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A Study of Some Determinants of Adolescent Reproductive Health in Bangladesh

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A Study of Some Determinants of Adolescent Reproductive Health in Bangladesh

By

Md.Rashed Alam

Thesis submitted for the Degree of

Doctor of Philosophy

in **Population Science and Human Resource Development**

Department of Population Science and Human Resource Development

Faculty of Science

University of Rajshahi, Bangladesh

April 2016

Dedicated to

my beloved child

and respectable parents

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Ph D Thesis

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Declaration

I declare that the thesis entitled "A Study of Some Determinants of Adolescent Reproductive Health in Bangladesh" embodies the findings of original research work carried out by myself under the supervisions of Dr. Tapan Kumar Roy and Dr. Md. Mizanur Rahman, Associate Professor, Department of Population Science and Human Resource Development, University of Rajshahi. This thesis is submitted to the University of Rajshahi for the Degree of Doctor of Philosophy in Population Science and Human Resource Development. No part of this thesis has never been submitted anywhere for any Degree.

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Certificate

This is to certify that the thesis entitled "A Study of Some Determinants of Adolescent Reproductive Health in Bangladesh" is an original research work carried out by Md. Rashed Alam under our direct supervision and submitted to the University of Rajshahi for the Degree of **Doctor of Philosophy** in Population Science and Human Resource Development. This work has never been submitted anywhere for any Degree. Mr. Alam has fulfilled all the terms and conditions for the PhD degree including presentations of the findings of the research work in two seminars held in the Department of Population Science and Human Resource Development, University of Rajshahi.

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Abstract

Adolescent reproductive health is an important agenda for any developing countries due to population momentum- a consequence of the increasing numbers of adolescents in this region. The generation entering the adolescent years now is the largest in human history. During adolescent period many girls experience critical and various life events such as first marriage, first sexual cohabitation, motherhood, pregnancy complications, early neonatal mortality etc. Adolescents should be able to protect themselves from unwanted sex, unplanned pregnancy, early childbearing, pregnancy complications, unsafe abortion and others adverse reproductive health outcomes. However, early pregnancy and motherhood among adolescent is still a major public health concern in worldwide especially in developing countries. One third of women give birth during adolescent periods in low-income countries. Adolescent pregnancy is a potential threat of mother, offspring and also lead high fertility in resource-limited countries like Bangladesh. Therefore, critical assessment of adolescent childbearing and consequences of early pregnancy may helpful for policy makers to identify risk group in Bangladesh. The objectives of this study was to determine the potential risk factors for adolescent childbearing, and then assess the association between adolescent age at birth and risk of adverse birth and health outcomes through empirical and review analysis.

The data for this study was extracted from Bangladesh Demographic and Health Survey (BDHS) 2011. This is a cross-sectional population study based on a two-stage, stratified, cluster-sampling design, which collected information from 17,141 households during May to October 2011. The maternal age at birth especially adolescent versus adult was the main dependent variable when determine the potential determinants. The study modeled adolescent childbearing as a function of individual, household, and community characteristics. In analyzing adverse birth and health outcomes, maternal childbearing age was treated as main exposure variable. Descriptive statistics were calculated for continuous data using the mean (confidence interval) for normally distributed data and the median (inter-quartile range) for non-normally distributed data. Determinants of adolescent childbearing were estimated using a multilevel logistic regression models with random intercept term household and community. In addition the multilevel poisson regression was used to determine the risk factors of adverse birth and health outcomes among adolescent childbearing mothers. It is worthwhile to mention that systematic review was done to know the association between adverse birth and health

outcomes among adolescents in South East Asia including Bangladesh. Meta-analysis and meta- regression were used to get pool results. All analyses at both the univariate and multilevel analysis at different stages were adjusted for the probability sample design.

The study finding indicates that on average, mean age at childbearing was 26 years, years of schooling 5.54 years, children ever born 2.52, age at first marriage 15.94 years and 35% of women give birth before reaching age 20 years i.e during adolescence. Adolescent's age of childbearing was affected by social factors at personal, family, community, and national levels. The multilevel logistic regression models indicated that women with lower education, early age at first cohabitation, and poor economic conditions were more likely to influence early childbearing compared to adult women. However, the multilevel poisson regression models indicated that higher risk of low birth weight (adjusted relative risk (aRR), 1.15; 95% CI, 1.00–1.33), childhood stunting (aRR, 1.06; 95% CI, 0.98–1.14) and early neonatal mortality (aRR, 1.60; 95% CI, 0.85–1.27) is observed among the adolescent mother compared to young adult mother. Maternal aged 35 years or over found to be risk factor of pregnancy termination (aRR, 1.31; 95% CI, 1.09–1.56), cesarean delivery (aRR, 1.35; 95% CI, 1.02–1.79) and menstrual irregularities (aRR, 1.35; 95% CI, 1.02–1.79) than young adult mother. The systematic review and meta-analysis suggested that adolescent pregnancy had an increased risk of low birth weight, preterm birth, small for gestational age and neonatal mortality; however, lower risk is to be found in case of cesarean delivery and perinatal mortality.

Finally, it may be concluded that maternal education, age at first cohabitation and socioeconomic conditions are the key determinants of adolescent childbearing in Bangladesh. In this systematic review and meta-analysis along with empirical data analysis, conclude that adolescence pregnancy increase the risk of low birth weight (LBW), preterm birth (PTB), small for gestational age (SGA) and early neonatal mortality. The risk of cesarean delivery and perinatal mortality are found to be lower among adolescent mothers. The author feels that the results obtained in the thesis may be useful for policy planners for appropriate policy decisions. It is expected that the result presented in this thesis will be helpful for researchers who are interested to work in the field of adolescent childbearing and adverse birth and health outcomes among adolescent mothers.

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In fine, I am alone responsible for the shortcoming and the errors if there be any, I am sorry for that!

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Chapter One

Introduction

1.1 Background

Adolescence is individual's life stage that relates to the periods of transition from childhood to adulthood and according to WHO the periods of adolescence is defined from 10-19 years (WHO 2000). Major physical, cognitive, emotional, sexual and social changes that affect adolescent behaviour occur during this period. This stage is always visual and develops gradually without proper care and attention especially in the developing countries. It is generally agreed that adolescence consists of four main aspects of life stages: biological and demographic; psychological and emotional; social and economic. Adolescence is the most critical stage of human life and most important events occurs during this period. This period is also considered the "Demographically Dense" phase because most of the demographic movements take place during this period. Contrary to the early development theorists notion that adolescents are a relatively healthy group with no major physical illness (Dehne and Riedner, 2005), there is now substantial literature indicating that adolescents face unique reproductive health challenges.

The 1994 International Conference on Population and Development (ICPD) marked a paradigm shift by recognizing that adolescents have unique needs and vulnerabilities (ICPD 1994). In addition adolescents for their reproductive health are typically poorly informed about how to protect themselves from pregnancies and other reproductive health diseases. There has been a worldwide increase in the rates of adolescent pregnancy during the last three decades. Such pregnancy is linked to poor education, poverty and social exclusion, and is a major worldwide public health problem (Suwal 2008).

Chapter One

Introduction

Adolescent reproductive health has been gained increasing attention among researchers, public health experts and policy makers over the past few decades. Adolescents will constitute a large share of population and growing segments of the global population day by day. This huge share of adolescent is and will continue to be in Asia, which is hope to 60 percent of the world population (UNFPA 2010). In Bangladesh, adolescents comprised of a significant proportion of the population, which is one-fourth of the total population (BBS 2011). According to population census 2011, it showed that about 32 percent are age range 10-24 years, about 45 percent of the total population is very young (below 15 years), 48 percent of 15 to 19 years old adolescent girls are married and about 60 percent of them are becoming pregnant before reaching the age 19 years. The ratio of urban and rural adolescent is 1: 5; mean age at marriage is 16.9 years (BBS 2011). A large number of them are out of school, malnourished, working in vulnerable situations, getting worried early and care sexually active although most of them do not have knowledge about contraception and safer sex. The sexual and reproductive health behavior of them will critically affect global population growth patterns. Adolescents have special sexual and reproductive health needs because of their relatively high risk of being exposed to inaccurate or incomplete information about unintended pregnancies and maternal complications.

Adolescent pregnancy is still considered as the major health problem in South Asia (Acharya et al., 2014), which may also contribute to the increase rate of maternal mortality (Carine Ronsmans et al., 2006). Around 35% of the total birth occurred among the adolescent in Bangladesh which is consistently higher than others Asian countries (Majumder, 2013). It contributes around 40% of the total child death in Bangladesh and India (Ghosh, 2012; Kundu et al., 2013). Prevalence of child diarrhea, malnutrition (stunting, wasting and underweight), low birth weight (LBW) remained significant among the child of adolescent mother (Raj et al., 2010). Maternal mortality is inextricably linked with the adolescent fertility; around 42% higher risk of maternal mortality reported among the adolescent mother in Bangladesh (Chowdhury et al., 2007). A recent study analyzed data from 38-countries and it is estimated that the risk of death per birth for adolescents aged 15–19 years is 28% higher than for women aged 20–24

years (Blanc et al., 2013). Adolescent pregnancy were also found to be linked with different adverse pregnancy outcomes including peclampsia, systemic infections, preterm delivery and severe neonatal conditions (Ganchimeg et al., 2014).

Like many develop countries, late child bearing among married women (aged 35 years or more) in Bangladesh is also increasing. Around 10% of the total birth occurred in this ages (Arifeen et al., 2014). Previous study found the J-shape relationship among the maternal age and adverse outcome which clearly indicate the risk of late and adolescent pregnancy (Ganchimeg et al., 2014). Despite the growing burden among adolescent and late pregnancy in Bangladesh, very few studies assess the birth and health outcomes in relation to maternal age at birth particularly focusing adolescent using population based survey data.

