2013

Changing Pattern of Fertility in Bangladesh

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University of Rajshahi

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A Thesis
Submitted to the Department of Statistics, University of Rajshahi
in Partial Fulfillment of the requirements for the degree of
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in
Statistics

By

Md. Abdul Jobbar

DEPARTMENT OF STATISTICS
UNIVERSITY OF RAJSHAHI
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Under the Supervision of

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Session: 2006-2007

DEPARTMENT OF STATISTICS
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June, 2013

Dedicated

To

My Beloved Mother

Dr. Md. Nurul Islam
Professor
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Certificate

This is to certify that the thesis entitled "Changing Pattern of Fertility in Bangladesh" is afaithful record of original research work, for the degree of Master of Philosophy in Statistics done by Md. Abdul Jobbar, Department of Statistics at the University of Rajshahi, bearing Examination Roll No: 06241, Session (MPhil): 2006-2007, Registration No: 2728, has completed the research work for the full period and that dissertation embodies the results of his investigation conducted the period he worked as an (M Phil) student under my direct supervision.

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26 June, 2013

DECLARATION

I do hereby declare that the thesis entitled "Changing Pattern of Fertility in Bangladesh" submitted to the Department of Statistics, University of Rajshahi, for the award of the degree of Master of Philosophy in Statistics is a record of original and independent research work done by me under the supervision of Dr. Md. Nurul Islam, Professor, Department of Statistics, University of Rajshihi, Rajshahi, Bangladesh and it has not been submitted elsewhere for any other degree or diploma.

M.A-. Jabb00

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ACKNOWLEDGEMENT

First and foremost thanks to almighty Allah, source of all power and knowledge for giving me strength, courage, patience and ability to accomplish this study in time despite my personal troubles and hazards.

I would like to express my sincere and heartiest gratitude to my reverend teacher and supervisor Dr. Md. Nurul Islam, Professor, Department of Statistics, University of Rajshahi, for his untiring patience, constant inspiration, excellent co-operation and constructive guidance accorded to me throughout the progress of this research work. I am highly grateful to him for allowing me to work under his guidance.

I gratefully acknowledge the assistance that I have received from Dr. Md. Abdul Karim, Professor, Department of Statistics and Dean of Science, University of Chittagong. I shall always remember his contribution because in spite of his business he has solved my maximum problems when I have asked, never feels boring. He is very polite and tremendous patient person. His valuable suggestions, remarkable assistance and continuous encouragement that inspiring me at every stage of this work.

I am very much grateful to my honorable teacher Dr. Md. Golam Hossain, Professor, Department of Statistics, University of Rajshahi for his constructive suggestions, helping and inspiration accorded to me throughout the entire period of my work.

I am indebted a great deal of my respectable teacher Professor M. A. Razzak. Professor Dr. Md. Ripter Hossain, Professor Dr. Md. Ayub Ali, Professor Dr. Asaduzzaman Shah and Professor Dr. Md. Monsur Rahman, for their advice, co-operation and encouragement.

[express my sincere gratitude to Dr. Nazrul Islam, associate Professor, and Md. Aminur Rahman , Lecturer, Department of Population science and Human Resource Development, University of Rajshahi for their timely advice and continuous encouragement that help me to go forward.

I also acknowledge with thanks the co-operation of my younger brother Md. Ashraful Islam (Ph. D. Fellow) and Md. Abu Shahin (M. Phil Fellow), Department of Statistics, University of Rajshahi, Rajshahi, Bangladesh.

I am grateful to all of my friends, especially Mahmudul Hassan, Assistant professor, Department of population science and human Resource Development, University of Rajshahi and Md. Shahjada Ali Nawaz, (Ph. D. Fellow of Statistics, University of Rajshahi) Assistant professor, Jessore Shikka Board Model School and Collage, Jessore, for giving me information and journals concerning on fertility and also their encouragement and co-operation in every stage in accomplishing my research work.

Also thanks are all officers and staff of the office and computer unit of the Department of Statistics, University of Rajshahi for their cordial co-operation and assistance during my research work.

Finally, I express my regards to all of my family members and well wishers, especially to my wife Rehana Akter for their rigorous sacrifice, constant encouragement and continuous inspiration throughout this study.

ABSTRACT

In this study, an attempt has been made to assess the factors associated with changing pattern of fertility in Bangladesh using nationally representative data from Bangladesh Demographic and Health Survey (BOHS), 2007. Multivariate technique named Logistic regression analysis has been used to find out the effects of the selected demographic and socio-economic factors on fertility pattern. Geometric distribution, Beta Geometric distribution and also multivariate technique named Cox's proportional hazard regression analysis have been used to identify the relationship between fertility, conception wait and fecundability.

Fertility is still high in Bangladesh, though it has been declining over time. A major cause of declining fertility has been the steady increase in contraceptive use over the last 32 years; another major cause of declining fertility has been the steady increase the age at marriage. Current contraceptive prevalence rate (CPR) is 56% in 2007 BOHS (Mitra et, al., May 2009).

The result of Logistic regression analysis shows that several socio-economic and demographic factors significantly affect on fertility. These are age at first marriage, current age of respondent, place of residence, religion, region, respondent's educational level, partner's educational level, work status of women, partner's occupation, contraceptive use, spousal age difference, marital duration, wealth index, body mass index, mass media contact, partner's age etc.

From the result of logistic regression analysis, we observed that lower age at marriage giving higher fertility on the other hand higher educated women giving lower fertility. From place of residence we observed that fertility is higher in rural areas. There are several reasons, these include may be the rural women are less educated than urban women; rural women have less media connection etc. Regional difference reveals that fertility is higher in Rajshahi and lower in Sylhet Division. Barisal, Chittagong, Dhaka and Khulna division have intermediate levels of fertility. Religion has affect on fertility behavior through Muslims and Non-Muslims. The analysis shows that fertility among Muslims is higher as compared with Non-Muslims in each age group. Work status of women suggests that labor force participation may be consequence of

lower fertility than non-working counterpart. Women who are involved with any service are not dependent on men (husbands), both socially and mentally have their own rights and absence of dependence, men cannot forcibly use women to increase their fertility. This has resulted in lower fertility.

Fecundability is regarded as one of the important proximate parameters of fertility performance of the married women. Due to the complex nature of fecundability, we have attempted in this study to estimate mean fecundability from the first conception interval, which is not associated with postpartum infecundability. The first conception intervals have been estimated indirectly by utilizing the data. Since the cohort of women is not homogenous in regards to reproductive performance, we have attempted to estimate the mean recognizable effective fecundability by fitting the Pearson Type-I beta geometric model with parameters a and b to the observed distribution of first conception delay in addition to geometric distribution. In our analysis, we have estimated the parameters by the method of moments. The purpose of the present study, to estimate the mean conception delay, mean and corresponding variance of fecundability and levels, trends and differentials of fecundability of the Bangladeshi women. The mean conception delay of the Bangladeshi women has been found

23.88 months after their first marriage and the mean fecundability is 0.042, which is estimated by geometric distribution. The theoretical arithmetic and harmonic mean fecundabilities are found 0.045 and 0.042 respectively by fitting Beta geometric distribution. This study reveals that the women with higher education have lower mean conception delay and higher mean fecundability. We have also seen from this study that age at first marriage has negative relation with conception wait and positive relation with fecundabihity. It is observed that conception wait is decreasing and level of fecundability is increasing with the increasing age at first marriage whatever be the marital duration. Moreover, the fecundability decreases with the increasing marital duration whatever be the ages at first marriage. This indicates that the more the age at first marriage the higher the fecundability level and less the conception wait and vice-versa. Furthermore, the more the marital duration the less the fecundability and higher the conception wait and vice-versa. We get the significant regression coefficient between age at first marriage and conception wait as -1.849, which reflects that with the increase of age at first marriage by one year, conception wait tends to decrease by

1.85 months. The trend analysis shows that conception wait is lower consequently fecundability is higher in the recent past than at some distant point of time.

The multivariate analysis through the Cox's proportional Hazard Regression model shows that the respondent age at first marriage, current age of respondent, place of residence, religion, region, respondent's educational level, partner's educational level, work status of women, partner's occupation, contraceptive use, spousal age difference, marital duration, wealth index, body mass index, mass media contact and partner's age are found to have statistically significant association with the marriage to first conception wait.

From the result of multivariate analysis we conclude that the associated factors which affect fertility those factors also affect fecundability with the same direction.

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INTRODUCTION

1.1 Background of the Study

The United Nations World Population Conference held on 1974 in Bucharest adopted a world population plan of action that asserted "Population and Development are interrelated and population variables influence development and are also influenced by them" (Stamper, 1978, P:28). It is clear that for development plan population study and research is undoubtedly essential. Population growth is the resultant of three components- Fertility, Mortality and Migration. As such manipulating any or all or a combination of these components can bring about any change in the growth rate. The possibility to bring down population growth by migration seems to be unwelcoming, because of imposed restrictions on migration, as also the possibility by raising the mortality (on moral grounds). Thus it appears that the fertility is the only variable which may have to be manipulated by policy interventions in order to reduce population growth (N.A.S, 1971:70-90 UN 1973: 631,660). Thus the problematical factors in determining the course of population have been the levels and conditions of fertility and the prospects for their changes (UN 1979:57).

Rapid population growth is a potential threat to people's standard of living and healthy growth of an economy. It is significant to note that no country has ever modernized or reached an advanced level economically with sustained high rate of growth. But the economic benefit of low growth of population should not also be exaggerated. There is no clear historical evidence that rapid population growth has hindered economic growth. The growth of population is only one factor out of many affecting economic development and the point is that lowering the growth rate is not the cure for all ills. Rather it is that, given the local socio-economic and broader world setting, a decline in growth rates in time enhances a countries' potential to achieve rapid economic development through its effect on the underlying social and political structure.

At the national level many more nations today particularly the developing countries have identified rapid population growth as a problem than at any previous point in history. In a review by Stamper, it was found that countries with three quarters of the population of the developing world have official population policy as a commitment to improving the welfare of their people (Stamper, 1977). Population related policies are one of the tools available to them for this purpose. Before policy formulation it is essential to identify the important factors that affect the population growth among the many factors. All the effects that are made by any government to control and change the population structure is termed as population policy. UNESCO Population Commission report of the Adhoc Consultative group of experts on population policy (23rd March,1972), includes measures and programs which contribute to the achievements of economy, social, demographic, political and other collective goals through critical demographic variables e.g. size and growth of population and its geographical distribution.

The present population size, density and growth of Bangladesh are worrying not only the Bangladesh Government but also the countries and international agencies that are trying to assist Bangladesh in her various development efforts. Now population problem is the main problem among the various problems and higher fertility is responsible for higher population growth in Bangladesh. Within the general context of development and socio-economic changes the present study addresses itself to an examination of relevant information on one of the major components of population growth viz., fertility in Bangladesh.

The population of Bangladesh has growth from 42 million in 1941 to more than 130 million in 2001, with a corresponding population density 839 per square kilometer. During the first half of the last century the population increased by only 45 percent. This, slow increase was due to a combination of high birth rates and high death rates. In the second half of the century, population growth was rapid, tripling during the period. According to 2001 population census, 39 percent of the population is under 15 years of age, 57 percent are between 15 and 64 years and 4 percent are age 65 and over (BBS, 2003:51). The young age structure coupled with high rate of growth, persistent high fertility, high density, limited natural resources and great poverty make Bangladesh as one of the most crucial areas of the world.

According to the Bangladesh population policy, the population should stabilize at 210 million by 2060, if replacement- level fertility is reached by 2010. This estimate of future population size is reasonably consistent with World Bank projections from 1994(Bos et al., 1994) and the 1996 revision of United Nations projections (United nations, 1996), both of which estimated a mid-21st century population 218 million. However, there is wide disparity between the estimates of Bangladesh Government and others on the time when the population would stabilize. The World Bank boldly forecast a final stationary population of 263 million by mid-22nd century, whereas others have not made projections beyond the mid-21st century. Recently however, the United Nations has revised their estimate for 2050 upward by 25 million (or 11 percent) to 243 million, apparently on the basis of the decade long fertility plateau (United Nations, 2004).

Despite the absence of apparent development in human development indices, Bangladesh has witnessed an incredible decline in fertility from the mid-1970s to early 1990s. During this period, TFR declined dramatically from 6.3 births in 1975 to 3.4 births per women in 1993-1994 and after then the TFR halted abruptly in a static point 3.3 births per women in 1996-1997, 1999-2000, BDHS. Again TFR decline from 3.0 births per women in BDHS, 2004 to 2.7 births per women in 2007 (BDHS published March, 2009).

The sequential fertility decline from 1975 to 2007 in Bangladesh has drawn up attention to the in home and abroad. At present, the stagnant situation in TFR is now a major concern to the government, demographers, social workers academicians, the donor agencies and policy makers interested in achieving lower fertility in developing countries may see manipulation of marriage patterns as a potentials useful means of reaching that end but the relationship of marriage patterns to fertility reveals that in some countries later marriage reduces a women's fertility largely.

The dramatic changes in fertility had occurred while Bangladesh was facing many negative factors, such as high poverty, low status of women, low literacy, low health status etc. on the contrary, TFR stood in a stagnant point when the country is in under development situation relating to such human development indices. Hence, there raise question regarding the factors responsible for fertility change.

1.2 Reproductive Behavior in Bangladesh

Bengali peasant culture is suffused with a pro-fertility ethos, which evolved over 3,000 years of adaptation and symbolic relationship between man and the land. The culture has-become highly successful in its ecological setting. The various great religions are superimposed but rural beliefs about fertility and the human body are more fundamental and cut across them.

Human fertility and land fertility are analogous. A woman is the field and the seed is nourished by her juices before birth and by her milk after birth.

Muslims commonly say that every mouth brings its own food, and each person's food is pre-allocated before his birth. Therefore, some conclude that land can indefinitely support those souls to be born. Such pro-fertility beliefs were at one time functional, but because life expectancy is now over 65 years, they have become dysfunctional. It is thought by

Muslims to be a moral duty to have and raise children and to increase one's kinship and lineage groups. The bodily substances shared by the breeding group are said to be transmitted by the male semen and female semen, which mix at conception.

Muslims consistently have higher fertility than Hindu and give negative advice about population control twice as much as Hindus. But these differences have disappeared through motivation. The most fertile group is the rural middle class and urban labor class, who are mostly Muslim cultivators. There higher fertility is not just because of religious affiliation, but because they are enmeshed in the matrix of peasant life that evolved with a pro-fertility bias.

It is believed that one's fate is written on one's forehead at conception, or that at birth, fate is determined by Allah before the soul is sent to the fetus. God controls the four main aspects of living: life, death, wealth and sustenance. There are two kinds of fate-unchangeable and changeable - and Muslims seek God's favor for the changeable fate on the night of Shab-e-Barat. The concept of Karma is actively assented to by Muslims and Hindus: one's deeds, especially bad deeds, will affect the doer.

The reproductive period

It is difficult to define clearly the bounds of the woman's reproductive period. There are of course, two objective limits -menarche (or puberty) and menopause, the cessation of menstrual period.

Menarche: Menarche (the on set of menstruation) is thought to signal the time when a female becomes capable of reproduction. Menarche usually occur somewhere between the age of 11 and 15 with considerable variation in the mean age among different population.(Sheps et .al, 1973 : Leridon, 1977) The menses are often rather irregular at first, and anovular cycles (without the release of ova from ovary)may be frequent. The release of behavioral and ova does nor necessarily indicates that these ova can be fertilizes or implemented in the uterus and brought to term. Hence full sexual maturity probably occurs some time after menarche. However, it is difficult to study the socio-cultural factors influencing age at menarche, since it will be chiefly determined by the biological and nutritional factors (Sheila, J., 2001);

Menopause: Menopause is the end of a woman's reproductive life. Generally it occurs between the age of about 42 and 50 (Sheps and Menken 1973, Wyon ND Gordon, 1971). A woman is postmenopausal if she has experienced at least 12 months since the last menses in the absence of a known pregnancy (Wood, 1995). After the menopause a woman is sterile.

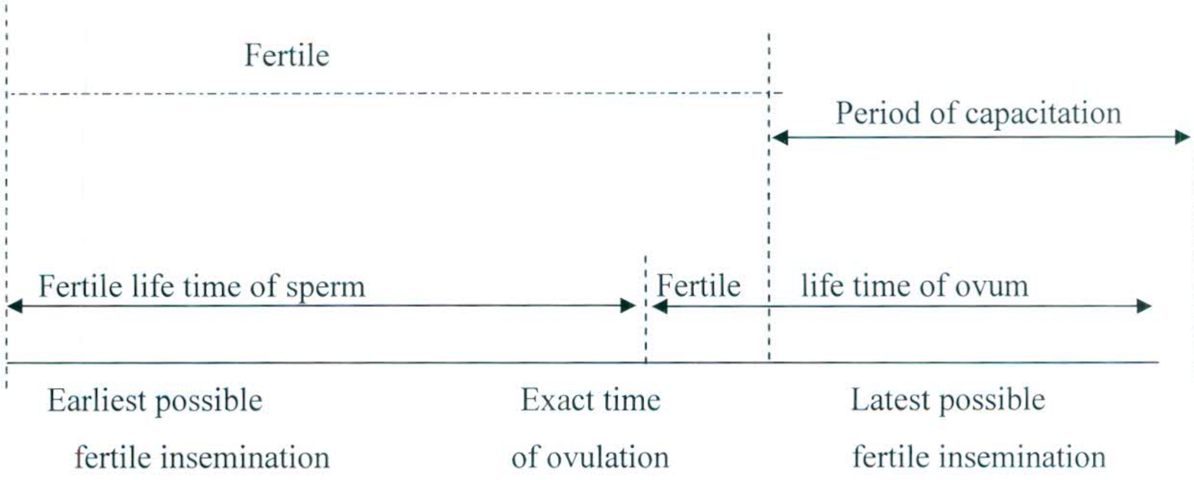
The interval between puberty and menopause is termed Reproductive period of a female. The total length of reproductive if could be longer than 35 years if we consider the complete interval between puberty and menopause: actually, the fecund period is on the average only 27-38 years (Leridon, H. 1977)

Sterility: Sterility is a couples incapacity to produce a live-born child. A sterile couple can not procreate a child. The sterility may be due to either or both partners. If conception is impossible physiologically to a female she is said to be sterile or infecund. If the fecundability is zero throughout the life of a female, she is said to be primarily sterile: if it becomes zero at any time during her reproductive period (which arises after one or more children have been born), she is known as secondary sterile (Heter , 1970: Weir and Weir, 1961).

Fetal wastage: A conception may not always result in a live birth, the outcome of the corresponding pregnancy may end in a spontaneous fetal death, in an induced abortion, in a still birth or in a live birth. For convenience, if a conception results in a live[1] birth, it is termed as complete and if the conception result in a fetal wastage, it is termed as incomplete. It seems reasonable to consider that in a given context each of these outcomes have a numerical probability which may vary with maternal age and health, rank order of the pregnancy and the time elapsed since the previous pregnancy(Abramson, 1973: Potter at. Al., 1965).

Non-susceptible Period: The fecundability of a female is temporarily suspended following each conception when menstruation discontinues for some times. This period: of non-susceptibility is the sum of two parts: first, gestation period and second, the interval after its terminative and before the resumption of ovulation which is known as post partum amenorrhea (PPA) period. The outcome of a pregnancy depends upon the duration of pregnancy and PPA, while the later depends also upon the breastfeeding practices and their physiological impact.

Duration of fertile period: The exact duration of fertile period has proven difficult to determine, and, as a consequence, the existing estimates vary widely from less than a day (Tietze, 1960) to a week or more (Hartman, 1962). The fertile period is a brief interval around the time of ovulation during which an insemination can result in a fertilization. Fertilization is possible if insemination occurs before ovulation because sperm 'retains its fertility for a short time after insemination. Fertilization can also take place following ovulation because the ovum remains viable for a brief interval. An approximate estimate of fertile period therefore would be the sum of the fertile life times of sperm and ovum, but this estimate is slightly too high because it does not take into account the time required for the sperm capacitation. Sperm needs 6 hours after insemination before becoming fertile (James, 1979) and this time should be subtracted to yield an accurate of the fertile period.



Best available estimates of the fertile life times range from 24 to 48 hours for sperm (Robert G and Potter Jr. 1961 ;Vander Vliet and Hafez 1974) and from 12 to 24 hours for the ovum (Barret and Marshall 1969). Summing these life times and subtracting 6 hour for capacitation gives a range of 30 to 66 hours for the fertile period with an average of about 48 hour or two days.

Fertility, Fecundity and Fecundability

It is useful to briefly discuss the basic terms, fertility, fecundity and fecundability. Fertility refers to actual reproduction, whereas fecundity denotes the ability to reproduce. A woman who is bearing children is fertile; a women is considered fecund if she is capable of bearing live off spring. The opposite terms are infertility, also called childlessness and infecundity, which is synonymous with sterility. Sterility (infecundity) implies the existence of infertility but the reverse is not necessarily the case. A fecund woman may choose to remain in fertile by not marrying or by practicing highly effective contraceptive. Infertility then is either due to a voluntary decision not to have children or it is caused by (biological) infecundity.

The term fecundability refers to the ability to conceive. Fecund and fertile women are necessarily fecundable, although the may experience temporary periods of infecundability. However, some fecundable women are infecund, and consequently infertile, because they are physiologically unable to successfully complete a pregnancy. The term fecundability has taken on a specific meaning as the probability of conceiving per month (among cohabiting women who are not pregnant, sterile or temporary infecundable)

These definitions are given in the Multilingual *Demographic Dictionary* (United Nations, 1959) and are constantly used in the English demographic literature. It should be noted that in France and in other Roman Language the terms fertility and fecundability are reversed; that is, fecundity is the equivalent of fertility and fertiles equal to fecundity. To add further to the confusion, the words fertility and fecundity are used virtually synonymously in the biological and medical literature.

More specific meaning can be given in the terms fertility and fecundity by adding objectives. For example, natural fertility is found in populations where no contraception or induced abortions is practiced (no deliberate birth control is practiced); controlled or regulated fertility is observed in societies where fertility control practices are widespread. Similarly, natural fecundability is the monthly probability of conception in the absence of contraception, and residual or controlled fecundability refers to the conception risk in the presence of contraception.

In practice recognizable and effective fecundability are two most widely used measure of fecundability. In this study, by the term fecundability we will mainly refer to net recognizable and effective fecundability. For convenience, the term 'fecundability' will be reserved to refer to it. The time unit for the measurement of fecundability is the duration of one menstrual cycle. However, many investigators use the more convenient calendar month, a practice that is accepted in the present model. In any case, the difference between the average duration of a cycle and a month is small (Matsumoto, 1962; Vollmen 1956).

1.3 Research Perspectives

Bangladesh is one of the developing countries which have been experiencing accelerated population growth in recent decades. The ever-growing population is putting severe constraints on national efforts to improve the overall living conditions of the people. The high rate of growth is presumably due to sustained high level of fertility and declining mortality as in other developing countries. High population - growth in the recent decades in the world, in general, in the developing countries in particular, has drawn attention of several researches because of its indirect relationships with and important bearing on the socio-economic development. There is now a general recognition that rapid population growth in developing countries is jeopardizing all the developmental efforts in ameliorating the socio-economic conditions in these countries. For large increase in population of limited land space as that of other resources would not only lead to an increasing presser on land but also may create ecological imbalance.

Moreover, sustained population growth, ceterisparibus, means more consumption, less saving, high social overhead cost, less investment, reduced output per worker, less job opportunities- all leading to a vicious circle of poverty and fatalism (Coale and Hoover; 1958;Kuzntes, 1969;Demney, 1972; 154; Mueller, 1977; Birsall, 1977).

Planner in the developing countries previously maintained that, like the presently developing countries of the world, it would be possible to make socio-economic development without taking into cognizance the population variable. But they proved to be not correct because the initial conditions (Low rate of natural increase, high man/land/resource ratio etc). Which helped the developing countries in maintaining balance between population growth and development were quite different from those now prevailing in the developing countries. Consequently, population variables are increasingly being taken into account in formulating socio-economic planes and developing strategies and policies in order to promote balanced and rational development.

Population growth is the resultant of three components- fertility, mortality and migration as such any change in the growth rate can be brought about by manipulating any all of a combination of these components. The possibility to bring down population growth by migration seems to be bleak, because of imposed restrictions on migration, as also the possibility by raising the mortality (no moral grounds). Thus, it appears that, fertility is the only variable which may have to be manipulated by policy interventions in order to reduce population growth (N, A, S., 1971: 70-92; 1973: 631-660).

Thus "the problematical conditions of fertility and the prospects for their change" (U. N. 1979: 57). This has made the study of fertility so important in recent years. Human reproduction is influenced by social, economic, physiological, genetic and cultural factors interacting with each in a complex manner. As Simon and Saunders (1977: 85) point out "genetic and physiological factors set conditions that make reproduction both certain and limited. Social forces determine to a large extent when and where it will occur.

Thus with equal level of development, other determining factors may cause variation in the fertility level among nations and even among regions within the same nation. Moreover, socio-cultural considerations may be pre-determining the economic considerations in some countries or region in determining the level of fertility in contrast of others. Thus, study of fertility and its determinants is the prime importance not only for its own sake, but also in understanding the mechanism through which it works and its subsequent relationship with other components of the population growth and related matters.

In explaining the decline of fertility in the developed countries Ryder maintains that low fertility has been achieved in Western Europe through four transitional phases: high nuptiality-high marital fertility; low nuptiality- high marital fertility; low nuptiality-low fertility; high nuptiality-low fertility; where as Eastern Europe has cut the sequence by omitting the two intermediate stages (Ryder 1967; 300).

Coale asserts that the presently low fertility countries achieved this stage by employing both Mulhusion and Neo-Mulhusion methods of fertility regulation (Coale, 1967: 205-209). Hence, age at marriage and proportion marrying occupy a very important place in studies related to policy interventions for reducing fertility in countries with sustained high fertility like Bangladesh (Duza and Baldin, 1977; Nortman and Hofstatter, 1978).

Levels and patterns of fertility considerably vary in various sub-groups of the same population. Study of differential fertility is useful in identifying the factors, which determine fertility levels among various subgroups. It is also helpful in projecting more accurately population size of entire country. Not only can this but such a study which family planning programs can be concentrated.

There are several factors, which are responsible for differential fertility. Moreover, assessment of the extent of differences among various groups in a population is often the first step in identifying the important determinants of fertility behavior.

Information on fertility also provides a basis for Projecting changes in the overall level in the fertility necessary for reliable population projections, which are essential ingredients of development planning (Rele, 1963; U.N., 1979: 65-66).

Differentials fertility includes ecological factors, regional differences, urban-rural setting, educational attainment, economical status, occupation, employment of women, religion, caste, race, age structure, health status, social status, mass media etc, therefore, for differential fertility study several factors combined together are always taken into consideration.

Recent studies have identified many reasons for plateauing and slow decline of fertility in Bangladesh. Unwanted fertility play an important role in determining actual level of fertility (Islam et al., 2002). Pritchet (1994), in his classical study, argued that to reduce fertility in a population, desired fertility, which depends on development, culture etc., is important, and a family planning program and even contraception use itself have a very minor role to play in decreasing fertility in a population. So, the policies that improve the socio-economic conditions and reduce the demand for children are the most important and sustainable way to reduce fertility.

In order to improve our understanding of the causes of fertility decline in Bangladesh during early 1990's and then its stabilization, it is necessary to analyze the mechanisms through which socio-economic variables interact with biological and behavioral factor to influence fertility. In this study, an attempt is made to explore the relative importance of the effect of different proximate determinants on fertility in Bangladesh and their role on fertility decline and then stabilization.

1.4 Review of Literature

Bangladesh is characterized by high fertility and comparatively high mortality. Study conducted in the early sixties reported total fertility rates as seven in Bangladesh (Afzal, 1967; Alauddin and Faruque, 1983). Since the mid sixties, several surveys reveal the persistence of fertility patterns, a characterized, which has been corroborated by the fertility surveys (Sirageldin et al, 1975; BFS, 1978).

A solid understanding of the influences of the socio-demographic (also socio-economic) characteristics of the population on fertility is a necessary part of the foundation for the sound population policies. A good deal of research has been devoted to reach such an understanding. An extensive literature on "the Influences of the Socio-Demographic Characteristics of the Population on fertility" exists. These sections have been set out the major bodies of the past research about the influences of the socio-demographic characteristics of the population on fertility and highlight the gaps that are revealed.

Bangladesh has undergone a remarkable demographic change over the last three decades. The total fertility rate has declined from about 6.3 in the 1975 to 2.7 in 2007 (BDHS, 2007). From various sources suggest that the CBR fluctuated around 45 per thousand populations until the mid-1960s and in recent years there has been a modest decline in CBR in Bangladesh. Policy makers interested in achieving lower fertility in developing countries may see manipulation of marriage patterns as a, potentials useful means of reaching that end but the relationship of marriage patterns .to fertility reveals that in some countries later marriage reduces a women's fertility largely by limiting her opportunity for childbearing.

Abedin (1982) had estimated the mean and median age at first marriage in rural community of Bangladesh. He has estimated various nuptiality parameters recursion` Coale's nuptiality model and using these values estimated the frequency of first marriage and risk of first marriage.

Choudhury RH. (1983), reported that the relationship between certain aspects of the status of women that is education, work experience and age at marriage, and the use of contraception and fertility, using data collected by Bangladesh Fertility Survey (BFS) of 1975. The analysis is presented separately for rural and urban areas. Results of the tests in brief are as follows: (a) Education is found to be strongly correlated with the use of contraception within each sub-group of the study population. Education is positively related with use of contraception and negatively with fertility, (b) Age at marriage is found to be the most important factor explaining fertility for every sub-group of the study population. Couples marrying at higher ages are likely to have fewer children and (c) work experience has very little or no effect on current use of contraception and fertility.

Using **Bongaarts (1987)** model , they estimated that 8 percent increases in contraception use would be needed to bring down TFR from 5.3 to 4.8 and 17 percent increase in contraception will be needed to bring down TFR from 5.3 to 4.3, these reductions could be produced by raising the minimum age at marriage to 18 and 21 years respectively.

Thein et al., (1988) found despite the legal age at marriage, many girls being married before they reach the age of 15 years. This had suggested that introducing legislation to increase age at marriage has little impact unless social traditions are changed. In this respect, access to higher education for female students would have greater impact. Findings from a female scholarship program suggest that more highly educated girls tend to marry later.

Cleland (1989) examined the fertility decline in Bangladesh and show that there is a patriarchal society in which most women are in purdah, there status is low, and they are dependent on their father's, brothers and sons. Families and individuals face many risks for which relatives, especially adult sons, are only available insurance. This is a complex of conditions generally considered and these conditions led many component observes as recently as the decade to believe that in Bangladesh there could not be a significant demand for family planning services and lower fertility before substantial structural changes occurred. Indeed, they remain a basis for the plausible idea that further gains will be difficult and that a plateau will be reached in fertility levels long before the recent decline brings fertility to replacement levels.

