness, hair loss, ataxia, confusion, pneumonia, eye irritation, non-productive cough, tachycardia, arrhythmias and impaired lung function in man and animals. The study established that indoor activities like cigarette smoking and cooking with gas stoves produce nitrogen oxide, while ultraviolet lamps, electrostatic precipitators, photocopying machines and odour equipment increase the level of ozone in the atmosphere. These gases as produced, especially ozone, affect the respiratory tract particularly the pulmonary parenchyma, causing metaplasia, fibrosis of the bronchiolar epithelium, atelectasis, bronchopneumonia and emphysema. The study noted that ozone at 740g/m³ (0.37ppm), sulfur dioxide at 960g/m³ (0.37ppm) had synergistic actions and individuals

exposed to them developed severe chronic obstructive lung diseases. In addition, the study confirmed that ozone induces chromosome breakage in man. The study established that increase in the levels of ozone, sulfur dioxide, nitrogen oxide and carbon monoxide in the environment killed green plants thereby giving rise to the depletion of oxygen in the atmosphere. In rats and dogs, the study found that exposure to ozone caused oedema in rats, haemorrhage and death in dogs. Generally, there was degeneration and destruction of type I alveolar cells as well as that of type II epithelial cells in both rats and dogs. Further findings showed that in cats, exposure to ozone resulted in loss of ciliated epithelium in the upper respiratory tract, swelling of type I alveolar cells, lysis of erythrocyte within alveolar capillaries, as well as complete loss of motor activities. Detailed analysis of the findings showed that exposure to ozone in both man and animals resulted in the reduction of alveolar cells particularly those that synthesize deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). In guinea pigs, the finding identified increased rate of respiration and decrease in tidal volume. In rabbits, the study identified metaplasia and fibrosis of the lungs as well as inflammation of the cells in the tonsil. Further analysis on the effects of exposing experimental animals to ozone showed increase in the activities of the enzymes that protect against intracellular oxidation of unsaturated fatty acids.

This effect was noted in the experimental animals both in vivo and in vitro. Also the finding showed that ozone reacted with the animals' body to produce free radicals that initiated peroxidation of other unsaturated fatty acids. In all, the animals with vitamin E deficiency were found more susceptible to the adverse effects of ozone than others. Further, the study found that some experimental animals lacked the ability to synthesize both deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) and as such, they were highly susceptible to bacteria and virus infections.

The study noted that lung cancer and cardiovascular diseases are common among individuals living in

areas where no demarcation exists between plants and residential areas. The finding noted that gases like ozone, nitrogen oxide, sulfur dioxide and carbon monoxide had lethal effects on green plants. This effect caused a reduction in the amount of oxygen the plants produced in the atmosphere. The study found that constant smoke/fumes from coal and firewood affect the respiratory organs as well as the reproductive system. It noted that 35% of men who by the nature of their jobs were constantly exposed to smoke /fumes from coal and firewood had reproductive health problems. About 45% of women whose husbands worked as Cooks and Stewards had problems with conception. Specifically, these men who worked as Cooks were diagnosed with low semen quality. The finding further confirmed that about 45 (55%) of the pregnant women living in areas where coal, during winter, was used to heat the living rooms had premature births, low birth weight babies, and miscarriages and that 69 (36%) of others whose pregnancies were carried to term had babies with congenital abnormalities.

The finding also noticed that individuals as well as animals exposed to ozone had difficulty in synthesizing DNA and RNA. Health problems like phlegm, chronic cough, wheezing, breathlessness, hair loss, ataxia, confusion, pneumonia, eye irritation, non-productive cough, tachycardia, arrhythmias and impaired lung function were common among individuals exposed to nitrogen oxide, sulfur dioxide and carbon monoxide. The study noted that experimental animals when exposed to nitrogen oxide and sulfur dioxide developed several health problems. For instance, in cats, nitrogen oxide caused erythrocyte lysis with alveolar capillaries and a breakdown of capillary endothelium while exposure to sulfur dioxide resulted in swelling of type I alveolar cells as well as loss of ciliated epithelium. In rabbits, exposure to sulfur dioxide caused inflammation of the cells in the tonsil. Generally, animals exposed to nitrogen oxide and sulfur dioxide exhibited impaired phagocytic properties in the pulmonary alveolar macrophages and also had complete loss in motor

activities. As a result, the animals suffered decrease in resistance to bacteria infections. The Tables below contain the compilation of the health problems of individuals and animals exposed to domestic energy as noted in the study.

Discussion

The study highlighted the types of health problems human beings and animals experience when exposed to pollutants from different types of domestic energy. The finding showed that gas stoves, kerosene stoves, firewood, coal, electric stoves, cigarette smoking, ultraviolet lamps, electrostatic precipitators, photocopying machines and odour control equipment all emit ozone, nitrogen oxide, sulfur dioxide, and carbon monoxide which adversely affect health. The study found that exposure to coal and firewood produced more health problems than other types of domestic energy. This finding confirms that of Goran, et al. (1995), Romm and Ervin (1996), Selevan, et al. (1995), and Spin, et al. (1993), which observed that exposure to smoke/fumes from coal and firewood produce more health problems than others and that the effects are more on the respiratory organs. Goran, et al. (1995), as well as Dejmek, et al. (1995) Selevan et al. (1995) found adverse health effects on the reproductive systems. In man, exposure caused low sperm count while in women, exposure caused miscarriages and infertility. This health problem may be as a result of the large amounts of pollutants generated by burning coal and firewood, which were the main sources of energy used. Subsequently, coal and firewood produce more ozone and nitrogen oxide than other sources of domestic energy (Coffin and Gardner 1972, and Goldberg et al. 1996). These authors found that exposure to ozone and nitrogen oxide gives more health problems than other pollutants. Rasmussen (1992) identified that health problems like phlegm, chronic cough, wheezing, breathlessness, hair loss, ataxia, confusion, pneumonia, eye irritation, non-productive cough, tachycardia, arrhythmias and lung cancer were common among individuals exposed to ozone and nitrogen oxide.

Four important issues were noted in this study. First, respiratory tract mortality levels were significantly high in both man and animals. The study showed that the larger the amount of pollutants generated, the higher the respiratory tract mortality levels. This is consistent with the views of (Kagawa, and Toyama 1975, Ko 1996, Ng et al. 1993 Spin et al. 1993 Freeman et al. 1973, and Yoko 1974). Secondly, the finding showed that exposure of man and animals to ozone reduces their resistance to bacterial infection. This observation agrees with that of Coffin, and Gardner (1972) Goran et al. (1995), White et al (1976) and Stephen et al. (1973) in which low immunity was noted as a result of the general impairment of the phagocytic properties of microphages on microorganisms. As a result, microorganisms continuously invade the immune system. The study found that in such animals, that they develop complete loss of motor activities. This view is consistent with that of (Coffin, and Gardner, 1972). Thirdly, exposure to high levels of pollutants directly reduces growth in children (Kagawa. and Toyama 1975, longevity in adult) Graedal 1978, and Holland et al. 1979). Also, exposure to high levels of pollutants retard the sexual capacities in man (Goran et al. 1995, and Selevan et al. 1995), and also that in animals (Stephen et al. 1973, and Freeman et al. 1973). Exposure also increases miscarriages in women (Fetner et al. 1962 and Dejmek et al 1995). Additionally, this exposure caused mothers to give birth to children with congenital abnormalities (Dejmek et al 1995). The study argues that this condition in which some babies were born with congenital abnormalities, may be as a result of the effects of ozone on chromosomes. Ozone induces the breakage of chromosomes by adversely affecting the synthesis of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) in living things (Fetner et al 1962). The living things exposed to high levels of pollutants were susceptible to bacteria and virus infections. The findings are consistent with that of Stephen et al. (1973), Freeman et al. (1973), Yoko (1974), and Coffin and Gardner (1972) in which laboratory animals exposed to ozone and nitrogen oxide presented

faulty motor activities. Finally, individuals exposed to pollutants from coal and firewood presented with similar health problems as those exposed to cigarette smoking, ultraviolet lamps, electrostatic precipitators, photocopying machines and odour control equipment. This agrees with the findings of Coffin and Gardner, (1972), Klassen (1980), Ng et al.(1993), and Radim et al.(1966).