Adolescent pregnancy intends to increase maternal complications and consequently occurrence of maternal mortality. Reduction of maternal mortality to less than 70 deaths per 100,000 live birth by 2030 and, improvement of maternal and child health are the core agenda in newly adopted Sustainable Development Goals (Organization, 2015b). Access, affordable healthcare, and better nutrition are prerequisites to achieve these goals. However, around 10 to 19% of women aged 15-49 years are underweight, which become more evident (34%) in most countries in Sub-Saharan Africa, South central and Southeastern Asia (Black & Hopkins Bloomberg, 2008). Despite the wide recognition of health services coverage in Bangladesh, two major factors contributing to high maternal mortality. These are low professional (doctors or nurse) antenatal care (ANC) visit and lack of skill birth attendants during delivery (Chaudhury, 2008; Kidney et al., 2009; C Ronsmans et al., 2009). In Bangladesh, 32% of women received no ANC in 2011.Those who received ANC, around a quarter completed the minimum of four ANC visits during their pregnancy (Bangladesh Demographic and Health Survey, 2012) as recommended by World Health Organization (WHO), to detect health problems associated with pregnancy. The proportion of births attended by medically trained personnel was only about 24.4% (Koenig et al., 2007). Therefore, fewer professional ANC and delivery care would a

barrier to improve maternal and child health lower middle-income countries like Bangladesh.

ICPD draws attention for adolescent health including areas of unmet need in the field of reproductive and sexual health and acknowledges the urgent need to address the adolescent reproductive health issues of unplanned pregnancies, unsafe abortion, maternal mortality and sexual transmitted diseases. Governments, whether in developing or developed countries, have not always been very sensitive or responsive to the needs of their adolescent people. A tragic expression of the failure to support adolescent in dealing with their sexuality is the high incidence of pregnancies and its complications and various birth and health outcomes among adolescents incidence which affects some developed societies as well as developing ones.

Thus it may conclude that adolescent needs accurate user-friendly information about their health including marriage, reproduction, infant and child mortality and child health etc. Adolescents must also be adequately equipped with the information and skills needed to translate knowledge into healthy behaviours. This information is critical to creation of user-friendly reproductive health programs for adolescents. It should also need to know the determinants of adolescents health and its consequences of early child bearing and adverse birth and health outcomes. This information can help demographers and social scientists to formulate appropriate policy against adolescent reproductive health.

1.2 Problem Statement and Research Question

Although adolescents share many characteristics with adults, their health related problems and needs are different. Adolescent reproductive health remains a global challenge particularly in developing countries. Globally, 60 out of every 1,000 adolescent girls give birth each year, and many of the pregnancies are unwanted. Further, up to 4.4 million girls aged 15 to 19 years undergo unsafe abortions (WHO, 1998). Adding to the challenge is the sheer magnitude of the numbers day by day each year. About half of the world's population is under the age of 25 years, and one in every five people in the world is an adolescent (UNFPA, 2005a; WHO, 1998). About 85% of adolescents live in

developing countries and the remainder in the industrialized countries (Dehne and Riedner, 2005).

In Bangladesh, provision of reproductive health services for adolescents is controversial. The lack of consensus has slowed down the publishing of an information pack that would equip adolescents with information about reproductive health including pregnancy complications, maternal mortality, neonatal mortality and where to get services. Though, NGOs are governed by organization policies and mandate about various health and development programs and but they may not provide adolescents with reproductive health services. The effect has been lack of focused guidance for adolescents about their reproductive health and reproductive rights. As a result, adolescents have little knowledge about reproductive health matters relating to their bodies, marriage, conception time and pregnancy complications. Consequently, they depend on their peers for information. The lack of clear policies on adolescent reproductive health means that adolescents are not guaranteed their right to access reproductive health services. Lack of clear policies has also led to professional dilemma among health care providers on whether to provide adolescents with services and the kind of services to provide. Adolescents thus rely mainly on themselves and other uninformed sources for guidance and information on where to seek care and services. For example, lack of private consulting rooms denies adolescents confidentiality and privacy. Whereas health facilities are located in open areas and public places where they can be easily accessed, this does not translate into effective use by adolescents who need the services. Adolescents may fail to use services if the services do not enhance confidentiality and privacy. The highlighted challenges, inadequacies and gaps point towards the need to develop clear policies for addressing adolescent reproductive health problems.

In this context, the principal purpose of this study was to fill this research gap and add to existing literature by investigating determinant factors that influence adolescent's access and use of reproductive health services. To achieve this, the study sought to answer the following research questions.

1. What are the determinants of adolescent childbearing age which affect on adolescent reproductive health?

2. What sort of birth and health outcomes are frequently occurring in Bangladesh associated with maternal age at birth?

3. What sort of adverse birth and health outcomes frequently reported in connection to adolescent pregnancy in South Asia?

To overcome these questions, in the first stage of this study, a nationally representative data analysis was performed to assess the association between maternal age at birth and risk of adverse birth and health outcomes in Bangladesh. In the second stage of this study, we perform a systematic review and meta-analysis to determine the types of adverse birth and health outcomes associated with maternal adolescent childbearing in South Asian countries.

1.3 Adolescent Reproductive Health Perspectives

Adolescent reproductive health is a global public health concern. This is because adolescent reproductive health activity has increased in many countries around the world in the last two or three decades (Naré, Katz and Tolley, 1997), and at increasingly younger ages. Adolescence is described as a period of increased risk-taking because adolescents are susceptible to behavioural problems during puberty (UNFPA, 1997). Adolescents at this period try to form their own identity, to be autonomous and are conscious of making their own choices and actions (Häggström-Nordin, 2005). Since they have few peers facing major illness, adolescents tend to think that they are invulnerable to illness. This perception creates the tendency among adolescents to engage in risk-taking behaviours that expose them to health and birth risks which adversely affect their present and future health. Adolescents simultaneously engage in multiple health and birth risk behaviours that threaten their health and well-being (Elster and uznets, 1994). The consequences have social, economic and physical health ramifications like illegal abortions, unwanted pregnancy, dropping out of school and out-of-wedlock births. There are also gender variations. Girls face greater reproductive health challenges

than boys following puberty. Foremost among these are early pregnancies and childbearing.

Adolescents globally continue to face challenges in accessing reproductive health services. They access health services less frequently than expected and are also more likely to seek services after sexual exposure. Kipke (1999) identified problems that adolescents undergo particularly the lack of access to health care services. He noted that many adolescents lack a consistent source of basic care and are less likely to visit a doctor or have any regular source of medical care than young children or adults. Hock Long et al. (2003) in an article on access to adolescent reproductive health services supported this view. The 1994 and 2004 ICPD conferences in Cairo and Dakar respectively made several recommendations for improving adolescents access to reproductive health services and education. Participating countries affirmed their commitment to intensify efforts to enhance the rights of adolescents to access sexuality information, counseling and youth-friendly services; to safeguard adolescents right to privacy, confidentiality and informed consent; and to involve them in the design, implementation, monitoring and evaluation of youth programmes (UNFPA, 2005b). Since the 1994 ICPD, attempts have been made globally to address reproductive health challenges of adolescence. An example is the establishment of adolescent friendly clinics, particularly in developed countries. However, there are no standard or uniform models of adolescent health services. Different countries adopt different approaches. Some countries use varying models. In the United States, for example, some programmes maintain the traditional medical model by offering drop-in and after school hours. Others set aside time in clinics for sessions open only to teenagers. In addition, some communities support reproductive health care as a component of school based health services (Hock Long et al. 2003).

1.4 Review of Earlier Studies

A review of the works related to the present study reveals a wide range of socio-economic and demographic factors which affects adolescent's reproductive health. The socio-economic and demographic characteristics of the people in one society are likely to be different from another. These may also vary from one geographical setting to another. Thus to know about the previous works done in the field, a review of literature is essential. Only the relevant literature in this context of the present study is reviewed.

One of the most important features of the adolescents- the period of development between the ages ranges 10 to 19 years. The adolescent phase of human life is often termed as very "demographic dense" phase, because more demographic events occur during these years than at any stage of life. Adolescents from the leading age of a much-hoped- for revolution in reproductive behaviour (Caldwell *et al*., 1992). Recent reviews if childbearing persists among adolescent fertility are extremely high in contrast to some East Asian countries where adolescent childbearing is uncommon (U N, 1989). In a study Khan *et al.* (1988) took a study on adolescent child bearing and found that, adolescent pregnancy and its complications appears as a leading cause of death among teenagers in Bangladesh. About 40 percent of deaths among teenage mothers can be attributed to maternal cause.

Zeidenstein (1989) has reported that early marriage is one factor that contributes to high teen-age birth rates. Once of the central issues underlying adolescent pregnancy is the lack of alternative options for women other than motherhood, as well as their subordinate role in the society. Early marriage leads early beginning of childbearing, large complicated family size and short birth intervals. The subsequent children of young mothers suffer additionally from hazards of close spacing, as the mother health and nutrition status does not have time to recover from the previous pregnancy and consequently increase risk of morbidity and mortality for both mother and child. Besides, early motherhood can severely curtail educational and employment opportunities and are likely to have a long-term adverse impact on their children's quality of life (ICPD, 1994).

Introduction

Hirve et al. 1994 reported that socio-economic status, non-pregnant weight, maternal height, and severe anemia in pregnancy had substantial attributable risk for low birth weight. The findings suggest that selectively targeted interventions such as improving maternal education and nutrition, specifically anemia, wider availability of contraception to Birth weight is an important predictor of perinatal and neonatal survival.

Adolescent fertility is also taken up in terms of its relation with some variables and in the social context that is in question. Klepinger et al. (1995) conducted a study on adolescent fertility and the relationship between adolescent childbearing and early human capital development, and the resulting consequences for earning in early adulthood. The analysis recognized that the adolescent childbearing decision is endogenous because it is likely to be related to the costs of and returns to investing in education, teen work experience and early adult work experience.

Deshmukh, et al. (1998) reported that the low birth weight (LBW) prevalence was 30.3%. and the maternal factors significantly associated with LBW, anemia, low socioeconomic status, short birth interval, tobacco exposure, height, maternal age , body mass index, and prim parity.

Ajuwon et al. (2000) studied on sexual Coercion among Adolescents in Ibadan, Nigeria. They identified reproductive health behaviours among adolescents perceive as coercive. The most frequently mentioned were rape, unwanted touch, mockery, forceful exposure to pornographic film, and incest. They concurred that perpetrators of sexual coercion are not strangers to their victims, but tend to be boyfriends, fellow students, neighbors, and parents. Participants in the study (15–19 years old) agreed that typically males are the perpetrators and females the main victims. The study recommends that interventions targeting boys should focus on helping them appreciate the consequences of their actions and provide them with the skills that enable them to take responsible actions in resolving conflicts in their relationship with girls.