Kabir and Rab (1990) had analyzed Coale's index, I_m (the index of proportion married) to see the change in marriage patterns. The index of proportion married among women in the childbearing ages is divided by comparing the experiencing Hutterite Schedule of marital fertility rates; with the number of children all women bear subject to the same fertility schedule. The interpretation of the index is straightforward. The proportion-married index indicates how much marriage contributes to the overall fertility of the given population. Thus the proportion-married index can be thought of as a weighted index of the proportion of women married in each age group with weight varying at the level of potential fertility. The nuptality index began to change since 1975 and modest decline in fertility is observed around this time. These lead us to conclude that the decline in fertility can be partly explained by change in proportion married.

Islam et al., (1991) had estimated the fertility inhibiting effect of the three most important proximate determinants: marriage, contraception and lactational infecundability. The analysis shows that although the fertility level of Bangladesh is declining, it is still very high (around 5 births per women). They suggest that fertility reducing effect of the marriage variable is also increasing but at a very slow rate. In fact, the fertility inhibiting effect of marriage and lactational infecundability are compensating each other.

This study reported that, among females marrying before the age of 18 years, the impact of age at marriage on children born till the age 45-49 years was small. But the reliability of this estimation is questionable for several reasons. Firstly, the data were collected retrospectively and accuracy of both an individual's age and age at marriage data is unknown. Secondly, the findings that completed fertility of women married before their tenth day was higher by one birth than of women married between their tenth and twelfth, births days is highly unlikely. Since all those women should be in fecund at the time of marriage and should be fecund at the same age of their married life and the same fertility.

Chowdhury and Bairagi (1992) estimate the effect of age at marriage on fertility using Matlab data. They suggest that most of the girls who married before age 12 or 13 years were not fecund at the marriage and their age specific fecundability, at least for first 10 years of married life (this follow-up time was for about 10 years), is not different from that of women married at a higher age. In other words, age specific fecundability up to 25 years of life does not depend on age at marriage. They also suggested that the monthly risk of a birth during 20-24 years of life and up to 25 years of life did not vary with age at marriage could potentially affect fertility, because the age specific monthly risk of birth, which is equivalent to age specific fecundability in this population, has not affect by age at marriage, which in turn produce a higher total fertility for women married at a young age. They also estimated the average first birth interval, which has been almost two years (1.9 years) for women whose age at first marriage was 18 years, most of the births, which took place to the mothers before age 20 could be averted. Applying these results to the age specific births rates, and assuming that age at first marriage on crude birth rate (CBR) and total fertility rate (TFR) have been estimated. The results showed that CBR would be reduced by 13 percent and TFR by 9 percent. If the minimum female age at marriage could be raised to 21 (which is the minimum age at marriage set for males in the Bangladesh Population Policy), CBR could be reduced by 32 percent and TFR by 20 percent.

Islam SM, Khan HT, Khan HM. (1993) had reported that the effects of selected socio-economic and demographic factors on fertility in a rural area of Bangladesh. It has been revealed that age at first marriage and coital frequency has direct significant effects while ever use of contraception and duration of breast-feeding have direct positive significant effects on total parity. Total effects of wife's education and age at first marriage on fertility are found to be negative while those of religion and household income on fertility are found to be positive.

Islam and Islam (1993) studied the fertility inhibiting effects of the three most important proximate determinants: marriage, contraception, and lactational infecundability, using data extracted from the 1989 Bangladesh Fertility Survey (BFS), Lactational infecundability was found as the most prominent fertility reducing factor. Contraception was found to be the second most important factor in the reduction of fertility. Their analysis suggested that the fertility reducing effects of contraception was steadily increasing, whereas the effect of lactation infecundability remained nearly constant. In another study, using data from the 1993-94 BDHS, Islam et al., (1996) observed that contraception appeared as the most prominent determinant of fertility reduction followed by lactational infecufidability and marriage.

Khan HT, Islam SM, Khan HM and Bari R. (1993) analyzed data from two sources in rural Bangladesh had been used in this study to examine the differentials in fertility by selected socio-economic and demographic factors. They found that age at first marriage, education of spouses and availability of electricity in the household had inverse relationship with fertility. Higher fertility is observed for Muslim's women than for non-Muslims. It had also been found that fertility was the lowest to those women whose husbands were service holders and the highest for those engaged in agriculture.

Cleland et al., (1994) analyzed the World Bank report gives a major place to government actions in moving the onset of fertility decline and stepping that decline in Bangladesh. The report states that the crucial change that has taken place concerns acceptability of and access to birth control and not structural change that has driven down the demand for children. Economic and socio change, with concomitant shifts in ideas and outlook may have an important facilitating factor, just as contraceptive availability is seen as a facilitating factor.

Deborah Balk (1994) had examined that women's status is well represented neither by one direct measure nor one indirect single proxy. Implementing the data (approximately 5,000 women) from some villages of rural Bangladesh. Different dimensions of women's status influence fertility differently in terms of magnitude, direction, and statistical significance. The effects of status on fertility are widely different in rural Bangladesh and measures that not account for the simultaneous determination on reverse causality of women's status and fertility will probably mistake the direction and under estimate the effects of status on fertility.

Pritchett (1994) argued that to reduce fertility in a population, desired fertility, which depends on development, culture etc. is important, and a family planning program and even contraceptive use itself have a vary minor role to-play in decreasing fertility in a population. Citing the examples of different countries, he demonstrated that keeping the desired family size constant, contraceptive has no major role to play in bringing fertility down.

Amin et al., (1994) have observed that total marital fertility rate fall by around 10 percent from 5.3 percent in 1990. Similarly, the average number of children ever born and percentage pregnant declined from 4.3 and 11.7 percent in 1983 to 3.7 and 10.6 percent in 1991, respectively. They also showed between 1983 and 1991, the decline in total marital fertility was higher among urban residents and educated women than that of rural resident and uneducated women respectively.

Das Gupta and Narayana (1996) criticized the World Bank Report (Cleland et al.; 1994) on fertility decline in Bangladesh from other stances. They showed that Bangladesh's socio-economic, family planning and demographic trends were not unique but were similar to some Indian states. They explained the fertility traditions not only by local events but every largely by happening on a much larger scale.

Islam (1996) indicated by application of Bongaarts' model that there was a downward trend in all the proximate indices. He estimated that between 1975 and 1989, the amount of decrement of fertility was about 23 percent and it was about 31 percent in between 1975 to 1991. Islam concluded that this was primarily caused by an increase in the use and effectiveness of contraception. He also investigated the fertility differentials by various demographic and socio-economic works status of women, education of husband and occupation of husband. He suggested that socio-economic variables have positive or negative effect on proximate variables, which in turn affect reproductive performance. He concluded that age at marriage and education have strong determinant of fertility as well as higher age at marriage and educational level affect on fertility decreasing.

Khan HT, Raeside R. (1997) reported on which have been undertaken using data from the 1989 BFS to determine the significance of influences on the probability of birth in the year preceding the survey. In the survey a total of 11905 ever-married women of reproductive age were asked battery of questions related to fertility aspects of women. Variables selected in this study were grouped into demographic, socio-economic, cultural, and decision making variables. Findings from the study indicate that the mother's age, whether contraception has ever been used, the death of a child at any time, whether the women has ever worked, religion, region of residence, and female independence are the important covariates for explaining recent fertility in Bangladesh.

Models are developed for the probabilities of a women giving birth in urban and rural areas, dependent on her demographic and socio-economic conditions. Also, developed models for contraceptive use which is applicable in urban- rural Bangladesh. This modeling contributes to a better understanding of fertility changes in Bangladesh and the differentials between urban and rural fertility. It is indicated that a continued fertility decline is likely.

Caldwell et al., (1999) viewed that the national family planning program in Bangladesh had a "marked effect over a short time within the larger framework provided by socio-economic change". Change in the socio-economic environment in the late 1970s and early 1980s clearly indicate that the economics of demand for children had undergone revision causing the motivation to limit family size to become increasingly widespread since the mid-1980s. The demand for children decrease not only among the wealthy and better education classes 'but more importantly among the vast majority of the population belonging to the proper less educated classes living in the rural areas.

Razzaque A. (1999) examines wife-husband preference for children and subsequent fertility for a period of five years in the treatment and comparison areas of Matlab, Bangladesh. The two data sets used were the in-depth Survey (1984) and the Demographic Surveillance System (1994-89). In the case of wives' preferences for children, subsequent childbearing was 13.8 percent higher than desired in the treatment area and 44.7 percent higher than desired in the comparison area. After controlling for all variables in the model, the likelihood of giving birth was 1.78 times higher for wives who wanted no more children, but whose husbands did want more, compared with couples where neither husband nor wife wanted more children. For couples where the wife wanted more, but the husband did not want more children, the likelihood of giving birth was 0.63 times that of couples where both the husband and wife wanted more children. This finding suggests that to enhance the decline in fertility in these two areas of Matlab, it will be necessary to motivate both wives and husbands to cease childbearing.

Ray (2000) stated that slowing down, of fertility levels in Bangladesh confirms that the socio-economic rational for limiting fertility is even more important today, if anything. This is evident from persistent socio-economic differentials in desired family size, observed fertility and in the proximate determinants (Contraceptive use, age at marriage and mean duration of insusceptibility). The lack of further decline in the birth rate despite increasing contraceptive prevalence, although much more slowly, is because current fertility preferences measured by mean ideal family in

1999-2000 of 2.5 are still high relative to replacement level fertility (TFR of 2.1) especially among the poor, firmed the "micro inertia" of fertility.

Abdur Razzaque and Peter Kim Streafield (2000) have Studied the past, present and future fertility in Bangladesh. They observed that the population of Bangladesh has been much increases in the second half of the 20th century, 41 million in 1950 to 120 million in 1998. Such huge increase mainly due to mortality decline after the war-II with improvement of medical science and public health measures. However, in Bangladesh, fertility decline at a very low level of socio-economic development. The study used two data sources: Matlab Demographic Surveillance, ICDDRB and Demographic and Health Survey of Micro International, 1993-94, 1996-97, 1999-2000. They observed that in the past, fertility was high because familial, social and economic conditions were favorable to many rather than few children but recent data shows widespread motivation for small family size and it is mainly due to increase in the direct economic cost of living. Such appreciable decline in fertility was possible mainly due to the family planning program have been successful.

It has also documented that a large proportion of birth is still unwanted in Bangladesh as well as in both the MCH-FP and comparison area of Matlab. If the unwanted birth could have been eliminated, fertility would have been much lower along with fewer abortions, because contraceptive use can lower down abortion by reducing unwanted birth. They also discussed the future level of fertility in Bangladesh.

Bairagi (2001) conducted a study in Matlab (a research unit of ICDDR,B) and found that the fertility in Matlab converges to the desired fertility. The Matlab couples used different proximate determinants of fertility, including contraception and abortion, in this converging process. The Study does not support the hypothesis that an MCH-FP project alone can bring fertility down to any low level, and t he view that the government of Bangladesh will be able to bring population growth down by 25 percent by increasing only the CPR from its present 51 percent to 71 percent. It was concluded in the study that a change in the desired family size and gender preference, along with family planning and reproductive health services, is apparently essential to have a further decline in fertility to complete the fertility change in Bangladesh.

Islam and Abedin ,(2001) examined the effect of women's education on age at marriage of the females and as well as on fertility. They showed that education is one of the important social variables of fertility differentials. It is an achieved status of individuals, which does not change over time like some other variables and is expected to give individuals an alternative source of new normative orientations as opposed to traditional ones. Women engaged in such activity contribute in rising age at marriage and thereby affect fertility to reduce.

Vera Zlindar, Rober Gardner (2001) observed, why increasing contraceptive use doesn't always results in an immediate decline in total fertility rate. They showed that other direct factors also affect fertility. The contraceptive prevalence rate (CPR) is not the only predictor of what will happen to fertility levels. The level of contraceptive use is one of the fertility strongest factors affecting the level of fertility linear regression of 105 countries comparing fertility levels and contraceptive use levels found 77 percent of the variation in fertility is explained by variation in contraceptive use and remaining 23 percent of the variation in total fertility is also important.

Bongaart's (2002) conducted a study on fertility trends for 143 "Less Developed Countries (LDC)". Assuming the past record of fertility transition will be repeated, he expected that the small number of countries that are still pre-transitional would likely enter the transition. When this will happen depends on achievement of some socio-economic progress, but the level of development for entering the transition has been dropping. He also expected that fertility transition would proceed relatively rapidly for countries in the early phases of the transition. He also argued that as countries approach the later stages of the transition, the pace of decline would slow down. The conclusion made in this paper is consistent projections, which expect the (un-weighted) average TFR of all developing countries to decline at a modest pace to 2.8 in 2020-2025.

Islam, Islam and Chakraborty (2002) focused on the exploration of the reality underlying the fertility change in Bangladesh. They have identified a number of factors responsible for unchanging of fertility in Bangladesh since 1993-94, which are due to population momentum effects, shifting of childbearing towards younger ages, shifting towards adoption of a less effective method mix, no substantial improvement in child survival status and reduction in postpartum infecundability period. They mentioned that the actual level of fertility in Bangladesh in 1999-2000 after adjusting for tempo effect would be close to 4, as compared to that of 3.8 in 1996-97. They analyzed statistical characteristics such as location, dispersion and skewness of age specific fertility distribution, which indicate an emerging pattern: (a) the fertility is tending towards young age during the recent past, (b) the births are occurring at a relatively lower span in recent times, that is , the births are taking place at shorter distance from the central tendency of fertility, and (c) the fertility curve is now less skewed to the right, indicating that more births are taking place within a shorter span now than before.

Eltigani (2003), in a study of causes of slow change of fertility in Egypt, indicated that the reproductive behavior of women from high and middle standards households is largely responsible for slow change of fertility. He mentioned that the key for future decline in desired number of children below the current level of 3 children depends on the reproductive preferences of women.

Islam (2003) examined the current status of the process of fertility change in Bangladesh and highlighted the major policy concerns stemming from dynamics of population. He showed that universal education with uncrossed mean years of schooling could reduce under-5 mortality thereby reducing the fertility to replacement level. He argued that the impact of population momentum could be reduced through some deliberate efforts. The policy strategies are instrumental in order to complete stage 3 of the demographic chance in Bangladesh. Three possible means to keep the impact of population momentum relatively small are: to achieve replacement level fertility soon, to increase mean age at marriage and to encourage further widening space between births.

Bongaart's (2003), in a study of completing fertility transition in 57 less developed countries, found that as the transition proceeds, educational differentials- in wanted fertility tend to decline and differentials in unwanted fertility tend to rise. He also concluded that educational composition of the population remains a key predictor of overall fertility in late transitional countries and that low levels of schooling could be a cause of slow change of fertility.

Agyei-Mensah,S. (2005) investigated the causes of constant fertility change in Ghana, during the period 1998-2003. Fertility desires was given as a plausible reason.

He mentioned that reducing fertility from levels of 6 to 8 down to 4 to 5 may not be so difficult, because most couples do not want the burden a lots of children surviving (6+). But the further step down below 4 children makes couples anxious and insecure.

Bongaart's (2005) in an examination of causes of the slow change of fertility in seven mid-transition countries: Bangladesh, Colombia, Dominican Republic, Ghana, Kenya, Peru and Turkey revealed a systematic pattern of leveling off or near leveling in a number of determinants. The findings suggest no major deterioration in contraceptive access during the stall, but levels of unmet need and unwanted fertility are relatively high. At the onset of the stall the level of fertility was low relative to the level of development in all but one of the stalling countries.

Aya Goto, Seiji Yasumura, Junko Yabe and Michael R Reich (2006), studied about "Influences of Unintended Pregnancy on Child Rearing" Addressing Japan's Fertility Decline. Japan has been experiencing a continuing decline in fertility and an increase in pre-marital conceptions and abortions among young people. Child rearing is often viewed as a burden. In response, Japan is now seeking ways to improve the child-rearing environment for parents. In this context, they conducted a prospective study among 206 pregnant women in Sukagawa City. They found that unintended pregnancy was associated with a higher risk of negative child-rearing outcomes, including lower mother-to-child attachment, increased negative feelings of mothers and a lower level of participation of fathers in child rearing. Unintended pregnancy exacerbates the real and perceived burdens of child rearing. Researchers believe the government needs to address the social challenges affecting people's family lives, which underpin low fertility, rather than focus on fertility decline. They suggest adopting a comprehensive approach to improve the lives of young couples, with a focus on adolescents, including life-skills education to prepare for adulthood, marriage and parenthood.

Sabina F R (2006), studied about "Emerging Changes in Reproductive Behavior among Married Adolescent Girl in an Urban Slum in Dhaka, Bangladesh". Structural and social inequalities, a harsh political economy and neglect on the part of the state have made married adolescent girls on extremely vulnerable group in the urban slum environment in Bangladesh. The importance placed on newly married girls' fertility results in high fertility rates and low rates of contraceptive use. Ethnographic fieldwork among married adolescent girls, aged 15-19, was carried out in a Dhaka slum from December 2001 to January 2003, including 50 in-depth interviews and eight case studies from among 153 married adolescent girls, and observations and discussions with family and community members. Cultural and social expectations meant that 128 of the girls had borne children before they were emotionally or physically ready. Twenty-seven had terminated their pregnancies, of whom 11 reported they were forced to do so by family members. Poverty, economic conditions, marital insecurity, politics in the household, absence of dowry and rivalry among family, co-wives and in-laws made these young women acquiesce to decisions made by others in order to survive. Young married women's status is changing in urban slum conditions. When their economical productivity takes priority over their reproductive role, the effects on reproductive decision-making within families may be considerable.

Ahmed Kabir et al., (2009) conducted a comparison of regional variations of fertility in Bangladesh. This study, based on the 2004 Bangladesh demographic and health survey (BDHS), examines the extent to which regional variations of reproductive behavior are explained by inherent demographic, socioeconomic, and programmatic differences among regions. This article also attempts to investigate the impact of four intermediate fertility variables; namely marriage, contraception, lactational infecundability, and induced abortion, on fertility among different regions in Bangladesh. The contribution of proximate variables was observed through the decomposition of the total fertility rate (TFR) into proximate components. The results indicate that contraception is the highest fertility reducing factor in all the regions.

Adhikari R. (2010) studied the demographic, socio-economic, and cultural factors affecting fertility differentials in Nepal. The contributing factors age at first marriage, perceived ideal number of children, literacy status, mass media exposure, wealth status, an child-death experience by mothers. He concluded that programs should aim to reduce fertility rates by focusing on these identified factors so that fertility as well as infant and maternal mortality and morbidity will be decreased and the overall well-being of the family maintained and enhanced.

Bussarawan, T.& S. Amin (2010) designed a study on the role of abortion in the last stage of fertility decline in Vietnam. He mentioned that Vietnam has experienced a rapid fertility decline over the last decades, yet fertility rates vary considerably across the country's 54 ethnic groups. He also concluded that because better access to abortion in unlikely by itself to reduce fertility among high-fertility minority groups, program that provide supportive health services and that target young, low-parity and less educated women may help to lower fertility among these groups.

Islam S, et al., (2010) studied on high fertility regions in Bangladesh: a marriage cohort analysis. The results show that the probability that a woman from the recent cohort in Sylhet or Chittagong who had a third birth will have a fourth birth is nearly twice that of her counterpart in other regions. Social characteristics such as education, occupation, religion and residence have no effect on fertility in Sylhet and Chittagong. Additional period-specific analyses using the 2007 BDHS data show that women in Sylhet are considerably more likely to have a third or fourth birth sooner than those in other divisions, especially Khulna. The findings call for specific family planning policy interventions in Sylhet and Chittagong ensuring gender equity, promoting female education and delaying entry into marriage and childbearing.

Sarkar P (2010) investigated determinants of age at first birth in Bangladesh. He shows that that women in Bangladesh engage in sexual activities at an early age before 15 years and most use modern methods (43%) for birth control. Most of women use specific pills method. Islam religion has a more tendency to marry at age before 15 years. The incidence of primary sterility for formerly married women; it is increases as duration of marriage increase and for currently married women; it is decreases with increase in duration of marriage. Findings need to be scientifically used in suitable programs addressing the case of fertility control in the developing countries as well as in Bangladesh.

Baqui A M, et al., (2011) examined the levels, timing, and etiology of stillbirths in Sylhet district of Bangladesh. They were recorded a total of 1748 stillbirths recorded during 2003-2005 from 48,192 births (stillbirth rate: 36.3 per 1000 total births). About 60% and 40% of stillbirths were categorized as antepartum and intrapartum, respectively. Maternal conditions, including infections, hypertensive disorders, and anemia, contributed to about 29% of total antepartum stillbirths. About 50% of intrapartum stillbirths were attributed to obstetric complications. Maternal infections and hypertensive disorders contributed to another 11% of stillbirths. A cause could not be assigned in nearly half (49%) of stillbirths

Ellis M M et al., (2011) studied about the Intrapartum-related stillbirths and neonatal deaths in rural Bangladesh: a prospective, community-based cohort study. They concluded that the Difficulty initiating respiration among infants born at home in rural Bangladesh is common, and resuscitation is frequently attempted. Newborns who remain in poor condition at 5 minutes have a 20% mortality rate. Evaluation of resuscitation methods, early intervention trials including antibiotic regimes, and follow-up studies of survivors of community-based resuscitation are needed.

Khan M M et al., (2011) estimated the study on trends in sociodemographic and health-related indicators in Bangladesh, 1993-2007: will inequities persist. They found the positive trends in urbanization, availability of electricity, age at first marriage, use of modern contraception, access to skilled antenatal care, child vaccination, knowledge of human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome and overweight and obesity. In contrast, negative trends were seen in factors such as literacy, infant and child mortality, fertility rate, home delivery and malnutrition and underweight.

Rahman A, et al., (2011) conducted on the arsenic exposure and risk of spontaneous abortion, stillbirth, and infant mortality. They found evidence of increased risk of infant mortality with increasing arsenic exposure during pregnancy, with less evidence of associations with spontaneous abortion or stillbirth risk.

After the independence, from Pakistan, political leaders and social thinkers began to be aware of the growing population problems. But they had a long wait until the people realized that legal action was needed to rise the minimum age at first marriage. The Muslim Family Law Ordinance was passed in 1961 requiring registration of all Muslim marriages. The Sarda Act was amended rising the minimum age of marriage for females from 14 to 16 years and for males from 18 to 21 years. But in actual practice on action was taken for the violation of the ordinance so far as age at marriage was concerned. In the absence of a vital registration system it is difficult to implement the law as there is no way to challenge the age as stated by a person. The Bangladesh Population Council has recommended that a proposal should be developed in due-course to rise the age at marriage giving due consideration to the existing socio-economic conditions of the country (Population Control and Family planning Division, 1976). Its recommended age at marriage for females is 18 to 25 years and for males 20 to 28 years.

The universality of marriage and low age at marriage is related to the religious affiliation and lower status of females in the society. Pre-marital sex is strictly prohibited and unacceptable in this society. Bangladesh remains desperately a poor country, despite some signs of improving condition. Even through some improvement have been made over the last two decades, most Bangladeshi remain uneducated and malnourished. Most agricultural holdings are small and increasingly becoming smaller and income inequality is growing.

A considerable amount of effort has been expanded in attempts to estimate fecundability since Gini (1964) first define it. In 1975 Bongaart's derived a new method for the estimation of the mean and variance of fecundability from the distribution of interval from marriage to first birth or from the resumption of the conception risk after contraception to the subsequent birth. The estimates of the mean and variance of fecundability are obtained by fitting a model for the distribution of intervals from marriage to first birth.

Although the theoretical importance of fecundability is beyond question as a major proximate determinants of natural fertility and as a major standard by which it assess the impact of fertility regulation but the enormous variation of its estimates undoubtedly attributable to difference in methodology and definitions. Bongaart's (1975) pointed out that intervals of fecundability vary greatly from study to study because of deferent methods and different definitions.

Yet even when the same method and the same definition were applied in a study of several historical populations, fecundability ranged from 0.18 to 0.31 (Wilson, 1987). Larsan and Voupel, (1993) provided the estimates that are based on the models that incorporate the effects of persistent heterogeneity and that are use the full information provided by multiple spell duration data. Empirical studies based on birth histories arc few. Estimates in the studies vary from 0.144 to and 0.189 in United States (Potter and Parker, 1964; Westoff et al., 1961) and from 0.163 in Taiwan (Jain. 1969) to 0.318 in eighteen centaury European population (Henry, 1964). Differences in the characteristics of the sample population make the validity of comparison tenuous.

Sheps and Perrin (1963) have used a special case of Henry's discrete time model namely, constant infecundable period associated with live births and still births, to study the relationship between birth rate and effectiveness of contraceptives and to obtain the probability generating function for the distribution of intervals between two live births . In a later paper the same probability generating function has been found by Srinivasan (1967).

Sheps and Perrin (1966) have again used the same special case of Henry's discrete time model to obtain the distribution of time required for the occurrence of a fixed number of conceptions terminating in live birth. In their model, They have taken into account more than one type of pregnancy, i.e., any pregnancy that terminates either in fetal wastage, stillbirth or live birth with a given probability. The model also allows for variable periods of gestation and of non-susceptibility to conception.

Although Henry's models recognize the possibility of live births and stillbirths, they consider the infecundable period following a conception as a random variable and do not allow for the variation in the gestation period and the amenorrhea period separately. These limitations have been removed by Perrin and Sheps (1964) in the model in which human reproduction is viewed as a Markov renewal process with a finite number of states. In this model, they have assumed that at any time after marriage (before the occurrence of secondary sterility or menopause) a woman is in any one of the following five states: (1) nonpregnant fecundable, (2) pregnant, (3) postpartum amenorrhea period associated with abortion or fetal wastage, (4) postpartum amenorrhea state associated with still birth, and (5) postpartum amenorrhea period associated with live birth. They have also assumed that the length of stay in each slate is a random variable and that each pregnancy terminates in one of the following outcomes: fetal death, stillbirth or live birth with fixed probabilities. In their model, they have further assumed constant fecundability for women in the nonpregnant fecundable slat, and the waiting time for a conception follows a geometric distribution. Expression have been derived by them for the mean and variance of different time intervals (e,g., the interval between successive live births), and for the monthly probability of a live birth. They have also obtained expressions lor the mean and variance of live births stillbirths, and miscarriages in a given period after marriage, and the probabilities of the different states at a given point in time.

Assuming time as a discrete random variable in the non-pregnant fecundable state and the length of stay in any other state as the continuous random variable Sheps(!964) has derived the distribution of time needed for conception and the distribution of conception delays for a heterogeneous population °f couples with unequal monthly probability of conception. In a later paper Sheps (1967) has formulated a class of stochastic models for a homogeneous cohort of women in terms of Markov renewal process on the assumption that the process is independent of age and parity and the length of stay in the non pregnant state has been to be continuous with the arbitrary probability density function. She has explored the effects of various levels of contraceptive effectiveness and abortion rates on birth rates, and the use of this models in evaluating population policies. She has also derived the moments of the distribution of conception delays in a group where the monthly probability of conception remains constant for any women but varies between women in an unspecified manner.

Sheps and Menken (1971) have presented a unified approach to the derivation of the existing models of human reproduction. While introducing the various models, they have included a comprehensive review of the techniques and methods used in their construction.

In addition to developing a stochastic model of conjugal history in terms of Markov renewal process, Krisnan (1971) has introduced a special type of Markov renewal process to set up a model of human fertility taking into consideration only social institutional factors. He has also suggested alternative models of conjugal history and fertility incorporating mortality factor explicitly into the model.

Chiang (1971) has developed a stochastic model of human reproduction considering two transient states namely nonpregnant fecundable and pregnant infecunduble (combining both gestation and amenorrhea) and an absorbing state (death state). The model is non homogeneous with respect to time as he has treated the transition from fecundable slate to pregnant or in infecundable state and the corresponding probability as a function of woman's age and the transition from infecundable to fecundable state a function of the length of time she has been pregnant and her age. Expressions have been derived for the multiple transition probabilities between the three states. lie has also estimated the length of time needed .to for a female to have certain number of pregnancies. As he has considered both gestation and postpartum amenorrhea into a single state, namely infecundable state there is some limitations in his model. The probability that a women aged x who has been in the pregnant or infecundable state for a length of time t will have a transition to the fecundable state in the age interval (x, x+dx) will not only be influenced by x and t, but also on the derivation of t into its two parts, (segments) namely gestation period and postpartum amenorrhea period.

The analysis of human reproduction process using different types of models to' various kinds of data available has enable to derive several theoretical behavior of fertility. Mode (1972) has studied the intrinsic rate of geometric growth of a population in terms of a modification of the Markov renewal model of human reproduction formulated by Perrin and Sheps (1964). In his stochastic model, mode has taken into account the biological factors that the reproductive period of every woman terminates eventually and that every woman runs the risk of death throughout her life span. lie has derived an expression for evaluating what influences a population policy consisting, for example, of contraceptive practices and laws of abortion may have on population growth. In a later paper considering, considering discrete and continuous time simultaneously, Mode (1975) has suggested a modification of classical renewal theory to construct a model of terminating reproductive process in which waiting times among live births are age and parity dependent. He has presented the distribution of waiting times among live births by restricting the Perrin-Sheps model as a non-homogeneous semi-Markov process. He has also given numerical examples illustrating how models of human reproduction may be linked to generalized age dependent branching process to give insight into the problem arising in the evaluation of family planning programs. Mode and Litman (1975), and Mode

(1985) also developed the more comprehensive population growth model required for simulating the events to the women in the simulation population.

Extending the results of Perrin and Sheps (1964), Das Gupta (1973a, 1973b) has derived a more general probability model of human reproduction. I his stochastic model of human reproduction removes some of the limitations of the Perrin and Sheps model. It considers the possibility of dependence of amenorrhea period on the preceding gestation period, and also for live births, on the breastfeeding practices of of the mother. He has formulated two models, virtually identical in concepts are considered depending on whether time is treated as a continuous or discrete variable, lie has derived exact probability distribution of various characteristics of fertility by solving integral equations by Laplace transformations in the continuous model and by solving difference equations with the help of probability generating function in the discrete model. The results he derived include the distribution of time intervals that do not involve more than one conception and their means and variances; the distribution of the time intervals that may involve more than one conception and their means and variances; and the exact probabilities of different states at time t and their asymptotic forms. He also illustrates the applications of the models for special case and generates many known results. In a later paper, Das Gupta and Hickman (1974) have derived truncated version of the distribution of wailing time of first conception and live births.

Singh et al. (1974) derived a probability model for a number of births to a female during a given time interval since marriage assuming fecundability to be parity dependent, no fetal wastage, and a constant period of non-susceptibility associated with each conception. The distribution takes into account the changes of primary sterility and secondary sterility following each pregnancy termination. It is demonstrated that the model can be used to predict the number of children born to females of a marriage cohort during a given period under different hypothetical situations involve in family planning programmers. In a later paper Singh et al. (1975) have derived a probability model of the number of births to a female during a specified period oft years assuming that females have the same conception rate. They have discussed the application of the model and as on illustration. Ft has been lilted to the observed data collected in the demographic survey of Varanahi (India), 1967-70. They have suggested that the model may be used to assess the effectiveness of a family planning program in the case where couples want to limit their family size after a certain number of births.