Additionally, respiratory tract problems were common among individuals living in areas where there is no demarcation between plants and residential quarters. Specifically, lung cancer and cardiovascular diseases were common among individuals living in these areas. This condition may be as a result of the quantity of oxygen available to the lungs during respiration. The finding noted that gases like ozone, nitrogen oxide, sulfur dioxide and carbon monoxide exterminate green plants thereby reducing the amount of oxygen that the plants can produce in the atmosphere. Depletion of oxygen levels in the atmosphere may reduce the amount of oxygen reaching the lungs during respiration. This can cause impaired lung function. This finding confirms that of (Ko, 1996, Nakazawa 1990 and Rasmussen, 1992).

The findings have important implications on the health status of all living things in Nigerian society. This is because many individuals especially in rural areas do not have clear demarcation between the living apartments and plants. In addition to this, most individuals who have no kitchen, cook under these trees. In many of the living quarters, ventilation is deficient and at times, people cook and sleep in the same room.

The study recommends educating individuals on the risks of excessive exposure to domestic energy. At the same time, since there is inadvertent exposure of individuals to domestic energy as a result of the living conditions and gender roles, the paper recommends periodic clinical and epidemiological studies to ascertain the extent of the problem in Nigerian society. This is necessary because the bulk of the study was from developed countries, with little or nothing from developing countries

including Nigeria.

The paper also recommends cooking in the open and less crowded areas so as to enhance the atmospheric absorption of pollutants produced by the use of domestic energy.

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Table 1: Health problems of individuals exposed to different sources of domestic energy.

Health problems of individuals	Sources of domestic energy				
	Gas	Coal	Kerosene	Firewood	Other indoor activities (Cigarette smoking, ultraviolet lamps, electrostatic precipitators, photocopying machines and odour control equipment)
Phlegm	20%	11%	5%	20%	5%
Nasal discharge	12%	50%	14%	12%	11%
Asthma	2%	5%	3%	2%	4%
Emphysema	12%	15%	13%	12%	1%
Flu epidemics	2%	3%	2%	2%	7%
Tachycardia	7%	40%	9%	7%	19%
Metaplasia of bronchiolar epithelium	30%	32%	20%	30%	7%
Atelectasis	3%	21%	2%	13%	18%
Pneumonia	1%	5%	1%	7%	5%
Chronic cough	40%	33%	38%	40%	24%
Hair loss	14%	21%	18%	14%	18%
Headache	2%	2%	1%	2%	6%
Eye irritation	22%	23%	21%	22%	15%
Chromosomal abnormality	9%	15%	10%	9%	19%
Bronchitis	16%	30%	12%	16%	9%
Low sperm count	10%	12%	19%	9%	3%
Abortion/miscarriage	21%	20%	17%	13%	14%
Low birth weight babies	17%	28%	10%	17%	19%
Premature babies	16%	24%	12%	16%	25%

Table 2: Health problems of animals exposed to different sources of Domestic energy

Health problems in animals	Types of domestic energy				
	Gas	Coal	Kerosene	Firewood	Other indoor activities (Cigarette smoking, ultraviolet lamps, electrostatic precipitators, photocopying machines and odour control equipment)
Loss of ciliated epithelium	4%	15%	10%	18%	18%
Pulmonary oedema	2%	20%	7%	10%	6%
Hemorrhage	1%	11%	3%	14%	27%
Destruction of type I alveolar cells	3%	17%	1%	22%	33%
Destruction of type II alveolar cells	2%	23%	4%	25%	30%
Swelling of type I alveolar cells	8%	36%	11%	38%	29%
Lysis of erythrocyte within alveolar capillaries	6%	33%	8%	33%	35%
Increased frequency of respiration and decrease in tidal volume	-	3%	1%	8%	24%
Metaplasia and fibrosis of bronchiolar epithelium	1%	27%	5%	34%	22%
Inflammation of cells in the tonsil	15	32%	1%	35%	38%
Production of free radicals	5%	30%	7%	36%	30%
Chronic lung disease	1%	25%	3%	19%	20%
Increase in concentration of enzymes	6%	32%	10%	29%	19%
Loss of motor activity	1%	17%	4%	35%	15%

DIFFERENTIALS OF ARSENICOSIS IN BANGLADESH

ABSTRACT

This study was conducted on the basis of primary data on 250 arsenicosis patients from the arsenic affected districts Nawabganj, Bangladesh. The data indicates that most of the patients are young, illiterate, of low socioeconomic background and they are suffering from various diseases such as diabetes, blood pressure, asthma and heart diseases. The finding also shows that arsenicosis disease has changed the socioeconomic status of the patients and women are divorced due to arsenicosis. The multivariate analysis suggests that source of drinking water is the most important factor for arsenicosis. Proper initiatives should be taken immediately for the welfare of mankind.

Key Words: Arsenicosis, Arsenic Contamination, Safe Drinking Water, Multiple Classification Analysis

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Introduction

Arsenic contamination of groundwater and its adverse impact on people has been identified as one of the most horrendous man-made environmental disasters of the twentieth as well as twenty-first centuries. The CBS television of USA compared it with the Chernobyl atomic reactor accident of Russia and Bhopal chemical industry accident of India, with UNICEF and WHO responsible for this extensive and horrible tragedy in Bangladesh (New York Times, 1998). More than 50 per cent of the total population is estimated at risk of contamination and already thousands of people have been affected by the disease arsenicosis (Khan MM et al. 2003). The number of people affected by this arsenic disaster is among the greatest of any disease facing the world today and about 130 million people in 62 districts out of 64 are vulnerable to arsenic contamination (Momotaj et. al., 2001).

Arsenicosis is known as a disease borne by drinking arsenic contaminated water over a long period. The symptoms of this disease manifest after a long period such as from 5 to 20 years from when people start drinking arsenic contaminated water. The period differs from patient to patient depending on the amount of arsenic ingested, nutritional status of the person, immunity level of the individual and the total time period of arsenic ingestion. The different signs and symptoms are observed among arsenicosis patients such as colour changes on the skin, hard patches on the palms and soles of the feet, skin cancer, cancers of the bladder, kidney and lung, and diseases of blood vessels of the legs and feet, and reproductive disorders, etc. The apparent symptoms of arsenicosis may be said to have manifested in patients

as melanosis and keratosis mainly. Melanosis is the earliest symptom and is a very common symptom. It results in the gradual change of complexions towards blackishness and or duskiness. Generally, the limbs are first affected and subsequently the change affects all of the body, which is named 'diffuse melanosis'. In the process of melanosis, white and black spots occur over the body, medically termed as 'spotted melanosis', and this stage of melanosis is generally a pre-cursor of cancer. On the other hand, the hardening and thickening of the palms and soles is called keratosis.

Diffuse with modular keratosis on palms and soles is a sign of moderately severe toxicity. Rough, dry skin often with palpable modules in dorsum of hands, feet and legs are the symptoms seen in severe cases.

The arsenic contamination of the ground water of Bangladesh is not only the reason for serious health hazards for the people, but also the cause of a widespread social problem (Quamruzzaman and Rahman, 1998). This pollution also creates serious social problems in family relations in the rural areas. It is difficult to arrange marriage for a young girl affected by arsenic. Some affected housewives are divorced by their husbands and even forcibly sent to their paternal home with children. The consequence of this contamination, is that the life of a child faces risks every moment; active people become inactive and overall it creates formidable difficulties for the progress of socioeconomic development in this country.

People who drink arsenic contaminated water (>0.05 mg/l) for 5 to 10 years are attacked by arsenicosis and they have also a risk of developing cancer. The consumption of arsenic contaminated groundwater over a prolonged period of time has adverse

health effects such as arsenical dermatosis, melanosis, leucomelanosis, keratosis, hyperkeratosis, ulcer, gangrene and several other symptoms of arsenicosis (Khan et al. 1997, Haque R et al. 2003, Saha K.C. 2003, Khan MM et al. 2003).

In 1987, the first arsenicosis patient was identified at Baroghoria in Nawabganj district, Bangladesh. The Department of Public Health Engineering confirmed the presence of arsenic in tube-wells in the same district in 1993. They detected 8 arsenicosis patients through a survey in 1994. They have also argued that about 8 million people belonging to 61 of 64 districts have been affected with arsenicosis. At present, there are about 10,000 to 14,000 registered arsenicosis patients and among them hundreds of patients have already died (Mitra A. K. et al. 2002). It is surprising that there are no official statistics about the death caused by arsenicosis. The unofficial statistics suggest that the disease has claimed several hundreds of lives over the year (Silver J. and Wilson R. 2003).