Senderowitz (2000) provided in-depth information on program issues related to adolescent reproductive health in developed and developing countries. This study

classifies approaches to adolescent reproductive health under three objectives and describes the strategies used to achieve them: (1) fostering an enabling environment; (2) improving knowledge skills, attitudes, and self-efficacy; and (3) improving health-seeking and safer sex practices. The review includes information about the benefits young men derive from a specific program, and approaches used to attract male adolescents. The bulk of the review provides information on successful strategies such as working in partnership with youth organizations, including schools, community-based organizations, and Non Government Organizations (NGOs) that work with young people; youth development projects; peer programs; using mass media; building linkages with employers; and using new technologies, a strategy found to be particularly successful in reaching young men.

Shahabuddin et al. (2000) took a study to assess the nutritional status of adolescent boys and girls in a rural community in Bangladesh. A cross-sectional survey was carried out in 803 households, each containing at least one adolescent, sampled consecutively from four purposely-selected villages in Rupganj Thana, Narayanganj district. Initially, the guardians of 1483 healthy and unmarried 10–17 year old adolescents (51% boys and 49% girls) were interviewed about family structure and socio-economic status. Out of these children, 906 (47% boys and 53% girls) from 597 households were weighed, had their height and MUAC measured and were clinically examined. Blood was then collected from 861 adolescents for hemoglobin estimation. The median monthly income per person in these 597 families was approximately Taka 554 (US $12). Twenty seven per cent of the household heads were laborers, 21% were solvent farmers, 14% ran small scale businesses and 6% were unemployed. Sixty seven per cent of adolescents were thin (defined as BMI < 5th percentile of WHO recommended reference) with 75% boys and 59% girls being affected. The percentage of thin adolescents fell from 95% at age 10 years to 12 % at age 17 years. The prevalence of stunting (height for age < 3rd percentile NCHS/WHO) was 48% for both boys and girls and rose from 34% at age 10 to 65% at age 17. On clinical examination angular stomatitis was present in 46%, 27% had glossaries, 38% had pallor, 11% had dental caries, 3.2% had an conspicuously enlarged thyroid and 2.1% had eye changes of vitamin A deficiency.

Bhakta B. and Gubhaju (2002) provided the improvement of the adverse health consequences of adolescent fertility for both mothers and children include the high rate of maternal mortality and infant mortality. The vulnerability schoolgirls become pregnant, they either resort to illicit abortion, which is often unsafe, or carry the foetus to full term, which hampers their opportunities for socio-economic advancement.

Bela Ganatra et al. (2002) exhibited that never-married and separated adolescents seeking abortion showed that non-consensual sex made many pregnancies unwanted, and cost, limited mobility, lack of family and partner support and the need for privacy to prevent stigma led many to go to traditional providers, even though safer options existed. Family planning programmes need to address the contraceptive needs of newly married adolescent women as well as unmarried adolescents. Informing adolescents of their legal rights, sensitizing providers to adopt an empathetic attitude, and exploring innovative ways of increasing access to safe services for unmarried adolescents are all recommended.

Islam et al. (2004) reported that hemorrhage during the antenatal period increases the risk of excessive hemorrhage during delivery, the risk of obstructed labor increases significantly if abdominal pain is observed during the antenatal period, prolonged labor appears to be significantly higher for the first pregnancy, and pregnancies suffering from abdominal pain during pregnancy tend to have a higher risk of prolonged labor during delivery. The duration of labor appears to be negatively associated with the number of previous pregnancies, being longest for the first pregnancies.

Chhabra MD et al. (2004) reported that the prevalence of LBW remains high in the underprivileged sections of the urban areas living in the slums. Mother's weight, height, age and parity are important determinants for low birth weight. Improving maternal nutrition and having the first pregnancy after 20 years of age, the effect of parity on birth weight can be reduced.

Bangladesh National Nutrition Programme 2004 examined nutritional status, knowledge and practices of never married adolescent girls (aged 13-19) living in rural

Bangladesh. Adolescents were of poor nutritional status; 9% were severely thin and 16% were moderately thin. More than half did not know the names of energy-dense and protein-rich foods. Most (65%) reported understanding of the need to take extra nutrients during adolescence to attain potential growth. On average adolescent girls ate 4.7 servings of protein rich and 3.3 servings of fat rich foods in the preceding week. Adolescents in the highest asset quintile (a proxy for economic condition) were 54% more likely to have had fish or meat and 91% more likely to have had egg or milk in the preceding week than those in the lowest asset quintile. Strong community-based nutrition counselling backed by basic services may improve adolescent nutrition knowledge and practices and address under nutrition 'carried-over' from childhood.

Monawar Hosain et al (2005) examined that factors associated with low birth weight (LBW) in rural Bangladesh. Enrolled in early first trimester, 350 women were followed for duration of pregnancy and data gathered on maternal factors such as social, demographic, anthropometric, biochemical measures and newborn's birth weight within 48 hours of birth. He also found that the associations between LBW and mother's age, parity, weight and hemoglobin level at booking, weight gain and health problems during pregnancy, tobacco consumption, and gestational age. But no such association was seen for birth spacing, mother's height, economic status, educational level, body mass index, mid upper arm circumference and number of ANC visits.

Goonewardene and Waduge (2005) observed that no significant differences in the mode of delivery and the younger teenagers had a much higher proportion of unplanned pregnancies compared to the controls. A significantly higher proportion of younger teenagers and older teenagers, if counselled, would have delayed their pregnancies compared to the controls. Teenage pregnancies, especially those below17 years of age have a significantly higher risk of adverse outcomes. A large proportion of these pregnancies is unplanned and could be prevented by counselling.

Michelle J.et al. (2007) showed that the largest cohort of young people in history, it is essential to continue to carefully design interventions and review their impact to assure

that adolescents have the tools to make informed and healthy choices concerning their sexual and reproductive health.

Muganyizi et al. (2009) reported that the proportion of teenage mothers (12–19 years) progressively decreased over time while that of 30–34 years age group increased. This study has revealed a steady decline in the proportion of teenage and a rise in the proportion of older (30–34years) mothers. These changes in age composition have contributed substantially to the parallel increase in CS rate and the decrease in LBWT deliveries at MNH.

Baqui et al. (2011) reported that the stillbirth rate is high in rural Bangladesh. Based on algorithmic approaches using verbal autopsy data, a substantial portion of stillbirths is attributable to maternal conditions and obstetric complications. Programs need to deliver community-level interventions to prevent and manage maternal complications, and to develop strategies to improve access to emergency obstetric care. Improvements in care to avert stillbirth can be accomplished in the context of existing maternal and child health programs. Methodological improvements in the measurement of stillbirths, especially causes of stillbirths, are also needed to better define the burden of stillbirths in low-resource settings.

Senbanjo et al. (2011) observed that Stunting adversely affects the physical and mental outcome of children. The objectives of the study were to determine the prevalence of and risk factors associated with stunting among urban school children and adolescents in Abeokuta, Nigeria.

Pelloso et al. (2012) reported that the study have revealed high indexes of preterm birth, low birth weight, and five-minute Apgar score of lower than seven in children born to adolescent women and women older than 35 years and perinatal risks were related to prematurity (OR 1,35) and five-minute Apgar scores of less than seven (OR 1,44) among infants born to adolescent mothers.

Introduction

Suwal A et al (2012) reported that most of the teenagers were unlooked, from low socioeconomic status and with no or inadequate education. They had little knowledge about contraception and less number of teenagers used temporary means of contraception. Because of our social custom of early marriage, most of the teenage mothers were married.

Fleming et al. (2013) reported that adolescents have improved outcomes such as lower rates of gestational hypertension, gestational diabetes, antepartum hemorrhage, and operative deliveries. However, adolescents also have higher socio-demographic risk factors and seek prenatal care later than adults. These risk factors in combination with young age, lead to other important maternal, obstetrical, and neonatal adverse outcomes. These findings highlight the importance of multidisciplinary prenatal management in the adolescent population to address their high-risk needs, to ensure healthy pregnancies, and to reduce adverse peinatal outcomes.

Baig et al. (2013) reported that Low maternal weight, multiple previous preterm deliveries, periodontal diseases, maternal anaemia, physical and emotional stress are among the factors associated with the risk of preterm birth among the local population delivering in tertiary care, governmental hospitals of Karachi, Pakistan.

Lule et al. (2014) observed that young women from the poorest households were more likely than those from the richest households to be married by age 18 and to have had at least one child by that age; they were less likely to report a mistimed birth, to be practicing contraception, to use maternal health services.

Negandhi et al. (2014) found that the explores the risk factors for low birth weight (LBW) in an urban Indian setting by using a nested case-control design. Information on potential risk factors was sought from384 pregnant women attending an antenatal clinic, and they were followed until birth. This study emphasizes the continuing importance of timely and regular antenatal visits and intake of appropriate amount of calories.

Kochar et al (2014) reported that still birth, induced abortion and miscarriage from the Indian state of Bihar to assess the magnitude of the problem and to inform corrective

action showed a significant burden of still births in Bihar, suggesting that addressing these must become an important part of maternal and child health initiatives. The higher induced abortion in the more developed districts, and the inverse trend between induced abortion and neonatal mortality rates, have programmatic implications.

Karkee et al. (2014) observed that the study investigated exclusive breastfeeding rates, and compared the duration of exclusive breastfeeding between rural and urban mothers in central Nepal and exclusive breastfeeding rates declined substantially over time. Exclusive breastfeeding up to six months was more common in rural than urban areas of central Nepal. Urban mothers also exclusively breastfed shorter than rural mothers.

Fall et al. (2015) showed that children of older mothers are at increased risk of preterm birth, and might have increased plasma glucose concentrations in adult life. However, at a given socioeconomic level and parity, children of older mothers have advantages in terms of childhood nutrition and educational attainment.

Zimet et al. (2016) investigated that constitutes an important step toward understanding the relationship between unintended child-bearing and marriage. They observed in Oklahoma should be further investigated in other settings to clarify potential linkages between unintended childbearing and marriage. Such relationships are likely to play an important role in the health and well-being of American families.