Ruzica and Bhatia (1982) have reported that in rural Bangladesh (Mallab), around 25 per cent of the husbands frequently stay away from home and almost half of them for periods exceeding three months. A large number of married men also go to the oil-rich Middle East countries leaving their families behind. All the above factors affect women's exposure to the risk of conception and arc responsible for lowering fecundability.

Edmonston (1983) has developed a micro analytic stochastic model of human reproduction with special features for use in examining reproduction in high mortality populations of Bangladesh. The conditions of micro analytic arc biological, and do not rely any explicit-formulation of social and cultural aspects. The model assumes that the biological factors (fecundability, live births, stillbirths, fetal deaths and sterility) vary with woman's age. The motivation of this paper is not to estimate the exact condition of human reproduction but also to incorporate mortality and breastfeeding aspects in a fertility simulation model and to analyze the results of the simulation interns of major fertility factors. In both the cases, the incorporation in the model appears to be successful. This simulation model incorporates a logit transformation on a Weibul survival function for a model schedule for postpartum amenorrhea and for early childhood mortality developed by Lesthase and Page (1980) which depends on the duration of breastfeeding. Employing the monte carlo simulation model Edmonston (1983) has found that only use at marriage is allowed for very and the mean family size reported in Bangladesh Fertility survey 1975-76 agrees in general with non-contraception simulation. Fetal deaths and still births are assumed to depend linearly on a woman's age and fetal deaths are geometrically distributed. Edmonsion also derived age specific marital fertility rates and display the mean birth intervals by birth order for the three ages of marriage of 15, 17.5 and 20 years for simulation rate. He observed that the Coale-trussel (1974) natural model fertility schedule show slightly higher fertility through about 35 years of age.

Islam (1986) has formulated a stochastic model of human reproduction along with lines suggested by Perrins and Sheps (1964). In this model death states have been considered as an absorbing state. Hence it is more realistic than that of Perrin and Ships particularly in cases of developing countries where mortality rate and in particular, the maternal mortality rate is significantly higher(Of high mortality populations). He has attempted to develop a stochastic model to study the fertility pattern of two marriage cohorts of women in terms of conception intervals, live birth intervals and annual probability of occurrence of live birth under certain assumptions regarding socio-biological factors that influence reproductive behavior. 1 le has found a woman belonging to the 1965-69 cohorts in non-pregnant state for 6.7 months on an average while the corresponding average time spent by a woman in the 1970-74 cohorts is 7.2 months before direct transition to pregnant state. Mean conception intervals are at 32.0 and 32.7 months for women in the 1965-1974 and 1970-1974 first marriage cohort respectively. The estimate of mean live birth interval is found to be 33.6 and 36.0 month for the two cohorts,

Respectively. His estimates reflects that average time spent in non-pregnant slate before a direct transition before a direct transition to pregnant state, mean conception and mean live births intervals for women in both the cohorts are found to be higher among urban than rural women, among women, with at least some schooling than those with no schooling and among Muslims than their Non-Muslims counterparts. Annual fertility rate per woman are estimated as 0.375 and 0.334 for the 1965-69 and 1970-94 first marriage cohorts respectively. The model estimates of fertility for both the cohorts have exhibited negative relationships with urbanization and education and fertility for the non-Muslims is found to be lower than that for Muslims.

Meridith et al. (1987) attempted for the first time to disentangle the relationships between nutrition, lactation and a woman's monthly probability of conception from the data taken from the Determinants of Natural Fertility Study, Conducted under (he auspices of the International Center for Diarrhoeal Disease Research, Bangladesh. Applying Multivariate Hazard models to the study of fecundability they observed that there is strong seasonal patterns of conception in Bangladesh,

which can more plausibly attributed to seasonal variations in coital frequency than to seasonality in nutritional status. They showed that fecundability varies both among women of a given age arid for a particular women by age. The variation is related f>

four variables: separation, which effects coital frequency, age, which represent biological and perhaps decline in coital frequency; lactation practices; and the duration of amenorrhea. The study revealed that the longer a woman's post partum amenorrhea the higher the fecundability when she resumes menses and the more rapidly she conceives. Undoubtedly, the most sticking finding of this study is the effect of the patterns of breastfeeding in the monthly probability of conception as woman begins to wean her child, her probability of conceiving increase, presumably the result of decreased levels of serum prolactin which inhibit ovulation.

Balakrisnan (1988) analysis the probability of conceiving and conception delay by duration from the date of entry into union from the data collected in National Fertility Surveys in rural and semi-urban areas of Mexico, Costarica, Colombia and Perue for all non-contracepting women in sexual unions by applying life table methods using both clouded and open birth intervals. However fecundability estimates were constructed using only closed intervals in other words based on women who had at least one pregnancy. He observed overall low mean fecundability compared to other populations, but this difference is largely due to the lower mean age at entry into union neither than to lower age-specific fecundability.

Goldman and Montgomery (1990) considered a fundamental demographic issue which surprisingly little is known: on the effects of husband's age on fecundability. They evaluated the effects of husband's age on the probability of conception from world fertility surveys data in live developing countries. The Ivory cost, Ghana, Kenya, The Sudan and Syria. Proportional hazard model, which include wive's age husband's age, marriage duration, union type and post-partum exposure as covariates were used by them to describe the monthly conception rate lor second and higher order birth intervals in which no contraception was used. With the exception of Syria, the resulting models indicate that the effect of male age is generally small in relation to the influence of marital duration and age of the woman.

Tewari et al. (1994) have derived some stochastic models to describe the variation in the length of open birth interval of women having given birth to a child during the last "T" years of their current reproductive age. Assuming the reproduction process as steady state derives the first model, the second is obtained by varying the fecundability parameter involved in the first model after the last birth. The present exercise intends to propose simple cohort model of open birth interval conforming to the steady state conditions and to estimate biological parameters of the model along with standard error and best asymptotic normal (BAN) estimates of parameter.

Pathak (1996) has outlined a modified stochastic model of family formation by incorporated age patterns of marriage characterized by a displaced lognormal distribution under some simplified assumptions. He has found that the mean age of mothers at the time of births of the first and last offspring's are sensitive to age patterns of child bearing which is characterized by age specific marital fertility rate, He has also shown that the average number of children per mother is dominantly mounded by mortality and level of fertility

Islam et al. (1997) have estimate fecundability by the model fitting technique to data on the distribution of the number of births to women with a fixed marital duration. The study was based on data from two national level fertility surveys, the Bangladesh Fertility survey (BFS) 1975 and 1989. The patterns and trends of fecundability in Bangladesh were investigated by fitting by model developed by Singh(1969, singh et al. 1971) with a slight modification. They obtained low mean fecundability in Bangladesh compared to western countries. The urged that the low fecundability of Bangladeshi women as compared to that of western countries may be due to a number of social, biological and cultural factors, and also the many social taboos. One of such factors is low age at marriage of girls especially in rural areas. For which fecundability during the first few years of marriage could be lower

Thomas el al. (1997) has constructed a discrete survival model that allows time - dependent covariates to assess the influence of the covariates on time to pregnancy (TIP). Time to pregnancy (TIP), the number of menstrual cycles it takes a couple lo conceive, is potentially an informative measure of human reproduction. A random effect was included to account for unobserved heterogeneity. The collected wailing limes are obtained through retrospective ascertainment and are analyzed as truncated data. Fisher scoring through iterative reweighed least squares implemented maximum likelihood estimation. The analyze of TIP data revealed that, fecundability increased with the mother's age contrary to what could be expected for prospectively obtained waiting times, whereas it decreased with the fathers age. The analysis further revealed a weak, but significant, effect of mother's body mass index (BMI) around 22 had slightly higher fecundability than women with higher or lower BMI. Finally the negative effect of recent use of contraception appeared to wash out soon after the end of use.

Islam, Mazharul M; Yadava, R.C sept (1997) has observed that Bangladesh is a poor country, and malnutrition and ill-health are largely prevalent particularly among women, and may also contribute to low fecundability though the fertility rate is rather high due to the low contraceptive use rate and/or lack of effective use of contraception, as also due to the higher desired family si/e.

The BDIIS 1999-2000 demonstrates lower interval between marriage to first birth- but higher interval between subsequent births than observed in the BDHS 1996-97(Azad, 2001).

To control for variation in fecundity among women, we include information on the length of time elapsing between marriage and the first birth for women (the vast majority) who were not pregnant when they married. Only 0.3 percent of married women in the F.DUS used contraception before the birth of their first child> so the length of the first birth interval is likely to he largely determined by a couple's fecundity. We do not have data on frequency of intercourse, nor on the duration of viability of ova and Sperm. These will, we hope, be captured by the inclusion in the model of an unobserved heterogeneity term. Publications, Delhi (February, 2001), 31-46.

To investigate the pattern and differentials of interval by selected demographic and Socioeconomic variables, they (M. Nurul Islam, Department of Statistics, University of Dhaka and Salehin Khan Chowdhury, Daffodil University, Dhaka) used Cox's proportional Hazard regression model. The data used for. The completion of this work is extracted from the Bangladesh Demographic and Health Survey (IJDIIS) conducted in 1999-2000. The mean of first birth interval is slightly shorter than the mean of subsequent birth intervals and it is around 36 months. The median first birth interval is 28 months, which is four months shorter than that of subsequent birth intervals. They observed that, about 63.4% of the women take their first child within three years of marriage. They concluded that in Bangladesh marriage to first birth interval decreases and subsequent birth interval increases over time. The life table analysis of birth intervals reveals that about 76 percent of Bangladeshi women take their first child within five years of marriage and their average first birth interval is 25 months. To identify the determinants of birth interval Cox's proportional Hazard Regression has been applied. This result indicates that while controlling the other variables women living in the urban areas tend to have a longer birth interval than the women living in the rural areas. The life table analysis of birth intervals reveals that about 76 percent of Bangladeshi women take their first child within five years of marriage and their average first birth interval is 25 months. This percentage is almost the same for overall subsequent births but the average subsequent birth interval is 30.5 months. The differential analysis of quantum and tempo of fertility has been done for place of residence, working status, level of education and region of residence. To identify the determinants of birth interval Cox's proportional Hazard Regression has been applied. This result indicates that while controlling the other variables women living in the urban areas tend to have a longer birth interval than the women living ill the rural areas. Subsequent birth interval of urban women is also longer than rural women. In the multivariate analysis longer duration of first and subsequent birth intervals ate observed among the working women. Educated women are likely to have shorter first but longer subsequent birth interval than women having no education. Upper social class women used to have shorter first but longer subsequent birth interval than middle or lower class women. The results indicate that marriage to first birth interval increases significantly with age of the respondent but decreases with age at marriage. An unexpected finding was that ever users of contraception have distinctly shorter birth interval than never users. Gender preferences also have significant effect on birth interval in Bangladesh. Their analysis also shows that religion and region of residence have no significant effect on marriage to first birth interval but appears to have significant effect on subsequent birth interval.

Greater education participation can cause a delay in births because being in education can be incompatible with having children, for financial and life-style reasons. Moreover, after leaving education, highly educated women are likely to spend more time in investment in job search and in finding the right job. There is also a positive correlation between investment in schooling and investment in on the job training, both of which combine to provide higher wages for educated women (Gustafsson, 2001). This results in those with higher education levels tending to have higher growth in earnings in the years immediately following education. Therefore more highly educated women may wish to delay having a child until a stable and desired career pattern has been established

Gustafsson, (2002) cited two principle reasons given by Hotz et al., (1997) for the general postponement of first birth in Western countries; the consumption smoothing and women's career planning motives. The consumption-smoothing motive relates to having enough resources to afford having a child, while the career-planning motive refers to the need to have the time for child caring and rearing.

Bangladesh's adolescent fertility rate is one of the highest in the world, and consistent high adolescent fertility is one of the main reasons for the slow fertility decline in recent years (NIPORT, Mitra and Associates, and ORC Macro, 2005).

Quamrun Nahar and Hosik Min (2008) have observed using four sets of Bangladesh Demographic and Health Survey data collected during 1993-94, 1996-97, 1999-2000 and 2004, the paper examines the trends and determinants of adolescent childbearing in Bangladesh, and identifies area-level variation in explaining differentials in adolescent first birth. Discrete-time multilevel hazard modeling is used lo estimate the hazard of first birth before age 20 after controlling the e flee Is of oilier individual and household factors. The results suggest that the overall probability of first birth before age 20 among Bangladeshi women remained static or even increased slightly over time. There was a significant area level variation in teenage first birth in 1993-94 and 1996-97. However, over time the effect of area is decreasing. At the individual level, women's education, especially higher education, has the strongest effect in delaying first birth during adolescence. Age at marriage has a strong association with age at first birth: a one-year increase in age at marriage decreases the chance of teenage first birth by 10% or more. Frequent media exposure has a significant delaying effect, and the effect is more distinct in the most recent year.

1.5 Objectives of the study

A logical statement of the objectives is most helpful to any scientific undertaking. Without this, it becomes complex in the context of reaching a decision and making inference. So in this study our first step is to give clear statement of objectives of the study. Objectives of the study are briefly discusses in the concluding paragraph of this heading.

The key clement behind the change in population, particularly in developing countries, is the level and pattern of fertility. Furthermore, an ability to estimate the magnitude of changes in fertility and the causes of those changes arc required background information for the development of policy in many areas. For example, for the projection of expenditure on primary education, the analyst must know the number of children who may be enrolled in the future, and for such projections, data concerning fertility and child survival are very important. Even more obvious, knowledge about fertility is necessary for the designing of policies so that they are likely to have direct or indirect effect on fertility and hence population growth. Within this context, planners and policy-makers may examine the probable impact of proposed policies and programs directed towards other social or economic development objectives on fertility. Hence, it may be desirable to have an understanding of the linkages between fertility and socio-economic factors not only to enable the development of policies and programs for achieving desired fertility goals, but also to contribute to the attainment of other development objectives through influencing patterns and levels of fertility.

The specific objectives of the present study are to analyze the trends, levels and differentials of fertility, conception wait and fecundability for Bangladeshi women and to estimate the effects of demographic and socio- economic factors on fertility and fecundability. These are as follows:

(i) To explore the present situation of fertility in Bangladesh.

(ii) To investigate the associated factors significantly affected the fertility pattern.

(iii) To estimate the levels, trends and differentials of mean conception wait and fecundability by fitting Geometric and Beta geometric distribution.

(iv) To investigate the covariate effects on fecundability

1.6 Organization of the Study

In order to furnish a meaningful representation (of this study), the complete work has been presented into six chapters.

The first chapter is introductory one which contains background of the study, research perspectives, reproductive behavior, review of literature, objectives and organization of the study.

Information about data and methodology are provided in chapter two. This chapter also contains data source, selection of variables, concepts of terminology, selection of some techniques of analysis and review of fertility pattern are presented in this chapter.

Chapter three contains identification of significant factors that affecting fertility pattern.

Chapter four presents the levels, trends and differentials of mean conception wait and fecundability for some selected socio-economic and demographic factors.

Chapter five accommodate the differentials of selected set of covariates on conception wait and fecundability.

Finally, summery of the major findings, limitation of the study and policy implications are included in chapter six. A bibliography has given at the end of the dissertation.

Chapter Two
Data, Methodology and Overview of Fertility

DATA, METHODOLOGY AND OVERVIEW OF FERTILITY

2.1 Sources of Data

The secondary data for the present study have been extracted from the following organizations:

Bangladesh fertility survey (BFS), Population census (PC), Vital registration survey (VRS), Survey Vital Registration (SVR), ICDDR'B Matlab, Sample vital registration survey (SVRS) and Bangladesh Demographic and Health survey (BDHS).

In the estimation of fertility, conception waits and fecundability among women in Bangladesh, we have mainly used the data extracted from the response of women questionnaire of 2007 Bangladesh Demographic and Health Survey (BDHS). The survey was conducted under the authority of the National Institute for Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare. The survey was implemented by Mitra and Associates, a Bangladeshi research firm located in Dhaka. Macro International Inc., a private research firm located in Calverton, Maryland, USA, provided technical assistance to the survey as part of its international Demographic and Health Surveys program. The U.S. Agency for International Development (USAID)/Bangladesh provided financial assistance.

2.2 Selection of the Sample Size

The 2007, Bangladesh Demographic and Health Survey(BDHS) is a nationally representative survey of 10,996 women age 10-49 and 3,771 men age 15-54 from 10,400 households covering 361 sample points (clusters) throughout Bangladesh, 134 in urban areas and 227 in the rural areas.

2.3 Sample Design

The 2007 BDHS employs a nationally representative sample that covers the entire population residing in private dwelling units in Bangladesh. The survey used the sampling frame provided by the list of census enumeration areas (EAs) with population and household information from the 2001 Population Census. Bangladesh is divided into six administrative divisions: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, and Sylhet. In turn, each division is divided into zilas, and each zila into upazilas. Rural areas in an upazila ae divided into union parishads (UPs), and UPs are further divided into mouzas. Urban areas in an upazila are divided into wards, and wards are subdivided into mahallas. These divisions allow the country as a whole to be easily divided into rural and urban areas. EAs from the census were used as the Primary Sampling Units (PSUs) for the survey, because they could be easily located with correct geographical boundaries and sketch maps were available for each one. An EA, which consists of about 100 households, on average, is equivalent to a mauza in rural areas and to a mohallah in urban areas.

The survey is based on a two-stage stratified sample of households. At the first stage of sampling, 361 PSUs were selected. Figure 1.1 shows the geographical distribution of the 361 clusters visited in the 2007 BDHS. The selection of PSUs was done independently for each stratum and with probability proportional to PSU size, in terms of number of households. The distribution of the sample over different of the country was not proportional, because that would have allocated the two smallest divisions, Barisal and Sylhet, too small a sample for statistical precision. Because only a small proportion of Bangladesh's population lives in urban areas, urban areas also had to be over-sampled to achieve statistical precision comparable to that of rural areas. Therefore, it was necessary to divide the country into strata, with different probabilities of selection calculated for the various strata. Stratification of the sample was achieved by separating the sample into divisions and, within divisions, into urban and rural areas. The urban areas of each division were further subdivided into three strata: statistical metropolitan areas (SMAs), municipality areas, and other urban areas. In all, the sample consisted of 22 strata, because Barisal and Sylhet do not have SMAs.

The 361 PSUs selected in the first stage of sampling included 227 rural PSUs and 134 urban PSUs. A household listing operation was carried out in all selected PSUs from January to March 2007. The resulting lists of households were used as the sampling frame for the selection of households in the second stage of sampling. On average, 30 households were selected from each PSU, using an equal probability systematic sampling technique. In this way, 10,819 households were selected for the sample.

However, some of the PSUs were large and contained more than 300 households. Large PSUs were segmented, and only one segment was selected for the survey, with probability proportional to segment size. Households in the selected segments were then listed prior to their selection. Thus, a 2007 BDHS sample cluster is either an EA or a segment of an EA.

2.4 Questionnaire

The 2007 BDHS used five questionnaires: a Household Questionnaire, a Women's Questionnaire, a Men's Questionnaire, a Community Questionnaire, and a Facility Questionnaire. Their contents were based on the MEASURE DHS Model Questionnaire. These model questionnaires were adapted for use in Bangladesh during a series of meetings with a Technical Task Force (TTF) that included representatives from NIPORT, Mitra and Associates, ICDDRB: Knowledge for Global Lifesaving Solutions, the Bangladesh Rural Advancement Committee (BRAC), USAID/Dhaka, and Macro International (see Appendix E for a list of members). Draft questionnaires were then circulated to other interested groups and reviewed by the BDHS Technical Review Committee (see Appendix E). The questionnaires were developed in English and then translated and printed in Bangla.

The Household Questionnaire was used to list all the usual members of and visitors to selected households. Some basic information was collected on the characteristics of each person listed, including age, sex, education, and relationship to the head of the household. The main purpose of the Household Questionnaire was to identify women and men who were eligible for individual interviews. In addition, the questionnaire collected information about the dwelling unit, such as the source of water, type of toilet facilities, flooring and roofing materials, and ownership of various consumer goods. The Household Questionnaire was also used to record height and weight measurements of all women age 10-49 and all children below six years of age.

The Women's Questionnaire was used to collect information from ever-married women age 10-49. Women were asked questions on the following topics:

- Background characteristics, including age, residential history, education, religion, and media exposure,

- Reproductive history,
- Knowledge and use of family planning methods,
- Antenatal, delivery, postnatal, and newborn care,
- Breastfeeding and infant feeding practices,
- Vaccinations and childhood illnesses,
- Marriage,
- Fertility preferences,
- Husband's background and respondent's work,
- Awareness of AIDS and other sexually transmitted diseases,
- Knowledge of tuberculosis, and
- Domestic violence.

The Men's Questionnaire was used to collect information from ever-married men age 15-54. Men were asked questions on the following topics:

- Background characteristics, including respondent's work,
- Marriage,
- Fertility preferences,
- Participation in reproductive health care,
- Awareness of AIDS and other sexually transmitted diseases,
- Knowledge of tuberculosis, injuries, and tobacco consumption and
- Domestic violence.

Questions on domestic violence (which were included in both the Women's and Men's Questionnaires) were administered to only one eligible respondent per household, whether female or male. In households with two or more eligible respondents, special procedures were followed to ensure that the selection of the woman or man was random and that these questions were administered in private.

The Community and Facility Questionnaires were administered in each selected cluster during listing. These questionnaires collected information about the existence of development organizations in the community and the availability and accessibility of health services and other facilities. 1 This information was also used to verify information gathered in the Women's and Men's Questionnaires on the type of facilities respondents accessed and the health service personnel they saw.

2.5 Training and Fieldwork for Data Collection

Forty-two field staff were trained and organized into six teams to carry out the listing of households and delineation of EAs and to administer the Community and Facility Questionnaires. In addition, six supervisor were deployed to check and verify the work of the listing teams. Listers were also trained in the use of Global Positioning System Gps) units so that they could obtain locational coordinates for each selected EA and for facilities located within each Ea.

The Household, Women's, and Men's Questionnaires were pretested in February 2007. Fourteen interviewers were trained for the pretest. The questionnaires were pretested on 100 women and 100 men in two rural areas in Bariasal district and two urban areas in Dhaka. Based on observations in the field and suggestions made by the pretest teams, revisions were made in the wording and translation of the questionnaires.

Training fort he main survey was conducted for four weeks from February 25 to March 23, 2007. A total of 128 field staff were recruited based on their educational level, prior experience with surveys, maturity, and willingness to spend up to five months on the project. Training included lectures on how to complete the questionnaires, mock interviews between participants, and field paretic. Fieldwork for the BDHS was carried out by 12 interview teams, each consisting of one male supervisor, one female field editor, five female interviewers, two male interviewers, and one logistics staff member. Four quality control teams ensured data quality; each team included one male and one female data quality control worker. In addition, NIPORT monitored fieldwork with another set of quality control teams. Data quality was also monitored through field check tables generated concurrently with data processing. This permitted the quality control teams to advise field teams about problems detected during data entry. Tables were specifically generated to check various data quality parameters. Fieldwork was also monitored through visits by representatives from USAID, Macro International, and INPORT. Fieldwork was implemented in five phases and carried out from March 24 to August 11, 2007.

2.6 Data Processing

All questionnaires for the BDHS were periodically returned to Dhaka for data processing at Mitra and Associates. The processing of data collected in the filed began shortly after fieldwork commenced. Data processing consisted of office editing, coding of open-ended questions, data entry, and editing inconsistencies found by the computer program. The data were processed by 10 data entry operators and two data entry supervisors working in double shifts using six microcomputers. Data processing commenced on Aprill 16 and ended on August 31, 2007. Data processing was carried out using CSPro, a joint software product of the U.S. Census Bureau, Macro International, and Serpro S.A.

2.7 Coverage of the Sample

The data of the present study are collected from Bangladesh Demographic and Health Survey (BDHS) 2007.A total of 10,819 households were selected for the sample; 10,461 were found to be occupied, of which 10,400 were successfully Interviewed .The shortfall is preliminary due to dwellings that was vacant or destroyed or in which inhabitants had left for an extended period at the time the interviewing teams visited them. Of the households occupied, 96.4 percent were successfully interviewed. In these households, 11,178 women were identified as eligible for the individual interview (i.e. ever married and age 10–49 and interviews were completed for 10,966 or 98.5 percent of them.

2.8 Methods of Finding Relevant Data

To estimate "The associated factors significantly affect fertility, Conception wait and fecundability" for Bangladeshi women we have extracted 10996 ever married women from Bangladesh Demographic and Health Survey (BDHS) 2007. Since our study is based on the first birth history data, so we have excluded those of the women having no birth at the time of the survey(1147) and included those women whose year of first marriage were last fifteen years preceding the survey. Assuming that who were no birth during this time period, they are sterile. After that we have excluded those conceptions of the women whose pregnancy have terminated before first live birth (240). We also test the homogeneity for overall group using statistical technique (Levene test) for applying statistical tools to interpret the appropriate results. We eventually, came up with 8095 respondent's who have at least one live birth for the study.

2.9 Definition of Variables

The aim of the study is to find the covariates influencing the index of fertility which is positively related on fecundability. So the index of fertility had been considered as the dependent variable and all other possible characteristics that may influence the index of fertility were considered as independent variables. Another, important dependent variable is conception wait which is inversely related on fecundability i.e. index of fertility.

Mere we need to be sure that the quality of data of independent variables is satisfactory i.e.,

i) the data set is reliable

ii) the frequencies are not concentrated to any point or group

iii) the variables are well defined and do not contain a large number of missing observations

For the purpose, we observe the frequency distribution of the number of respondents for all the variables and select the data set.

2.9.1 Dependent Variables

Since the analysis is restricted to ever-married women who had at least one live birth.The collected BDHS gives the scope to study index of fertility. The dependent variable used in this analysis was found directly from the BDHS data set which is supposed as a dichotomous variable, such as less than or equal to two birth per woman is equal to 1 and three or more birth per woman is equal to 0. The another dependent variable conception wait was not found directly from the BDHS data set, is computed by subtracting the date of first marriage and 9 moths (gestation period) from the date of first birth, i.e.

Conception wait = Date of first birth – 9 – Date of first marriage.

2.9.2 Independent Variables

A great deal of independent variables is considered in this study. All the independent variables used in the analysis were not found directly from the BDHS data set. Again for the convenience, we computed some new explanatory variables and transformed some original and computed variables that are suitable for study. They were recoded into homogeneous sub-groups where necessary. Some other variables remain unchanged. Most of the variables are coded as categorical and some are in dummy. Above sixteen explanatory variables are included and examined in this study. All independent variables, we can broadly classify into four groups. These are:

(1) Demographic variables

(2) Socio-economic variables

(3) Cultural variables

(4) Anthropometric variables

(1) Demographic variables

The explanatory variables that summarize the demographic behaviors of the respondents are treated as demographic variables. In this study the demographic variables that are used to analysis:

(i) current age of respondent (ii) age at first marriage (iii) spousal age difference (iv) marital duration (v) contraceptive use of respondent and (vi) partner's age.

Respondents age at first marriage

Age at marriage needs to be considered. The Government of Bangladesh order in 1984, the legislative age at marriage was fixed at 18 years for female and 21 years for males. However, in the countryside, such requirements are hardly known and among those who do know about them, they have little impact on behavior (Islam and Ahmed, 1996). A large portion of marriages still take place before the legal age i.e., around 79% of Bangladeshi women marry before the age of 20 years (Mitra and Associates, 2005V Late married women may have their first birth sooner, but with most higher educated and service holder couples only having one or two children, age at marriage may be an influential factor than it once was (Zheng, 2000, Rahman, 2005a).Age at first marriage is an important factor in any demographic analysis. Age at first marriage has a direct effect on fertility or fecundability as well as conception waits & timing of first birth. This variable is included in this study. The information on age at first marriage was collected by asking the respondent 'How old are you when you got married? and reported incomplete years. Then we get age of first marriage of respondents. Plainly speaking, age of women when they first get married is easily known as age of first marriage. The respondents are categorized into three categories as less than 16 years, 16 to 18 years and 19 years & above. In this study 73.2 percent women get married in the age group less than 16 years, 15.5 percent women get married in the age group 16 years to 18 years and only 11.4 percent women get married at age 19 years & above.

Current age of respondent

Current age of respondent has a remarkable contribution on fertility pattern. Though the variable current age of respondent has no original category, I have recoded them into three categories as less than or equal to 18 years, 19 to 23 years and 24 years & above. This study includes 5.2 percent women in the current age group less than or equal to 18 years, 18.7 percent women in the current age group 19 to 23 years and 76.1 percent women at the age 24 years & above.

Husband's age

Husband's age (partner's age) are also sub-divided into three categories such as less than 25 years, 26 to 32 years and 33 years & above. As shown in Table 2.1, we observed that only 5.9 percent husband's age lies in the age group <25 years, 18.7 percent husband's age lies in the age group 26-32 years and 75.4 percent husband's age lies at age 33 years & above which is the highest percent among category.

Marital duration

The variable marital duration has six groups originally but I have re-grouped into two as 0–4 years and 5 years & above. In this study 12.9 percent respondent's marital duration is between 0 to 4 years and 87.1 percent respondent's marital duration is 5 years and more.

Contraceptive Use

Contraception (birth control) prevents pregnancy by interfering with the normal process of ovulation, fertilization, and implantation. Ever use of contraception method is an important factor in any demographic analysis. This variable is included in this study. Ever use of contraceptive woman means any woman who wanted to prevent pregnancy using a reliable form of birth control. In this data set the variable is given by four categories and I categorized it into two as not use of contraception and Use of contraception. In the present study 14 percent of women never used any method of contraception before their first birth. On the other hand, 86 percent of them used any one of the contraceptive methods. This indicates almost universality of use of contraception.

Spousal age difference

Women and their husband's age difference is another important covariate in fertility analysis. In developing countries spousal age difference is also another important factor affecting fertility (Sembajwe, 1981; Levin et al., 1997). The variable spousal age difference is calculated by subtracting women's age (in years from household report) from Husband's age. It was mainly continuous variable in original form of BDHS data. For my research convenience, it is categorized in three class such as less than or equal to 4 year's age difference between spouses, 5 to 8 years and lastly 9 years or more. As shown in Table 2.1, we observed that only 13.4 percent women and their husband's have ≤4 year's age difference, and couples with 52.1 percent have age difference 9 years or more which is the highest percent among category.

(2) Socio-economic variables

The variables which reflect the social and economic status of any community are known as socio-economic variables. These variables are important in any demographic studies. The following socio-economic variables are examined in the analysis:

(i) Respondent's educational level, (ii) Husband's educational level,(iii) Work status of women, (iv) Partner's occupation, (v) Wealth index and (vi) Mass media contact.