In the backdrop of the above discussion, the arsenic catastrophe is considered as a great threat to the future generations in Bangladesh. This country has emerged as the most vulnerable place with regards to arsenic pollution as the extent and spread of the problem has taken a serious turn. Our next generation will be subject to a more dangerous situation due to arsenic poisoning. This is the right time to be aware of the problem and take steps to combat the spread of arsenic pollution. The present paper investigates the differentials of arsenic affected people in Bangladesh. This study also examines the socioeconomic conditions and factors affecting arsenic patients.

Data and Methodology

The data was collected on 250 arsenic patients by using a simple random sampling technique from May 15 2005 to June 30, 2005. For this sampling, the patient list was collected from the Civil Surgeon office of Nawabganj district in Rajshahi division. For data collection purposes, personal interview approach followed.

This method relates to the collection of information directly from the patients. A patient was directly contacted and the desired information was collected through pre-designed questionnaire. The purpose of each question was explained to them and they were told about the scope of the survey and manner in which the answers were to be recorded. The multiple classification analysis (MCA) was used to determine the contribution of various factors on arsenicosis and to know the intensity of the influences of the various factors. MCA can equally handle the normal ordinal variables and can also deal with linear and non-linear relationships of predictor variables with dependent variables. The unadjusted eta-square (η^2) coefficient is a correlation ratio that explains how well the predictor variable explains the variation in dependent variables by solving the normal equations with only one predictor. This unadjusted coefficient indicates the proportion of variance explained by a single predictor alone. Similarly, the beta-square (b^2) coefficient indicates the proportion of variation explained by a predictor variable taking into account the proportion explained by the other predictor variables. The beta coefficient is compared to the partial correlation coefficient in multiple regressions. The MCA has advantages because it provides estimates of each category of the predictor variable and at the same time provides the coefficient for explaining the strength of the relationship. In this study, arsenicosis condition is considered as a dependent variable. The selected independent variables are: age, sex, education, occupation, working status, source of drinking water, watching television and listening to radio.

Background Characteristics of the Patients

Table 2 presents socio-economic and demographic characteristics of the patients. The 250 arsenic affected patients interviewed ranged in age from 8 to 65, with a mean of 32 years. In this analysis, age was grouped into four classes according to human life cycles such as children, adolescents, youths and older aged. The respondents tend to be young with the

largest proportion in their middle age or even younger (61.2 per cent). Only 6.8 per cent are under age 10 years of age, 19.6 per cent are adolescents aged 10-19 years and that less than thirteen per cent (12.4 per cent) are older than 50 and over. About half (54.4 per cent) of the sample was female and the rest (45.6 per cent) of the samples were males. Besides this, about a quarter (24.8 per cent) of the sample was single, while more than half (59.2 per cent) were married at the time of the interview, with 4.8 per cent divorced and 11.2 per cent widowed. The educational level of respondents was generally low. The majority of the respondents (44.0 per cent) were illiterate or had no education. More than a quarter of the respondents (32.0 per cent) had completed primary education, whilst 14.0 per cent had completed secondary education. A small proportion (10.0 per cent) had completed a higher level of education (graduate and higher education). All occupational categories of rural society were represented. The occupations of patients varied widely representing diverse segments of rural Bangladeshi society, including agricultural laborer, day laborers, businessmen, unemployed and others. 32.0 per cent of the sample worked as agricultural laborers, 20.0 per cent worked as day laborers and 6.8 per cent worked in small business and 1.2 per cent worked in other occupations.

Drinking arsenic contaminated water is assumed to be the major cause of arsenicosis. The result indicates that tube-wells are the major sources of drinking water. 60.4 per cent of patients obtain drinking water from tube-wells; 30.4 per cent use well water for their drinking purposes and fewer (9.2 per cent) depend on other sources of water including pond, tank, lake, river, etc. In this study, mass media variables such as watching television, listening to radio and reading newspapers are considered important media to acquire knowledge about the disease, its prevention and cure. The results in Table 2 exhibit that 26.0 per cent of patients watch television, 44.8 per cent listen to radio and 13.2 per cent read newspaper regularly.

Table 3 indicates the health characteristics of the patients. The most common illnesses reported by the patients were asthma (15.6 per cent), diabetes (10.4 per cent), heart disease (9.2 per cent), blood pressure (5.2 per cent) and other diseases (9.6 per cent). Among the patients, 52.0 per cent are suffering second stages, 44.0 per cent are in first stages and only 4.0 per cent are in third stages. More than half of the patients (54.8 per cent) were suffering various physical problems. It is noted that 60.8 per cent have been suffering arsenicosis for five years and below, 32.4 per cent have been suffering for six to ten years and only 6.8 per cent had been suffering ten years and above. Below fifty per cent of the patients (41.2 per cent) had taken any treatment for arsenicosis. More than fifty per cent of the patients (58.8) didn't take any treatment. 28.0 per cent took treatment from an NGO, 10.0 per cent from thana health complex and 3.2 per cent had taken treatment from other sources.

Changes in the Socio-Economic Status of Patients

An attempt is made to observe what changes occurred to the economic status of patients before and after contracting the disease. For this purpose, the socio-economic status such as working status, kind of work, monthly income, monthly costs and invitation to social ceremonies among the patients prior to the disease are compared with those after disease occurrence.

About 60 percent of patients were working before contracting the disease but after having the disease it declined to 34 percent. Some of the patients got day laborer jobs (20.0 per cent), some got small business related jobs (6.8 per cent), most engaged in agricultural activities (32.0 per cent) and 40.0 per cent were not working before the disease. A radical change of working patterns was observed after the disease. The majority (58 per cent) didn't work after the disease. Due to the disease, agricultural labor, day labor and business work declined to 45 per cent, 29 per cent and 60 per cent respectively.

The disease directly impacts on

patients' monthly income. Before the disease the average monthly income of patients was 2556.75 taka and after the disease it has changed to 1563.35 taka. Before the disease, 4 per cent earn monthly salary of 1000 taka and below, 32 per cent earned 1001 to 2000 taka, 22 per cent earned 2001 to 3000 taka and only 2 per cent earned 3000 and above taka. After the disease, it has changed to, 22.0 per cent earned 1000 and below taka, 14.0 per cent earned 1001 to 2000 taka, 5.6 per cent earned 2001 to 3000 taka and a small (0.4 per cent) proportion earned 3001 and above taka. Actually, family income of patients showed a tremendous decrease after the disease. With deterioration of their condition, the patients gradually lose their ability to work and thus they fall into poverty. Disease also affects expenditure status of patients. Due to disease occurrence, their costs of living have increased. Before the disease, monthly average costs of patients were 1675.50 taka and after the disease it has changed to 1985.15 taka. Arsenic patients cannot move freely due to social problems. Most of the villagers consider arsenicosis is a contagious disease. Nobody wants to come into contact with the arsenic-affected people and avoid inviting them for social functions. In this study, there has been shown a marked difference in invitations to social functions between before and after disease among the arsenicosis patients. It is found in Table 3 that 94.4 per cent had got invitations before the disease, whereas, after the disease it had declined to 34.0 per cent.

Differentials of Arsenicosis

In this analysis, the selected variables age, sex, education, occupation, working status, source of drinking water, watching television and listening to radio are considered as the determinants of arsenicosis. The results are described in Table 5. Among the selected factors, source of drinking water is the most effective, ($h^2=0.31$ and $b^2=0.28$). The mean number of arsenicosis patient is 1.80 who drink tube-well water and 1.35 who drink other sources of

water. We may conclude that tube-well is one of the sources of arsenicosis. Education has emerged

as the important determinant for arsenicosis. It is important to note that literate people have been found to have lower prevalence of arsenicosis. On average 1.52 persons are affected by arsenicosis who are literate whereas, 1.73 person are affected by arsenic contamination, who are illiterate. It may be that literate people have knowledge of arsenic contamination and they avoid drinking arsenic contaminated water. The work status of patients shows a substantial effect of arsenicosis. The patients who were involved in income generating activities had a lower (1.42) number of arsenicosis sufferers than their non-working (1.91) counterparts. It is often observed in developing societies that occupation is closely associated with social status. It shows a moderate effect on arsenicosis ($h=0.05$ and $b=0.06$).