Imtiaz et al. (2016) observed that 66.4% newborn was male; 76% of low birth weight newborn was premature and 7.9% of full term newborns were with low birth weight (IUGR). 28% of mothers were < 20 years of age and 63% were uneducated. Prematurity and Intrauterine growth restriction were associated with low birth weight but this was not significant after adjustment for potential confounders. They concluded that low birth weight was mainly due to prematurity. However, our study could not establish association of low birth weight with young maternal age.

1.5 Significance of the Study

This study explores the in-depth association between maternal age at birth and adverse birth and health outcomes observed in Bangladesh as well as South Asian region. The finding of this research will improve the understanding about which birth and health outcomes are particularly associated adolescent age as well as the adult maternal age, which may provide the useful information about adolescent reproductive health for the health authorities and pregnant women. Moreover, the different types of adverse birth and health outcomes are frequently occur in South Asian countries due to adolescent childbearing are also determined by systematic review and meta-analysis.

In addition, the best of our knowledge it is only the nationally representative study in Bangladesh to examine the determinants of adolescent child bearing and its effect on adverse birth and health outcomes among adolescents. Findings of this study can provide insight into aspect of maternal age, early marriage risks to early childbearing and its birth and health outcomes effects on adolescents in Bangladesh which contribute for policy implications.

1.6 Objectives of the Study

The ultimate objective of this study is to provide fruitful information for policy makers with constructive information for formulating policies on adolescent's reproductive health with the aim to get better status of adolescents. The study also intends to observe the reproductive health of adolescents of the study part and to propose possible actions that can be taken in order to improve the status of adolescents. The summary of the above discussion can be outlined in the following specific objectives are formulated to address the research question:

1. To explore the national prevalence of adolescent and its differentiability by the selected socio-demographic characteristics;
2. To identify the determinants factor of adolescent childbearing in Bangladesh;
3. To summarize the adverse birth and health outcome to clarify the controversies in connection to maternal age at childbearing;
4. To summarize the birth and health outcomes associated adolescent maternal age in South Asian countries.

1.7 Organization of the Study

The thesis consists of six chapters along with the list of references related to this work. Chapter one is introductory which contents the background, problem statement and research question, adolescent reproductive health perspectives, review of earlier study, significance of the study, specific objectives of this study and organization of this thesis. In this chapter, research problems, research gaps and objectives are critically identified.

Chapter two is known as data sources and methodology that describes the study area, data sources, sample design, sampling procedure, sample size, variables used in the study, exposure variables, outcome variables and confounding variables. The description of various sophisticated statistical tools such as descriptive analysis, multilevel regression analysis, systematic review and meta-analysis are presented in this chapter.

Chapter three named determinants of adolescent childbearing in Bangladesh: A multilevel logistic regression analysis which includes background, method and materials, dependent and independent variables, statistical analysis such as chi square test and results of multilevel logistic regression, discussion and conclusion. This section is also conducted a cross-sectional data to determine the determinants of adolescent childbearing in Bangladesh.

Chapter four is adverse birth and health outcomes of adolescent reproductive health: A multilevel poisson regression analysis which describes background, method and materials, exposure and outcomes variables, results of multilevel poisson regression, discussion and conclusion. This chapter identifies the risk factors of various birth and health outcomes among adolescent mothers.

Chapter five is known as adolescent childbearing age and risk of adverse birth and health outcomes: a systematic review and meta-analysis which presents introduction of systematic reviews and meta analysis, method and materials, search strategy, study eligibility criteria, study selection, data collection process and data items, data synthesis, results, discussion and conclusion. This section has been performed to know the acute effect of maternal age at birth on health and birth outcomes through systematically reviewed and meta-analysis. This chapter summarizes the health and birth outcomes situation among adolescent mothers in South East Asia.

Finally chapter six is summary and policy implications. It includes the major findings of this thesis, the strengths and limitations, and future research directions. The policy implications and recommendations are made based on the findings of the dissertation in this chapter.

Chapter Two

Data Sources and Methodology

2.1 Introduction

Researching determinants of adolescent reproductive health is one of the potentially difficult areas as it is open to all sorts of misunderstandings and objections. The chapter begins by examining the philosophical assumptions applied in the study. The present chapter mainly focuses on data and methodology of this dissertation. It is devoted to indicate a brief description of the study area, sources of data, sample design, exposure variables, outcomes variables and confounding variables. In this study secondary data extracted from Bangladesh Demographic Health survey (BDHS) 2011 have been used. This chapter also describes the procedure for statistical analysis such as descriptive analysis and multilevel analysis. The mechanism of systematic review and meta analysis are also presented in this chapter.

2.2 Study Area

Bangladesh was under the Muslim rule for over five and a half centuries from 1201 to 1757 A. D. Subsequently, it was under the subjugation of the British after the defeat of the last sovereign ruler, Nawab Sirajuddowla, at the Battle of Please on the fateful day of June 23, 1757. Afterwards British ruled it for over 190 years unto 1947. During that period Bangladesh was a part of the British Indian provinces of Bangal and Assam. With the termination of the British rule in August, 1947 the sub-continent was partitioned into India and Pakistan, Bangladesh was then a part of Pakistan and was known as East Pakistan. It appeared on the World map as an independent and sovereign state on December 16, 1971 following the victory at the war of Liberation from March 26 to December 16, 1971. Bangladesh lies in the northeastern part of South Asia between 20° 34 and 26° 38-North latitude and between 88° 01 and 92° 41-East longitude. The country is bounded by India on the West, the north and the Northeast and Burma on the Southeast and the Bay of Bangal on the South. The area of the country is 56,977 square miles or 1,47,570 square kilometers. The limits of territorial waters of Bangladesh are 12 nautical miles and the area of the high

seas extending to 200 nautical miles measured from the base lines constitutes the economics zone of the country.

Bangladesh's population estimated to be 160.99 million in 2015 (Worldometers 2015). In 1973, when the country launched its First Five Year Plan (1973-78), population was 74 million and the rate of population growth was then 3.0 per cent per annum. In a span of forty two years, the population growth rate was reduced by 1.2 percentage points, while adding approximately 87 million more people and which belongs to 2.32% of the total world population. The percentage of urban and rural population was 23.39 and 76.61 respectively (Census 2011). But the population distribution has been changed to 34.2% urban population. The intercensal growth rate is 1.48 percent (Census, 2011). In the mid-seventies, Bangladesh was Asia's fifth and World's eighth most populous country. Bangladesh's population has a tremendous growth potential built into its age structure. Still population below 15 years is around 32.3 per cent and age (15-49 years) represent 52.4 per cent of the total population; among women in reproductive age 26.8 percent of the total female population (CIA World Fact book 2015).

2.3 Data Sources

The data used in this study was extracted from the Bangladesh Demographic Health Survey (BDHS, 2011), which was a nationally representative cross-sectional survey. The data were originally collected by the Macro, Calverton, USA. ORC Macro Institutional Review Board reviewed and approved the data collection procedure. The National Institute of Population Research and Training (NIPORT) under the Ministry of Health and Family Welfare organized the whole data collection process. Inform consent was obtained from each participant prior to subject enrollment (National Institute of Population Research and Training (NIPORT) & Associates, 2013). The data was collected in five phases, starting on July 8 and ending on December 27, 2011. The survey was undertaken in seven administrative regions (divisions): Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet covering both rural and urban areas.

A numerous type of data were carried out by BDHS to provide up-to-date information on fertility and childhood mortality levels; fertility preferences; awareness, approval, and use

of family planning methods; maternal and child health; knowledge and attitudes toward sexually transmitted infections; community-level data on accessibility and availability of health and family planning services; and prevalence of non-communicable diseases. It was designed to produce representative results for the country as a whole, for the urban and the rural areas separately, and for each of the seven administrative divisions of the country. All ever-married women aged 12-49 years who were usual members of the selected households and those who spent the night before the survey in the selected households were eligible to be interviewed in the survey.

2.4 Methodology

2.4.1 Sample Design and Sampling Procedure

The two stage cluster sampling for the BDHS 2011 is nationally representative a cross sectional design and covers the entire population residing in non institutional dwelling units in the country. The survey used as a sampling frame the list of enumeration areas (EAs) prepared for the 2011 population and housing census, provided by the Bangladesh Bureau of Statistics (BBS). The primary sampling unit (PSU) for the survey is an EA that was created to have an average of about 120 households. In the first stage, 600 EAs were selected with a probability proportional to the EA size, with 207 clusters in urban areas and 393 clusters in rural areas. A complete household listing operation was carried out by Mitra and Associates in all selected EAs from 22 May to 5 October 2011 to provide the sampling frame for the second-stage selection of household. In the second stage of selection, fixed number- 30 households per cluster- were selected with an equal probability systematic selection from the newly created household listing of key demographic and health variables for the whole country as urban and rural areas respectively.

Based on the sampling procedure, the survey was conducted in 18,000 residential households, 6,210 in urban areas and 11,790 in rural areas among them 17,511 household were found to be occupied. A total of 18,222 ever married women age 12-49 were identified in these households and 17842 were interviewed yielding a response rate of 98 percent and 45,844 respondents health information collected. One in three household in the survey were selected for male survey. In these household, all ever married men aged

15-54 who were usual member of the selected household or who spent the night before the survey in the selected household were eligible for individual interview. Of the 4,343 eligible men, 3,997, or 92 percent, were successfully interviewed. In this subsample, groups of eligible male and female aged 35 years and over were selected to participate in testing of the biomarker component, including blood pressure measurements, anemia, blood glucose testing, and height and weight measurements. Briefly the sampling framework can be presented in framework 2.1.