Mother's Educational Level

Level of education is another important significant factor that should be related to fertility as it affects knowledge and awareness of conception, and is linked to a women's age at marriage and occupation. Women who have graduated from high school are more likely to have a paid full-time job, even in rural areas. Thus average number of CEB decreased with the increased level of education (Rahman, et al, 2005). Three levels of education are considered: illiterate, primary and secondary & higher education. The vast majority of Bangladeshi ever married women are illiterate. Table 2.1 shows that most (38.5%) of ever married women had no formal education, while another 31.3% said that they received primary education. It is also seen that 30.2 percent of women had completed secondary & higher education.

Partners Educational Level

Partner's education is very important factor in socio-economic analysis. It is mainly related to his occupation and income of family and family status. It is also categorized into Illiterate, primary, secondary & higher education. Table 2.1 shows that around 35.8 percent of women reported, their husband have no education, 25.6 percent have primary education and about 38.7 percent have secondary and higher education.

Work Status of Women

Woman's work status may have a significant effect on the index of fertility. The employment status of women has some influence on the fertility and, as such, an attempt has been made to investigate whether the women are involved in any activities for earning cash income. It has coded into two categorized such as working and not-working. Table 2.1 indicates that of the 8095 women, 28.7 percent were reported to be working and 71.3 percent were not working. Thus, the length of subsequent birth interval may vary from working mother to non-working mother.

Husband's occupation

Husband occupation has also a large number of levels for its broad scope. In developing countries like Bangladesh, the husband's occupation is closely related to fertility. The various occupational categories included in 2007 BDHS data. For the sake of our analysis the categories are classified into three major groups viz unemployed, manual and non-manual. The classes of occupations included in the manual and non-manual categories are as follows.

Manual: The term manual occupation refer's to those occupation who earned money by their daily labour, such as cultivator's(own land), cultivator's (share cropper's), landless, agricultural labourer's, farm managers, supervisors, production and related workers, poultry firming, fishermen, domestic servant etc.

Non-Manual: The term non-manual occupation refer's to those occupation who are involved in profesional worker, such as businessman, small business, teachers, doctors, nurses, engeers, professional, technical, clerical, service, sales, trades, administrative and executive.

According to prof. Donald J Bogus's view fertility is influenced by the occupation of the head of the family. The people with good occupations are likely to check fertility; where as those with menial occupations are likely to have more children. He has related this to income also. According to him where income is low, fertility goes up, but income is not very high, then the fertility is the lowest, but when income considerably increases with that fertility goes up. He is of the opinion that it is wrong to think that when the family is reached the number of children will be less (Bogue,1967). In this study, we get from Table 2.1 only 2.2 percent husbands are unemployed, 68.1 percent husband whose occupation is manual and 29.7 percent husband whose occupation is non-manual. From the result we observed that majority of the partner's occupation is manual.

Wealth Index of Respondent's

Wealth index is another important variable for fertility analysis. The sample was then divided into quintiles from one (lowest) to five (highest). It has been categorized into three classes: poor, middle and rich. Poor class is created by merging first two quintiles, Middle is made by taking itself from the original data and Rich class is created by taking last two quintiles altogether. In this study table 2.1 shows that out of total selected respondent's, 46.9 percent respondent's wealth index is reported to be rich, 18.9 percent respondent's wealth index is middle and 34.2 percent respondent's wealth index is poor.

Mass Media contact

Newspaper, radio and television are the main types of mass media in Bangladesh. Television is at present are of the most powerful media. It plays a very strong role for mass media; it shows some health awareness programs. According to Table 2.1 observed that only 55.8 percent women have TV in their house and 44.2% women in their family have no television.

(3) Cultural variables

The cultural settings and tradition has an important effect on fertility or fecundability as well as timing of first birth. That is why we included the following cultural variables in our study;

(i) Type of place of residence (ii) Division and (iii) Religion.

Type of place of residence

Bangladesh is a predominantly rural country. There are a number of reasons to expect differences in the index of fertility between rural and urban households. The employment situation of women differs substantially between rural and urban areas. Most urban women have a job while most rural women work not far from home, on the farm or household sideline industries, or as a housewife. Housing is a major concern for newly married couples in urban areas, but less so for those in rural areas. These employment and housing differences mean that the desire to plan or delay first birth will be different for rural and urban couples. Therefore place of residence should be an important factor affecting fertility pattern and it has been coded in two categories: value one is urban areas and value two is rural areas. The result indicates that 37.6 percent living in urban areas and 62.4 percent are in rural areas.

Region/Division of Residence

For administrative purpose, Bangladesh is divided into six divisions. Region of residence (Barisal, Chittagong, Dhaka, Khulna, Rajshahi and Sylhet) is considered as evidence suggesting that the Chittagong region is culturally different from other parts of Bangladesh, because people adhere to traditional beliefs and values there more than those in other regions with regard to religion and preference for male children. So this variable is included into the analysis. Table 2.1 indicates that among the selected respondent almost (21.6%) were selected from Dhaka division, and lowest percent (12.4%) from Sylhet division. About 13.3 percent respondent lived in Barisal division, 17.8 percent in Chittagong, 15.6 percent in Khulna and 19.2 percent in Rajshahi division.

Religion of Respondent

Religion is certainly a significant independent variable. Most studies indicate that Muslim often have higher fertility than non-Muslim. Islam is the dominant religion in Bangladesh. Majority (90%) persons of this category are Muslim and the remaining percent are Hindu, Christian, Baddish and others (BBS, 2004). So in the present study, religion is categorized into Muslim and Non-Muslim. In this study, we get from Table 2.1 about 90.2 percent were Muslim and around 9.8 percent were Non-Muslim respondent.

(4) Anthropometric variable

Body mass index

Body mass index is one measure of obesity (or Non-obesity). The 2007 BDHS also collected data on the height and weight of ever-married women age 10- 49. The data are used to derive two measures of nutritional status: height and body mass index (BMI). A woman's height can be used to predict the risk of having difficulty in pregnancy, given the relationship between height and pelvic (basin-shaped cavity in most vertebrates, formed from the hip-bone with the sacrum and other vertebrae) size. The risk of giving birth to low-weight babies is also higher among women of small stature. The cutoff point at which mothers can be considered at risk because of short stature is normally taken to be between 140 and 150 centimeters. The BMI index is used to measure thinness or obesity. It is defined as weight in kilograms divided by height in meters squared (kg/m^2). The main advantage of the BMI is that it does not require a reference table from a well nourished population. A cutoff point of 18.5 is used to define thinness or acute under nutrition. A BMI of 25 or above usually indicates overweight or obesity. Thus, for analysis a women is categorized into three categories according to BMI as Under weight if BMI is less than 18.5, Normal weight if BMI is 18.5 to 24.9, Over weight if BMI is more than 24.9 (25 and more Body mass index is also known as Quetelet index). In the present study 27.6 percent respondents have under weight, 57.7 percent respondents have normal weight and 14.9 percent respondents have over weight. Body mass index is a guideline used to judge whether we are at risk for health problems associated with our weight. Body mass index is calculated by using the formula:

$\text{BMI}=\frac{weight}{(hight)^2}$ where weight is in kilograms and hight is in meter's. The selected socio-demographic variables and their percentage according to category are presented in Table 2.1.

Table 2.1: Independent variables, their categories, number of respondents (n) and percentage in each category.

Background characteristics	Categories	Number of respondents(n)	Percentage (%)
Current age of respondent's	≤18	423	5.2
	19-23	1510	18.7
	24 and above	6162	76.1
Age at first marriage	<16	5922	73.2
	16-18	1251	15.5
	19 and above	922	11.4
Type of place of residence	Urban	3042	37.6
	Rural	5053	62.4
Religion	Muslim	7298	90.2
	Non muslim	797	9.8
Region	Barisal	1079	13.3
	Chittagong	1442	17.8
	Dhaka	1751	21.6
	Khulna	1265	15.6
	Rajshahi	1553	19.2
	Sylhet	1005	12.4
Respondent's educational level	Illiterate	2535	38.5
	Primary	2441	31.3
	Secondary & Hgher	3119	30.2
Partner's educational level	Illiterate	2646	35.8
	Primary	2074	25.6
	Secondary & Higher	3375	38.7
Respondent's work status	Not working	5775	71.3
	working	2320	28.7
Partner's occupation	Unemployed	181	2.2
	Manual	5513	68.1
	Non manual	2401	29.7

Spousal age difference	≤4	1082	13.4
	5-8	2796	34.5
	9 and above	4217	52.1
Marital duration	0-4	1043	12.9
	5 and above	7052	87.1
Wealth index	Poor	2776	34.2
	Middle	1536	18.9
	Rich	3793	46.9
Contraceptive use	Not use	1134	14.0
	Use	6961	86.0
Body mass index	< 18.5	2233	27.6
	18.5-24.9	4669	57.7
	24.91 and above	1193	14.7
Mass media contact	No	3579	44.2
	Yes	4516	55.8
Partner's age	<25	481	5.9
	25-32	1508	18.7
	33 and above	6106	75.4

2.10 Trends in Age Specific Fertility rates (ASFR)

Table 2.2 and figure 2.1 summarizes the characteristic of fertility pattern over the period of 1975 to 2007. The table reveals some increasing features of change in the age specific fertility behavior of the women during the recent past. Most of the childbirths in recent years took place within a shorter span than in the past and the central tendency of fertility is shifting towards younger ages.

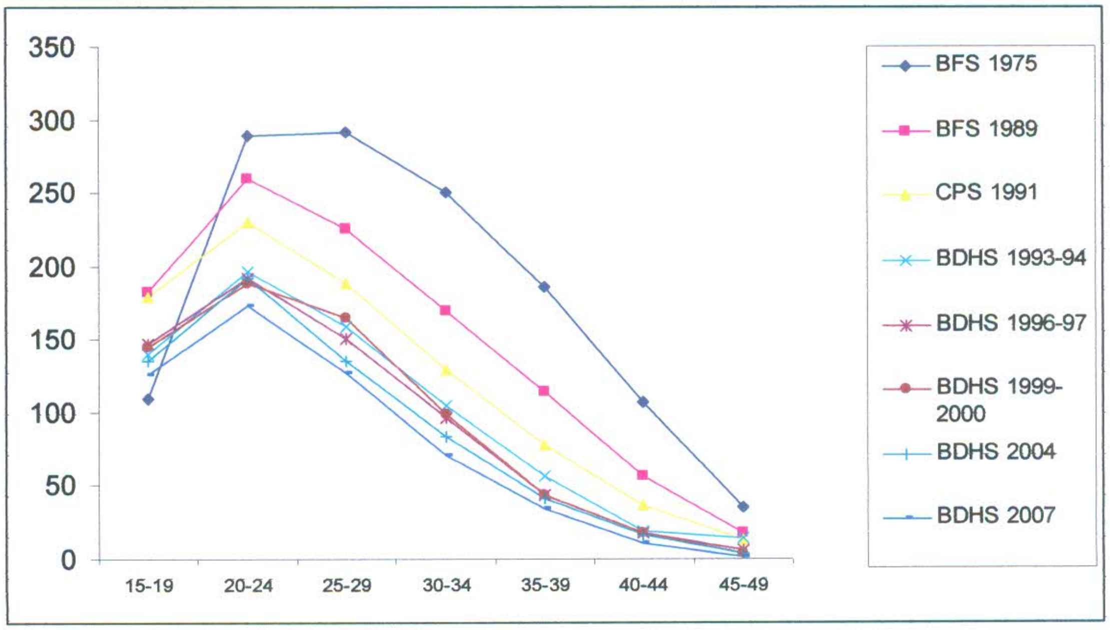
Table 2.2: Trends in Age Specific Fertility rates, per 1000 women of age 15-49, selected sources, Bangladesh 1975-2007

Age Group	Year							
	BFS	BFS	CPS	BDHS				
	1975	1989	1991	1993-94	1996-97	1999-2000	2004	2007
15-19	109	182	179	140	147	144	135	126
20-24	289	260	230	196	192	188	192	173
25-29	291	225	188	158	150	165	135	127
30-34	250	169	129	105	96	99	83	70
35-39	185	114	78	56	44	44	41	34
40-44	107	56	36	19	18	18	16	10
45-49	35	18	13	14	6	3	3	1

Source: Mitra and Associates, march 2009; 46. BFS, 1975, 1989; CPS, 1991; BDHS, 1993-94, 1996-97, 1999-2000, 2004, 2007.

This table also reveals that the level of fertility is still very high in Bangladesh although ASFR has been decreasing over time in each age group. The peak age has shifted from 25-29 in 1975 to 20-24 in 2004 and in 2007.

Figure 2.1: Age Specific Fertility Rates, Per 1000 women of age 15-49, Bangladesh 1975 to 2007.



Looking at figure 2.1, it is observed that the age pattern of fertility remains almost similar at different time points. The fertility curve is less skewed in the recent years than in the past.

Thus it may be concluded that the level of fertility is still high and seems to change little over time. It is observed that fertility increasing up to age 25 years then decline sharply. This implies that women who postpone their marriages to later ages try to recover the reproductive period already lost by producing on the average more children. But beyond age 25, the fertility performance slows down, which might be due to the fact that women who postpone their marriage up to that age might be motivated to reduce their fertility by using some method of modern contraception and/ or might have become less fecund as the level of fecundity decreases with increasing age or might have been sterile.

2.11 Trends in Total Fertility Rates (TFR)

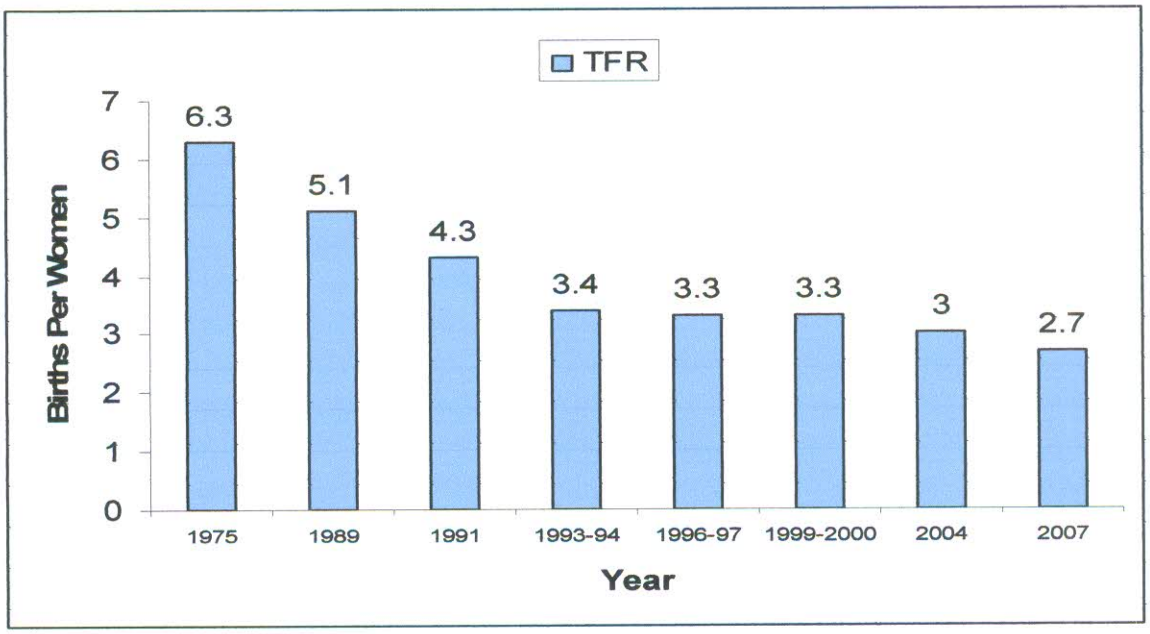
Trends in fertility in Bangladesh since the early 1970s can be examined by observing a time series estimates of TFR, produced from demographic surveys fielded over the last three decades, beginning with the 1975 Bangladesh fertility survey. The estimates shows in table 2.3 describe the ongoing Bangladeshi fertility change, fertility has declined sharply from 6.3 in 1975 to 2.7 in 2007(BDHS), which shows in figure 2.2. During this period, fertility declined rapidly in the late 1980s and early 1990s, and stalled at around 3.3 for most of the 1990s. TFR 3.3 was stagnant almost a decade in 1996-97 and 1999-2000(BDHS).The 2004 BDHS data indicates that after almost a decade-long stagnation the TFR declined slightly from 3.3 to 3.0 between 1997-1999 and 2004. Further from the 2007 BDHS TFR is slightly declined from 3.0 to 2.7 between 2004 and 2007. Investigation of the age pattern of fertility shows no anomalous, the decline since the mid-1980s has been fairly uniform over all age groups of women.

Table 2.3: Trends in Total Fertility Rates (TFR), Bangladesh 1975-2007

Source	Year	TFR
BFS	1975	6.3
BFS	1989	5.1
CPS	1991	4.3
BDHS	1993-94	3.4
BDHS	1996-97	3.3
BDHS	1999-2000	3.3
BDHS	2004	3.0
BDHS	2007	2.7

Source: Mitra and associates, BDHS report 2007, Page 50.

Figure 2.2: Total fertility rates, Bangladesh 1975-2007



2.12 Analytical Methods

There are different types of statistical and demographic techniques used to analysis the selected data according to perform the specified objectives.

(i) Descriptive statistics: frequency distribution.

(ii) Cross tabulation analysis, in this section, we have tried to trace out those independent variables which have a significant effect on fertility pattern and first conception wait.

(iii) A multivariate technique namely, a Binary Logistic Regression analysis, in this study, we have tried to identify the associated factor's significantly affect fertility pattern.

(iv) Geometric and Beta geometric distribution: to find the levels, trends and differentials of both conception wait and fecundability.

(v) Cox's multivariate proportional hazard regression analysis, in this study, we have to find out those independent variables which have a simultaneous significant effect on marriage to first conception wait.

Briefly of the technical aspects of the methods used in this analysis such as frequency distribution, chi-square distribution, binary logistic regression model, geometric and beta geometric distribution and cox's proportional hazard regression model etc, are given in relevant chapters. In the present study, Statistical Package for Social Science (SPSS), Microsoft excel and Microsoft words are used to analyze the data.

Chapter Three

Factors Affecting Fertility Pattern: A Logistic Regression Analysis

FACTORS AFFECTING FERTILITY PATTERN: A LOGISTIC REGRESSION ANALYSIS

3.1 Bivariate Analysis

Bivariate analysis is a useful step in studying the relationship between associated variables. It tells us how important an individual variable is by itself. Moreover, it helps us to identify those independent variables, which have significant effect on the index of fertility In this analysis, the dependent variable, the index of fertility is categorized into two groups i.e first one is, less than or equal to two births per woman (<=2 births) which is denoted by 1(yes) and second one is 3 or more births per woman which is denoted by 0 (no). In this analysis, we use χ^2 (Chi-square) test for the independency of attributes. From the Table-3.1, it is seen that the independent variables type of place of residence, respondent's work status, contraceptive use and body mass index are found to be significant at 1% level, religion, partner's educational level and partner's occupation are found to be significant at 5% level and wealth index is found to be significant at 10% level. The remaining independent variables current age of respondent's, respondent's age at first marriage, region, respondent's educational level, spousal age difference , marital duration, mass media contact and partner's age are found to be highly significant with index of fertility.

Table 3.1: Bivariate distribution of index of fertility by different background characteristics of the respondents.

Background characteristics	Categories	Percentage of respondent's index of fertility		Value of Chi-square	P-value
		No(3 or more birth)	Yes(less than or equal 2 birth)		
Current age of respondent's	≤18	0.7 (03)	99.3 (420)	175.03	0.000
	19-23	9.6 (145)	90.4 (1365)		
	24 and above	65.4 (4030)	34.6 (2132)		
Age at first marriage	<16	58.4 (3457)	41.6 (2465)	459.77	0.000
	16-18	40.0 (501)	60.0 (750)		
	19 and above	23.9 (220)	76.1 (720)		
Type of place of residence	Urban	46.9 (1428)	53.1 (1614)	42.54	0.007
	Rural	54.4 (2750)	45.6 (2303)		
Religion	Muslim	52.4 (3824)	47.6 (3474)	18.32	0.044
	Non-Muslim	44.4 (354)	55.6 (443)		
Region	Barisal	51.3 (553)	48.7 (526)	140.67	0.000
	Chittagong	56.5 (815)	43.5 (627)		
	Dhaka	51.2 (896)	48.8 (855)		
	Khulna	42.9 (543)	57.1 (722)		
	Rajshahi	46.3 (715)	53.7 (834)		
	Sylhet	64.9 (652)	35.1 (353)		
Respondent's educational level	Illiterate	75.0 (1902)	25.0 (633)	259.23	0.000
	Primary	57.0 (1391)	43.0 (1050)		
	Secondary & Higher	28.4 (885)	71.6 (2234)		
Partner's educational level	Illiterate	65.6 (1737)	34.4 (909)	365.06	0.038
	Primary	51.2 (1062)	48.4 (1012)		
	Secondary & Higher	40.9 (1379)	59.1 (1996)		

Respondent's work status	Not working	50.5 (2918)	49.5 (2857)	9.48	0.002
	Working	54.3 (1260)	45.7 (1060)		
Partner's occupation	Unemployed	65.7 (119)	34.3 (62)	43.48	0.026
	Manual	53.3 (2937)	46.7 (2576)		
	Non -manual	46.7 (1122)			
Spousal age difference	≤4	40.4 (437)	59.6 (645)	92.07	0.000
	5-8	49.4 (1381)	50.6 (1415)		
	9 and above	56.0 (2360)	44.0 (1857)		
Marital duration	0-4	0.6 (6)	99.4 (1037)	248.72	0.000
	5 and above	59.2 (4172)	40.8 (2880)		
Wealth index	Poor	58.2 (1615)	41.8 (1161)	117.99	0.064
	Middle	55.4 (846)	44.6 (680)		
	Rich	45.3 (1717)	54.7 (2076)		
Contraceptive use	Not use	51.1 (579)	48.9 (555)	0.162	0.043
	Use	51.7 (3599)	48.3 (3362)		
Body mass index	< 18.5	55.6 (1242)	44.4 (991)	23.76	0.001
	18.5-24.9	50.7 (2369)	49.3 (2300)		
	24.91 and above	47.5 (567)	52.5 (626)		
Mass media contact	No	62.4 (2233)	37.6 (1346)	298.49	0.000
	Yes	43.1 (1945)	56.9 (2571)		
Partner's age	<25	3.1 (15)	96.9 (466)	719.68	0.000
	25-32	14.1 (312)	85.9 (1295)		
	33 and above	64. (3950)	35.3 (2156)		

3.2 Logistic Regression Analysis Approach

It is an attempt to find out those variables, which are truly related to fertility differentials. Logistic regression technique will be employed to identify the contribution of the independent variables on fertility pattern. These techniques are applicable only when the dependent and independent variables are measured in interval scale under the assumption that they are normally distributed.

3.2.1 Logistic Regression Analysis

There are a variety of multivariate statistical techniques that can be used to estimate a binary dependent variable from a set of independent variables. Multiple regression analysis and discriminate analysis are two related techniques but these techniques are applicable only when the dependent and independent variables are measured in interval scale under the assumption that they are normally distributed. However, in most applications, dependent variable may be dichotomous one and one or more explanatory variables are qualitative or measured in nominal or ordinal scales and the assumption of normality is violated. to solved this problem, a very interesting and appropriate techniques is the linear logistic regression method. Cox (1958) is the pioneer of logistic regression model. Subsequently this model was developed by Worker and Duncun (1967) and Cox (1970). More recently Lee (1980) and Fox (1984) have further modified the Cox's model. So, to observe the factors, which affect the dependent variable-children ever born, we use logistic regression analysis. Here the dependent variable is children ever born which is coded as 0=No and 1=Yes.

The logistic regression method does not require any distributional assumption. This regression is useful when the dependent variable is dichotomous. Since it does not require any distributional assumptions, unlike many other multivariate techniques (i.e, the variables are normally distributed with equal variances), it can appropriately handle situations in which the dependent variables are qualitative or measured in nominal and ordinal scale. The logistic regression model can be used not only to identify risk factors but also to predict the probability of success.

These models express a qualitative dependent variable as a function of several independent variables, both qualitative and quantitative (Fox, 1984). Suppose, some of them are called "Success" and others are "Failure". Let Yi denote the dependent variable for i-th observation (where i=1,2,.........,n) and

$$Y_i = \begin{cases} 1, \text{if they have low total chidlren ever born (0,1,2 chidlren), will be} \\ \text{regarded as probabilit y of "success" } P_i \\ 0, \text{if they have high total chidlren ever born (3,4,.... ,15 chidlren), will be} \\ \text{regarded as probabilit y of "failure" } 1 - P_i \end{cases}$$

Consider a collection of k independent variables which will be denoted by the vector $X' = (x_1, x_2, \ldots\ldots, x_k)$ and the vector of the coefficients of x is $\beta' = (\beta_1, \beta_2, \ldots\ldots, \beta_k)$. If we include the intercept term β_0 then $\beta = (\beta_0, \beta_1, \beta_2, \ldots, \beta_k)$ be a (k+1) x 1 vector of unknown parameters. Let the conditional probability that the outcome is present be denoted by

$(Y_i=1/x_{i1}, x_{i2}, \ldots\ldots, x_{ik}) = P_i$. Then the logit of the multiple logistic regression model is given by the equation

$$g(x) = \beta_0 + X_1\beta_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k \ldots\ldots \text{(i)}$$

In which case

$$P_i = P_r(Y_i=1/X=x_i) = \frac{e^{g(x)}}{1+e^{g(x)}} = \frac{e^{x_i\beta}}{1+e^{x_i\beta}} \ldots\ldots \text{(ii)}$$

$$\text{and } 1-P_i = P_r(Y_i=0/X=x_i) = \frac{1}{1+e^{g(x)}} = \frac{1}{1+e^{x_i\beta}} \ldots\ldots \text{(iii)}$$

Equation (ii) and (iii) look complicated, however, the logarithm of the ratio P_i and $1-P_i$, is a simple linear function of X_{ij} (where j= 1, 2,.......,k) and the model becomes

$$g(x)=\log_e\left(\frac{P_i}{1-P_i}\right)=X_i\beta=(1,X_{i1},X_{i2},\ldots\ldots\ldots\ldots,X_{ik})\begin{pmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \vdots\\ \beta_k\end{pmatrix}$$

$$=\beta_0+\beta_1X_{i1}+\beta_2X_{i2}+\ldots\ldots+\beta_k X_{ik}$$

$$=\sum_{j=o}^{k}X_{ij}\beta_j\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(iv)}$$

Where $X_{io} = 1$ and β is the parameter relating to X_{ij}

The function (iv) is a linear function of both the variable x and the parameterβ. g(x) is called the logit and hence the model (iv) is called the logistic regression model. Which express the log odds of occurrence on an event (i.e. independent variable).

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 . It has several nice properties; P_i is bounded only between 0 and 1, if $P_i<0.5$, logit P_i is negative while if $P_i>0.5$, logit P_i is positive. Probability of P_i lies between 0 and 1, that is, $0\leq P_i=E(Y_i|X)\leq 1$.

3.2.1 (a) Estimation Technique

The most common method used to estimate unknown parameters in linear regression is least squares. Under usual assumptions, least squares estimators have some desirable properties. But when least squares method is applied to estimate a model with dichotomous outcome the estimators on longer have these same properties. In such situations, the general method for estimating the parameters of logistic regression models is the method of maximum likelihood.

In logistic regression, the likelihood equation is non-linear and explicit function of unknown parameters. Therefore, we use a very effective and well known iterative method, Newton-Raphson method. Now, let us consider a single regression model as

$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$; (i=1, 2,.............,n.) ....(i)

Where Y_i is a dichotomous variable, it takes two values 0 and 1.