Day laborers (1.30) tend to have a higher prevalence of arsenicosis than the average, followed by agricultural laborers (1.28), small businessmen (1.19) and others (1.14). Sex differentials are observed among arsenic patients. Females (1.62) have a higher prevalence of disease than their male (1.51) counterparts. Age also shows relatively weak influence on explaining variation in mean numbers of arsenicosis patients ($h=0.002$ and $b=0.003$). Middle aged (1.85) persons are more vulnerable to developing arsenicosis than young (1.47) and older (1.55) persons. The patients who do not watch television or listen to radio are more likely to attack from arsenicosis than those patients who are exposed to some mass media. On average 1.54 patients have arsenicosis who don't watch television, whereas 1.45 patient have arsenicosis who watch television. On the other hand, the mean number of arsenic patients who don't listen to radio have a 0.5 higher prevalence of disease than those who listen to the radio.

Discussion and Conclusion

The study reveals some of the important features of arsenicosis patients at Nawabganj in Bangladesh. It is evident from the data that more than half of the patients were over twenty years of age. The patients are

mostly the young generation, with the largest proportion in their middle age and a sizeable portion are old. The arsenic poses a serious threat to young generations (Watanabe et al. 2003). It is also noted that more than half of the patients were female. Ahmad et al. (1999) observed similar findings. They also showed that female arsenicosis patients were mostly illiterate and most of the patients were between 10 to 39 years. The data also indicates that the sample is uneducated; about sixty per cent were married at the time of interview, a quarter were single and a noticeable proportion were divorced or widowed. The divorced patients were due to the cause of arsenicosis.

The result indicates that the majority of the patients drink tube-well water. In this connection, Khan et al. (1997) conducted a study on arsenic contamination in ground water and its toxicity effect on health. They found that tube-well was the main source of arsenic contaminated water. Those who were drinking contaminated tube-well water, were attacked by melanosis, keratosis, hyperkeratosis and depigmentation (Leukomelanosis) is common. It is noted in a study that more than 50 percent of the tube-wells in 62 out of 64 districts contain more than 0.05 mg of arsenic per liter of water (Momotaj H. et al.: 2001). There is need to take the initiative for developing appropriate alternative water supply options immediately. There is also need to develop awareness about the problems associated with arsenic contamination in drinking water. It has been observed in this study that the maximum number of patients have low socioeconomic status and they are very poor. More than fifty per cent of arsenic patients were suffering from various physical problems. They suffered from different diseases such as diabetes, heart disease, blood pressure and asthma. Several studies have suggested that arsenic patients have been suffering from various physical problems and several diseases (Khan et al. 1997, Rahman et al. 1998, Khan MM et al. 2003). It has been observed that the maximum number of patients are in first and second stages, which can be curable. Immediate action should be taken to provide adequate medicine, proper treatment, nutritious

food and availability of pure drinking water. Proper steps should be taken to identify arsenicosis patients with their particular disease and stages of arsenicosis accurately on an emergency basis. In this connection government should take proper action for detecting the early signs of arsenicosis on a regular basis.

Exposure to knowledge and awareness is very poor among arsenic patients. A few proportion of patients watch television, listen to the radio and read newspapers daily. It is essential to have the involvement of mass media and development of information, education and communication material for awareness of the people. For this purpose, campaigns in mass media (radio/television/newspaper/magazine/poster/bill board) should be increased indicating the causes of arsenicosis disease, its effects and efforts to be free from arsenic contamination water. Government and non-governmental levels should take proper steps to increase and modify mass media exposure to arsenicosis i.e. existing programs and steps which are being campaigned in the radio/television/newspaper/magazine/poster/bill board need to improve the knowledge and attitudes and also should increase the publicity regarding safe drinking water messages in the mass media. The data indicates that the occurrence of arsenic disease has changed the socioeconomic condition of arsenic patients. This disease influences working status, occupation, income, finances and invitations for social functions, of the patients. Due to disease occurrence their incomes have decreased but living cost has increased. It has been found that people exclude them from various social activities. Due to arsenic disease they are less efficient than before. It is remarkable that arsenicosis is not a contagious disease. On the other hand, the mean arsenic patient who doesn't listen to the radio has a 0.5 higher prevalence of disease than those who listen to the radio.

Arsenicosis should not be thought of as a fault of the patients and the patients should not be socially boycotted. Motivation and awareness should be increased regarding

arsenicosis disease. It can be concluded that due to lack of literacy, superstitions, insufficient awareness and scarcity of proper motivational programs at both governmental and non-governmental levels, the arsenic problem has been creating a serious crisis in rural Bangladesh. The patients should be diagnosed at their early stages. At the same time, safe drinking water should be supplied to the affected areas as immediate relief on an emergency basis. Proper initiatives should be taken to make people aware of any method of removing arsenic from water prior to introducing the method.

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Table 2 Distribution of arsenicosis patients by some selected socio-economic and demographic characteristics

Variables	N	Percentage (%)
Age		
< 10 years	17	6.8
10-19 years	49	19.6
20-59 years	153	61.2
50 and over	31	12.4
Mean and SD		Mean=31.77
Sex		
Male	114	45.6
Female	136	54.4
Marital Status		
Single	62	24.8
Married	148	59.2
Divorced	12	4.8
Widowed	28	11.2
Education		
No education	110	44.0
Primary	80	32.0
Secondary	35	14.0
Higher	25	10.0
Occupation		
Not working	100	40.0
Agricultural labor	80	32.0
Day labor	50	20.0
Small business	17	6.8
Others	3	1.2
Sources of drinking water		
Tube-well	151	60.4
Well	76	30.4
Others	23	9.2
Watching Television		
Yes	65	26.0
No	185	74.0
Listening Radio		
Yes	112	44.8
No	138	55.2
Reading Newspaper		
Yes	33	13.2
No	217	86.8

Table 3: Distribution of arsenicosis patients by some selected health characteristics

Variables	Number of respondents	Percentage
Suffer from Diseases		
Asthma	39	15.6
Diabetes	26	10.4
Heart disease	23	9.2
Blood pressure	13	5.2
Others	24	9.6
No problem	132	52.8
Condition of Arsenicosis		
Initial stage	110	44.0
Second stage	130	52.0
Third stage	10	4.0
Physical Problem		
Yes	137	54.8
No	113	45.2
Duration of Disease		
< 5 Years	152	60.8
6-10 Years	81	32.4
10+ Years	17	6.8
Taken any Treatment		
Yes	152	60.8
No	98	39.2
Taken Treatment From		
NGO	70	28.0
Thana Health Complex	25	10.0
Others	8	3.2
No treatment	147	58.8

Table 4: Changes in the socioeconomic status of the patients due to arsenicosis

Variables	Before disease		After disease	
	N	Percent	N	Percent
Working Status				
Working	150	60.0	85	34.0
Not Working	100	40.0	165	66.0
Kinds of Work				
Not working	100	40.0	145	58.0
Agricultural	80	32.0	65	26.0
Day Labor	50	20.0	30	12.0
Business	17	6.8	7	2.8
Others	3	1.2	3	1.2
Monthly Income				
Not Working	100	40.0	145	58.0
1000 and below	10	4.0	55	22.0
1001-2000	80	32.0	35	14.0
2001-3000	55	22.0	14	5.6
3001 and above	5	2.0	1	0.4
Mean	2556.76		1563.35	
Monthly Cost				
No	30	12.0	20	8.0
<1000	80	32.0	50	20.0
1001-1500	65	26.0	85	34.0
1501-2000	43	17.2	55	22.0
2500+	32	12.8	40	16.0
Mean	1675.50		1985.15	
Invitation to Social Functions				
Yes	236	94.4	166	34.0
No	14	5.6	84	66.0

Table 5: Results of multiple classification analysis of arsenicosis patients by selected some socio-demographic variables

Variable	Unadjusted	Adjusted	Correlation ratio	
			η_2	β_2
Age				
< 20 years	1.45	1.47	.002	.003
20-49 years	1.85	1.80		
50+ years	1.67	1.55		
Sex				
Male	1.50	1.51	.046	.051
Female	1.65	1.62		
Education				
Illiterate	1.75	1.73	.083	.065
Literate	1.43	1.52		
Occupation				
Housewife	1.67	1.63	.051	.038
Student	1.50	1.57		
Others	1.48	1.52		
Working status				
Yes	1.43	1.42	.071	.083
No	1.82	1.91		
Source of drinking water				
Tube-well	1.78	1.80	.31	.28
Other	1.43	1.35		
Watching television				
Yes	1.43	1.52	.003	.005
No	1.68	1.54		
Listening radio				
Yes	1.38	1.47	.006	.004
No	1.59	1.51		
Grand Mean= 1.65				
Proportion variation explained, R ² =0.57				

ABSTRACT

Bangladesh is one of the most populated countries of the world. In the last two decades despite pervasive poverty and under-development Bangladesh has achieved considerable fertility decline. Unfortunately, recent statistics suggest that despite continued increase in contraceptive use and the functioning of NGO activities the fertility decline has stalled. Thus Bangladesh becomes an interesting case study for exploring the question, of what factors are necessary to bring about further fertility decline. In this paper an attempt will be made to highlight women's status, socio-economic and demographic factors, which are affecting the decline in fertility. It is found that the desire for an additional child is lower among working women who have better access to mass media regularly and are involved in NGO activities. In order to achieve further decline in fertility, therefore, the policy makers should emphasize those policies that actively enhance women's status through education, more access to mass media as well as getting them involved in the workforce in the country and need to encourage other NGOs to include family planning and education programs like BRAC and Grameen Bank.