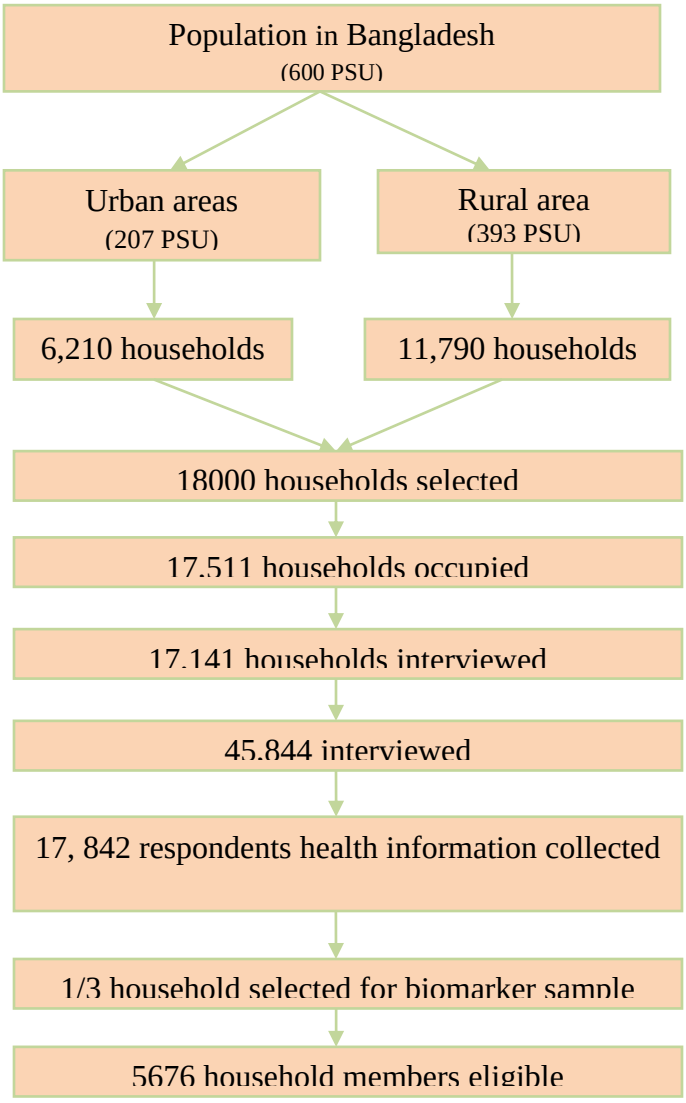

Figure 2.1: Sampling procedure of BDHS, 2011 data

2.4.2 Sample Size

The BDHS collected the information of 45,844 women whereas 17,842 respondents interviewed for various health and birth outcome and hemoglobin measurements of 5,676 ever-married women of reproductive age (15-49 years) from the total 17,842 interviewed women.

For analytical purposes, the data was restricted to women who have at least one child during her reproductive life. Based on this restriction, 45,844 women who have at least one child during her reproductive live were included in this study to identify the determinants factors of adolescent childbearing. In addition, 17,842 women were extracted to determine the adverse birth and health outcome with adolescent pregnancy.

2.4.3 Exposure and Outcomes Variables

Three types of variables used in this study such as exposure variables, outcomes variables or independent variables and confounding variables.

The present study included two exposure and list of outcomes variables. The outcomes variables are further categorized as health complication and birth complication. The concept of terminology of each of exposure and outcome variable are presented in Table 2.1 and 2.2 respectively.

Table 2.1: Exposure variable and concept of terminology

Name	Exposure variable	
	Definition	**Measurement procedure**
Maternal age at birth	Adolescent (≤19 years) Young adult (20-34 years) Adult (≥35 years)	Adolescent, young adult and adult were classified based on the standard definition of WHO.

Table 2.2: Maternal health and birth outcomes and concept of terminology

	Outcomes Variable
Health complication	**Definition**
Pregnancy complication	Symptoms (bleeding, severe nausea and vomiting, gestational diabetes, gestational hypertension) that adversely affect the health of a pregnant women and warrant immediate medical attention.
Pregnancy termination	Termination of the embryo or fetus before capable of independent life or survival outside the uterus. It includes both spontaneous termination and the surgical. In this study, only spontaneous termination included.
Genital sore/ulcer	Genital sores are bumps and lesions in or around the vagina that may be itchy, painful, or produce a discharge. They are most often symptoms of a sexually transmitted infection (STI).
Genital discharge	Genital discharge refers to discharge from the vaginal that may be thick, pasty, thin or clear, cloudy, bloody, white, yellow or green. It can be due to STI.
Menstrual irregularities	Menstrual irregularities occurs when its cycle vary from normal menstrual cycle ranged 21-34 days.
Cesarean delivery	One form of childbirth in which a surgical incision is made through a mother's abdomen and uterus to deliver the baby.
Exclusive breastfeeding	Infants receive only breast milk up to six month
Birth complication	**Definition**
Stunting	Child is shorter than for age.
Wasting	Weight is low as compared to height.
Low birth weight	Babies born with weight <2500 gm.
Stillbirths	Stillbirths are fetal death in pregnancies lasting seven or more months.
Early neonatal mortality	Early neonatal deaths are deaths at age 0-7 days among live born children.
Perinatal mortality	The sum of the number of stillbirths and early neonatal death is perinatal mortality.
Macrosomonia	Newborn with an excessive birth weight

Confounding Variables

The present study adjusted with lager number of confounding factors. The selected socio-economic, demographic and health related confounding variables used for this study are: women's age, education, number of children, current working status, husband's education, wealth index, household food security, place of residence, region, antenatal care. Among the confounding factors, BDHS created wealth index using the household asset data via principle component analysis (Rutstein, 1999). The calculation procedures are available in BDHS, 2011 report and Demography and Health Survey (DHS) website (http://dhsprogram.com). Furthermore, this study developed an index to measure the household food security by the following questions; (i) How often did you eat three `square meals' (full stomach meals) a day in the past 12 months (not a festival day)? (ii) In the last 12 months how often did you yourself skip entire meals because there was not enough food? (iii) In the last 12 months how often did you personally eat less food in a meal because there was not enough food? (iv) In the last 12 months, how often did you or any of your family have to eat wheat (or another grain) although you wanted to eat rice (not including when you were sick)? (v) In the past 12 months how often did your family have to ask food from relatives or neighbors to make a meal? Only in the first question, responses were coded as (0); Mostly (3 meals each day); (1); Sometimes (3 meals per day); (2); Rarely (3 meals per day 1-6 times this year); (3); Never. For other four questions responses were coded as (0); Never; (1); Rarely (1-6 times this year); (2) Sometimes (7-12 times this year); (3); Often (few times each month). Here, zero is the most food secure response and 3 is the most food in-secured response. Then all the frequency responses were summed in a single food security score for each ever-married woman. The range of the composite score varied from a minimum of "0" to a maximum of "15". Later, the value of composite score was used to calculate food security index (Coates, Swindale, & Bilinsky, 2007).

2.4.4 Statistical Analysis

Descriptive Analysis

Frequencies, percentages and contingency tables were used for descriptive analysis. In case of numeric data, mean and standard error were calculated to describe the participant

characteristics. Prevalence and 95% CI were calculated for all others birth and health outcomes. Prevalence of BMI and anemia by selected socio-demographic characteristics estimated and bivariate analyses were performed to identify variation of these prevalence across different socio-demographic characteristics is significant or not.

Multilevel Analysis

Multilevel analysis is a suitable approach to take into account the social contexts as well as the individual respondents or subjects. The hierarchical linear model is a type of regression analysis for multilevel data where the dependent variable is at the lowest level (Tom Snijders & Roel Bosker 2012). Multilevel analysis is a relatively new statistical technique that particularly appropriate for the research designs where the data for the participants are organized at more than one level (Tabachnick & Fidell, 2001).Because of cost, time and efficiency considerations, stratified multistage samples are the norm for sociological and demographic surveys. For such samples the clustering of the data is, in the phase of data analysis and data reporting, a nuisance which should be taken into consideration. However, these samples, while efficient for estimation of the descriptive population quantities pose many challenges for model-based statistical inference (Raudenbush & Bryk, 2002).This clustering sampling scheme often introduces multilevel dependency or correlation among the observations that can have implications for model parameter estimates (Gelman & Hill, 2006). For multistage clustered samples, the dependence among observations often comes from several levels of the hierarchy. The problem of dependencies between individual observations also occurs in survey research, where the sample is not taken randomly but cluster sampling from geographical areas is used instead. In this case, the use of single-level statistical models like traditional regression model is no longer valid and reasonable (Preacher, Zyphur, & Zhang, 2010). Hence, in order to draw appropriate inferences and conclusions from multistage stratified clustered survey data we may require tricky and complicated modeling techniques like multilevel modeling. Multilevel models recognize the existence of such data hierarchies by allowing for residual components at each level in the hierarchy. Multilevel models can also be fitted to non-hierarchical structures (Professor Bill Browne, University of Bristol).

There are a number of reasons for using multilevel models:

1. **Correct inferences:** Traditional multiple regression techniques treat the units of analysis as independent observations. One consequence of failing to recognize hierarchical structures is that standard errors of regression coefficients will be underestimated, leading to an overstatement of statistical significance. Standard errors for the coefficients of higher-level predictor variables will be the most affected by ignoring grouping.
2. **Substantive interest in group effects:** In many situations a key research question concerns the extent of grouping in individual outcomes, and the identification of 'outlying' groups.
3. **Estimating group effects simultaneously with the effects of group-level predictors:** An alternative way to allow for group effects is to include dummy variables for groups in a traditional (ordinary least squares) regression model. Such a model is called an *analysis of variance* or *fixed effects* model. In many cases there will be predictors defined at the group level. In a fixed effects model, the effects of group-level predictors are confounded with the effects of the group dummies, ie it is not possible to separate out effects due to observed and unobserved group characteristics. In a multilevel (*random effects*) model, the effects of both types of variable can be estimated.
4. **Inference to a population of groups:** In a multilevel model the groups in the sample are treated as a random sample from a population of groups. Using a fixed effects model, inferences cannot be made beyond the groups in the sample.