So, Y_i is a Bernoulli random variable. So, the p.d.f. of Y_i is given by

$f_i(Y_i) = P_i^{Y_i}(1-p_i)^{1-Y_i}$; (Y_i=0 or 1) ; i =1, 2,................,n ....(ii)

Where p_i is a probability that define as

$$P_i = \frac{e^{\beta_0+\beta_1 x_i}}{1+e^{\beta_0+\beta_1 x_i}}$$

$$\therefore \frac{P_i}{1-P_i} = e^{\beta_0+\beta_1 x_i} \quad \text{...(iii)}$$

Implies, $\log_e\left(\frac{P_i}{1-P_i}\right) = \log_e\left(e^{\beta_0+\beta_1 x_i}\right)$

Since those are assumed to be independent, the joint probability density function is

$$g(Y_1, Y_2,\ldots\ldots, Y_n) = \prod_{i=1}^{n} f_i(Y_i)$$

$$= \prod_{i=1}^{n} P_i^{Y_i}(1-p_i)^{1-Y_i} \quad \text{..................................(iv)}$$

Since the logarithm is a monotonic function, so, taking logarithm on (iv), we get

$$\log_e g(Y_1, Y_2,\ldots\ldots, Y_n) = \log_e \prod_{i=1}^{n} P_i^{Y_i}(1-p_i)^{1-Y_i}$$

$$= \sum_{i=1}^{n}\left[Y_i \log_e P_i + (1-Y_i)\log_e(1-p_i)\right]$$

$$\log_e g(Y_1, Y_2,\ldots\ldots, Y_n) = \sum_{i=1}^{n}\left[Y_i\left\{\log_e P_i - \log_e(1-P_i)\right\} + \log_e(1-P_i)\right]$$

$$= \sum_{i=1}^{n}\left[Y_i \log_e\left(\frac{P_i}{1-P_i}\right) + \log_e(1-P_i)\right]$$

$$= \sum_{i=1}^{n}\left[Y_i(\beta_0+\beta_1X_i)+\log_e\left(\frac{1}{1+e^{(\beta_0+\beta_1X_i)}}\right)\right]$$

$$I_i \text{ (say)} = \sum_{i=1}^{n}\left[Y_i(\beta_0+\beta_1X_i)-\log_e\left\{1+e^{(\beta_0+\beta_1X_i)}\right\}\right]$$

$$= \sum_{i=1}^{n}Y_i(\beta_0+\beta_1X_i)-\sum_{i=1}^{n}\log_e\left\{1+e^{(\beta_0+\beta_1X_i)}\right\} \quad \text{................(v)}$$

Now, differentiating eq. (v) with respect to β_0 and β_1 respectively,

$$\frac{\delta I_i}{\delta\beta_0} = \sum_{i=1}^{n}Y_i - \sum_{i=1}^{n}\left[\frac{e^{\beta_0+\beta_1X_i}}{1+e^{\beta_0+\beta_1X_i}}\right]$$

$$\text{or } \frac{\delta I_i}{\delta\beta_0} = \sum_{i=1}^{n}Y_i - \sum_{i=1}^{n}P_i$$

$$\text{and } \frac{\delta I_i}{\delta\beta_1} = \sum_{i=1}^{n}X_iY_i - \sum_{i=1}^{n}\left[\frac{X_ie^{(\beta_0+\beta_1X_i)}}{1+e^{(\beta_0+\beta_1X_i)}}\right]$$

$$\text{or } \frac{\delta I_i}{\delta\beta_1} = \sum_{i=1}^{n}X_iY_i - \sum_{i=1}^{n}X_iP_i$$

$$\frac{\delta I_i}{\delta\beta} = \begin{pmatrix}\dfrac{\delta I_i}{\delta\beta_0}\\[2ex]\dfrac{\delta I_i}{\delta\beta_1}\end{pmatrix} = \begin{pmatrix}\sum_{i=1}^{n}Y_i - \sum_{i=1}^{n}P_i\\[2ex]\sum_{i=1}^{n}X_iY_i - \sum_{i=1}^{n}X_iP_i\end{pmatrix}$$

$$= X^T Y - X^T p$$

$$= X^T (Y-p) \quad \text{..(vi)}$$

Where,

$$X=\begin{pmatrix}1 & X_1\\ 1 & X_2\\ \vdots & \vdots\\ 1 & X_n\end{pmatrix},\qquad Y=\begin{pmatrix}Y_1\\ Y_2\\ \vdots\\ Y_n\end{pmatrix},\qquad P=\begin{pmatrix}P_1\\ P_2\\ \vdots\\ P_n\end{pmatrix}$$

Now, we put $\frac{\delta I_i}{\delta\beta}=0$, then we get

$$x^T (Y-p)= 0 \text{ ....(vii)}$$

$$\text{or } X^T Y = X^T p$$

$$\text{or } \hat{Y}=\hat{P},$$

The solution to eq^n. (vii) will satisfy

$$X^T \left(Y-\hat{Y}\right)=0 \text{ ....(viii)}$$

Equation (viii) is generally solved by using Newton-Raphson method. This entails first determining .

$$\frac{\delta}{\delta\beta}(X^TY-Y^Tp)=\frac{\delta}{\delta\beta}\{X^T(Y-p)\}=-\frac{\delta}{\delta\beta}X^T p=-[\frac{\delta}{\delta\beta}p\,]X$$

But we have,

$$P_i=\frac{e^{(\beta_0+\beta_1 X_i)}}{1+e^{(\beta_0+\beta_1 X_i)}}$$

$$\frac{\delta p_i}{\delta\beta_0}=\frac{\left\{1+e^{(\beta_0+\beta_1 X_i)}\right\}e^{(\beta_0+\beta_1 X_i)}-e^{(\beta_0+\beta_1 X_i)}e^{(\beta_0+\beta_1 X_i)}}{\left\{1+e^{(\beta_0+\beta_1 X_i)}\right\}^2}$$

$$=\frac{e^{(\beta_0+\beta_1 X_i)}}{\left\{1+e^{(\beta_0+\beta_1 X_i)}\right\}}\times\frac{1}{\left\{1+e^{(\beta_0+\beta_1 X_i)}\right\}}$$

$$=p_i\,(1-p_i)$$

$$\therefore \frac{\delta p_i}{\delta \beta_1} = \frac{\left\{X_i e^{(\beta_0 + \beta_1 X_i)}\right\}}{\left\{1 + e^{(\beta_0 + \beta_1 X_i)}\right\}^2}$$

$$= X_i P_i (1 - p_i)$$

$$\therefore \frac{\delta p_i}{\delta \beta} = X^T W$$

Where, W= diag.

And $X^T = \begin{pmatrix} 11..........1 \\ X_1 X_2 .... X_n \end{pmatrix}$

$$\therefore \frac{\delta p_i}{\delta \beta} X = X^T W X$$

Iterative estimates of β are then obtained as

$$\hat{\beta} = (X^T W X)^{-1} (X^T W Z) \quad \text{.....(ix)}$$

With Z playing the role of Y in this iteratively reweighted least squares approach. Specifically.

$$Z_i = \hat{\eta} + \frac{Y_i + \hat{p}_i}{\hat{p}_i (1 - \hat{p}_i)}$$

With $\eta_i = \log_e \left(\frac{p_i}{1 - p_i} \right)$. Notice that $\hat{\eta}_i$ plays an important role of Y_i and $\frac{(Y_i - \hat{p}_i)}{\hat{p}_i (1 - p_i)}$ is the residual corresponding to Y_i divided by the estimated variance of Y_i.

If we wish to write eq^n. (ix) in an equivalent form that shows the updating of $\hat{\beta}$, we may write Z as:

$$Z = X\hat{\beta}^{(i)} + W^{-1} e$$

with e= Y- $\hat{p}_i$, we then obtain

$$\hat{\beta}^{(i+1)} = (X^T W X)^{-1} X^T W (X \hat{\beta}^{(i)} + W^{-1} e)$$

$$= \hat{\beta}^{(i)} + (X^T W X)^{-1} X^T e \quad \text{.....(x)}$$

The updating formula given by equation (x) is used until the estimates converge.

The first step is to obtain the initial estimates; $\beta^{(0)}$. Various approaches are used to obtain these. As originally derived by Lachebrunch (1975) and displayed by Hosmer and Lemeshow (1989), the initial estimates obtained using the discriminant function are given by

$$\hat{\beta}^{(0)} = \begin{pmatrix} \hat{\beta}_0^{(0)} \\ \hat{\beta}_1^{(0)} \end{pmatrix} = \begin{pmatrix} \log_e\left(\dfrac{\hat{\Theta}_1}{\hat{\Theta}_0}\right) - 0.5\left(\hat{\mu}_1^{\,2} - \hat{\mu}_0^{\,2}\right) \div \hat{\sigma}^2 \\ \dfrac{\hat{\mu}_1 - \hat{\mu}_0}{\hat{\sigma}^2} \end{pmatrix}$$

Here, $\hat{\mu}_0 = \overline{X}_0$ and $\hat{\mu}_1 = \overline{X}_1$, where $\overline{X}_0$ and $\overline{X}_1$, are the average of the n-values when Y=0 and Y=1 respectively. And $\hat{\Theta}_1 = \overline{Y}$ and $\hat{\Theta}_0 = 1 - \hat{\Theta}_1$

And $$\hat{\sigma}^2 = \frac{(n_0 - 1)s_0^{\,2} + (n_1 - 1)s_1^{\,2}}{n_0 + n_1 - 2},$$

Where s_0^2 and s_1^2 are the usual sample variances computed using Y =0 and Y = 1 respectively, and n_0 and n_1 are the corresponding sample sizes.

3.2.1 (b) Testing the significance of the coefficients

To assess the effect of independent variables on the dependent variable, we have to follow some procedures incorporated with logistic regression model, such as

(1) Likelihood ratio test.

(2) Wald test.

(3) Score test.

We have used Wald test to test our hypothesis

H_0: The contribution of the covariates in the model is equal to zero.

vs H_1: At least one of them is non zero.

Wald Test:

The Wald test statistic is an alternative test which is used to test the significance of individual logistic regression coefficients for each independent variable that is, to test the null hypothesis in logistic regression that a particular logit (effect) coefficient is zero. For dichotomous independents, the Wald statistic is the squared ratio of the unstandardized logit coefficient to its standard error.

When the overall null hypothesis $H_0 : \beta_1 = \beta_2 = \text{-----------} = \beta_k = 0$, is rejected we may decide that at least one β_i is non-zero. Then to identify significant coefficient, we have to perform the test procedures for any specific parameter and wald test plays this role. This test procedure is known after the name of Wald who has given this test procedure in 1943. The assumption of this test is the same as those of the likelihood ratio test. The test statistic is obtained by comparing the maximum likelihood estimate of any slope parameter to be estimate of its standard error.

Lest us set the null hypothesis

$$H_0 : \beta_j = 0$$

$$\text{vs,} \qquad H_1 : \beta_j \neq 0 \text{ for } j = 1,2,3,\ldots\ldots,k$$

Then the univariate Wald statistic is defined as

$$W_j = \frac{\hat{\beta}_j}{SE\left(\hat{\beta}_j\right)}$$

Where $\hat{\beta}_j$ is the M.L.E. of j[th] coefficient and S.E. ($\hat{\beta}_j$) denote the standard error of $\hat{\beta}_j$. Under the null hypothesis that the slope parameter is zero, this statistic follows as standard distribution. Let, α be the level of significance and $Z_{\alpha/2}$ be the critical value of standard normal distribution. Then we accept the null hypothesis if-$Z_{\alpha/2} < Z_j < Z_{\alpha/2}$; otherwise it will be rejected at α% level of significance. The multivariate analogue of the wald test can be expressed as

$$W = \hat{\beta}^T \left[var\left(\hat{\beta}\right)\right]^{-1}$$

$$= \beta\ (X^T WX)\beta$$

Which is distributed as chi-square with (k+1) degrees of freedom under the hypothesis that each of the (k+1) coefficients is zero. Since we are interested only in the slope coefficient, the multivariate Wald test for the slope coefficients can be obtained by eliminating β_0 and β and the corresponding first row and first column from $(X^T WX)$.

3.2.1 (c) Interpretation of Parameters

Interpretation of parameters in logistic regression model is not so straightforward as in linear regression model. So it is relevant to present a little discussion about it. Since the logit transformation of g (x) is linear in parameters, we can interpret the parameters using the arguments of linear regression. Thus the interpretation may be described as follows: We know that the logit transformation of a logistic regression model is

$$p(x) = \frac{e^{\left(\beta_0 + \beta_1 X_1 + \ldots\ldots + \beta_k x_k\right)}}{1 + e^{\left(\beta_0 + \beta_1 X_1 + \ldots\ldots + \beta_k x_k\right)}} \text{ is linear in parameters.}$$

That is,

$$g(x) = \log_e \left[\frac{p(x)}{1 - p(x)}\right]$$

$$= \beta_0 + \beta_1 x_1 + \ldots\ldots\ldots\ldots + \beta_k x_k$$

So, arguing analogously as in the case of linear regression model, we can say that β_j (j = 1, 2, 3,..............,k) represents the rate of change in $\log_e \left[\frac{p(x)}{1 - p(x)}\right]$ for one unit change in X_j (other variables remaining constant).

The interpretation of parameters in logistic regression has another interesting aspect. In fact, this is the proper interpretation. To describe this, we first consider that the independent variables (X_j) are dichotomous. This case is not only simplest but also it gives the conceptual foundation for all other saturations. The description is as the following:

3.2.1 (d) Interpretation of Parameters in Terms of Odds Ratio

We begin our consideration of the interpretation of logistic regression coefficients with the situation where the independent variable is nominal scale and dichotomous (that is, measured at two levels). This case provides the conceptual foundation for all the other situations.

we have $\log_e\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \dots\dots\dots + \beta_j X_j + \dots\dots + \beta_k X_k$

Now if X_j is a dichotomous variable taking values 0 and 1, then the odds ratio, denoted O, is defined as the ratio of odds (say) for $X_j = 1$ against $X_j = 0$ is (keeping all other X's fixed).

$$O = \frac{P_i\left(Y_i = 1 \mid X, X_j = 1\right) \big/ \left\{1 - P_i\left(Y_i = 1 \mid X, X_j = 1\right)\right\}}{P_i\left(Y_i = 0 \mid X, X_j = 0\right) \big/ \left\{1 - P_i\left(Y_i = 0 \mid X, X_j = 0\right)\right\}}$$

$$= \frac{e^{\beta_0 + \beta_1 X_1 + \dots\dots\dots + \beta_j + \dots\dots + \beta_k X_k}}{e^{\beta_0 + \beta_1 X_1 + \dots\dots\dots + 0.\beta_j + \dots\dots + \beta_k X_k}}$$

$\Rightarrow O = e^{\beta j}$

$\Rightarrow \log_e O = \beta_j$

So, we can directly estimate the coefficients of a logistic regression model as $\log_e \hat{O}$ and hence can interpret.

The simple relationship between the coefficient and the odds ratio is the fundamental reason why logistic regression has proven to be such a powerful analytical research tool.

The odds ratio is a measure of association which has found wide use, especially in epidemiology, as it approximates how much more likely (or unlikely) is for the outcome to be present among those with x=1 (or 2, or 3) then among those with x=0. For example if Y denotes the presence or absence of lung cancer and if x denotes whether the person is a smoker, then O= 2, estimate that lung cancer is twice more likely to occur among smokers than non smokers in the study population. As an another example, suppose Y denotes the presence or absence of heart disease and X denotes whether or not the person engage in regular strenuous physical exercise. It the estimated odds ratio is O = 0.5, then occurrence of heart disease is one half as likely to occur among those who exercise than among those who do not in the study population. The interpretation gives for the odds ratio is based on the fact that in many instances it approximates a quantity called relative risk. The odds ratio approximates the relative risk if $\{1\text{-}p(0)\}/\{1\text{-}p(1)\} \approx 1$. This holds when p (x) is small for both 1 and 0.

3.2.1 (e) Computation of Probability (P_i)

We can compute the probability P_i form the estimated odds ratio. This calculation is very simplest, Given a data set of x variables in following equation.

$$\lg o_e\left(\frac{P_i}{1-P_i}\right) = \sum_{j=0}^{k} X_{ij}\ \beta_j$$; *where of course β's* are estimated from the fitted model, then we have

$$\lg o_e\left(\frac{P_i}{1-P_i}\right) = \text{C (constant)}$$

$$\Rightarrow \qquad \left(\frac{P_i}{1-P_i}\right) = e^c \qquad \text{.......(i)}$$

From this equation (i) P_i can be computed easily.

3.2.1 (f) Results and Discussion of Logistic Regression Analysis

As index of fertility is a dichotomous numeric variable, we have tried to find out the significant factors affecting on fertility through binary logistic regression model.

The results of the logistic regression analysis are presented in Table 3.2, presents the estimate of the logistic regression coefficient (β), p-value, relative odds that are calculated for each of the categorical variable. According to the fitted model, there are sixteen variables appear as the significant predictors in case of children ever born or index of fertility. In accordance with their importance, current age of respondent, type of place of residence, religion, respondent's education level, work status of women, marital duration, contraceptive use, body mass index and mass media contact have statistically significant negative effect on children ever born. The variables age at first marriage and spousal age difference have significant positive effect on children ever born. Also the variables region and partner's age have the significant effect on children ever born. On the other hand, partner's educational level, partner's occupation and wealth index have insignificant effect on children ever born.

The regression coefficients of the current age of respondent's are being calculated. From the results, it is appeared that the respondent's current age is the negative and most significant factor, affecting children ever born. It has also been found in bivariate analysis. Children ever born are higher among those women who belong to the age group ≤ 18(10-17). From Table 3.2, the odds ratios of respondent's current age are 0.321 and 0.040 respectively. It indicates that children ever born will be 0.321 and 0.040 times lower for those respondents whose age group 19-23 and 24& above than those respondents whose age group ≤ 18 (10-17) (reference category). Hence we saw that the lower age group of respondent is the higher probability of giving more children ever born.

Age at first marriage has also come out as a highly significant and positive factor affecting children ever born. From the results, children ever born is higher among those women who belong to age group 19& above. The odds ratio of age at first marriage are 2.114 and 5.331, which indicate that children ever born is 2.114 and 5.331 times higher for those women corresponding to age group 16-18 and 19& above than those women who belong to age group <16. Which reveals that fertility rate goes up when marriage takes place at an early stage. Generally higher educated women marry at a very late stage than the illiterate women.

Type of place of residence has also been appeared as a significant factor affecting children ever born. The odds ratio of the place of residence is 1.132, which indicates that children ever born is 1.132 times higher for those women who lived in rural areas than those women who lived in urban areas. Which reveals that education facilities, work facilities and ignorance of the use of contraception method is severely limited, particularly in rural areas.

Religion has also come out as a significant factor affecting children ever born. In bivariate analysis the odds ratio of religion is 0.427 which indicates that children ever born is .678 times lower for those women who have religion non-Muslim than those women who have religion Muslim. In under developing country like Bangladesh family planning programs is difficult to introduce due to lack of knowledge as well as social restrictions as a result fertility rate goes up. On the other hand, since Muslims have no restrictions on remarriage which acts on the favor of fertility increasing.

From table-3.2 we observed that administrative division has important significant positive effect on children ever born in Bangladesh. In Dhaka division, this factor is not significant at all. The odds ratio reveals that the respondent who are living in Khulna and Rajshahi division are found to have 1.219 times and 1.610 times higher risk of children ever born than the respondent who are living in Barisal division. But women who are living in Chittagong and Sylhet divisions are 0.492 and 0.310 times lower risk of children ever born than those woman who are living in Barisal division. From the result, it is clear that the probability of giving children ever born is lowest in Sylhet division (0.310) and highest in Rajshahi division (1.610).

Respondent's education has also come out as an most significant factor affecting children ever born. From the bivariate analysis it has also found that a child ever born is the lowest among higher educated women. The odds ratio of respondent's education are 0.795 and 0.436, which indicate that children ever born are 0.795 and 0.436 times lower for those women who have primary and secondary& higher education than those women who are illiterate. From the results, it is clear that a higher educated woman is the lowest probability of giving children ever born. It is a well known fact that half of the populations among total population are women and most of them are illiterate, so the result may be suggested that Government attention should be need of providing education facilities, particularly in rural areas, children ever born must be decreased in Bangladesh.

Work status of women has also been appeared as an influential factor affecting children ever born. The odds ratio of working women is 0.825, which indicates that children ever born is 0.825 times lower for those women who are working than those women who are not working. It is a well known fact that work facilities of women outside home is severely limited in Bangladesh. So the result may be suggested that attention should be needed for Government and the higher authorities of various organizations of creating more work facilities of women outside home, particularly in rural areas children ever born must be decreased.

Spousal age difference has also come out as a significant factor affecting children ever born. From the results, children ever born is higher among the age group 9& above. The odds ratio of spousal age difference are 1.035 and 1.325, which indicate that children ever born is 1.035 and 1.325 times higher for those women corresponding to age group 5-8 and 9& above than those women who belong to age group ≤ 4.

Marital duration is found to have a statistically significant negative influence on index of fertility. The women whose marital duration is 5 years or more are found to have 0.055 times lower fertility than those women whose marital duration is less than or equal to 4 years.

Contraceptive use has also been appeared as an significant factor affecting children ever born. The odds ratio of contraceptive use is 0.530, which indicates that children ever born is 0.530 times lower for those women who have used contraception method than those women who do not have used contraception method. It is a well known fact that family planning programs is difficult to introduce due to lack of knowledge and social restrictions. It is clear that in order to decrease fertility, we must increase the use of contraception method.

Body mass index is found to have a significant effect on index of fertility. The relative odds ratio of the respondent's body mass index are 0.998 and 0.463, which indicates that children ever born is 0.998 times and 0.463 times lower for those woman whose body mass index lies in the group 18.5-24.9 and 24.91& above than those women whose body mass index lies in the group <18.5. From the result, it is clear that obesity respondent's index of fertility is the lowest than the other groups.

Mass media contact has also come out as a highly significant negative factor affecting children ever born. The odds ratio 0.893 indicates that children ever born is 0.893 times lower for those respondent who contact mass media than those respondent who do not contact it. It is clear that in order to decrease fertility, mass media contact increases the awareness of the use of contraception, particularly in rural areas.

Partner's age is found to have a highly significant influence on fertility in Bangladesh. For the partner's whose age lies in the group 33 and above, this factor is not significant at all. The Partner's whose age lies in the group 25 to 32 years are found to have1.312 times higher fertility than the partner's whose age lies in the group less than 25 years.

Table 3.2 Results of logistic regression analysis for the simultaneous effects of all factors in the model of children ever born in Bangladesh.

Background characteristics	Coefficient (β)	SE	P-Value	Odds Ratio
Current age respondents	-	-	0.000	-
≤18(ref)	-	-	-	1.00
19-23	-1.137	0.631	0.072	0.321
24 and above	-3.217	0.633	0.000	0.040
Age at first marriage	-	-	0.000	-
<16(ref)	-	-	-	1.00
16-18	-0.748	0.085	0.000	2.114
19 and above	-1.674	0.105	0.000	5.351
Type of place of residence	-	-	0.007	-
Urban (ref)	-	-	-	1.00
Rural	0.019	0.070	0.087	1.132
Religion	-	-	0.044	-
Muslim(ref)	-	-	-	1.00
Non-muslim	-0.413	0.098	0.000	0.427

Region	-	-	0.000	-
Barrisal(ref)	-	-	-	1.00
Chittagong	-0.709	0.112	0.000	0.492
Dhaka	-0.163	0.105	0.121	0.850
Khulna	0.476	0.109	0.000	1.610
Rajshahi	0.198	0.106	0.063	1.219
Sylhet	-1.171	0.130	0.000	0.310
Respondent's educational level	-	-	0.000	
Illiterate(ref)	-	-	-	1.00
Primary	-0.361	0.080	0.000	0.795
Secondary & higher	-1.215	0.095	0.000	0.436
Partner's educational level	-	-	0.255	-
Illiterate(ref)	-	-	-	1.00
Primary	0.134	0.084	0.112	1.143
Secondary & higher	0.112	0.091	0.219	1.119
Respondent's work status	-	-	0.002	-
not working(ref)	-	-	-	1.00
working	-0.180	0.068	0.008	0.825
Partner's occupation	-	-	0.255	-
Unemployed(ref)	-	-	-	1.00
Manual	0.306	0.213	0.151	1.357
Non manual	0.237	0.216	0.273	1.267
Spousal age difference				
≤4(ref)	-	-	0.001	
5-8	-	-	-	1.00
9 and above	0.035	0.103	0.736	1.035
	0.281	0.105	0.007	1.325

Marital duration	-	-	0.000	-
0-4(ref)	-	-	-	1.00
5 and above	-2.896	0.432	0.000	0.055
Wealth Index	-	-	0.116	-
Poor(ref)	-	-	-	1.00
Middle	-0.172	0.091	0.058	0.842
Rich	-0.152	0.092	0.100	0.819
Contraceptive use	-	-	0.008	-
Not use(ref)	-	-	-	1.00
Use	-0.634	0.096	0.000	0.530
Body mass index	-	-	0.003	-
<18.5(ref)	-	-	-	1.00
18.5-249	-0.187	0075	0.012	0.998
24.91 and above	-0.345	0.103	0.001	0.463
Mass media contact	-	-	0.000	-
No(ref)	-	-	-	1.00
Yes	-0.465	0.072	0.000	0.893
Partner's age	-	-	0.000	-
<25(ref)	-	-	-	1.00
25-32	0.272	0.308	0.000	1.312
33 and above	-1.426	0.312	0.377	0.240

Note: ref = Reference category

ESTIMATION OF CONCEPTION WAITS AND FECUNDABILITY: LEVELS, TRENDS AND DIFFERENTIALS

4.1 Introduction

Bangladesh is a poor country, and malnutrition and ill-health are largely prevalent particularly among women, and may also contribute to low fecundability though the fertility rate is rather high due to the low contraceptive use rate and/or lack of effective use of contraception, as also due to the higher desired family size (Islam, Mazharul M; Yadava, R.C sept 1997. 43(3). p-13-20. Location: SNDT Churchgate). Fecundability effects fertility through its relationship with the average time required for a conception to occur, and can also be thought of as the transition probability for the passage from susceptible state to pregnancy (Perrin and Sheps, 1964). The human reproduction starts from the on set of marriage and the timing of first conception signifies couples fertility at early stage of married life. The time, a women takes to conceive for the first time after her marriage is called the first conception wait or conception delay. A conception delay is defined as the exposure months preceding, but not including, the month of conception, whereas the conception wait or the time required to conceive includes that month as well (Potter and Parker, 1964). To avoid ambiguity between a "conception delay" and "waiting time of conception" the present analysis has considered the conception wait. Only pregnancies recognizable by the delay of the first menses after fertilization is included in this analysis, and fertilized ova that fail to implant or abort spontaneously before the women knows she is pregnant are not counted as conceptions.

The time of first conception, especially when the age at effective marriage is under teens, is said to be influenced by a number of biological, social and cultural factors. The biological factors include the age at menarche, length and level of adolescent sterility while the social factors include the visit of female partner to parents for the observance of festivals, social functions, and other taboos causing physical separation between the spouses. It is often very difficult to ascertain the exact age at attaining maturity and thus the actual waiting period for the first conception for such a women after her marriage. Because of this biological phenomenon, fertility behavior of women who marry in adolescence is quite different from that women who marry at late ages. Thus, analysis of the first conception wait following marriage has required special attention for the population where women marry under the age of 20 years, adolescent sterility elongates the time until their first conception and they can not be treated fecund right form the time of marriage (Prathak and Prasad, 1977). Thus a woman takes several months to conceive after entering the susceptible state. A woman is assumed have become biologically mature when her menstrual cycle becomes ovulatory and she continues to ovulate regularly (Pathak, 1978). She may enter the susceptible state by marriage or resumption of menses after a live birth while living with her partners. It has been observed that for a homogeneous group of women, the reciprocal of the mean waiting time for the first conception gives the harmonic mean of fecundability (Henry, 1972; James, 1963; Sheps, 1964). Since fecundability is inversely related to conception wait, estimating fecundability, conception wait may be calculated either from marriage to first birth or to first conception or from subsequent birth intervals.

After a birth a woman takes some time to have resumed her menses. In this time she passes postpartum infecundable period due to breastfeeding. Waiting times tend to be longer for younger women in the years immediately following menarche (Balakrishnan, 1979; Jain, 1969). Presumably because the incidence of anovulatory is then higher. Conception waits are also longer among women who experience prolonged period of separation from their spouses due to seasonal migration for work (Bongaart's, 1983). But in general women beyond adolescent the interval between marriage and first conception or first birth is, on average, substantially shorter then the interval between first and second birth and also higher order births (Gautier and Henry, 1958; Islam and Islam, 1995; Henripin, 1954). Plausible explanation for the difference in duration is the existence of an infecundable period called postpartum amenorrhea period because both intervals contain gestation and ovulatory segments of approximately the same duration and conception are subject to similar risk of intrauterine mortality (Henry, 1964). Besides, the interval following a birth is held by the prolonged duration of breastfeeding, malnutrition, which increase the duration of postpartum infecundable period.

Therefore, the waiting time for first conception is generally measured from the date of marriage. However, the assumption that the female is exposed to the risk of conception immediately after marriage has some biological implications because waiting time of first conception has some unique features to investigate it. Firstly, the effect of amenorrhea period which is random and is largely determined by the social and cultural factors of breastfeeding practices among women is completely absent. Secondly, a woman, generally, does not like to use contraceptives to postpone first birth. Thirdly, there is little chance of recall lapse in reporting the time of first birth from the date of marriage because birth of the first child is the most important event in the conjugal life of a couple. As a result, the time of first conception or birth is determined largely by the biological characteristics of the women and can, therefore, be utilized for estimating various biological determinants of human reproduction, the knowledge of which may be helpful in the assessment of the impact of contraception and induced abortion along with the impact of social and economic factors of fertility.

Determinants of biological parameters of human reproduction from the data on first conception waits has been rendered possible through the development of some probability models under the assumption that the occurrence of conception to a married women depends on chance. The development of such models has considered the time discrete as well as continuous. Although treating the time elapsed from the marriage or from the beginning of reproductive process to the first conception as continuous makes mathematical treatments more convenient and easy, the initial development treated time as discrete. Discrimination of the time seems more logical at the micro level as the reproductive life of a woman can be treated as a sequence of menstrual cycles.

In Certain populations, such as India, Pakistan, Nepal and Bangladesh, where most of the females consummate their marriage at adolescence stage, they may not be exposed to the risk of conception immediately after marriage because of the adolescent sterility or due to some socio-cultural taboos. The later may include the frequent visits of female partners to their parent's house especially in the beginning of their married life (Yadava, 1971). To cope up with the with such problems it has been suggested the model of waiting time of first conception by assuming that certain proportions of female are adolescent sterile at the time of marriage (Prasad et al., 1977; Nair, 1983). Further, in some situations it has been reported that some of the women who are pregnant at the time of marriage report to have conceived within a short interval of time (generally first months) after marriage (James, 1973). In such cases, the observations will be inflated in the first few months. To overcome the problems of premarital conceptions, inflated form of probability distributions of the waiting time of first conception have been suggested (Singh, 1964; Pathak, 1967; Singh et al., 1976). There has been another problem with regard to the data collection that the duration of the observation period for collecting data on first conceptive delays is not sufficiently large in the sense that one can not wait till the last women gives birth. Das Gupta and Hickman (1974) and Suchindran and Lachenbruch (1974) have derived truncated version of the distributions of the waiting time of first conception. In additions, Dwivedi (1985) accounted for both, the period of temporary separation between husband and wife and the adolescent sterility among females at early days of married life while analyzing the first conception wait. Battaacharya et al., (1988) have proposed a time dependent probability model for the study of first conception interval under the consideration that female may be exposed to the risk of conception at different points of time after marriage. They considered the risk of conception as a second degree polynomial of time in order to derive the true level of fecundability in the population.

In traditional populations like Bangladesh where marriage is almost universal and early marriage is vogue, all the female are not exposed to the risk of conception immediately after marriage either mainly due to biosocial immaturity or due temporary separation from their spouses. Since premarital conception is forbidden in Bangladesh, inflated form of probability distributions of the waiting time for first conception has not been considered in this analysis. Since date has been used in this study mainly based on retrospective enquiry, right censoring occurs because the information about the duration of risk period is incomplete due to limited observation period. As with the timing of a first conception, we usually can not follow all sampled women until they either have a fist conception or reach menopause and are no long ``able to have a first conception. Therefore, instead of deriving the truncated version of the distributions of waiting time of first conception proportional hazard model has been employed in this analysis. In addition, temporary separation of husband and wife before first conception was not taken in to cognizance in the present study. To estimate the levels, trends and differentials of fecundability; we are going to apply "Geometric Distribution for Homogenous women and Type I Geometric Distribution for Heterogeneous women". These two cases are discussed in brief in bellow.

4.2 Model of Homogeneous Fecundability (Geometric Distribution)

The process of human reproduction starts from the on set of effective marriage and the timing of first conception following it depends on the biological characteristics of women. According to Gini (1924), conception is a random event even though all the possible biological and sociological factor influencing conception are controlled. This randomness of conception gave a clue for the application of probability theory. Treating fecundability to be constant for a long span till she conceives and time as a discrete random variable, Gini (1924) derived the geometric distribution for the time of first conception. Further applications are found in the works of Henry (1953), Henripon (1954) and Vincent (1961). Gini's results obtained the mean fecundability of the population and the co-efficient of variation from the data on the proportion of women conceiving during the first and second months of exposure to risk. The simplest case to consider is that in which fecundablity is not only constant among women but also from month to month.

Let for a woman p, $0<p>1$, be the probability of conception in any month and assume that the month represent independent trials. If the month in which conception occur is denatured by the random variable T, then prob $(T=1)=p$ which is the probability that the conception occurs in the first month. If T=t such that $t>1$, then the preceding (t-1) months conception has not occurred with probability $(1-p)^{t-1}$ and first conception occurs in the t-th month with probability p. Therefore, we can write

$h(t)=\text{prob}\ [T=t]=p\ (1-P)^{t-1}, t=1,2,3,\ldots\ldots\ldots$ is the desired formula for the probability density function of T. This probability function is, of course, that of the well-known geometric distribution.