Key Words: Fertility, NGOs, Women's Status, Micro-Data, Logistic Regression and Bangladesh.

FERTILITY DECLINE - THE ROLE OF NON-GOVERNMENT ORGANIZATIONS (NGOS) IN BANGLADESH: A MICRO DATA ANALYSIS

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Introduction

Women's status and their role in decision-making in reproduction have an important bearing on the success of family planning and the long-term reduction in fertility of a country. In a society in which women are mainly concerned with domestic affairs and raising children, fertility would be higher. The United Nations International Conference on Population and Development in Cairo, 1994, and the Fourth World Conference on Women in Beijing, 1995, outlined factors considered critical to "the empowerment of women". At these meetings, 179 countries agreed on a 20 year plan to stabilize the world's population, premised on the notions that population, development and the environment are integrally linked and the empowerment of women is required to make this vision a reality. Empowerment of women was defined to include providing women with access to employment, education and reproductive health care, free from discrimination, coercion and violence. These same factors are also linked with fertility decline, a global phenomenon that causes growing concern for governments planning for future workforce and social security needs. The 1994 International Conference on Population and Development in Cairo have stressed the integration of population policies with development policy.

Bangladesh is a nation with an estimated population of 130 million (BBS-2001). Except some Island States, Bangladesh has the highest population density in the World; resource scarcity and subsistence-level economic conditions characterize the Bangladesh economy (Khuda,

1991). Per capita income is as low as US\$ 444 and more than one-third of the population lives below the absolute poverty line (UNDP, 2003). In Asia, Bangladesh is one of the few countries where women's life expectancy remains lower than that of men. This is due in part to multiple high-risk pregnancies. The status of women appears to have changed somewhat over the past few decades, largely to their disadvantage. The shift is evidenced, for example, by a major trend away from bride wealth toward dowry and a general reduction of women's control over property transferred with them at marriage. The status of women, contemporarily at least, appears to be very low: women are powerless and depend upon men.

However, the past three decades saw a substantial decline in total fertility rate, for example, from 6.3 in 1975 to 3.3 in 2000 despite pervasive poverty and under-development, although recent statistics suggest that despite a continued increase in contraceptive use and NGO activities the fertility decline in Bangladesh has stalled.

It is interesting to note that the period saw various types of NGOs working in the country for the development of our society, particularly in villages where more than 80% of women live. Besides Micro credit (MC) activities most of the NGOs are working to improve health and education and trying to develop a new lifestyle among the Grameen (village) Society. The availability of various income-generating organizations such as Bangladesh Rural Development Board (BRDB), Bangladesh Rural Advancement Committee (BRAC),

Grameen Bank and Mothers' club/ Mothers' association may well have influenced women's reproductive behavior and consequently influenced fertility. Some NGOs have collaborated with the government to immunize children and pregnant women. Under the essential health care program, the NGO workers provide services to pregnant women for improving their health and nutritional status. The reproductive health needs of the community in general, with particular focus on NGOs members, are addressed through education on family life and awareness of some killer diseases and contraceptive methods. Under the BRAC's health, Nutrition and Population Programme, trained health workers and volunteers work to raise awareness among the rural poor about health issues that directly impact their lives and families. The NGO sector is the second largest source of contraceptive supplies for family planning users in the country (BDHS 2000).

In this paper, I would like to show by making use of micro data how different dimensions of women's status are related to different socio-economic and demographic factors. One factor that I will give particular emphasis in this paper is NGOs, which are believed to have positive interactions with some of the aspects of women's status. The structure of the paper is as follows. In section 2, I first discuss women's status, fertility, their employment and education situations, and possible relationships between female employment, fertility and related variables from a demographic point of view. Statistical methods will be applied to a Bangladesh Demographic and Health Survey sample (Section 3), whose results are presented in Section 4. Section 5 discusses regional variation, while concluding remarks and policy implications are set out in Section 6.

On the Status of Women

Literally "status" means a position in relation to others. Women's status is relative. A measure of women's status may implicitly compare the relative position of women to men or women to other women. The status of women in a society is deeply rooted

in culture, religious beliefs, traditions and economic environments. Traditionally, while women perform the major roles of reproduction, the household and so on, in recent times, many new roles have been added. The term status of women then would denote not only a conjunction of the rights and duties but also the degree of her subordination in the home, education, economic status, role in decision making in family affairs, and her self-perceived status in the home and in the community. According to the United Nations (UN), the status of women in society can be determined by her composite status which can be ascertained by the extent of control that she has over her own life derived from access to knowledge, economic resources and the degree of autonomy enjoyed in the process of decision making and choice at crucial points in her life cycle.

In recent years, despite increasing attention to the concept of women's status, the meaning of this concept has remained unclear. Among the terms used in the social demographic literature are not only "status of women" (e.g., Dixon, 1978), but also "women's autonomy" (Dyson and Moor, 1983). To measure women's status/autonomy more directly, the BDHS (2000) survey asked about women's roles in household decision making and their freedom of movement. Such information provides insight into women's control over their environment and their attitudes towards gender roles, both of which are relevant to understanding women's demographic and health behavior. Education, exposure to media, employment status and control over earnings are some of the means by which women gain status/autonomy, important aspects of their empowerment.

In the present study, I introduce the unconventional new variables NGOs (such as Bangladesh Rural Advancement Committee (BRAC), Grameen Bank, Bangladesh Rural Development Board (BRDB), Mother's club, etc.) involvement which can increase women's status. In addition included the variables related to women's status which are: residence, employment, education, religion and

freedom of access to mass media etc. After independence in 1971, the BRAC was established and is the biggest NGO in terms of development and micro-credit activities. BRAC's other development activities include free informal education (set up 1985, about 49,000 schools in 2004, accounting for 11% of the total primary school in Bangladesh) and health and medical facilities for low-income people in rural areas. Among the employees of BRAC, 61% are women and working with the twin objectives of poverty alleviation and empowerment of the poor women. BRAC outreach covers all 64 districts of Bangladesh and 78% of the total number of villages in Bangladesh. BRAC's has collaborated with the government to immunize children and pregnant women. Under the essential health care program, with the help of Shashtho Shebikas (Health Volunteers) and Shastho Kormis (Health Workers) immunization coverage of the population is 80% (BRAC, 2004). The program also provides services to pregnant women for improving their health and nutrition status. The reproductive health needs of the community in general, with particular focus on BRAC members, are addressed through education on family life, contraception, and awareness of HIV/AIDS. Therefore, due to the BRAC women's education and financial independence, they themselves come forward to learn about family planning and the women become determined to have fewer children. The Grameen Bank (GB) was established 1976 (Founded by the 2006 Nobel Laureate Professor Muhammad Yunus) with the objectives of extending banking facilities to poor men and women; eliminate the exploitation of the poor by money lenders; and create opportunities for self-employment for the vast multitude of unemployed people in rural Bangladesh. As of July 2004, it has 3.7 million borrowers, 96% of whom are women. GB provides services in 46,000 villages, covering 68% of the total villages in Bangladesh. GB has introduced higher education loans for all students from Grameen families who can enter into the higher educational institutions (medical schools, engineering, universities etc.). Students are responsible for

repaying the loans when they start earning. Half of the numbers of scholarships are reserved for female students. They believe that education leads to much better jobs and then much better income. BRAC is directly involved in education and health sectors and GB is indirectly involved in education sectors in Bangladesh.