The 2011 BDHS data set used for this study is based on multistage stratified cluster sampling. The appropriate approach to analyzing BMI and anemia data from this survey is therefore based on nested sources of variability. Here the units at lower level (level-1) are individuals (ever-married women aged (15−49) who are nested within units at higher level (clusters: level-2) and the clusters area gain nested within units at the next higher level (divisions: level-3) (Figure 2.2)

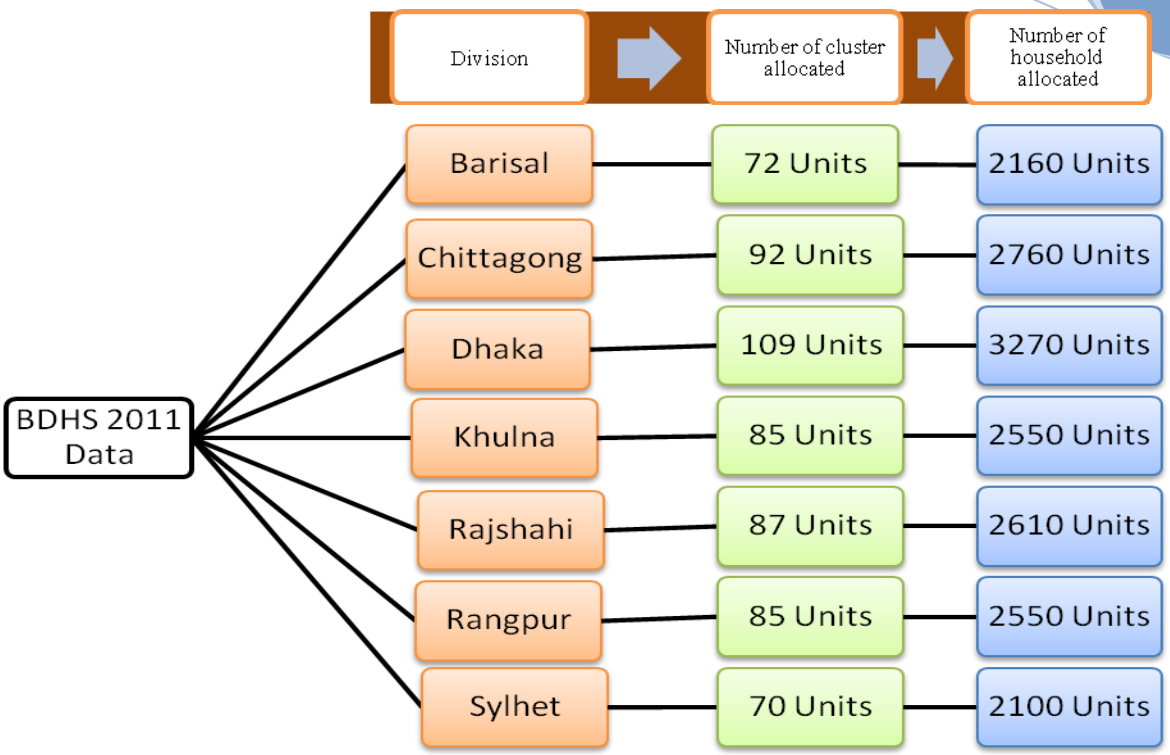

Figure 2.2: Hierarchical data structure of the BDHS, 2011

Clusters are primary sampling units (PSU) defined by the National Census of 2011, and correspond approximately to village in rural areas. All clusters are approximately of equal size in terms of area. On the other hand divisions are administrative areas each of which consists of a number of sub-administrative areas called zila. Due to this nested structure, the odds of women experiencing the outcome of interest are not independent, because women from the same cluster may share common exposure to community characteristics. For this I used multilevel analysis to estimate the effect of BMI and anemia on specific maternal health and birth outcomes.

However, five outcomes variable in my study (stillbirth, early neonatal death, perinatal death, preterm birth, prolonged labor) have the limited number of sample size. In these cases, model convergence issues arose with log binomial model and poisson regression model was used as an alternative. Many others previous literature established it as the most suitable statistical tools in case of rare event (D'unger, Land, McCall, & Nagin, 1998; Zou, 2004). The univariate and multivariate analysis were adjusted by the probability sample design. Both the analysis were performed by statistical software Stata /MP version 13.0 (Stata Corporation LP, College Station, TX).

In this study, the multilevel regression model such as the two level logistic and poisson regression are used in chapter three and chapter four respectively. The detailed description is given in the corresponding chapter.

2.4.5 Systematic Review and Meta-Analysis

Literature Search

To find out the direction of research results, we performed systematic review and meta-analysis. Using comprehensive search strategy, completed a literature search in the renewal database PubMed, Web of Science and Chinal. Searching the key journal and checking the reference list of the paper selected additional paper.

Meta-Analysis

Meta analysis is defined as the use of statistical methods to summarize the results of independent studies i.e. a specific type of systematic review (Huque MF. 1988). Systematic review and meta analysis were needed because of often not replicable/updated, may be biased by prior beliefs, may be commissioned due to published opinion, often miss small but important effects, different reviewers reached different conclusions, affected by subspecialty of reviewer and little attempt to discuss heterogeneity. Odds Ratio (OR) and 95% confidence interval (CI) were collected from each of the selected study. Row data regarding outcomes were extracted incase of absence OR. Meta-analysis was used to summarize the findings of independent study. However, studies can differ on the types of people studies, the nature of the study, study sample size, which can influence the results, leading to heterogeneity between studies. To identify the sources of heterogeneity, the study used I^2 statistic. This test seems to be attractive because it scores heterogeneity between 0% and 100%, with 25% corresponding to low heterogeneity, 50% to moderate and 75% to high (Baliatsas et al., 2012). When the moderate to high heterogeneity was noticed, the study used meta-regression technique to explore the sources of heterogeneity. The presence or absence of heterogeneity also influences the subsequent method of analysis. If the heterogeneity is absent, fixed effect model is used to summarize the series of study. Further, the random effect model is used to synthesis the heterogeneous research.

Chapter Three

Determinants of Adolescent Childbearing in Bangladesh: A Multilevel Logistic Regression Analysis

3.1 Background

In South-East Asia region particularly in Bangladesh, adolescent pregnancy or childbearing is important proxy component of adolescent reproductive health and it is still a major public concern. Thus the identification of potential risk factors of adolescent pregnancy and childbearing may help to formulate policy to prevent premature delivery, death and disability. Young girl grow to adolescent within a complex web of family, peer, community, societal, and cultural influences that affect present and future health and wellbeing (Raatikainen et al 2006). Adolescent age of childbearing, which occurred within 19 years of age is the major public health concern worldwide (Acharya et al., 2014; Chandra-Mouli et al 2014). It is found that each year about 16 million adolescent girls give birth constitutes about 11% of all births worldwide (Christiansen, Gibbs, & Chandra-Mouli, 2013). However, in developing world it is shown that one third to one half birth occurred among adolescent mothers (Acharya et al., 2014). In South Asian countries the situation is severe as higher proportions of adolescent pregnancies due to the common practice of early marriage and social expectation to have a child soon after marriage (Stone, Ingham, & Simkhada, 2003). Within the South Asian countries, the higher rate of adolescent pregnancy reported in Bangladesh (35%) followed by India (21%), Nepal (21%) (Acharya et al., 2014). Lack of reproductive health knowledge, unable to obtain condoms and contraceptives and unable to refuse unwanted sex or to resist coerced sex are another important reasons (Lawlor & Shaw, 2004).

Adolescent pregnancy is emerged as one of the major public health problem in developing countries (Imtiaz et al. 2016). Childbirth at an early age is associated with

greater health risks for the mother as well as her child. Around 529,000 women die every year globally due to the pregnancy and child birth related complication . An estimated 3 million unsafe abortions occur globally every year among adolescent girls aged 15–19 years. Adolescent mother are more likely to be low birth weight, still birth and new born death (WHO, 2014). Consequently adolescent pregnancy significantly affect the women and family, including women education and women employment opportunity and increased economic and social dependency on family and neighbors (Sayem & Nury, 2011).

A larger number of studies were conducted worldwide to find out the determinants of adolescent pregnancy (Brahmbhatt et al., 2014; Jeha, Usta, Ghulmiyyah, & Nassar, 2015). A recent study has identified the social-economic determinants and health consequences of adolescent pregnancy (Maddow-Zimet et al. 2016). But no attempt has done to find out the determinants of adolescent pregnancy in Bangladesh using multilevel model as far as my knowledge. Under these circumstances, in this chapter, an attempt has been made to identify the determinant factors of adolescent childbearing in Bangladesh context employing the nationally representative survey data.

3.2 Method and Materials

In this study the data have been extracted from Bangladesh Demographic and Health Survey 2011. A sub sample of 7641 women has been selected for analysis. We have been used multilevel logistic regression model.

3.2.1 Dependent Variable

Maternal age of child bearing has been considered as a dependent variable. For analytical purposes, we have classified the maternal age of childbearing into two categories, adolescent, women who are ≤19 years and adult women who belongs to greater than equal to 20 years).

3.2.2 Independent Variable

Most of the independent variables in this study have been considered based on previous literature review (Acharya et al., 2014; Brahmbhatt et al., 2014; Henry et al., 2014). Covariates are classified into three level characteristics: individual-level, household-level, and community-level. Individual-level characteristics were respondents education,

husband education, religion, age at first cohabitation, respondent working status and the number of antenatal visit. Community-level characteristics are included as place of residence and region. Household food security and household socio economic status are considered as the household level characteristics. Food security indicators experienced by respondents in 12 months prior to the survey, included in women's questionnaire, have been selected using Household Food Insecurity Access Scale (HFIAS) developed by USAID. Household socioeconomic status, namely the wealth index was calculated using the information of household assets (BDHS, 2011). The wealth index was constructed using household asset data via principal components analysis in demographic and health surveys (BDHS, 2011). Household socio economic status was then estimated by separating the wealth index into quintiles: the first quintile: poorest, the second quintile: poorer, the third quintile: middle class, the fourth quintile: richer and the fifth quintile: richest (BDHS, 2011).

3.2.3 Statistical Analysis

Chi-square test is used to know the association between some selected socio-demographic variables. Prevalence of the adolescent and adult was estimated across the selected variable.

Multilevel Logistic Regression Model

For a dichotomous dependent variable the error distribution in regression model is likely to be binomial, hence binary logistic regression models are useful. A two-level random intercept binary logistic regression model is an extension of single level binary logistic regression model. Multilevel binary logistic regression model with a random intercept at household and community levels were used for investigating the relationships among individual-level, household-level, and community-level characteristics and adolescent age at childbearing. Let the binary response Y_{ij} which equals 1; if the individual *i* in community *j* has experienced positive change in outcome variables and 0 otherwise. Then the probability that the individual has experienced positive change is $P_{ij}= Pr(Y_{ij}=1)$. If k independent variables X_{ij1}, X_{ij2}.....X_{ijk} are measured at the individual level, then a two level random intercept binary logistic regression model can be written as follows:

$$logit\ (Pij)= \beta_{0j} + \sum_{i=1}^{k} \beta_i\ Xij1 \qquad with \qquad \beta_{0j}=\beta_{oj} + u_{0j}$$

Where β_0 is a fixed component and u_{0j} is a community-specific component, the random effect which is assumed to follow a normal distribution with mean zero and variance σ^2_{u0}. Stata version 11.2/SE (Stata Corp, College Station, Texas, USA) was used for all statistical analyses.