The probability function is a monotonic decreasing function of t with a mode, the most probable value, at t=l. The survival function at time t, s(t) defined by

$s(t)=prob[T>t]$ is given by $s(t) = (1- p)^t = q^t$. The distribution function of the random variable T is given by

$H(t) = P[T \le t] = 1 - (1 - P)^t$.

The mean time of conception is $E(T) = m = \frac{1}{P}$, represent the mean number of ovulations before conception. The mean time to conception is between m and m-1, depending on the interval that separated marriage from the first ovulation thus follows.

The variance of distribution is.

$$V(T) = \frac{1-P}{P^2}$$

In the homogeneous case, the mean waiting time for the first conception is

$$E(T) = \frac{1}{\text{Arithmatic mean of p}}$$

Since $\frac{1}{H.M.} > \frac{1}{A.M.}$, we under estimate fecundability if we use homogeneous model.

The moment estimator of p is $\frac{1}{T}$. For the geometric distribution, the maximum likelihood estimator coincides with the moment estimator.

4.3 Model of Heterogeneous Fecundability:

In the last centuries, demographers have employed a variety of techniques to study the mean value of fecundability and it's distribution discussed in this chapter. Among these techniques, the most commonly and widely applicable technique, is the fitting of a theoretical distribution to the observed distribution of waiting time to conception. In such case the waiting time to conception or the conception interval is measured by subtracting the date of first marriage from the date of first conception. The theoretical fitting of the type I geometric distribution has the limitation that it can be used only after the beginning of the marital life of the women as the conception interval for the pre-marital pregnant women are not possible to calculate. However, the model has the great advantages that it makes minimum assumption and is equivalent with the Gini's definition of fecundability because the range of the Pearsonian type I geometric distribution lies between 0 and 1. Pearson's type I distribution has been recommended and used by the Henry (1964) for the first time to study the mean value of fecundability. Following his work, Potter and Parker (1964), Majumdar and Sheps (1970) and Anrudh Kumar Jain (1969) fitted the type I beta geometric distribution for predicting the time required to conceive and for estimating the mean fecundabilities for women in the United States, Princeton fertility survey data and Taiwanese women respectively.

The Model

For analyzing the data on the conception interval the type I geometric distribution is considered as a useful model. The model relies on the following assumptions:

(i) The fecundability of each couple remains constant from month to month until pregnancy,

(ii) Among couples, fecundability is distributed as a Pearson Type I curve, i.e., Beta distribution with parameters a and b.

(iii) Conception is a random event conditional on fecundability.

(iv) The number of couples is large.

In a population, not all women may be having same fecundability to bear children. There is simple evidence that couples vary in their fecundability. A significant proportion of sexually active couples get pregnancy in their first non-contraception cycle, a smaller proportion of the remaining couples conceive in the conception rate continues to decline as the risk dampens. Therefore, the first assumption may be violated if spouse are temporarily separated, if the couple intentionally changes the timing and frequency of intercourse, and / or if a miscarriage of six or eight weeks is not reported. Even among healthy, regularly menstruating women, the proportion of anovulalory cycles is put at 5 percent or thereabouts (Potter, 1961). During the period of separation occurs for a short period and does not coincide with the fertile period during the month, then it will no effect on the monthly probability of conception. The pronounced decrease in the probability of conception over time is not purely due to time effect but as a sorting effect in a heterogeneous population (Leridon 1977; Weinberg and Gladen, 1986). As such, the fecundability, p of a particular woman, which is assumed to be constant earlier from month to month may be though as a realization of the random variable P, hence the distribution of T is the conditional distribution of T for given P, that.

$\text{Prob}[T=t/P] = P(1-P)^{1-1}, t = 1,2,3..................$

the unconditional probability that a conception occurs at t for a randomly selected couple is given by

$$h(t) = \text{Prob}[T=t] = \int_0^1 \Pr ob[T=t|P]f(P)dp$$

$$= \int_0^1 f(P)f(t|P)dp$$

t= 1.2,3......... is the probability density function of the random variable T. it is easy to see that *f(t/P)* is a proper probability density function for each P, then so is h(t).The given probability density function are frequently referred to as mixture distributions.

It can also be shown that the variance of the waiting time of first conception in case of heterogeneity is always greater than the variance of the same in the homogeneous estimation. For the application of the above mathematical model, we need to have a specific form of f(P). A Judicious choice of f(P), when *f(t/P)* is the probability density function of the geometric distribution is the well-known two-parameter Beta distribution whose probability density function is.

$$f(P) = \frac{1}{B(a,b)} P^{a-1}(1-P)^{b-1} \qquad \text{Where, } 0<p<1, a>0 \text{ and } b>0$$

The distribution is also known as a Type I Geometric, so named because of a classification system introduced by the British statistician, Karl Pearson. Pearson Type I distribution has been recommended first by Henry (1961) to study the fecundability. Following his work Potter and Parker (1964) constructed the Type I geometric model for predicting the time required to conceive and for estimating the mean fecundability for women in United States. Pearson type I distribution is convenient and gives a good approximation to unimodal distributions that are encountered in reality, for a variable that, like fecundability, ranges between 0 and 1. The normalizing constant B(a,b) is the famous beta type I function defined by.

$$B(a,b)=\int_0^1 P^{a-1}(1-P)^{b-1}\,dp;\text{ which may also be written}$$

$$f(p)=AP^{a-1}(1-P)^{b-1}$$

$$\text{with } A=\frac{\Gamma a\Gamma b}{\Gamma(a+b)}$$

The mean, mode and variance of fecundability are

$$\overline{P}=\frac{a}{a+b},\ P^{1}=\frac{(a-1)}{(a+b-2)}$$

$$\text{and } V(P)=\frac{ab}{(a+b)^2(a+b+1)}$$

For a>l and b>l, the mode of the Beta geometric distribution M (p) is given by

$$M(p)=\frac{a-1}{a+b-1}$$

It is moreover, simple to calculate the value of the coefficient of variation of fecundability in case of a beta distribution. Starting from

$\overline{P}=\frac{a}{a+b}$ and $c^2=\frac{v}{\overline{p}^2}=\frac{ab}{a(a+b+1)}$; where c is the coefficient of variation and v is the variance of fecundabilitry.

The proportion of conceiving during the first month of exposure is given by

$$P(1) = \int_0^1 f(P)Pdp = \int_0^1 \frac{P^a(1-P)^{b-1}}{(a,b)} dp$$

$$= \frac{B(a+b)}{B(a,b)}$$

More generally, the number of conceiving during the month of exposure is equal to

$$P(j) = \int_0^1 f(P)(1-P)^{j-1} Pdp$$

$$= \frac{B(a+1, b+j-1}{B(a,b)}$$

$$= \frac{ab(b+1).......(b+j-1)}{(a+1)(a+b+1)......(a+b+j)}, \text{ for } j=2,3,.............$$

and $P(0) = \frac{a}{a+b} = \overline{P}.$

The number of women conceiving during the jth month is

$N(j) = N.P(j)$

Where, N is the total number of women in the sample.

The rate of conceiving in month j is given by

$$q_j = \frac{a}{a+b+j}$$

Under the assumption of Type I geometric model, the theoretical average and variance of time required to conceive are given by the following expression:

$$E(T) = m = \int_0^1 E\left(\frac{1}{P}\right) f(P)dp$$

$$=\frac{\Gamma(a+b)}{\Gamma a\Gamma b}\int_0^1 P^{a-1}(1-P)^{b-1}dp$$

$=\dfrac{a+b-1}{a-1}$ and this is true when a>l. Simply, the variance of time of first conception can be obtained as

$$V(T)=S^2=\frac{ab(a+b-1)}{(a-1)^2(a-2)}, \text{if } a>2$$

4.4 Estimation of the Parameters

There are various statistical methods for estimating the parameters. Among them, the method of "moments" is used in this context for it's simplicity.

Method of Moments:

Let m_1 and m_2 are the two observed first and second sample raw moments of the month required for women to conceive for the first time after their marriage. The corresponding two population moments of T about origin, conditional on p as given by the simple geometric distribution are

$$E(T)=\sum_{x=1}^{\infty} tp(1-P)^{t-1}=\frac{1}{P}$$

$$E(T^2)=\sum_{x=1}^{\infty} t^2p(1-p)^{t-1}=\frac{2}{\theta^2}-\frac{1}{\theta}=\frac{2-\theta}{\theta^2}$$

To obtain the unconditional moments of X we also have

$$\mu'_1=E(T)=\int E(\frac{1}{P})f(p)dp$$

$$=\frac{\Gamma a+b}{\Gamma a\Gamma b}\int_0^1 p^{a-2}(1-b)^{b-1}dp$$

$$=\frac{a+b-1}{a-1}$$

and $$\mu'_2 = \frac{2(a+b-1)(a+b-2)}{(a-1)(a-2)} - \frac{a+b-1}{a-1}$$

Hence the variance of T is given by

$$m_1 = \frac{a+b-1}{a-1}$$

or $$b=(a-1)(m_1-1)$$

and $$m_2 = \frac{2(a+b-1)(a+b-2)}{(a-1)(a-2)} - \frac{a+b-1}{a-1}$$

or $$m_2 = \frac{m_1(a-1)\{2m_1(a-1)-a\}}{(a-1)(a-2)}$$

or $$m_2a - 2m_1 = 2m_1^2a - 2m_1^2 - m_1^2$$

or $$\hat{a} = \frac{2s^2}{s^2 - m_1^2 + m_1} \text{ and}$$

$$\hat{b} = (\hat{a}-1)(m_1-1)$$

Note that $s^2 > m(m-l) > 0$; otherwise a will be less than 2 for which the theoretical variance S^2 is not defined. Whenever this condition is not satisfied the Type I geometric model can not be fitted. Again to find the variance-covariance matrix of the moment estimate of *a*& b we need the third and fourth moments of T since the estimate of *a*& b are the functions of the first two moments of T and in this case the method is restricted to the situations when a is greater than 4. The analysis of the method of moments has shown that the moment estimators of *a*& b are moderately reliable only within a specified range of values of a. Outside this range, either the estimators are extremely inefficient or their variances are not defined at all. Fortunately our moment estimates of a and b for 8095 women having at least one recognizable effective conception after their marriage are 10.86 and 225.59.

The values of $\overline{p}, p'$ and v^2 can be estimated by substituting the estimated values of a and b in the formulae of mean, mode and variance of fecundability.

The expression for estimating $\overline{p}$ is given as

$$\text{Estimated } \overline{p} = 2s^2 \Big/ \left[s^2 (m+1) + m(m-1)^2 \right]$$

t can be seen that the estimated p is a function of mean conception delay m and variance s^2. If there were some unreported pregnancy losses and some women had reported their first live birth, instead of miscarriage or abortion as their first pregnancy, than the estimated mean m would be higher than true M and the estimated" $\overline{p}$ would be deflated. The under reporting of pregnancy losses would also increase the estimated variance s^2, but this will have smaller effect on the estimated $\overline{p}$, because s^2 appears both in denominator and numerator. Similar expressions for p' and v^2 can be obtained easily.

The theoretical values of P_j and N_j for j = 1,2,3, ...etc. are obtained by using FORTRAN language (Appendix -1).

The survival function, in this case, is given by

$$S(t) = \text{Prob}[T > t] = \int_0^1 s(t/p) f(p) dp$$

$$= \frac{b(b+1)........(b+t-1)}{(a+b)(a+b+1).......(a+b+t-1)}, \text{ which is valid for } t>1.$$

Recursively, it can be seen that

$$S(t) = \frac{s(t-1)(b+t-1)}{(a+b+t-1)}, \; t = 1,2,..............; \text{ where } s(0) = 1.$$

4.5 Efeect of Memory and Truncation Biases on Fecundability

In estimating fecundability there is a possibility to occur two types of biases: (a) 'memory' bias and (b) truncation bias. As a result of memory bias the overall fecundability estimate is deflated and it is inflated by the truncation bias. The memory bias arises because in the BDHS survey the information about pregnancy histories was collected retrospectively at the time of survey. Usually two types of memory bias which may effect the mean fecundability are: (a) underreporting of pregnancy losses and (b) misreporting of the time of marriage, date of birth and hence the time of first conception. The effect of unreported conceptions prior to the first reported conception is to lengthen the first pregnancy interval and hence to reduce mean fecundability because it can be observed from the expression that the estimated *p* is a function of mean conception wait m and variance s^2. If there were some under reporting of pregnancy losses and some women had reported their first live birth, instead of a miscarriage or abortion as their first pregnancy, then the estimated m would be higher than true mean M and consequently p would be deflated. The underreporting of pregnancy losses would also increase the estimated variance s^2 but this will have smaller effect on the estimated *p,* because s^2 appears both in denominator and numerator. On the other hand the effect of memory bias depends upon the nature of the error: if the first pregnancy interval is lengthened then the mean fecundability will be reduced and if the first pregnancy interval is shortened then the mean fecundability will be increased. It may be assumed that recall lapse is function of the length of the period between the occurrence of an event and its reporting date. Therefore, duration of marriage being a good measure of this elapsed period, it may be assumed that both types of memory bias will increase with duration of marriage.

The truncation bias arises because the interview date curtailed the observed child bearing experience of women as the survey was conducted retrospectively. In estimating overall fecundability we included women with at least one pregnancy; hence given short marriage duration, a woman could not be included in the analysis at all unless her first recognizable effective conception is considerably prompt. This indicates that short marriage duration with a conception select for quick conceptions, thereby increasing mean fecundability. On the other hand, if long marriage duration is included comparatively sub-fecund women will also included in the analysis and the over estimation will be less. Thus it can be said that the longer the marriage duration the less the effect of truncation on mean fecundability.

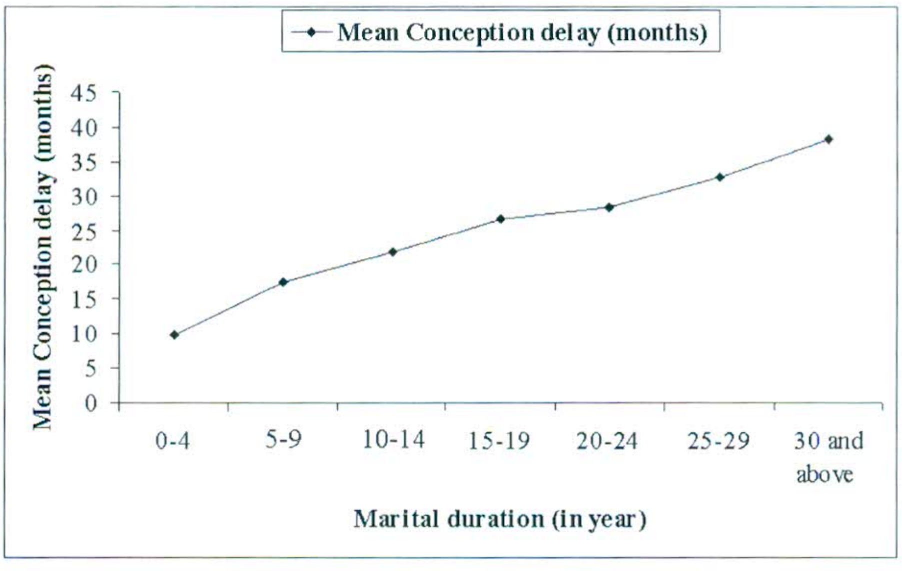
To study the effect of both memory and truncation biases on mean fecundability it is necessary to study the variation in fecundability, it is necessary to study the variation in fecundability by marriage duration. The findings are shown in Table 4.1. Duration of marriage of the respondents, who have at least one recognizable effective pregnancy, can be divided into different segments with distinct mean fecundabilities. The result indicates that mean fecundability is very high for women married 48 months or less and it declines substantially as we pass successively from one segment to the next. The sharp decline in mean fecundability from short marital duration to long marital duration is probably due to the positive effect of truncation bias and the negative effect of memory bias. It seems quite reasonable to assume that mean fecundability for women married for 5-9 years would provide a closer estimate of fecundability for Bangladeshi women then that based on all women. Women married for 5-9 years are not as seriously affected by the two biases, as are all women. Moreover, the effects of these two biases on mean fecundability for the women can be assumed to be compensatory. If this were so, the mean fecundability for women in this sample will be closer to 0.0572.

Table-4.1 Estimates of conception delay and fecundability for women by marital duration, Bangladesh(2007) BDHS.

Marital duration (in year)	Mean Conception delay (months)	Variance	Number of Women	Fecund ability
0-4	9.86	82.19	1043	0.1014
5-9	17.48	264.64	1601	0.0572
10-14	21.87	459.78	1416	0.0457
15-19	26.66	655.60	1286	0.0375
20-24	28.47	800.30	1099	0.0351
25-29	32.79	1118.59	835	0.0304
30 and above	38.22	1306.36	815	0.0261
All women	23.88	669.66	8095	0.418

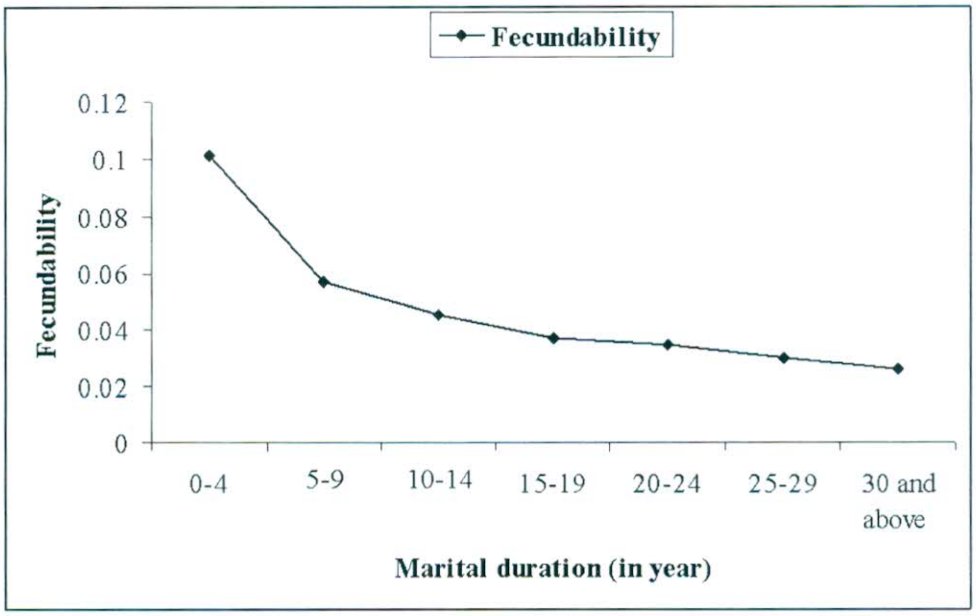
Fecundabilities are estimated on the basis of Geometric distribution as the individual marriage cohorts are homogeneous.

Figure-4.1 Mean conception wait by marital duration



The trend line regarding marital duration and mean conception wait indicates that up to 9 years mean conception wait is increasing sharply, after that it is increasing slowly.

Figure-4.2 Mean fecundability by marital duration



The trend line regarding marital duration and mean fecundability indicates that up to 9 years fecundability is decreasing sharply, after that it is slowly decreasing.

4.6 Age at Marriage, Conception Wait and Fecundabil1ty

Marriage marks the beginning of childbearing period, as it is the starting point of legitimate sexual union between husband and wife. Fecundability being dependent upon physiology, the age at marriage will play significant role in determining its level. The prevailing generalizations in the literature about the variations in mean fecundability with age as fecundability is zero until some age a, then increases to some age b, passes through constant maximum from age b to age y and then decreases until age z when it becomes zero again (Henry 1965). Ignoring fetal deaths Vincent's estimates of mean effective fecundability for newly wed French women, aged 16 to 25 years, and supported a part of Henry's hypothesis. We have an opportunity here to observe the variation in fecundability for Bangladesh by applying the Geometric model to age at marriage classes.

Estimates of mean conception delays shown in Table 3.2 reflect that women who marry before 14 years of age take the longest time to conceive and the delay reduces with increasing age at marriage. The conception delay is shortest when reaches at the age 21 years and above. Like time required conceiving, the mean fecundabilities based on geometric model for each age at marriage group are shown in the same Table 4.2. The result indicates that fecundability varies with the age at marriage group. These results also show that fecundability increases with the age at marriage. The findings suggest that the mean fecundability is lowest when women are in their early teens; it gradually increases as women move to their late teens and age 21 and above. The trend of fecundability is constant with Henry's (1965) hypothesized relationship between age and fecundability, and with Vincent's (1961) estimates of effective fecundability by age. The same trend was also obtained by Jain (1969) for the Taiwanese women. Our findings did not tell us much about fecundability after age 23 years. In this sample there are only 136 women who married at age 24 years and above, and the mean fecundabilities of these women are higher than that of women of other age at marriage class.

One of the plausible explanations for the longer conception delays at early age at marriage is that in Bangladesh most of the females consummate their marriages under the age of 20 years and they can not be treated right from the time of marriage (Pathak and Prasad, 1977). A woman is assumed to have become biologically mature when her menstrual cycle becomes ovulatory and she continues to ovulate regularly (Pathak, 1978). The time interval between menarche and attainment of full biologically maturity is called the adolescent sterility. Thus the probability of conceiving in a month in Bangladesh is lower at early age at marriage is mainly due to adolescent sub-fecundity of the respondents or due to some socio-cultural taboos.

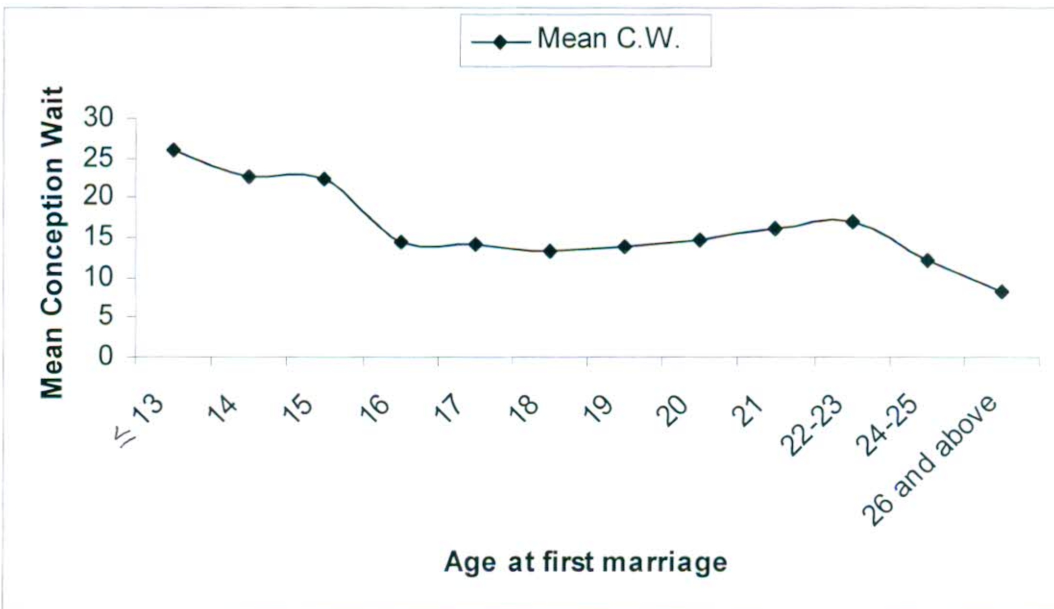
Table 4.2 shows that as the age at first marriage increasing mean conception wait is decreasing resulting fecundability is increasing. From this table it also reveals that the significant correlation coefficient between age at first marriage and conception wait is -0.199, which discloses that age at first marriage is negatively correlated with marriage to conception wait. We also get the significant regression coefficient between age at first marriage and conception wait is -1.849 which indicates that if age at first marriage will increase by one year, conception wait will decrease by 1.849 months.

Table 4.2: Relationship among age at first marriage, conception wait and fecundability.

Age at first marriage	Mean Conception wait	Standard deviation	No. of respondent's	Fecundability	P-value	correlation co-efficient	Regression co-efficient
≤13	32.19	31.53	2385	0.031	0.000	-0.199	-1.849
14	23.36	24.63	1280	0.042			
15	22.49	24.79	1263	0.044			
16	19.86	20.69	994	0.050			
17	18.47	17.92	692	0.054			
18	17.61	18.34	559	0.057			
19	17.71	21.18	281	0.56			
20	18.85	22.12	231	0.053			
21	15.58	19.43	129	0.064			
22-23	17.00	22.07	145	0.058			
24-25	16.13	15.06	80	0.061			
26 and above	14.41	18.92	56	0.069			
Total	23.88	25.87	8095	0.042			

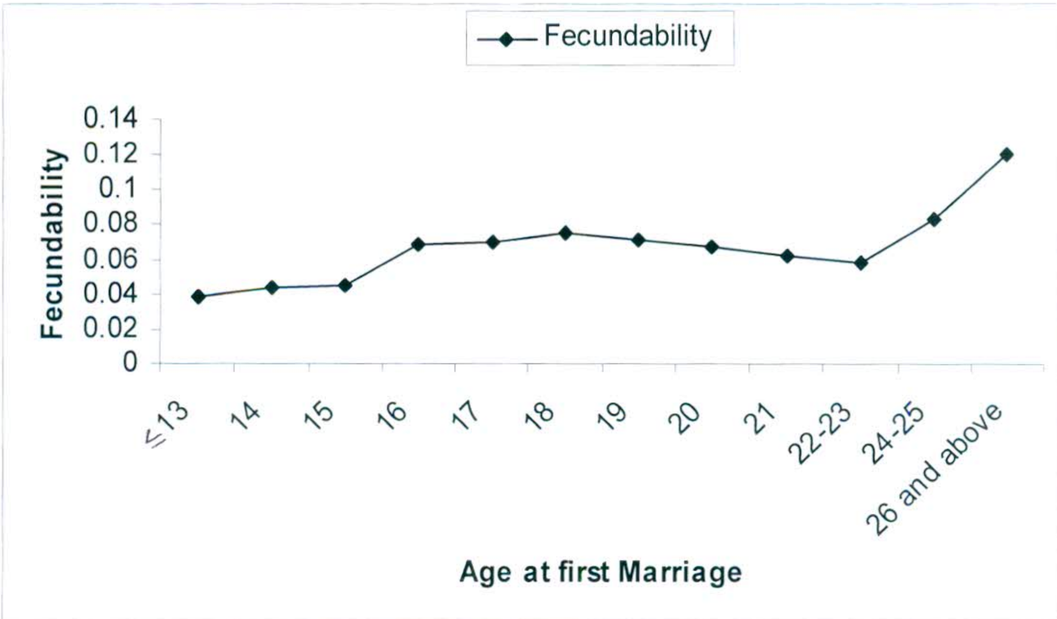
Correlation is significant at the 0.01 or 1% level.

Figure 4.3 Mean conception wait by age at first marriage



The trend line regarding age at first marriage and mean conception wait indicates that up to 18 years of age at first marriage, mean conception wait is decreasing narrowly after that it is narrowly increasing up to 23 years of age at first marriage thereafter it is sharply decreasing.

Figure-4.4 Mean fecundahility by age at first marriage



The trend line regarding age at first marriage and mean fecundability indicates that up to 18 years of age at first marriage, fecundability is increasing slowly after that it is slowly decreasing up to 23 years of age at first marriage thereafter it is sharply increasing.

Table 4.3: Mean conception wait and Fecundability in Bangladesh, 1993-2007(BDHS)

Source	Year	Mean Conception waits (estimated)	Standard deviation	Fecundability
BDHS	1993-94	29.35	27.05	0.03407
BDHS	1996-97	28.75	28.01	0.03478
BDHS	1999-2000	28.735	28.03	0.03474
BDHS	2004	24.42	26.00	0.04095
BDHS	2007	23.88	25.87	0.04187

4.7 Inter Dependance between Age at First Marriage and Marital Duration

The findings of the present study show that mean fecundability vary with the both age at marriage and marital duration. We want to verify now whether both the relationships are real or whether one is real and the other one artificial of the association between age at marriage and the marriage duration. Age at marriage is strongly associated with the marriage duration as shown by a value of Pearson's value contingency coefficient calculated on the assumption that the two variables are independent. For studying the association, marriage duration is divided into three groups: 0-9years, 10-19 years and 20 years or more. Age at marriage is also divided into three groups: less than or equal 13 years, 14-15 years and 16 years or more.

Mean fecundability after controlling for marriage duration within each age at marriage group, are shown in Table4.3. The findings in the last column show that the mean fecundability decreases monotonically from 0.0647 to 0.0321 with ascending marriage duration. Mean fecundability declines with ascending marriage duration within each age at marriage groups. The differentials presumably, are mainly due to memory laps and truncation biases.

The findings in the last row of the Table-4.3 reflect that mean fecundability increases monotonically from 0.0351 to 0.0504 with advancing age at marriage of the women. This result suggests that fecundability differentials are not only due to memory biases and probably due to some psychological changes, which differentiates the promptness of first conception.

Table-4.4 Mean fecundabilitics for women by marital duration and respondent's age at first marriage cohorts.

Duration of Marriage (years)	Fecundability			Total
	Wife's age at marriage (in completed years)			
	≤13	14-15	16 or more	
0-9	0.0556(406)	0.0652(791)	0.0767(1447)	0.0647(2644)
10-19	0.0357(754)	0.0424(885)	0.0455(1063)	0.0408(2702)
20 & above	0.0253(1225)	0.0342(867)	0.0407(657)	0.0321(2749)
Total	0.0351(2385)	0.0440(2543)	0.0504(3167)	

4.8 Differentials of Conception Waits and Fecundability

In non-contraception population alter entering susceptible state a woman who engaged in regular intercourse taken on an average several months to conceive. The women who are more fecund conceive more quickly then the women who are relatively less fecund. The time, a woman takes to conceive for the first time after her marriage is called the first conception wait or conception delay or first conception interval. In the sense Bongaart's et al. (1983) pointed out that the waiting time to conception is synonymous with the length of the menstrual interval. Many researchers including Demographers, Nutritionalists and epidemiologists have shown that the women's nutritional status, breastfeeding behavior, socio-economic, environment and personal characteristics have a great impact in determining the waiting time to conception and fecundability (Meridith et.al.,).

Bongaarts (1975) mentioned that the biological capacity of women to conceive, the coital frequency and the timing of sexual unions, the sperm count and the mobility of the sperms, contraceptive practices and the health status of the couple are some of the important factors affecting the conception delay and fecundability. The effect of various factors on fecundability can be analyzed by a study of the patterns of distributions of these menstruating intervals and their correlates. However, true fecundability is virtually complex to measure accurately, simply because many conceptions are unrecognized as it is not directly observable event, Hertig ct al., (1967) estimated that nearly half of all conceptions never identified, either because the fertilized ovum fails to implant in the uterous or because the ovum aborts shortly after implementation. Thus the study based on waiting time to an identified pregnancy estimate i.e, recognizable fecundability which is lower than the true fecundability; the difference is a function of the spontaneous abortion rate in the first few weeks of pregnancy. In this study we have dealt with the recognizable pregnancies and for this the most reliable and consistent estimates of the conception interval are measured from the date of first marriage to the date of first conception.