Fertility: Fertility is a key demographic process determining population change. The fertility transition in Bangladesh by observing time series estimates of TFR 1 over the last 25 years, beginning with the 1975 BFS, indicates a decline of 48 percent in TFR; a decline of 1.9 percent per year (Table 1) mainly because of rising contraceptive prevalence, due to effective immunization and reduction of child mortality. The pace of fertility decline has slowed down recently compared to the exceptionally rapid decline in the late 1980s and the early 1990s and since then it has remained almost constant. For example, within a period of five years, starting from 1989 to 1993-94, fertility has declined by 33 percent or 6.6 percent per year, while for the next six year period 1993-94 to 1999-2000, it is only 4% or less than 1% per year. The fertility rates by age group shows that starting from 1975 to 1993/94 fertility declined steadily in 1993/94 in all age groups with the exceptions of age group 15-19. The age specific fertility rates in 1999-2000 also shows decline in all age groups since 1993-94, except the age groups 15-19 and 25-29. The decline is steeper among women aged 35 and above. This indicates that there is a shift in fertility towards younger age groups in recent years and fertility has declined substantially among older age groups.

The rate of fertility decline in Bangladesh has not been uniform in different regions. Fertility is higher in rural (3.54) than in urban areas (2.45). For urban women, increased participation in the labour force, starting at adolescence, contributes significantly to controlling fertility. The difference is especially large at younger ages, which probably reflects longer education and later marriage of women in urban areas (BDHS 2000). Again Table 1 shows that during late 1980s to early 1990s all the divisions

in Bangladesh experienced more or less uniform decline in fertility. Even in Chittagong division having highest fertility in the mid 1980s, which is still continuing, the rate of decline was almost identical in magnitude as compared to that of the other divisions. However, since 1993-94 the decline in fertility is not uniform across the regions. During the period 1993-94 to 1996-97, Chittagong division shows an increase in fertility level by about 3%, while all other divisions show some decline in fertility. The magnitude of decline was higher in Khulna (17%) followed by Rajshahi (8%) and Barishal (5%). On the other hand, during the period 1996/97 to 1999/00, fertility has increased in low performing regions of Khulna and Rajshahi and also in Dhaka, but declined in Barishal and Sylhet divisions.

There are so many NGOs currently working on health and family planning as well as other problem areas in different regions of Bangladesh that their activities may have encouraged people to adopt contraception in the late 1980s, precipitating a change in reproductive behavior. BRAC is directly working in family planning sectors while the Grameen Bank (GB) is in economic and financial sectors. But their activities are not uniform between the regions. It appears that they are more active in regions, such as Khulna and Rajshahi, where fertility decline has been substantial, suggesting a link between services they have created for women and fertility decline.

Women's Employment:

Traditionally, women were involved largely in the non-monetised sector and in subsistence activities. In recent decades, women have experienced some major changes in the labour market, primarily in terms of the nature of jobs and opportunities. Table 2 shows that the rate was gradually decreasing till 1981 but there is an increase in 1991 and again a decrease in 2001 except for women's.

Table 2 shows that the activity rate was highest in 1961 for both males and females, which is undoubtedly due to the inclusion of household work in the economic activity during that time period (BBS 1981). From

1981 there has been an increasing trend in the female activity rate, which tremendously increased between 1991 and 2001. The urban female activity rates observed from different census years are higher than that of rural areas since 1974. Increases in female participation rate in urban areas from 6% in 1974 to 8% in 1981 and 10% in 1991 and 14% in 2001 display more and more involvement of females in economic activity outside the home. Also the proportion of females economically active in the non-agriculture sector increased substantially from 1961 to 1991. In 1961, only 8% of the total female workers were engaged in non-agriculture pursuits, which increased to 82% in 1991 although the percentage decreased to 56% in 2001. It is worth mentioning that a significant number of women also work as teachers (primary and BRAC School), lawyers, journalists, government employees and for non-government organizations (NGOs). Women's increasing labor force participation, on the one hand, and public awareness and efforts by NGOs and mass media, on the other, have played an important role in encouraging this.

In spite of these achievements, however, the majority of women in Bangladesh have yet to be empowered to participate actively in the social, cultural, economic and political life of the country. The policies and programs of the Government, some NGOs and other institutions do not sufficiently address the need for women's empowerment.

Women's Education and Training:

Education is a key determinant of lifestyle and status, in order for an individual to be able to enjoy life in a society. It affects almost all aspects of human life, including demographic and health behavior. In Bangladeshi society, as boys are perceived to take care of parents, sending them to school and investing in their education is more common than for girls. Nevertheless, the primary level enrolment rates for girls have gone up remarkably (Table 3). The gap between male and female enrollment rates, which stood at 22 percent in 1985, declined to 3 percent over the past decade and a half.

Although noteworthy achievements have been made in female enrollment at the primary level, progress has been very slow in secondary level education. At this level male and female enrollment rates improved only by 5 and 10 percentage points, respectively, between 1985 and 1995. At the primary level, girls' enrollment is increasing. In 1990 45% of girls aged 6-10 were enrolled but in 2000 it was 49%. However, the dropout rate of female students who went on to secondary school reaches half, 10 percentage points higher than their male counterparts. Very few women continue their education up to the tertiary level. This negatively affects the overall rate of return from education and women's labour markets.

Lower access to technical education and secondary and higher education, gender-biased curriculum and curriculum without job prospects are critical concerns for women's education that must be addressed through coordinated efforts. Adult education for women has also been emphasized. There is also provision for increasing teachers' training of women for both the primary and secondary levels. Government stipend schemes for girls up to grade 8 are some of the important factors behind the rise in girl's enrollment at the primary level. Non-formal education programs run by Bangladeshi NGOs such as the Bangladesh Rural Advancement Committee (BRAC) have been internationally acclaimed. Some large NGOs run thousands of schools providing education to children who are not able to avail themselves of Government-sponsored education. The Government has recognized this contribution of NGOs and there is significant collaboration between them. There is special emphasis on girls' education as education and eradication of illiteracy are considered to be the first steps toward the empowerment of women.

Population and Fertility Data

This study utilized mainly the 1999-2000 Bangladesh Demographic and Health Survey (BDHS) based on a nationally representative, two-stage sample that was selected from the

master sample maintained by the Bangladesh Bureau of Statistics (BBS) for the implementation of surveys before the census (2001). Other information comes from the Population census 2001. The 1999-2000 BDHS collected information on a respondent's background characteristics (age, residence, education, religion, etc), employment history and occupation, contraceptive use history, marriage and fertility preferences. The master sample consists of 500 primary sampling units (PSUs) with PSUs in each stratum except for the urban strata of the Barishal and Sylhet divisions. In the rural areas, the primary sampling unit was the mauza, while in urban areas, it was the mahalla. Mitra and associates conducted a household listing operation in all the sample points from September to December 1999. A total of 10,268 households were selected for the sample of which 9,854 were successfully interviewed. In these households, 10,855 women were identified as eligible for the individual interview (i.e. ever-married and age 10-49) and interviews were completed for 10,544 (97%) of them, with 9,720 currently married women. But my analysis covered only 9502 women who are able to bear children. Infecund, divorced, widowed etc. women were not involved in the analysis.

In BDHS, currently married women were asked "would you like to have (a/ another) child or would you prefer not have any more children"? Interviewers were instructed to use the words in parenthesis depending on whether the respondent had children or not. Pregnant respondents were asked if they wanted another child then asked how long they would like to wait before the birth of the next child. Almost 52 percent of currently married women age 10-49 in Bangladesh said that they wanted no more children and an additional 7 percent had been sterilized. 37 percent of women wanted to have a child at some time in the future; however the vast majority of these women answered that they would like to wait two or more years before having their next birth (Table-4). The desire for additional children declined noticeably in Bangladesh over the past decade. In 1991, 45

percent of married women with two children wanted to have another child in the future (Mitra et al., 1983:84); in the 1999-2000 BDHS survey, the proportion was only 30 percent. Conversely, the percentage of women with two children who wanted no more children or who had been sterilized rose from 48 percent in 1991 to 66 percent in 1999-2000. There was little change in overall fertility preferences since 1996-97, with the proportion of women who either wanted no more children or who had been sterilized increasing from 58 to 59 percent.

For analytical purposes, I divide the above data into two categories: one is women who wanted another child and the other is those did not want another child.

Methodology and Analysis

In this section, we examine what affects fertility outcomes, given stated preferences for more children or for no more children. In this paper for analytical purpose, logistic regression models are used. The logistic regression model has become the standard method of analyzing data in which the dependency of a binary response variable is being tested on a number of explanatory variables. A response (dependent) variable (Y) is binary. In our analysis, it can take "1" or "0" depending on whether a respondent (an ever-married women in the age group 10-49) wants another child or not. Variables of this type are often called binary or dichotomous variables. The SPSS for windows version 11.5 is utilized for the logistic regression analysis.