3.3 Results

3.3.1 Study Characteristics

The background characteristics of the study population are shown in table 3.1. This table represent that average maternal age is around 26 years. Fertility is one of the three principal components of population dynamics that determine the size, structure, and composition of the population in any country. The average children ever born of this study is around 2.53. The antenatal visit of study population is low and it has around 2.40. Age is an important determinant in any development. In this study age divided into three broad groups such as adolescent, young adult and adult. The prevalence of maternal age of adolescent was around 27.53 and the highest prevalence was young adult groups on the other hand the lowest prevalence observed in adult groups.

Table 3.1: Descriptive statistics of survey households and household members, BDHS, 2011

Characteristics	Number[a]	Crude
Mean (SE)		
Maternal age, years	7641	25. 52 (0.07)
Children ever born	7641	2.53 (0.02)
Age at first cohabitation	7641	15.94 (0.03)
Number of antennal visit	6553	2.40 (0.03)
Education, years	7641	5.54 (0.04)
Prevalence (95% CI)		
Maternal age at birth		
Adolescent	2062	27.6 (26.3-28.9)
Young adult	5173	67.3 (65.9-68.6)
Adult	406	5.2 (4.6-5.8)

SE: standard error; CI: confidence interval. [a] Numbers shown are of household members (for all other characteristics).

3.3.2 Distribution of Adolescent Childbearing by Different Characteristics

The proportion of adolescent childbearing and adult by selected characteristics are presented in Table 3.2. The result shows that respondent and her husband education, religion, working status, socio economic status, age at first cohabitation and antenatal care visits are significantly associated with adolescent childbearing in Bangladesh. But place of residence and food security shows insignificant relation with adolescent childbearing. Education is one of the major socioeconomic factors that influence a person's behaviors and attitudes. Generally, greater educational attainment, the more knowledgeable he or she is about the use of health services, family planning methods, and the health care of children and any others facilities to better living together. To meet the demand for education, the government of Bangladesh has increased investment in the educational sectors. The result exhibits that in respondent education the lowest prevalence of adolescent childbearing is seen higher education (13.8%) and higher secondary education (40.5%) and approximate same result seen in respondent husband education. Marriage is the leading social and demographic indicator of the exposure of women to the risk of pregnancy. Marriage in Bangladesh marks the point in a woman's life when childbearing becomes socially acceptable. Age at first marriage has a major effect on childbearing because the risk of pregnancy depends primarily on the age at which women first marry. In age at first cohabitation we observe that the adolescent who are after 15 years (43.34%) are the lowest prevalence and less than equal to 15 years (20.95%). The result exhibits that the highest prevalence of adolescent childbearing is seen in respondent no working status (31.25%) on the other hand who are work in lowest prevalence (4.13%). However the lowest prevalence is observed in richest (30.56%) and highest in poorest (36.75%). Muslims adolescent have higher prevalence (35.77%) than non-muslims (31.32%). The highest prevalence of adolescent childbearing is seen Rangpur division (41.15%) and Sylhet divisions (25.02%) are the lowest. Antenatal care visits is another important determinants of adolescent childbearing. In this study the prevalence of antenatal care visits shows highest who visit 4 and above (6.67%), 1 to 3 times visits (11.03%) and lowest prevalence no visits (18.17%).

Table 3.2: Percentage distribution of maternal age at childbearing by selected socio-demographic characteristics, BDHS 2011

Characteristics	Percent (95% confidence interval)		p-value
	Adolescent	Adult	
Respondent education			
No education	31.62 (30.7 - 32.55)	68.38 (67.45 - 69.3)	
Primary	38.77 (37.75 - 39.8)	61.23 (60.2 - 62.25)	<0.01
Secondary	40.5 (39.28 - 41.74)	59.5 (58.26 - 60.72)	
Higher	13.87 (12.17 - 15.77)	86.13 (84.23 - 87.83)	
Respondent partner education			
No education	35.05 (34.12 - 36.0)	64.95 (64.0 - 65.88)	
Primary	37.57 (36.52 - 38.62)	62.43 (61.38 - 63.48)	<0.01
Secondary	37.38 (36.32 - 38.45)	62.62 (61.55 - 63.68)	
Higher	25.53 (24.06 - 27.06)	74.47 (72.94 - 75.94)	
Age at first cohabitation			
Early marriage <=15			<0.01
years	43.34 (42.68 - 43.99)	57.54(56.01 - 57.32)	
After 15 years	20.95 (20.22 - 21.70)	79.05 (78.3 - 79.78)	
Antenatal Care			
No visit	18.17 (17.37 - 19.05)	27.29 (25.53 - 29.12)	<0.01
1-3 times visit	11.03 (10.19 - 11.92)	29.66 (28.31 - 31.04)	
4 and above visit	6.67 (5.93 - 7.48)	17.2 (15.92 - 18.56)	
Religion			
Muslims	35.77 (35.15 - 36.41)	64.23 (63.59 - 64.85)	<0.01
Others	31.32 (29.16 - 33.56)	68.68 (66.44 - 70.84)	
Respondent working status			
Yes	4.13 (3.74 - 4.56)	7.62 (7.00 - 8.28)	<0.01
No	31.25 (30.66 - 31.85)	57.0 (56.12 - 57.88)	
Socioeconomic status			
Poorest	36.76 (35.47 - 38.08)	63.24 (61.92 - 64.53)	<0.01
Poorer	36.59 (35.45 - 37.74)	63.41 (62.26 - 64.55)	
Average	36.32 (35.22 - 37.43)	63.68 (62.57 - 54.78)	
Richer	35.93 (34.77 - 37.1)	64.07 (62.9 - 65.23)	
Richest	30.56 (29.31 - 31.84)	69.44 (68.16 - 70.69)	
Food security			
Never	35.25 (34.53 - 35.99)	64.75 (64.01 - 65.47)	0.3
Sometime	35.95 (34.85 - 37.07)	64.05 (62.93 - 65.15)	
Few option	34.78 (33.36 - 36.24)	65.22 (63.76 - 66.64)	
Place of residence			
Rural	35.56 (34.88 - 36.25)	64.44 (63.75 - 65.12)	0.27
Urban	34.78 (33.58 - 36.0)	65.22 (64.0 - 66.42)	
Region			
Barisal	34.62 (33.12 - 36.16)	65.38 (63.84 - 66.88)	<0.01
Chittagong	30.16 (28.91 - 31.44)	69.84 (68.56 - 71.09)	
Dhaka	35.39 (34.13 - 36.68)	64.61 (63.32 - 65.87)	
Khulna	40.04 (38.44 - 41.66)	58.34 (57.34 - 61.56)	
Rajshahi	40.12 (38.44 - 41.66)	59.88 (58.39 - 61.56)	
Rangpur	41.15 (39.79 - 42.52)	58.85 (57.48 - 60.21)	
Sylhet	25.02 (34.79 - 35.98)	74.98 (73.16 - 76.71)	

3.3.3 Determinants of Adolescent Childbearing: A Multilevel Logistic Analysis

In this section the determinants of adolescent childbearing has been observed using multilevel logistic regression model analysis, the results of multilevel are presented in the table 3.3 which show the determinants of adolescent childbearing. This table showed that the risk factors identified using the multilevel binary logistic regression model based on individual, household and community and characteristics. The result indicates that there is a positive association between the respondent's education and the adolescent age at child bearing. The risk is significantly highest among adolescent women with secondary education (OR, 1.21; 95% CI, 1.03-1.39) . About 35% (OR=0.65, 95% CI, 0.49-0.96) lower risk of adolescent childbearing is found among the higher educated women. Similar directions of results are also shown when we adjusted the possible community and household level characteristics. About 31% (OR=0.69, 95% CI, 0.56-0.84) lower risk of adolescent child bearing reported among the adolescent with higher educated husband.

Table 3.3: Results of multilevel logistic regression analysis for adolescent child bearing by selected characteristics, BDHS 2011

Characteristics	Odds ratio (95% Confidence interval)			
	Individual characteristics	Household characteristics	Community characteristics	All characteristics adjusted
Respondents education				
No education	1.00			1.00
Primary	1.14 (0 .98 - 1.32)			1.14 (.98 - 1.33)
Secondary	1.21 (1.03 - 1.39)			1.22 (1.05 - 1.43)
Higher	0.65 (0.49 - 0.96)			0.73 (0.52 - 1.01)
Husband education				
No education	1.00			1.00
Primary	1.10 (0.98 - 1.22)			1.12 (1.00 - 1.24)
Secondary	1.08 (0.97 - 1.19)			1.13 (1.01 - 1.27)
Higher	0.69 (0.56 - 0.84)			.75 (0.61 - 0.92)
Religion				
Islam	1.00			1.00
Non-Muslim	0.94 (0.82 - 1.07)			0.95 (0.81 - 1.05)

Continued Table 3.3

Age at first cohabitation			
<=15 years	1.00		1.00
>15 years	0.50 (0.45 - 0.55)		0.51 (0.46 - 0.56)
Number of antenatal visit			
No visit	1.00		1.00
1-4	0.95 (0.87 - 1.04)		.97 (.89 - 1.07)
>4	0.92 (0.86 - 1.08)		0.95 (0.89 - 1.12)
Household characteristics			
Socioeconomic status			
Poorest	1.00		1.00
Poorer	0.98 (0.94 - 1.03)		1.02 (0.91 - 1.14)
Middle	0.97 (0.92 - 1.01)		0.92 (0.82 - 1.04)
Richer	0.95 (.90 - 0.99)		0.87 (0.76 - 0.99)
Richest	0.80 (0.75 - 0.85)		0.76 (0.65 - 0.90)
Food security			
Never	1.00		1.00
Sometimes	0.97 (0.94 - 1.01)		0.99 (.91 - 1.08)
Few often	0.94 (0.90 - 0.98)		0.91 (0.77 - 1.08)
Place of Residence			
Urban		1.00	1.00
Rural		1.02 (0.98- 1.06)	.96 (.87 - 1.05)
Region of residence			
Barisal		1.00	1.00
Chittagong		0.88 (0.82 - 0.93)	1.02 (0.89 - 1.17)
Dhaka		1.03 (0.97 - 1.09)	1.04 (0.92 - 1.19)
Khulna		1.16 (1.09 - 1.23)	0.97 (0.86 - 1.11)
Rajshahi		1.16 (1.09 - 1.23)	0.87 (0.75 - 1.02)
Rangpur		1.19 (1.12 - 1.25)	1.10 (0.97 - 1.25)
Sylhet		0.72 (0.67 - 0.78)	0.92 (0.78 - 1.09)