Fecundability is inversely related to the length of conception wait; the higher the fecundability, the shorter the conception waits and vice versa. In fact it can be shown that there is an exact inverse relationship between the conception wait and fecundability as $\theta = \frac{1}{m_1}$ in a homogeneous population of women with identical levels of fecundability (Henry,1953; Menken, 1973). However in case of heterogeneous women the average waiting time to conception is longer that in the homogeneous case as it is seen that the fecundability is not the same for all women because they have different frequencies of intercourse and different biological characteristics. Potter and Parker (1983) indicated that heterogeneous women with highest fecundability conceive rapidly, leaving slower conceivers with decreasing levels of fecundability in successive months. Bongaarts and Potter argued that the observed time to conceive, conception is on an average about 50 percent longer than the inverse of fecundability, so they suggested an approximation estimate of fecundability as $\frac{1.5}{\theta}$ instead of θ.

Considering the methodological differentials the mean fecundability levels are estimated by two different techniques as-

(a) Estimation of mean fecundability level from the observed duration of conception delay by geometric distribution.

(b) Estimation of mean fecundability level by fitting Pearson Type I beta geometric distribution where the parameters are estimated by the method of moments;

In this chapter an attempt has been made to estimate the fecundability level from the distribution of conception delays measured from the marriage to first conception interval. The chapter also analyses the differentials of conception wait and fecundability and identified the significant predictors affecting fecundability.

We have found from the conditional geometric distribution of the conception delay (in complete months) that there exists an exact inverse relationship between mean conception delay and fecundability under the assumption that the women are homogeneous having constant fecundability. The relationship, however, is not exact if the fecundability varies from women to women due to some biological and behavioral reasons. In that situation fecundability can be estimated by applying the method of beta geometric distribution with parameters a and b, estimated by the method of moments. In this study we estimate the average fecundability assuming that the women under study are homogeneous as well as heterogeneous in nature with respect to fecundability.

Since marriage to first conception is the most reliable and consistent estimate of waiting time to conception. We have estimated the average fecundability on the basis of the waiting time to conception for both the homogeneous and heterogeneous cases. Table 4.4 presents the estimate of fecundability and its socio-economic and demographic differentials. The results indicate that the mean fecundability for considering the women as homogeneous obtained from the conditional geometric distribution (1/m) is 0.042. The corresponding arithmetic and harmonic mean fecundability for the heterogeneous women have been found as 0.045 and 0.042 for method of moments. The results indicate that under the assumption of homogeneity, the mean fecundability in Bangladesh is much lower than the estimate obtained by Meredith et al. (1987). Meredith, Menken and Alauddin obtained an estimate of fecundability for rural Matlab as 0.060 taking data from Determinants of Natural Fertility Study, conducted under the auspices of the International Centre for Diarrhoeal Disease Research, Bangladesh. But their estimate is consistent with the estimated mean fecundability obtained in this study under the assumption of heterogeneity of women with respect to fecundability. There are several explanations for the lower estimate of fecundability. One of the important reasons for the lower estimate of fecundability is that 87.3% of the 8095 women were found to be married who have age limit from 10 to 19 year. i.e. most of the respondents are adolescents at the time of first marriage, they are relatively premature to conceive as compared to their adult counterparts. Another important reason is that the BDHS study was based on retrospective study, which leads to a great deal of memory bias of the respondents. And also may be due to the methodological differences. Now we shall discuss the differentials of fecundability associated with selected socioeconomic, demographic and cultural factors.

4.8.1 Current age of respondent, conception wait and fecundability

The BDHS 2007 data has been showing that current age of respondent have a positive association with the marriage to first conception interval but it has an inverse relationship with fecundability for both homogenous and heterogeneous case. i.e. the conception wait is increasing as the current age of respondent is increasing .As a result the fecundability is decreasing. In this variable for the respondents in the age group 19 to 23 years, we get variance of fecundability is negative this is because a= -65.95 which is less than 2 but according to Anrudh Kumar Jain,

Variance = $S^2 = ab(a+b-l)/((a-l)^2 .(a-2))$ is not defined unless a>2.

4.8.2 Age at first marriage, conception wait and fecundability

Age at first marriage is found to have an inverse relationship with the marriage to first conception interval. The results in table 4.4 show that the conception interval decreases as the age at first marriage increases and vice-versa. The women whose age at first marriage is less than sixteen years have higher mean conception interval (26.15 months) and lower fecundabilities (0.038) than the other women. This may happen because the women who got married in her early age takes time to conceive due to her menstruation delay and due to her reluctance to be the mother at the very beginning of her conjugal life and this increases their conception wait but decreases their fecundabilities. The women whose age at first marriage lies in the age group 19 years and above have lower mean conception interval (17.25 months) and higher fecundabilities (0.057) than the other women. The women whose age at first marriage lies between 16 to 18 years have very slightly higher mean conception interval (18.09 months) and fecundabilities (0.055) than the women whose age at first marriage is lies in the age group 19 years and above.

4.8.3 Type of place of residence, conception wait and fecundability

It has been shown in table 4.4 that the urban women have higher mean conception delay (23.88) and the lower fecundability (0.041) than rural women. This may happen because the women living in urban areas get greater scope to do job, for that the contraceptive practice in urban areas is high (84.9%) than in rural areas (75.2%). In the contrary, the women living in rural areas do not get more scope to do job due to some social and religious bindings and they have to contribute to their family work as well as field work in harvesting season. That's why they need children more rapidly to take help in their family work as well as field work. We also see the parallel results of mean fecundability for homogenous women as well as for heterogeneous women obtained from the harmonic mean.

4.8.4 Religion, conception wait und fecundability

We see from the table 4.4. that the women from the Non-Muslim community have a shorter conception interval (23.79) and higher fecundability (0.042) than the women from the Muslim community(23.89 and 0.041).This may happen because Non-Muslim women got married at higher age than their counter parts and it is known that adults have a lower mean conception delay and higher fecundability than the adolescent.

4.8.5 Region, conception wait and fecundability

The BDHS 2007 data has been showing that the Khulna division has a greater mean conception delay (25.96) and lower fecundability (0.038) than the other division. This is because the women surveyed in Khulna division were the adolescent and less educated and it is known that adolescent has a greater mean conception delay and lower fecundability than the adults. The Chittagong division has a lower mean conception delay (21.32) and higher fecundability (0.046) than the other division. This may happen because the women surveyed in Chittagong division were found with higher mean age at marriage, religious and holding higher educational status and hence they have lower conception wait and higher fecundability. Moreover, the contraceptive practice in Chittagong division is the lowest (48.4%) among the other division that causes the higher fertility rate in Chittagong and consequently the higher fecundability in Chittagong division. We also see the parallel results of mean fecundability for homogenous women as well as for heterogeneous women obtained from the harmonic mean.

4.8.6 Respondent's (wife's) education level, conception wait and fecundability

Respondent's (wile's) education levels have found to have an inverse relationship with the marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogeneous cases. It has been shown in the table 4.4 that when the education level of the respondents are increasing, then their mean fecundability are increasing and vice-versa. This is because, when the women are seen gradually adapting themselves with higher education, then their mean age at first marriage are also increased and for that they have a tendency to get a child quickly which causes the mean conception delay shorter and fecundability higher. It is also seen from the table that the women with no education has a greater mean conception delay(29.52) and lower fecundability (0.033) whereas we see the reverse result in the case of women having primary (24.03 and 0.041) and secondary and above (19.19 and 0.052) level of education. We have also seen that the mean fecundability for homogeneous women is equivalent with harmonic mean fecundability for heterogeneous women.

4.8.7 Husband's education level, conception wait and fecundability

Husband's education level has been found to have an inverse relationship with the marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogeneous case. It has been shown in the table 4.4 that when the education level of the husband's are increasing, then their mean fecundability are increasing and vice-versa. It has been found that the husband's with no education has a greater mean conception delay (27.34) and lower fecundability (0.036) than the husband's with primary education (23.46 and 0.042) or secondary and higher education (21.43 and 0.046).This may happen because the husband's with no education marry the adolescents who have a lower fecundity (biological capacity to conception) due to menstruation delay and longer conception delay and hence a lower fecundability.

4.8.8 Respondent's work status, conception wait and fecundability

Table-4.4 shows that the women, who do work, have higher conception delay (25.58) and lower fecundability (0.039) than the women, who do not work (23.20 and 0.043) i.e. home based. This is due to the fact that the women who do jobs have to spend more time in her work place than to house comparing to the women who are home based. This will increase their mean age at first marriage, mean age at first conception as well as decrease their tendency to be the mother of a child rapidly after marriage. It is also seen that the women who are doing jobs are found to use more contraceptive methods to linger their first conception than the women who are home based. These factors are enough to increase the conception interval and hence decrease the fecundability level for the women who are employed than the women who are home based.

4.8.9 Husband's occupation, conception wait and fecundability

It has been seen from the Table 4.4.that the husband's whose occupation is non-manual have the lower conception interval (22.46) and higher fecundability (0.044) than the other occupational husband's. This may happen due to the fact that the husband's possessing professional related occupation marry the matured women who have a higher fecundity (biological capacity to conception) and shorter conception delay and hence a higher fecundability. On the other hand, the husband's who are unemployed has the higher conception delay (27.76) and lower fecundability (0.036) than the other occupational husband's. This is because the husband's possessing unemployed and manual occupation marry the adolescents who have a lower fecundity (biological capacity to conception) due to menstruation delay and longer conception delay and hence a lower fecundability.

4.8.10 Spousal age difference, conception wait and fecundability

We see from the table 4.4. that the spousal whose age difference 9 years and above have the lowest conception interval (23.43) and higher fecundability (0.042) as compared to the other. This also indicates that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and less users of family planning. On the other hand the spousal whose age difference 4 years or less has the highest conception interval (25.83) as compared to the other. This also indicates that the women in the highest conception interval are less educated, got married in her adolescent age, lower fertile group of women and higher users of family planning.

4.8.11 Marital duration, conception wait and fecundability

Marital duration has a strong positive relationship with the marriage to first conception interval but it has a negative association with fecundability for both homogenous and heterogeneous case. For instance, the mean length of the first conception interval is found as 9.86 months for women who have spent 4 years or less as their conjugal life since their marriage and 25.96 months for those women who have spent more than 4 years as their conjugal life since their marriage. This indicates that conception interval increases as the marital duration increases and vice-versa. This also indicate that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and less users of family planning. One important social factor is the practice of permanent sexual abstinence arising from the attainment of the grandmother status. Since the age at first marriage is very low in Bangladesh, a large number of women become grandmothers by the time they reach their 35th year, that is, after 15 to 20 years of marriage. Mothers attaining their grandmother status usually feel embarrassed to compete with their daughters (or daughters-in-law) and usually practice permanent sexual abstinence although they are still physiologically capable of reproduction. The grandmother status thus marks a cultural as opposed to a biological end of the reproductive period of the woman's life.

In this variable for the marital duration group 4 years or less, we get variance of fecundability is negative this is because a= -31.34, which is less than 2 but according to Anrudh Kumar Jain,

Variance = $S^2 = (ab(a+b-l))/((a-l)^2.(a-2))$ is not defined unless $a>2$.

4.8.12 Wealth index, conception wait and fecundability

The BDHS 2007 data provides us a consistent result that wealth index has an inverse relationship with the marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogeneous cases. The women whose wealth index is high have shorter conception interval (22.50) and higher fecundability (0.044) than the women with low (25.59 and 0.039) or middle (24.23 and 0.041) wealth index.

4.8.13 Use of contraception, conception wait and fecundability

We see from the table 4.4. that the women who do not use contraception have greater conception delay (32.67) than their counter parts(22.45). This may happen because the women who do not use contraception are greatly suffering due to adolescent sterility.

4.8.14 Body mass index, conception wait and fecundability

The BDIIS 2007 data provides us an important result that the respondents whose body mass index is in 18.5-24.9 i.e. weight status is normal have the lower conception interval (23.42) and higher fecundability (0.042) as compared to the other. This indicates that the respondents, whose weight is normal, are physically sound enough and capable to conceive.

4.8.15 Mass media contact, conception wait and fecundability

The BDHS 2007 data has been showing that the women who have a contact with at least one media, have the lower conception interval (22.19) and higher fecundability (0.045) compared to their counter parts. This also indicate that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and interested to be a mother as early as compared to the other.

4.8.16 Partner's age, conception wait and fecundability

Partner's age has been found to have a positive relationship with the marriage to first conception interval but it has a negative association with fecundability for both homogeneous and heterogeneous case, .i.e. the conception wait is increasing as the husband's age of the respondent is increasing. As a result the fecundability is decreasing and vice-versa. In this variable for the husband's in the age group is less than 25 years, we get variance of fecundability is negative this is because a= - 11.78 which is less than 2 but according to Anrudh Kumar Jain,

Variance = $S^2 = (ab(a+b-l))/((a-l)^2 .(a-2))$ is not defined unless a>2.

Table 4.5 Mean conception wait and fecundability by the fecundability differentials (by geometric distribution and Beta geometric distribution by the method of moments)

Background characteristics	No. of respondents	Mean Conception wait (in month), m	Variance, s^2	Mean Fecundability						
				For homogenous Women	For heterogenous women					
					Method of Moments					
				$\hat{\theta}-\frac{1}{m}$	$\hat{a}$	$\hat{b}$	Mean= $\frac{\hat{a}}{(\hat{a}+\hat{b})}$	Mode= $\left(\frac{(\hat{a}-1)}{(\hat{a}+\hat{b}-2)}\right)$	Variance = $\frac{\hat{a}.\hat{b}}{(\hat{a}+\hat{b})^2(\hat{a}+\hat{b}}$	H.M= $\frac{(\hat{a}-1)}{(\hat{a}+\hat{b}-1)}$
Bangladesh	8095	23.88	606.07	0.042	10.86	225.59	0.045	0.042	0.000184	0.042
Current age of respondents (in years)										
≤ 18	423	10.09	99.38	0.099	25.94	226.70	0.102	0.099	0.000363	0.099
19-23	1510	15.53	219.01	0.064	-65.95	-972.78	0.063	0.064	-.0000057	0.064
24 and above	6162	26.88	780.19	0.037	18.45	415.60	0.042	0.040	0.000093	0.040
Age at first marriage (in years)										
<16	5922	26.15	760.28	0.038	14.82	347.57	0.041	0.038	0.000107	0.038
16-18	1251	18.09	328.05	0.055	34.72	576.27	0.056	0.055	0.000087	0.055
19 and above	922	17.25	429.56	0.057	5.75	77.18	0.069	0.058	0.000768	0.057

Type of place of residence										
Urban	23.88	697.58	5053 3042	0.041	9.22	188.07	0.046	0.042	0.000224	0.042
Rural	22.46	620.23		0.044	8.97	171.03	0.049	0.044	0.000261	0.043
Religion										
Muslim	23.89	680.75	7298	0.041	10.16	209.67	0.046	0.042	0.000199	0.041
Non Muslim	23.79	568.79	797	0.042	42.74	951.25	0.042	0042	0.00041	0.042
Region										
Barisal	23.93	537.18	1079	0.041	-93.13	-2158.40	0.041	0.041	-0.000017	0.041
Chittagong	22.50	581.02	1442	0.044	7.48	139.32	0.050	0.044	0.000340	0.043
Dhaka	24.91	691.76	1751	0.040	14.38	319.92	0.043	0.041	0.000122	0.040
Khulna	25.96	716.06	1265	0.038	21.03	499.94	0.040	0.038	0.000074	0.038
Rajshahi	24.28	777.37	1553	0.041	7.32	147.12	0.047	0.041	0.000290	0.041
Sylhet	21.32	660.13	1005	0.046	7.86	139.39	0.053	0.047	0.000327	0.046
Respondent's educational level										
Illiterate	29.52	994.70	2535	0.033	13.02	342.81	0.036	0.033	0.000098	0.033
Primary	24.03	582.19	2441	0.041	40.42	908.53	0.042	0.041	0.000042	0.041
Secondary & Higher	19.19	426.52	3119	0.052	11.01	182.08	0.057	0.052	0.000277	0.052
Partner's educational level										
Illiterate	27.34	854.66	2646	0.036	12.70	308.17	0.039	0.036	0.000118	0.036
Primary	23.46	648.70	2074	0.042	10.65	216.73	0.046	0.042	0.000195	0.042
Secondary & higher	21.43	522.41	3375	0.046	12.35	231.88	0.050	0.046	0.000195	0.046

Respondent's work status										
Not working	23.20	639.46	5775	0.043	10.27	205.79	0.047	0.043	0.000208	0.043
working	25.58	741.10	2320	0.039	13.19	299.63	0.042	0.039	0.000128	0.039
Partner's occupation										
Unemployed	27.76	712.27	181	0.036	-46.57	-1272.97	0.035	0.035	-0.000029	0.036
Manual	24.38	675.96	5513	0.041	12.75	274.71	0.044	0.041	0.000146	0.041
Non manual	22.46	648.81	2401	0.044	7.77	145.28	0.050	0.044	0.000312	0.044
Spousal age difference										
≤4	25.83	723.44	1082	0.038	17.62	412.67	0.041	0.038	0.000091	0.038
5-8	23.81	618.53	2796	0.041	16.40	351.27	0.044	0.042	0.000115	0.041
9 and above	23.43	688.90	4217	0.042	8.43	166.62	0.048	0.042	0.000260	0.042
Marital duration										
0-4	9.86	82.12	1043	0.101	-31.34	-286.53	0.098	0.101	-0.000280	0.101
5 and above	25.96	723.20	7052	0.038	19.22	454.77	0.041	0.038	0.000082	0.038
Wealth index										
Poor	25.59	727.25	2776	0.039	14.84	340.32	0.042	0.039	0.000112	0.038
Middle	24.23	610.26	1526	0.041	25.60	571.45	0.043	0.041	0.000068	0.041
Rich	22.50	647.53	647.53	0.044	7.90	148.35	0.050	0.05	0.000305	0.044

Contraceptive use										
Not use	32.67	1400.25	1134	0.031	7.66	210.92	0.035	0.031	0.000154	0.030
Use	22.45	536.20	6961	0.044	19.62	339.39	0.054	0.052	0.000143	0.052
Body mass index										
<18.5	25.34	800.73	22.33	0.039	8.71	187.66	0.044	0.039	0.000214	0.039
18.5-24.9	23.42	619.23	4669	0.042	13.15	272.40	0.046	0.043	0.000153	0.042
24.91 and above	28.98	917.20	1193	0.035	11.01	220.02	0.040	0.036	0.000195	0.035
Mass media contact										
No	26.02	729.63	3579	0.038	18.56	439.35	0.041	0.038	0.000084	0.038
Yes	22.19	615.78	4516	0.045	8.46	158.07	0.051	0.045	0.000287	0.045
Partner's age										
<25	14.09	157.67	481	0.071	-11.78	-167.29	0.065	0.071	-0.000345	0.070
25-32	17.11	296.53	1508	0.058	28.39	441.25	0.060	0.059	0.000121	0.058
33 and above	26.33	777.33	6106	0.037	14.07	331.06	0.041	0.038	0.000113	0.037

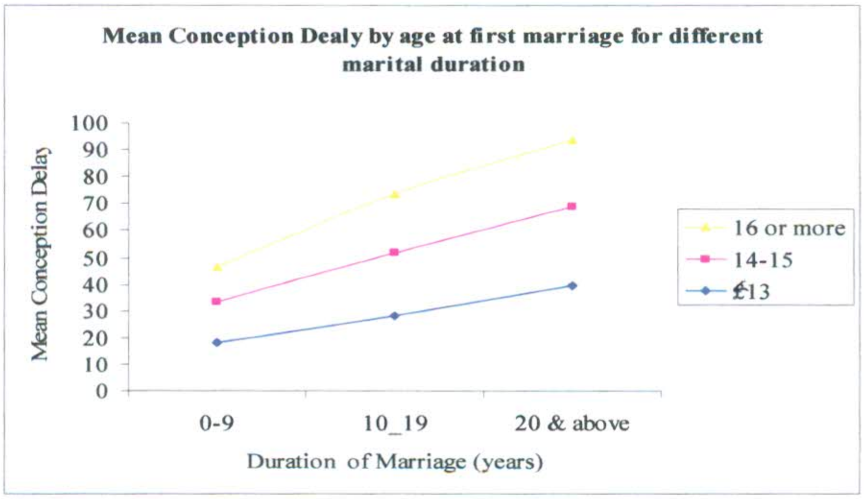
4.9 Trends in mean conception delay

It is seen from Table 4.5 that the mean conception delay decreases as the respondent's (wife's) age at first marriage increases for any of the three cases of marital duration. On the other hand mean conception delay increases as the marital duration increases for any of the three cases of respondent's age at first marriage.

Table-4.6. Mean conception delay for women by marital duration and respondent's age at first marriage.

Duration of Marriage (years)	Mean Conception Delay			Total
	Wife's age at marriage (in completed years)			
	≤13	14-15	16 or more	
0-9	17.98(406)	15.33 (791)	13.03(1447)	15.44(2644)
10-19	27.94(754)	23.57(885)	21.93(1063)	24.48(2702)
20 & above	39.51(1225)	29.20(867)	24.52(657)	31.07(2749)
Total	28.47(2385)	22.7(2543)	19.82(3167)	

Figure 4.5: Mean conception wait by age at first marriage for different marital duration



The trend line regarding marital duration, age at first marriage and mean conception wait indicates that mean conception wait is slowly increasing when marital duration is increasing for all the three groups of age at first marriage.

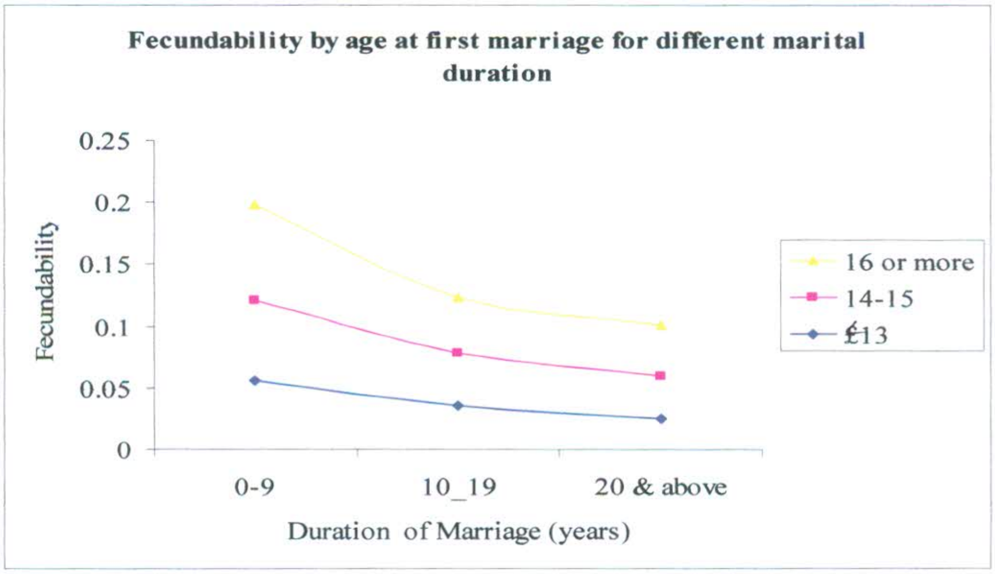
4.10 Trends in Mean Fecundability

It is observed from Table 4.6 that the mean fecundability increases as the respondent's (wife's) age at first marriage increases for any of the three cases of marital duration. On the other hand mean fecundability decreases as the marital duration increases for any of the three cases of respondent's age at first marriage.

Table-4.7. Mean fecundabilities for women by marital duration and respondent's age at first marriage.

Duration of Marriage (years)	Fecundability			Total
	Wife's age at marriage (in completed years)			
	≤13	14-15	16 or more	
0-9	0.0556(406)	0.0652(791)	0.0767(1447)	0.0647(2644)
10-19	0.0357(754)	0.0424(885)	0.0455(1063)	0.0408(2702)
20 & above	0.0253(1225)	0.0342(867)	0.0407(657)	0.0321(2749)
Total	0.0351(2385)	0.0440(2543)	0.0504(3167)	

Figure 4.6: Mean fecundability by age at first marriage for different marital duration



The trend line regarding marital duration, age at first marriage and mean fecundability indicates that mean fecundability is slowly decreasing as the marital duration is increasing for all the three groups of age at first marriage.

Chapter Five

Differentials of Conception Waits: Bivariate and Multivariate Analysis

DIFFERENTIALS OF CONCEPTION WAITS: BIVARIATE AND MULTIVARIATE ANALYSIS

5.1 Bivariate Analysis

Bivariate analysis is a useful step in studying the relationship between associated variables. It tells us how important an individual variable is by itself. Moreover, it helps us to identify those independent variables, which have significant effect on the conception wait from marriage to first birth. In this analysis, the dependent variable, the conception wait is categorized into two groups i.e one is, before and at mean conception wait (23.88 months) and another one is above 23.88 months. In this analysis, we use χ^2 (Chi-square) tests for the independency of attributes. From the Table-5.1, it is seen that the independent variables region, respondent's educational level, respondent's work status, mass media contact and contraceptive use are found to be significant at 1% level, type of place of residence, partner's occupation and body mass index are found to be significant at 5% level, partner's educational level and spousal age difference are found to be significant at 10% level. The remaining independent variables current age of respondent, respondent age at first marriage, marital duration and partner's age are found to be highly significant and a brief description of the Table-5.1 is given below:

It is seen from Table-5.1 that current age of respondent has highly significant effect on conception wait. 91.3% respondents whose age lies in $\leq$ 18 years conceive earlier,76.8% and 58,5%respondent's whose age lies between(19 to 23) and 24 and above respectively conceive before and at mean conception wait. 41.5% respondents whose age lies in 24 years & above conceive later mean conception wait compared with other groups.

Age at first marriage has a strong relationship with conception wait. It has inverse relation with conception wait. The respondents, whose age at first marriage is 19 years and above (77.0%) conceive before and at mean conception wait. Whereas, 59.7% and 72.3% respondents, whose age at first marriage is in (<16) years and (16 to 18) years respectively conceive before and at mean conception wait. On the other hand, the respondents (40.3%) whose age at first marriage is in (<15) years and 27.7% respondents whose age at first marriage is in (16 to 18) years conceive after the mean conception wait.

Type of place of residence has significant effect on conception wait. It is positively related with conception wait. The respondents (66.4%) who have urban place of residence are likely to conceive earlier i.e. before and at mean conception wait than the other group. While 38.1% respondents whose place of residence have rural are likely to conceive later i.e. after the mean conception wait than the other group.

In case of division, we observed that early conception occurred in Sylhet division i.e. before mean conception wait 67.8 % respondents conceive and the next higher proportion is in Chittagong division (67.4%). Rajshahi (64.5%) Barisal (62.2%). Dhaka (62.0%) and Khulna (58.3%) are the successive descending order of proportion of conception before and at mean conception wait. Moreover, we observed that after mean conception the respondents in Khulna division have tendency to conceive later (41.7%) with compare to other divisions namely, Dhaka (38.0%), Barisal (37.8%), Rajshahi (35.5%), Chittagong (32.6%) and Sylhet (32.2%). This regional differential is observed because of industrialization, Urbanization and education did not evolve uniformity in all regions.

Respondents' education has a significant relation with conception wait. Respondents, who have secondary and higher education (71.1%), conceive early than the others. The data shows that the respondents who have primary education (62.2%) conceive earlier than that of illiterate (55.7%) respondents. Whereas 44.3% illiterate and 37.8% primary educated respondents conceive after then mean conception wait. Husbands' education is not as strong as women education but has significant association on conception wait. The respondents whose husbands' education level are secondary and above (67.3%) conceived on or before mean conception wait than the respondents whose husbands have primary (64.6%) and no level of education (58.2%). Because higher educated husbands are likely to marry educated females as a result early conception occur than the other groups.

Work status of woman has a significant effect on conception wait. Generally the women who work out side home marry at a very late stage. The data reveals that 64.7% not working respondents conceive before and at mean conception wait and 60.9% working respondents conceive before and at mean conception wait respectively. On the other hand 39.1% working respondents conceive after mean conception wait.

Husband's occupation plays a significant role on conception wait. Husbands who have better occupation usually marry a woman who is conscious about her life. The data reveals that 66.7% respondents whose husbands are in non-manual occupation usually conceive before and at mean conception wait and 37.5% respondents whose husbands are in manual occupation usually conceive after mean conception wait.

Spousal age difference has also significant effect on conception wait. The spouse whose age difference is 9 years and above are more likely to conceive earlier i.e. before and at mean conception wait than the other groups. On the other hand the spouses (38.9%) whose age difference is less or equal 4 years are likely to conceive later i.e. after the mean conception wait than the other groups.

Marital duration has highly significant effect on conception wait. From previous chapter table:4.4 it reveals that Marital duration and conception wait are positively related i.e. conception wait is increasing as marital duration is lengthen. The respondents (90.9%) whose marital duration (0 to 4) years are likely to conceive earlier i.e. before and at mean conception wait than the other group. While 40.4% respondents whose marital duration more than 4 years are likely to conceive later i.e. after the mean conception wait than the other group.

Contraceptive use plays an important role on conception wait. 64.9% contraceptive women conceive earlier i.e. before and at mean conception wait than the others. Whereas 55.4% non contraceptive women conceive earlier i.e. before and at mean conception wait than the othersS. 35.1% contraceptive women conceive after mean conception wait than the others.

Body mass index is another significant measure of conception wait. According to the table 5.1, 64.1% normal weight respondents conceive before and at mean conception wait. While 61.8% of under weight respondents and 59.6 % over weight respondents conceive in the same interval.

Mass media contact plays an important role on conception wait. 66.5% mass media contact women conceive earlier i.e. before and at mean conception wait than the others. Whereas 60.0%% non mass media contact women conceive earlier i.e. before and at mean conception wait than the others. 33.5% mass media contact women conceive after mean conception wait than the others.

Partner's age has highly significant effect on conception wait. The women whose husbands' (81.3%) age lies between <25 years conceive earlier i.e. before and at mean conception wait than the other groups. The women whose husbands' (73.5%) age lies between (25 to 32) years and (59.8%) lies in (33 years and above) age group are the successive descending order of proportion of conception before and at mean conception wait. 40.2% respondents lies in the age group 32 years and above conceive later than the mean conception wait.

Table: 5.1 Bivariate distribution of conception interval by different background characteristics of the respondents.