The multivariate analysis controls for various characteristics that may have affected a woman's propensity to bear children. The probability of having a child generally decreases with the woman's advancing age owing to growing infecundity and less frequent sexual activity. The number of living children, controlling for the woman's age may reflect some measure of the woman's fecundity (in that she has a higher probability of conceiving and thus a greater potential for more births in her reproductive period) in addition to preferences for more children or to an infrequent use of contraception. A woman with higher education may

be better able to control family size because she tends to be an effective user of contraception (Mamlouk, 1982; Rodriguez, 1979). In addition, some evidence indicates that with increasing education and greater participation of women in the labour force, domestic labour becomes more equally divided between husband and wife. Although women still perform the most domestic work, this change may precipitate a shift to a smaller family size because men want to do less work at home after returning from outside activity (UN, 1985).

In this paper, most of the independent or explanatory variables are quantitative and for the purpose of comparison we converted them into qualitative variables of interval scale and the respondent belongs to a particular interval scale that has the value '1' otherwise '0'. The independent variables include the woman's residential status (rural, urban and administrative division), employment status (employed, not employed), occupational status (agriculture, non-agriculture, working for cash only, working for kind only), household head (male or female), educational status (no education, primary level, secondary level and higher education), religion (Muslim, Hindu, Christian and others), age group (10-14, 15-19, 20-24, 25-29, 30-39 and 40-49), exposure to mass media (listening to radio irregularly/regularly, watching TV irregularly/regularly), number of living children (below 2, exactly 2 and above 2 i.e. 3 or 4), pregnancy status (currently pregnant, not pregnant), involvement in NGOs (Grameen Bank, BRAC, BRDB, Mothers club/ Mothers' association and Others), and her husband's occupational status (agriculture, non-agriculture) and educational status (no education, primary level, secondary level and higher education). We also include interaction terms between some of these independent variables. Table 5 reports the results of this multiple binary logistic regression analysis. In order to measure the effect of each explanatory variable, we calculate an odds ratio, which is the anti-log of the co-efficient for each variable.

The results show, first, that women residing in urban areas are generally

less likely to want more children than those in rural areas and the results are statistically significant. For individual administrative divisions, the regression coefficients corresponding to the Chittagong and Sylhet division are positive but the Rajshahi, Khulna and Barisal division the coefficients are negative in sign and statistically significant except Barishal division. The effect in the Chittagong and Sylhet divisions is 1.7 and 1.84 times higher than that of the Dhaka division. On the contrary, in Khulna, Rajshahi and Barisal it is $(1-0.62) \times 100 = 38\%$, 25% and 6% less than that of Dhaka.

With respect to employed women in comparison with non-employed women (housewives), the results show that the desire for another child among working women is 9% less than that of non-working women and that the women engaged in the non-agriculture sector want fewer children than those in the agriculture sector. The category "working for cash" is a better indicator of women's working status, for which we found that the regression coefficient is -0.09, which is greater than that for the umbrella of non-agriculture. The odds ratio corresponding to the women working for cash is 0.91, indicating that the desire for another child is 9% less than that of women whose earnings are in kind.

The effect of age is important. Table 5 shows that the ever-married women under age 30 are likely to want more children and above age 30 are less likely to want any more children and the results are statistically significant. Female headship also turns out to be statistically significant. The female-headed family is less likely to want more children than the male headed.

Education is another important characteristic of the women. Increased education is often suggested as one way to raise women's status and to prompt their participation in the labour force. The regression coefficients of the primary level, secondary level and higher education are 0.05, -0.11 and -0.19 respectively, which are negative in sign and statistically significant except for primary education. The women's husbands extend similar effects on the demand for children through their employment and education.

Religion has a significant relevance in demography. Muslim communities consistently tend to show higher fertility than many other non-Muslim communities. In our analysis, 88 percent of the respondents practice Islam and it is evident from the data of BDHS 1996/97 that the proportion of women currently using any contraceptive method is 49%, lower than for non-Muslim 59% women. For example, the desire for another child among Hindu women is 69% less than that of the Muslim women.

According to 1996/97 BDHS data, the percentage of women exposed to Television has increased sharply (from 29 to 35 percent), while the percentage who listen to the radio has declined (from 39 to 29 percent). The regression coefficient of mass media is 0.14 for radio and -0.03 for TV, and it is for TV only that the coefficient has a right sign and is statistically significant. This result indicates that the demand for additional children among the women who watch TV regularly is 3% less than that for women who do not watch TV regularly.

The desire for an additional child also varies with the number of existing children. The regression coefficient is 3.0 if the number is below 2; if it is 3 the coefficient becomes -0.47 and -1.21 when it is 4. All the results are statistically significant. The odds ratios indicate that the women having less than two children are 21 times more likely and the women having 3 and 4 children are 38% and 70% less likely to want additional children than women having two children. It is interesting to note that the regression co-efficient of currently pregnant women is -2.24 and statistically significant. The odd ratio indicates that the desire for another child is 89% lower among the currently pregnant women than among non-pregnant women.

The next important variable is NGOs that are widespread in Bangladesh. In my study, a total of 2405 respondents are involved in different NGOs and out of them 1731 (72%) of respondents do not demand any more children. This proportion is highest in BRAC (21%) and next GB (17%). For measuring the association between fertility preference and involvement in different NGOs I would like to use

the following hypothesis. H0: There is no association between fertility preference and involvement in NGOs Vs H1: There is some association between the two attributes. To test the hypothesis we construct the following 2x2 contingency table.

Through χ^2 as well as Mantel-Hansel test it is observed that there is significant association between fertility preference and involvement in NGOs and the direction of the association is negative. Here we pay particular attention to the Bangladesh Rural Advancement Committee (BRAC) and Grameen Bank (GB). Their coefficients are negative, which suggests that those NGOs are instrumental in reducing fertility. According to Table 5, it is only BRAC that shows a statistically significant result. The odd ratio indicates that the women under the activities of BRAC have 26% lower demand for another child than that obtained from the women under the activities of Bangladesh Rural Development Board (BRDB). But Table 6 shows that all the NGOs have highly significant effects on fertility except Mothers club.

Regional Variation

In the previous sections it was discussed that the rate of fertility decline in Bangladesh was not uniform across regions (Table 1). It is evident that the fertility level has declined rapidly in Khulna and Rajshahi Divisions. On the other hand, Sylhet and Chittagong Divisions are lagging behind, while the performance is in-between in Dhaka and Barisal Divisions. According to the DHS findings on the age at marriage and fertility patterns in Rajshahi, Khulna and Chittagong (Islam and Zaman, 1995 a,b), it is also noteworthy that the age at marriage is lowest in the high performing regions of Khulna and Rajshahi. Marriage age and the cumulative number of births are related. The women of Khulna and Rajshahi get married earlier so that they tend to start childbearing at an early age (high teenage fertility). However, it is interesting to note that the use of contraception is highest in these divisions. In contrast, women living in Chittagong and Sylhet Divisions get married at relatively higher ages but

they tend to have more children within a shorter span of life, since the use of contraception is relatively lower there. This is clear from the data of BDHS 1999-2000: the percentage of women currently using contraceptive methods for Dhaka, Chittagong, Rajshahi, Khulna, Barisal and Sylhet is 54, 44, 59, 64, 59 and 34 respectively. It is also evident from the data that the percentage of working women is significantly lower in Chittagong and Sylhet as compared with Rajshahi and Khulna, while contraceptive use is generally higher among working women than among non-working women (Mitra and Associates, 2000). Studies have shown that Dhaka, Chittagong and Khulna are more urbanized while Rajshahi, Sylhet and Barisal are less urbanized (ranked according to per capita GDP and socio-economic index. See Islam 2003). More than 80% of women live in areas classified as 'rural'. BDHS 2000 data indicate that 56% of ever-married women in Bangladesh live in places where Grameen Bank, BRAC and Mother's club are active, and 60% live in areas where cooperative societies are functioning. It is also worth noting that BRAC and Grameen Bank are more active in rural divisions such as Rajshahi, Khulna and Sylhet than in others divisions. And it is these rural divisions where higher levels of contraceptive use are observed.

Conclusion and Policy Implication

The following points can be made by way of conclusion:

1. As expected, women's employment exerts a discouraging effect on the desire for another child. This effect is particularly marked for those engaged in non-agriculture activities and working for cash.
2. Another important factor reducing fertility is education. This operates through both men's and women's education. However, it is more important for women to receive secondary and higher education: they tend to want fewer additional children than non-educated women.
3. It is observed that mass media, especially television (TV), also

plays a role in reducing the desire for more children.