Background characteristics	Categories	Percentage of respondent's at conception wait (in month)		Value of Chi-square	P-value
		≤23.88 (mean)	>23.88 (mean)		
Current age of respondent's	≤18	91.3 (386)	8.7 (37)	322.19	0.000
	19-23	76.8 (1159)	23.2 (351)		
	24 and above	58.5 (3604)	41.5 (2558)		
Age at first marriage	<16	59.7 (3534)	40.3 (2388)	152.28	0.000
	16-18	72.3 (905)	27.7 (346)		
	19 and above	77.0 (710)	23.0 (212)		
Type of place of residence	Urban	66.4 (2021)	33.6 (1021)	16.58	0.024
	Rural	61.9 (3128)	38.1 (1925)		
Religion	Muslim	63.7 (4652)	36.3 (2646)	0.59	0.440
	Non-Muslim	62.4 (497)	37.6 (300)		
Region	Barisal	62.2 (671)	37.8 (408)	34.96	0.009
	Chittagong	67.4 (972)	32.6 (470)		
	Dhaka	62.0 (1086)	38.0 (665)		
	Khulna	58.3 (738)	41.7 (527)		
	Rajshahi	64.5 (1001)	35.5 (552)		
	Sylhet	67.8 (681)	32.2 (324)		
Respondent's educational level	Illiterate	55.7 (1413)	44.3 (1122)	145.80	0.004
	Primary	62.2 (1518)	37.8 (923)		
	Secondary & Higher	71.1 (2218)	28.9 (901)		
Partner's educational level	Illiterate	58.2 (1539)	41.8 (1107)	54.22	0.076
	Primary	64.6 (1340)	35.4 (734)		
	Secondary & Higher	67.3 (2270)	32.7 (1105)		

Respondent's work status	Not working Working	64.7 (3737) 60.9 (1412)	35.3 (2038) 391. (908)	10.58	0.001
Partner's occupation	Unemployed Manual Non -manual	55.8 (101) 62.5 (3446) 66.7 (1602)	44.2 (80) 37.5 (2067) 33.3 (799)	17.17	0.036
Spousal age difference	≤4 5-8 9 and above	61.1 (661) 63.2 (1766) 64.5 (2722)	38.9 (421) 36.8 (1030) 35.5 (1495)	4.81	0.090
Marital duration	0-4 5 and above	90.9 (948) 59.6 (4201)	9.1 (95) 40.4 (2851)	385.03	0.000
Wealth index	Poor Middle Rich	60.3 (1674) 63.2 (964) 66.2 (2511)	39.7 (1102) 36.8 (562) 33.8 (1282)	24.24	0.853
Contraceptive use	Not use Use	55.4 (628) 64.9 (4521)	66.6 (506) 35.1 (2440)	38.56	0.006
Body mass index	< 18.5 18.5-24.9 24.91 and above	61.8 (1380) 64.1 (2994) 59.6 (775)	38.2 (853) 35.9 (1675) 43.2 (418)	4.63	0.018
Mass media contact	No Yes	60.0 (2147) 66.5 (3002)	40.0 (1432) 33.5 (1514)	36.28	0.003
Partner's age	<25 25-32 33 and above	81.3 (391) 73.5 (1109) 59.8 (3649)	18.7 (90) 36.5 (399) 40.2 (2457)	168.27	0.000

5.2 Proportional Hazard Regression Analysis

This model was first developed by Cox (1972), and has been widely used by biostatistician, epidemiologists, and demographers (Breslow, 1974, Kalbfleish and Prentice, 1980; Cox and Okes, 1984). This model can be used to explain the effect of covariates on survival times (SAS, 1988, 1992; Colectt 1994, Hess 1994). Recently this method has been applied in demographic research and work has been done on marriage dissolution (Menken and others, 1981, Balakrisnan and others, 1987), contraceptive continuation (Akhter and Ahmed, 1992), timing of birth and birth intervals (Rodringuez et al., 1984: Rao and Balakrisnan, 1988; Ahn Sariff, 1993). Some demographers and statistician (see, for example, Rodriguez and others, 1984; Newman and McCulloc, 1984) have expressed the view that hazard technique is particularly well suited for determining the risk of having a birth. The Proportional Hazard model is used in the study to investigate the covariate effects on subsequent fertility in urban and rural Bangladesh. This will enable evaluation of the probability of having the next birth for a mother in view of her particular circumstances.

Like the standard life table, it is assumed that there is a hazard (or risk) at each duration t, of the occurrence of the end-point event (birth). The hazard function is the product of an underlying duration-dependent risk $\lambda_0(t)$ and covariates (z) expressed as $\exp\beta(z)$. It is assumed that the duration specific rates or risks for a given individuals characteristics are proportional. This is defined as

$$\lambda(z;) = \lambda_0(t)_e \, \beta_z$$

$$= \frac{\lambda(z;t)}{\lambda_0(t)} =_e \beta_z$$

where $\lambda(z;t)$ is the hazard of failure for an individual with covariate z at time t, $\lambda_0(t)$ is the unspecified base line hazard when z = 0, called the reference group.

z is a row vector of covariates and β is a column vector of unknown parameters to be estimated in the model.

The term $\exp\beta(z)$ is the relative hazard function or relative risk associated with having the characteristics z. Therefore, the hazard function enables one to estimate the relative risks of other groups in relation to the base line group (reference group). When there is no covariate present in the model, then $\exp\beta(z)$ is unity. Values greater the unity indicate that the relative risk of having a conception or having a birth is greater for that group compared with the reference group. The parameters in the model $(H_0 : \beta = 0)$ can be tested by the Wald statistic:

$\lambda^2 = \dfrac{\beta}{S.E(\beta)}$ where, S.E stands for standard errors. In using a proportional hazards model, it is assumed that the hazards associated with covariates are proportional.

In bivariate analysis, we have tried to trace out those independent variables who have a significant effect on the conception interval. Moreover, before going to the multivariate analysis by Cox's proportional hazard regression model, we need some most independent significant variables to run Cox's proportional hazard regression smoothly, which can be found by the bivariate analysis of conception interval with the various characteristics of the respondent through the cross tabulation. In Cox's proportional hazard regression analysis the women are categorized as zero(0) and one(1), where 0 stands for the women having no conception (921) as yet and 1 stands for the women having at least one conception (8095) during their fifteen years of marriage. The respondents who did not conceive during their fifteen years (180 months) of marriage are considered as primarily sterile and we have excluded them from this analysis. In the bivariate analysis, we have shown that some independent variables have very significant effect on the marriage to first conception interval. However, in multivariate analysis, we would try to find out those independent variables that have a simultaneous significant effect on the marriage to first conception interval. In such situation, when the independent variable is a time dependent event, the Proportional Hazard model introduced by Cox in 1972 is the best method to analyze the situation. As fecundability is a time dependent event, we have tried to find out the significant factors affecting on fecundability through Cox's regression model.

5.3 Results and Discussion of Cox's Proportional Hazard Regression Analysis

To fit the model, we have considered 14 socio-economic and demographic variables, which are found to have significant effect on the conception interval in bivariate analysis. We have found 11 variables having significant effect on marriage to first conception interval shown in table 5.2. Statistically significant variables in accordance with their importance are age at first marriage, spousal age difference, use of contraception, marital duration, current age of respondent, type of place of residence, region, respondent's educational level, respondent's work status, mass media contact and partner's age. The remaining three variables i.e. partner's education level, partner's occupation and body mass index do not have any significant effect on marriage to first conception interval.

It has been observed from the Cox's Proportional Hazard regression analysis that age at first marriage is an most important factor, which has a great influence on marriage to first conception interval. It is also seen that women with early age at marriage are to wait for a longer period of time to be pregnant for the first time than their higher age at marriage counterparts. This clearly indicates that age at first marriage has negative influence on marriage to first conception interval and positive with fecundability. The odds ratio indicates that the women got married at ages between 16 to 18 years are 1.211 times likely to conceive compared to those who got married at ages less than 16 years. Again, the odds ratio for women who got married at ages 19 years and above is 1.218, which indicates that this group of women are 1.218 times likely to conceive compared to those who got married at ages less than 16 years. This is because the early married women are primarily sterile due to in adolescent sterility and adopting family planning technique or they are reluctant to conceive due to their early age and the late marrying women are interested to conceive as they lost time due to higher education.

The spousal age difference is found to have a statistically significant negative influence on marriage to first conception interval. The spousal whose age difference is 5 to 8 years are found to have 1.152 times likely to conceive than the spousal whose age difference is less than or equal to 4 years. Again, the spousal whose age difference is 9 years and above are found to have 1.231 times likely to conceive than the spousal whose age difference is less than or equal to 4 years.

Marital duration is found to have a statistically significant positive influence on marriage to first conception interval. The women whose marital duration is 5 years or more are found to have 6 percent lower risk to conceive than the women whose marital duration is less or equal to 4 years.

Current age of respondent is found to have a statistically significant positive influence on marriage to first conception interval. The respondents who are in the are group 19 to 23 years and 24 years and above are found to have 0.976 times and 0.863 times lower risk to conceive than the respondents who are in the age group ≤ 18 years respectively.

Type of place of residence is found to have strongly significant positive influence on marriage to first conception interval in Bangladesh. The odds ratio indicates that the women who live in rural areas are 0.99 times lower probability to conceive than the women who live in urban areas. Thus we say that increasing the level of living status of mother is decreasing the marriage to first conception interval.

Respondent's educational level is found to have positive and significant effect on marriage to first conception interval. From the table-5.2 we see that the odds ratio of primary and secondary & higher educated mother are 0.836 times and 0.762 times lower risk on marriage to first conception interval than with illiterate mother. Thus we say that increasing the level of education of mother is decreasing the marriage to first conception interval.

Use of contraceptives is found to have a statistically significant negative influence on marriage to first conception interval. It is evident from Table 5.2 that the odds ratio for women who use contraceptives is 2.003, which indicates that those women are 2.003 times likely to conceive, compared to those who do not use contraceptives.

There is a significant positive regional effect on marriage to first conception interval in Bangladesh. In Dhaka and Rajshahi division, this factor is not significant at all.

Table 5.2 reveals that the respondent who are living in Chittagong & Sylhet division are found to have 1.204 times and 1.247 times higher risk of faster conception than the respondent's who are living in Barisal division respectively. The respondent's who are living in Khulna division are found to have 0.921 times lower risk to conceive than the respondent's who are living in Barisal division.

The mother's work status is strongly associated with marriage to first conception interval when all other demographic covariates included in the study are controlled. Work status of woman has highly significant and positive effect on the probability of marriage to first conception interval. The result indicates that women who work outside the home are 0.97 times lower likely to conceive than their not working counterparts. Currently working woman has a slightly longer duration of marriage to first conception interval than their not working counterparts.

Partner's age is also found to have a statistically significant positive influence on marriage to first conception interval in Bangladesh. For the partner's whose age lies in the group 33 and above, this factor is not significant at all. The partner's whose age lies in the group 25 to 32 years are found to have1.105 times likely to conceive than the partner's whose age lies in the group less than 25 years.

Table: 5.2 Cox's Proportional Hazard Regression of Conception waits by different characteristics of respondents.

Background characteristics	Coefficient (β)	SE	P-Value	Odds Ratio
Current age of respondents	-	-	0.000	-
≤18	-	-	-	1.00
19-23	-0.028	0.065	0.662	0.976
24 and above	-0.148	0.077	0.055	0.863
Age at first marriage	-	-	0.000	-
<16	-	-	-	1.00
16-18	0.191	0.033	0.000	1.211
19 and above	0.197	0.041	0.000	1.218
Type of place of residence	-	-	0.000	-
Urban	-	-	-	1.00
Rural	-0.001	0.026	0.974	0.99
Region	-	-	0.000	-
Barrisal	-	-	-	1.00
Chittagong	0.185	0.041	0.000	1.204
Dhaka	0.006	0.040	0.890	1.006
Khulna	-0.082	0.042	0.052	0.941
Rajshahi	0.039	0.041	0.340	1.040
Sylhet	0.220	0.046	0.000	1.247
Respondent's educational level	-	-	0.003	
Illiterate	-	-	-	1.00
Primary	-0.077	0.030	0.012	0.836
Secondary & higher	-0.122	0.037	0.001	0.762
Partner's educational level	-	-	0.183	-
Illiterate	-	-	-	1.00
Primary	-0.010	0.031	0.758	0.990
Secondary & higher	-0.058	0.034	0.089	0.944

Respondent's work status	-	-	0.000	-
not working	-	-	-	1.00
working	-0.033	0.026	0.201	0.968
Partner's occupation	-	-	0.297	-
Unemployed	-	-	-	1.00
Manual	0.086	0.076	0.258	1.090
Non manual	0.11	0.078	0.154	1.117
Spousal age difference	-	-	0.000	
≤4	-	-	-	1.00
5-8	0.142	0.037	0.000	1.152
9 and above	0.208	0.039	0.000	1.231
Marital duration	-	-	0.000	-
0-4	-	-	-	1.00
5 and above	-0.006	0.049	0.903	0.994
Contraceptive use	-	-	0.000	-
Not use	-	-	-	1.00
Use	0.695	0.034	0.000	2.00
Body mass index	-	-	0.302	-
<18.5	-	-	-	1.00
18.5-249	-0.013	0.026	0.614	0.987
24.91 and above	-0.060	0.040	0.130	0.942
Mass media contact	-	-	0.003	-
No	-	-	-	1.00
Yes	-0.007	0.027	0.783	0.993
Partner's age	-	-	0.026	-
<25	-	-	-	1.00
25-32	0.100	0.059	0.093	1.105
33 and above	0.013	0.070	0.856	1.013

Chapter Six

Summery, Limitation and Policy Implications

SUMMERY, LIMITATION AND POLICY IMPLICATIONS

6 .1 Summery of the Major Findings

From the table2.2 and table2.3, we observe the trends in fertility of Bangladesh, it is evident that fertility is declining over the past 3 decades. The age specific fertility rate has been decreasing over time in each age group. It has shifted from 25-29 in 1975 to 20-24 in 1999-2000 and in 2007. Total fertility rate (TFR) has declined dramatically from 6.3 births in 1975 to 3.4 births per women in 1993-1994 and after then the TFR halted abruptly in a static point 3.3 births per women in 1996-1997, 1999-2000, BDHS. Again TFR decline from 3.0 births per women in BDHS, 2004 to 2.7 births per women in 2007 (BDHS). It is truly an exceptionally steep decline. Period fertility approach reveals that the level of fertility is still very high in Bangladesh

The table 3.1 **(Logistic Regression Analysis)** indicates that children ever born is higher among those women who belong to the age group ≤18(10-17). The odds ratio of respondents current age 19-23(years) and 24& above(years) are 0.321 and 0.040 respectively. It indicates that children ever born will be 0.321 and 0.040 times lower for those respondents whose age group 19-23 and 24& above than those respondents whose age group ≤18 (10-17) (reference category). Hence we saw that the lower age group of respondent is the higher probability of giving more birth.

The odds ratio of age at first marriage are 2.114 and 5.331, which indicate that children ever born is 2.114 and 5.331 times higher for those women corresponding to age group 16-18 and 19& above than those women who belong to age group <16. Which reveals that fertility rate goes up when marriage takes place at a late stage.

The odds ratio of the place of residence is 1.132, which indicates that children ever born is 1.132 times higher for those women who lived in rural areas than those women who lived in urban areas.

In logistic regression analysis the odds ratio of religion is 0.427 which indicates that children ever born is 0.427 times lower for those women who have religion non-Muslim than those women who have religion Muslim.

The odds ratio reveals that the respondent who are living in Khulna and Rajshahi division are found to have 1.219 times and 1.610 times higher risk of children ever born than the respondent who are living in Barisal division. But women who are living in Chittagong and Sylhet divisions are 0.492 and 0.310 times lower risk of children ever born than those woman who are living in Barisal division. From the result, it is clear that the probability of giving children ever born is lowest in Sylhet division (0.310) and highest in Rajshahi division (1.610).

From the bivariate analysis it has also found that children ever born is the lowest among higher educated women. The odds ratio of respondent's education are 0.795 and 0.436, which indicate that children ever born are 0.795 and 0.436 times lower for those women who have primary and secondary& higher education than those women who are illiterate. From the results, it is clear that higher educated women have the lowest probability of giving birth.

The odds ratio of working women is 0.825, which indicates that children ever born is 0.825 times lower for those women who are working than those women who are not working

From the results, children ever born is higher among the spousal age difference is 9& above (years). The odds ratio of spousal age difference are 1.035 and 1.325, which indicate that children ever born is 1.035 and 1.325 times higher for those women corresponding to age group 5-8 and 9& above than those women who belong to age group ≤ 4(reference category).

The women whose marital duration is 5 years or more are found to have 0.055 times lower fertility than those women whose marital duration is less than or equal to 4 years.

The odds ratio of contraceptive use is 0.530, which indicates that children ever born is 0.530 times lower for those women who have used contraceptive method than those women who do not use contraceptive method.

The odds ratio of the respondent's body mass index are 0.998 and 0.463, which indicates that children ever born is 0.998 times and 0.463 times lower for those women whose body mass index lies in the group 18.5-24.9 and 24.91& above than those women whose body mass index lies in the group <18.5. From the result, it is clear that obesity respondent's index of fertility is the lowest than the other groups.

The odds ratio 0.893 indicates that children ever born is 0.893 times lower for those respondent who contact mass media than those respondent who do not contact it.

From table 4.4 **(Geometric and Beta Geometric Distribution)** we observe that current age of respondent has been found to have a positive association with marriage to first conception interval but it has an inverse relationship with fecundability for both homogeneous and heterogeneous case that is the conception wait is increasing as the current age of respondent is increasing .As a result the fecundability is decreasing. In this variable for the respondents in the age group 19 to 23 years, we get variance of fecundability is negative this is because a= -65.95 which is less than 2 but according to Anrudh Kumar Jain, Variance = $S^2 = ab(a+b-1)/((a-1)^2 .(a-2))$ is not defined unless a>2.

Age at first marriage is found to have an inverse relationship with the marriage to first conception interval. The results in table 4.4 show that the conception interval decreases as the age at first marriage increases and vice-versa. The women whose age at first marriage is less than sixteen years have higher mean conception interval (26.15 months) and lower fecundabilities (0.038) than the other women. This may happen because the women who got married in her early age takes time to conceive due to her menstruation delay and due to her reluctance to be the mother at the very beginning of her conjugal life and this increases their conception wait but decreases their fecundabilities. The women whose age at first marriage lies in the age group 19 years and above have lower mean conception interval (17.25 months) and higher fecundabilities (0.057) than the other women. The women whose age at first marriage lies between 16 to 18 years have very slightly higher mean conception interval (18.09 months) and fecundabilities (0.055) than the women whose age at first marriage is lies in the age group 19 years and above.

The urban women have higher mean conception delay (23.88) and the lower fecundability (0.041) than rural women. This may happen because the women living in urban areas, the contraceptive practice is higher (84.9%) than in rural areas (75.2%). We also see the similar results of mean fecundability for homogeneous women as well as for heterogeneous women obtained from the harmonic mean.

The women from the Non-Muslim community have a shorter conception interval (23.79) and higher fecundability (0.042) than the women from the Muslim community(23.89 and 0.041).This may happen because Non-Muslim women got married at higher age than their counter parts and it is known that adults have a lower mean conception delay and higher fecundability than the adolescent.

The BDHS 2007 data has been showing that the Khulna division has a greater mean conception delay (25.96) and lower fecundability (0.038) than the other division. This is because the women in Khulna division were the adolescent and less educated and it is known that adolescent has a greater mean conception delay and lower fecundability than the adults. The Chittagong division has a lower mean conception delay (21.32) and higher fecundability (0.046) than the other division. This may happen because the women in Chittagong division were found with higher mean age at marriage, religious and holding higher educational status and hence they have low conception wait and higher fecundability. Moreover, the contraceptive practice in Chittagong division is the lowest (48.4%) among the other division that causes the higher fertility rate in Chittagong and consequently the higher fecundability in Chittagong division. We also see the parallel results of mean fecundability for homogenous women as well as for heterogeneous women obtained from the harmonic mean.

Respondent's (wile's) education level have found an inverse relationship with the marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogeneous cases. It has been shown in the table 4.4 that when the education level of the respondents arc increasing, then their mean fecundability are increasing and vice-versa. This is because, when the women are seen gradually adapting themselves with higher education, then their mean age at first marriage arc also increased and for that they have a tendency to get a child quickly which causes the shorter mean conception delay and higher fecundability. It is also seen from the table that the women with no education has a greater mean conception delay(29.52) and lower fecundability (0.033) whereas we see the reverse result in the case of women having primary (24.03 and 0.041) and secondary and above (19.19 and 0.052) level of education. We have also seen that the mean fecundability for homogenous women is equivalent with harmonic mean fecundability for heterogeneous women.

Husband's education level has been found to have an inverse relationship with the marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogenous case. The table shows that when the education levels of the husband's are increasing, then their mean fecundability are increasing and vice-versa. It has been found that the husband's with no education has a greater mean conception delay (27.34) and lower fecundability (0.036) than the husband's with primary education (23.46 and 0.042) or secondary and higher education (21.43 and 0.046).This may happen because the husband's with no education marry the adolescents who have a lower fecundity (biological capacity to conception) due to menstruation delay and longer conception delay and hence a lower fecundability.

The table4.4 shows that the women, who do work, have higher conception delay (25.58) and lower fecundability (0.039) than the women, who do not work (23.20 and 0.043) i.e. home based. This is due to the fact that the women who do jobs have to spend more time in her work place than to house comparing to the women who are home based. This will increase their mean age at first marriage, mean age at first conception as well as decrease their tendency to be the mother of a child rapidly after marriage. These factors are enough to increase the conception interval and hence decrease the fecundability level for the women who are employed than the women who are home based.

It has been seen from the Table 4.4.that the husband's whose occupation is non-manual have the lower conception interval (22.46) and higher fecundability (0.044) than the other occupational husband's. This may happen due to the fact that the husband's possessing professional related occupation marry the matured women who have a higher fecundity (biological capacity to conception) and shorter conception delay and hence a higher fecundability. On the other hand, the husband's who are unemployed has the higher conception delay (27.76) and lower fecundability (0.036) than the other occupational husband's. This is because the husband's possessing unemployed and manual occupation marry the adolescents who have a lower fecundity (biological capacity to conception) due to menstruation delay and longer conception delay and hence a lower fecundability.

We see from the table 4.4 that the spousal whose age difference 9 years and above have the lowest conception interval (23.43) and higher fecundability (0.042) as compared to the other. This also indicates that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and less users of family planning methods. On the other hand the spousal whose age difference 4 years or less has the highest conception interval (25.83) as compared to the other. This also indicates that the women in the highest conception interval are less educated, got married in her adolescent age, lower fertile group of women and higher users of family planning methods.

Marital duration has a strong positive relationship with the marriage to first conception interval but it has a negative association with fecundability for both homogenous and heterogeneous case. For instance, the mean length of the first conception interval is found as 9.86 months for women who have spent 4 years or less as their conjugal life since their marriage and 25.96 months for those women who have spent more than 4 years as their conjugal life since their marriage. This indicates that conception interval increases as the marital duration increases and vice-versa. This also indicate that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and less users of family planning methods.

The BDHS 2007 data provides us a consistent result that wealth index has an inverse relationship with marriage to first conception interval but it has a positive association with fecundability for both homogenous and heterogeneous cases. The women whose wealth index is high have shorter conception interval (22.50) and higher fecundability (0.044) than the women with low (25.59 and 0.039) or medium (24.23 and 0.041) wealth index.

We see from the table 4.4 that the women who do not use contraceptives have greater conception delay (32.67) than their counterparts (22.45). This may happen because the women who do not use contraceptives are greatly suffering due to adolescent sterility.

The BDIIS 2007 data provides us an important result that the respondents whose Body Mass Index (BMI) is in 18.5-24.9 i.e. weight status is normal have the lower conception interval (23.42) and higher fecundability (0.042) as compared to the other. This indicates that the respondents, whose weight is normal, are physically sound enough and capable to conceive.

The BDHS 2007 data has been showing that the women who have a contact with at least one media, have the lower conception interval (22.19) and higher fecundability (0.045) compared to their counterparts. This also indicate that the women in the lower conception interval are highly educated, newly got married in her matured age, highly fertile group of women and interested to be a mother as early as compared to the other.

From the table5.1 and table 5.2 **(Cox's Proportional Hazard Regression Analysis)**, we observed that age at first marriage is a most important factor, which has a great influence on marriage to first conception interval. It is also seen that women with early age at marriage are to wait for a longer period of time to be pregnant for the first time than their higher age at marriage counterparts. This is clearly indicates that age at first marriage has negative influence on marriage to first conception interval and positive with fecundability. The odds ratio indicates that the women got married at ages between 16 to 18 years are 1.211 times likely to conceive compared to those who got married at ages less than 16 years. Again, the odds ratio for women who got married at ages 19 years and above is 1.218, which indicates that this group of women are 1.218 times likely to conceive compared to those who got married at ages less than 16 years.

The spousal age difference is found to have a statistically significant negative influence on marriage to first conception interval. The spousal whose age difference is 5 to 8 years are found to have 1.152 times likely to conceive than the spousal whose age difference is less than or equal to 4 years. Again, the spousal whose age difference is 9 years and above are found to have 1.231 times likely to conceive than the spousal whose age difference is less than or equal to 4 years.

Marital duration is found to have a statistically significant positive influence on marriage to first conception interval. The women whose marital duration is 5 years or more are found to have 6 percent lower risk to conceive than the women whose marital duration is less or equal to 4 years.

Current age of respondent are found to have a statistically significant positive influence on marriage to first conception interval. The respondents who are in the are group 19 to 23 years and 24 years and above are found to have 0.976 times and 0.863 times lower risk to conceive than the respondents who are in the age group ≤ 18 years respectively.

Type of place of residence are found to have strongly significant positive influence on marriage to first conception interval in Bangladesh. The odds ratio indicates that the women who live in rural areas are 0.99 times lower probability to conceive than the women who live in urban areas.

Respondent's educational level are found to have positive and significant effect on marriage to first conception interval. From the table-5.2 we see that the odds ratio of primary and secondary & higher educated mother are 0.836 times and 0.762 times lower risk on marriage to first conception interval than with illiterate mother. Thus, increasing the level of education of mother is decreasing the marriage to first conception interval.

Use of contraceptives are found to have a statistically significant negative influence on marriage to first conception interval. It is evident from Table 5.2 that the odds ratio for women who use contraceptives is 2.003, which indicates that those women are 2.003 times likely to conceive, compared to those who do not use contraceptives.

There is a significant positive regional effect on marriage to first conception interval in Bangladesh. In Dhaka and Rajshahi division, this factor is not significant at all. Table 5.2 reveals that the respondent who are living in Chittagong & Sylhet division are found to have 1.204 times and 1.247 times higher risk of faster conception than the respondent's who are living in Barisal division respectively. The respondent's who are living in Khulna division are found to have 0.921 times lower risk to conceive than the respondent's who are living in Barisal division.

The mother's work status are strongly associated with marriage to first conception interval when all other demographic covariates included in the study are controlled. Work status of woman has highly significant and positive effect on the probability of marriage to first conception interval. The result indicates that women who work outside the home are 0.97 times lower likely to conceive than their not working counterparts. Currently working woman has a slightly longer duration of marriage to first conception interval than their not working counterparts.

Partner's age is also found to have a statistically significant positive influence on marriage to first conception interval in Bangladesh. The partner's whose age lies in the group 25 to 32 years are found to have1.105 times likely to conceive than the partner's whose age lies in the group less than 25 years.

6.2 Limitations of the Study

This study is based on data of Bangladesh Demographic and Health Survey (BDHS) 2007. Though BDHS data is widely recognized and well accepted data, but may be affected by some non-sampling and sampling error. Non-sampling errors are made due to mistakes made in implementing data collection and data processing, such as failure to locate and interview the correct household, misunderstanding of the questions on the part of either the interview or the respondent and data entry errors.

Although numerous efforts were made during the implementation of the BDHS to minimize this type of error.

The BDHS data collection process was very systematic, methodical and up-to-date. But even there were limitations because of illiteracy and ignorance of the people. Age is a very essential determinant in our study, but relevant result may not found as many respondent do not know the exact date of conceive and date of birth of them or their children. It was based on respondent's personal reports or satisfaction and as a result date of birth may be subject to error.

6.3 Policy Implications

The findings of this study may have some policy implications that would help the planners and policy-makers of the Government to take necessary steps in decreasing fertility or fecundity among women in Bangladesh as soon as possible. Thus policy implications that can be drawn from this study as they are relate to achievement of further fertility decline are as follows:

(1) Education appears to the key factor through various causal mechanisms. Education delays marriage and maturity that comes with age may result in use more effective contraception and hence decrease the index of fertility. Education also increase the opportunity for paid employment in the modern sector and this completes with the demand for child bearing. Through increasing her odds of becoming employed out side the home and thus becoming an income producing member of a family, a women is more likely to acquire a role in decisions concerning all aspects of family life, including the number of her children. Hence it can be tentatively concluded that an improvement female education levels will help to decrease fertility. Hence Government should make education up to HSC completely free and compulsory for female, particularly in rural areas in order to depress the level of fertility in Bangladesh.

(2) The post-ponement of female age at marriage to18 years with a view to delay the onset of child bearing and it has noticeable effect in the level of fertility and thereby improving the health of women. In Bangladesh the legal

age at marriage is 18 years but about 73.2% women married before 16 years of age specially in rural areas. Hence it is essential that Government should not only to regulate laws but also strong punishment should make for those who violate laws. Early age at marriage increase the level of fertility which always happen more in rural areas. In order to decrease fertility we must increase age at marriage of women.

(3) Women will be motivated to accept contraceptive methods in order to limit their family size. Great attention should also be given for family planning service to women, particularly younger rural mother and to provide them with motivational messages about decline fertility.

(4) The mass media can bring dual benefits to help modernize the thinking of the people and help in other development activities as well as improve acceptance of family welfare program services. The use of audio-visual aids like radio and television particularly in rural areas should be increased. Simultaneously, efforts to involve satisfied clients to motivate new accepters of family planning, efforts to remove fear about side effects of contraceptives, efforts for offering a wider contraceptive choice for various groups for women etc, also are to be promoted.

(5) Work status of women has also been appeared as an influential factor. It is a well known fact that work facilities of women outside home is severely limited in Bangladesh. So, it may be suggested that Government and the higher authorities of various organizations attention should be needed of creating more work facilities of women outside home, particularly in rural areas, so that children ever born must be decreased.

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Quamrun Nahar(AUGUST 2009) ICDDR`B, Mohakhali, Dhaka 1212, Bangladesh; Trends and Determinants of Adolescent Childbearing in Bangladesh USAID Country Health Statistical Report, Bangladesh May 2009

Jeffrey Kallan and (Feb., 1986), J. Richard Udry Source: Demography, Vol. 23, No.1 pp. 53-66 "The Determinants of Effective Fecundability Based on the First Birth Interval Author(s)

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