4. It is also found that NGOs are instrumental in affecting fertility preference. Since the NGOs increase women's awareness and educational levels while creating employment opportunities, women involved in those activities can increase autonomy and gain empowerment. Especially, BRAC and Grameen Bank are likely to have been exerting an impact on the desire for an additional child.

The first three of these points have been shown in many studies, both in Bangladesh and elsewhere. But the fourth point is a new finding, and has important policy implications. The government cannot successfully intervene in all the areas commented above. For example, it is not easy for the administration to take a direct measure to increase the employment of women except in the state sector.

It is evident that the government should invest more in education for girls. Setting up more girls' schools is one of such measures, and parents should be encouraged to send more daughters, not just sons, to secondary and higher education. Therefore it should be considered that NGOs are partners in campaigns for women's empowerment and also for fertility decline. Many NGOs have their own programmes to increase the use of contraceptive measures, but what our research suggests is that women's involvement in these activities is likely to have interactions with the effect of education of fertility preference, so that the overall impact on fertility decline is expected to become more effective.

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Table 1: Total fertility rates (TFR) among women age 15 to 49, selected sources, by region, Bangladesh, 1975 to 1999-2000.

Indicators	Survey and approximate time period					
	1975 BFS	1989 BFS	1991 CPS	1993-94 BDHS	1996-97 BDHS	1999-2000 BDHS
Age group						
15-19	109	182	179	140	147	144
20-24	289	260	230	196	192	188
25-29	291	225	188	158	150	165
30-34	250	169	129	105	96	99
35-39	185	114	78	56	44	44
40-44	107	56	36	19	18	18
45-49	35	18	13	14	6	3
TFR 15-49	6.3	5.1	4.3	3.4	3.3	3.3
Region						
Urban	NA	NA	3.9	2.7	2.1	2.5
Rural	NA	NA	4.7	3.5	3.4	3.5
Division						
Rajshahi	NA	4.6	4.3	3.03	2.78	3.02
Khulna	NA	4.7*	4.2	3.05	2.52	2.7

Dhaka	NA	5.18	4.4	3.45	3.18	3.21
Chittagang	NA	5.9**	5.0**	3.95**	4.06	3.96
Barishal	NA	NA	NA	3.47	3.31	3.26
Sylhet	NA	NA	NA	NA	4.20	4.08

Note: NA = Not available, * Khulna and Barishal division is combined, ** Chittagong and Sylhet division is combined.

Source: Bangladesh fertility survey 1975 and 1989, Contraceptive prevalence survey 1991.

Bangladesh demographic and health survey 1993-94, 1996-97 and 1999-2000.

Notes: TFR 1: Total fertility rate, expressed per women. Rates are for the period 1-36 months preceding the survey. Rates for age group 45-49 may be slightly biased due to truncation.

Table-2: Urban and Rural Activity Rates by Sex and Proportions of Agricultural and Non-agricultural Workers, 1961-2001.

Census Year	Activity Rate						Proportion			
	Bangladesh		Urban		Rural		Agriculture		Non-Agriculture	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1961	87.6	17.4	75.0	14.3	88.0	17.9	85.0	91.8	15.0	8.2
1974	80.4	4.0	73.7	5.8	81.2	3.8	77.5	69.8	22.5	30.2
1981	73.9	4.3	69.1	7.5	75.0	4.2	63.0	61.3	37.0	72.0
1991	77.1	6.7	75.0	10.3	77.7	5.8	57.5	18.0	42.5	82.0
2001	64.6	9.3	63.1	13.7	64.7	7.9	52.2	43.9	47.8	56.1

Source: Bangladesh Population Census 2001

Notes: 2 Under the extended definition of labour force, persons who are engaged in some major household activities such as food processing, threshing, cleaning, and livestock and poultry raising are considered as part of the economically active population.

Table 3: Educational Status of women

Indicator	Bangladesh		Urban		Rural	
	Female	Male	Female	Male	Female	Male
Adult Literacy rate ¹ 15+, 2001	41.4	59.4	60.0	75.4	36.2	56.1
Net enrollment, primary school 2, 1997	77.1	84.7	93.0	96.0	73.6	82.5
Net enrollment, secondary school 3, 1995	19.0	23.0	n.a.	n.a.	n.a.	n.a.
Dropout rate at secondary level, 1996 (%)	48.4	37.8	n.a.	n.a.	n.a.	n.a.

n.a. = not available

Source: Sample Vital Registration, BBS; Multiple Indicator Cluster Survey, BBS; Statistical Yearbook, 1997, BBS; Population Census (2001).

Table 4: Percentage distribution of currently married women age 10-49, desire for more children, Bangladesh 1999-2000.

Desire for children	No. of Respondents	Percentage
Wants another child	3596	37.0
Wants no more child	5735	59.0
Undecided, infecund	389	3.7
Total	9720	100

Table 5: Logistic Regression Explaining whether Women wanted another Child, by background characteristics of ever-married women, Bangladesh: BDHS 1999-2000.

Selected Characteristics	Regression Co-efficient	Odds Ratio
Residential status		
Urban (Rural ¹)	-0.230**	0.795
Geographical Region (Division)		
Rajshahi (Dhaka ¹)	-0.293**	0.746
Chittagang	0.532	1.702
Khulna	-0.471*	0.624
Barishal	-0.057	0.944
Sylhet	0.612*	1.844
Employment Status		
Employed (Not Employed ¹)	-0.096 ***	0.908
Occupational status		
a) Non-Agriculture (Agriculture ¹)	-0.004 ****	0.996
b) Earns for cash only (Kind only ¹)	-0.093 ***	0.911
Household Head		
Female (Maler)	-0.034****	0.967
Age		
10-14 (25-29 ¹)	2.181*	8.858
15-19	1.057*	2.877
20-24	0.568*	1.765
30-39	-0.985*	0.373
40-49	-3.004*	0.050

Educational Status		
Primary level (No education ^r)	0.051	1.052
Secondary	-0.011****	0.989
Higher	-0.187 ***	0.829
Religion		
Hinduism (Islam ^r)	-1.168 **	0.311
Christianity	-0.423 *	0.655
Others	0.484	1.623
Access of mass media		
a) Listen to radio regularly (Irregularly ^r)	0.140	1.151
b) Watch TV regularly (Irregularly ^r)	-0.034****	0.967
Number of living Children		
Below 2 (Exactly 2 ^r)	3.001 *	20.098
Above 2		
3	-0.473 *	0.623
4	-1.212 *	0.298
Pregnancy Status		
Current Pregnant (Not pregnant ^r)	-2.238 *	0.107
Involvement in N.G.O's		
BRAC (BRDB ^r)	-0.299***	0.742
Grameen Bank	-0.113	0.893
Mothers Club	-0.450	0.637
Others Organization	0.018	1.018
Respondents Husband Occupation		
Non-Agriculture (Agriculture ^r)	-0.075****	0.928
Respondents Husband Educational Status		
Primary (No education ^r)	-0.072	0.930
Secondary	-0.200****	0.818
Higher	-0.090****	0.914
Intercept		
-2loglikelihood	-0.720*	
Cox & Snell R ²	6351.942	
Nagelkerke R ²	0.486	
df	0.652	
	35	

r = Reference category, * Significant at P<0.001, ** Significant at P<0.01, *** Significant at P<0.05

**** Significant at P<0.10

Notes: Not employed = housewife/housework. Agriculture = Own land, Rental land and other's land worker/ Cultivator. Non-agriculture= Professional, Technical, Clerical and Managerial occupations.

Table 6: 2 × 2 Contingency Tables

Attributes	Fertility Preference		Total	χ ² (M-H)	
	No	Yes			
Belongs to GB	No	5315	3622	8937	34.89*
	Yes	420	145		
Total		5735	3767	9502	
Belongs to BRAC	No	5240	3592	8832	36.24*
	Yes	495	175		
Total		5735	3767	9502	
Belongs to BRDB	No	5640	3736	9376	7.96**
	Yes	95	31		
Total		5735	3767	9502	
Belongs to MC	No	5716	3760	9476	0.35
	Yes	19	7		
Total		5735	3767	9502	
Belongs to Others organization	No	5033	3451	8484	18.12*
	Yes	702	316		
Total		5735	3767	9502	

* Significant at p< 0.001, ** Significant at P<0.01

Source: Goni, M. A. (2008).