It is observed that age at first cohabitation is an important predictor of adolescent child bearing. About 50% lower risk of adolescent child bearing reported among the adolescent whose age at first cohabitation occurs after 15 years as compared to women whose age at cohabitation occurs the less than 15 years. Religion is important socio-demographic variables that determinants of adolescent childbearing. Non-muslims (OR=0.94; 95% CI 0.82 – 1.07) have lower effect than muslims. Adolescent of the Khulna (OR=1.16; 95% CI, 1.09 -1.23), Rajshahi (OR=1.16; 95% CI, 1.09 -1.23) division and Rangpur (OR=1.16; 95% CI, 1.09 -1.25) are reported the higher risk of adolescent child bearing compared to the adolescent in Barisal (OR=0.72; 95% CI, 0.67 – 0.78) division. However, after adjusting the all individual, household and community level characteristics, this higher risk is found to be insignificant. Household socio economic status is also found to be important determinants of adolescent childbearing. In this study we found adolescent with richest wealth quintile (OR=0.80; 95% CI, 0.75 - 0.85) reported the lower risk of adolescent childbearing as compared to the poorer adolescents.

3.4 Discussion

Despite of rapid fertility transition in Bangladesh, adolescent fertility has not been changed at the same pace and magnitude, however the age specific fertility rate consistently during 1993-2011, but the contribution to the country's level of total fertility rates by adolescent has remained still high. The progress in reproductive health behavior of Bangladeshi women has been viewed as a success challenging environment (Mollika et al 2016). However, these pictures conceal the broad variations in reproductive behavior that are prevailing across regions and sub-groups of Bangladesh women by socio-economic strata. One such behavior is adolescent childbearing, and their reproductive health has been neglected. In fact, in the patriarchal Bangladeshi culture, early age at marriage as well as early childbearing like a tradition. In this context, this study attempts as far as possible firstly to identify factors affecting adolescent childbearing by using multilevel logistic regression model. This study tries to find out the linkage between adolescent childbearing and some socio-economic variables. This study found that majority of the women had experienced adolescent pregnancy occurred at the age 15-19

years. Similar findings were found from several studies in developing countries and in Bangladesh (N. Nahar, Afroza, & Hossain, 1998; Sayem & Nury, 2011). Adolescent childbearing age was also reported higher in this group than other age groups in others Asian countries (Berglas, Brindis, & Cohen, 2003).

It is found that five variables (respondent education, age at first cohabitation, current working status, religion and socio economic status) significantly affected the adolescent age of child bearing. Of the significant predictors of our study, education appeared to have a mixed effect of adolescent childbearing, i.e. secondary and less education increased the risk of adolescent childbearing age whereas higher education found to be protecting against adolescent. Previous study conducted in Bangladesh (Sayem & Nury, 2011) and another study (Gökçe, Özşahin, & Zencir, 2007) also found the similar results.

We found that the lower risk of adolescent childbearing age is observed among the women whose age at first cohabitation occurs after age 15 years. Due to early marriage, low contraceptive use, and the social expectation to have children soon after marriage, childbearing begins early in Bangladesh. Although the average age at marriage for females has been rising intermittently since the 1990s (United Nations, 2000; Xenos and Gultiano, 1992), the median age at which Bangladeshi women marry is low compared to other developing countries. We are unable to justify our findings due to the lack of appropriate literature. However, women whose first cohabitation took place before age 15 years, they are relatively lower educated and unaware about the way of unexpected pregnancy (Finer & Zolna, 2014). Higher rate of poverty and marginalized socio economic condition also reported in this groups (Christiansen et al., 2013). All these factors may contribute to the risk factors of adolescent childbearing (Brahmbhatt et al., 2014; Christiansen et al., 2013).

The current study identified that women with uneducated husband were more likely to be experienced the adolescent pregnancy. Previous studies conducted in Bangladesh also found the similar result (Q. Nahar & Min, 2008; Sayem & Nury, 2011). Higher education of husband may associated with high socio economic status on which low fertility and

adolescent marriage both are lower (Brahmbhatt et al., 2014). Educated husband are also aware complication about the adolescent pregnancy (Ahmad, Danborno, Jibril, & Ahmed, 2014). This awareness also contributes to prevent adolescent marriage as well as adolescent childbearing. The higher rate of adolescent childbearing is found among the women in Khulna, Rajshahi and Rangpur division respectively than any other divisions. Previous studies conducted in Bangladesh also found the regional effect on adolescent childbearing (Huang et al., 2008; Sayem & Nury, 2011).

Another socio-economic determinant that is thought to be associated with maternal childbearing age is respondent's place of residence. As hypothesized by (S. Singh, 1998), young girls living in urban areas may have greater motivation to attain higher education and to work for wages, as well as a greater availability of work opportunities, and thus, are less likely to have teenage pregnancy compared to their rural counterparts. Limited analyses from Bangladesh support this hypothesis and suggest that early childbearing among teenagers is less common among urban residents than rural residents (NIPORT, Mitra and Associates, and ORC Macro, 2005). The higher rate of adolescent childbearing in rural areas than urban areas.

3.5 Conclusion

Adolescent childbearing is a crucial moment of psychological and biological change in a mother's life. There is strong evidence that the adolescent's age of childbearing and adults is affected by social factors at personal, family, community, and national levels. Different individuals, household and community level characteristics contribute to the increasing rate of adolescent childbearing. We identified that the strongest determinants of adolescent childbearing were structural factors such as socio economic status, income inequality, age at first cohabitation and access to education. Our study found majority of the women age <=19 years experiencing the pregnancy, indicating a serious public health concern. Women education, husband education, age at first cohabitation, wealth index and region found to be important determinants of adolescent pregnancy. Proper education and increase awareness among adolescent about the adverse effect of adolescent pregnancy are necessary to reduce adolescent child bearing. This will help for the welfare of women health as well as child health.

Chapter Four

Adverse Birth and Health Outcomes of Adolescent Reproductive Health: A Multilevel Poisson Regression Analysis

4.1 Introduction

Delay childbirth has increased significantly over the past several decades in developed countries while teenage pregnancy is still a common in developing countries. Assessing the association between adolescent childbearing and risk of birth and health outcomes may help policy maker to reform or formulate new policies to prevent premature death, disability and other adverse birth outcomes. Globally, adulthood population aged 35 years or over is growing while population aged 10-19 years (adolescent) still accounted for the significant proportion of the total population. Around 18% and 20% of the total world population are now adolescent and adult respectively (UN, 2013). Of the total adolescent population, around 60% are in South Asian region (Akhter & Sondhya, 2013). One in ten birth occurs in adolescent age worldwide; while in developing countries it ranges 30% to 50% (Lloyd, 2005). This early childbearing could make a problem to reach Sustainable Development Goal 3.

Several observational studies show that maternal early and late childbearing is a threat to maternal and infant health (Chen et al., 2007; Jolly et al., 2000; Liu & Zhang, 2014). For mothers, the major health problems are pregnancy-induced hypertension, premature labor, anemia and unsafe abortions (Åhman & Shah, 2011; Mahavarkar, Madhu, & Mule, 2008). Infants of adolescent mothers (below age 15 years) are at increased risk of low birth weight, preterm birth, small for gestational age, stillbirth and early neonatal mortality (de Vienne et al., 2009; Fall et al., 2015; Fleming et al., 2013). Most of the studies focused the adverse child and adult outcomes in connection with maternal age at childbirth in developed countries (Abu-Heija, Ali, & Al-Dakheil, 2002; Chen et al., 2007;

Jolly et al., 2000) and very few from developing countries (Fall et al., 2015). However, findings of these studies are not consistent. For instance, some studies found increased risk of anemia (Conde-Agudelo et al., 2005; Jolly et al., 2000); whereas other found different result (Menacker et al., 2004). The role of maternal early childbirth in adverse perinatal and health outcomes is not well cleared in low-income countries where antenatal and delivery care is lacking sufficiently. Therefore, comprehensive research in low-income countries using nationally preventative survey data may provide the detail information on the association between adolescent pregnancy and related maternal and neonatal outcomes.

Like many developing countries, early childbearing and related premature death and disability are also a significant problem in Bangladesh. Around 35% of women in Bangladesh give birth before reaching age 19 years. To date, some studies addressed the determinant of early motherhood in Bangladesh using community-based survey (Sayem & Nury, 2011). None has assessed the adverse birth and health outcomes in connection with maternal childbearing age using nationally representative population-based survey data in Bangladesh. To the best of our knowledge, this is the first attempt to assess the association between adolescent childbearing and risk of adverse birth and health outcome using population-based survey data.

4.2 Method and Materials

In this section, we used nationally representative Bangladesh Demographic and Health Survey of Bangladesh 2011 data. For this purpose a multilevel poisson regression model has been employed to know the important factors of adverse birth and health outcomes among adolescent mothers. For analysis purposes 17,842 women of reproductive age (13–49 years old) were selected women who have at least one child. The birth recode data file has been used since mothers and health outcomes have been observed.

4.2.1 Variables Used in this Study

There are two types of variables used in this chapter such as exposure variable and another one is outcomes variables. All the exposure and outcomes variables are described below.

4.2.2 Exposure Variable

Women age of childbearing was the exposure variable in this study. We calculated women age at first birth from the date of birth. Consistent with previous studies, the calculated childbearing age was classified into three broad categories: adolescent, ≤19 years; young adult, 20-34 years; and middle adult, 35 years or over (Fleming et al., 2013; Phipps & Sowers, 2002).

4.2.3 Outcome Variables

We included a range of adverse birth and health outcome variables. The birth outcome were low birth weight (LBW) (<2500 gm), preterm birth (PTB) (<37 weeks of gestation), perinatal mortality (stillbirth and early neonatal mortality), early neonatal mortality (death within first seven days of birth), stillbirths (fetal death lasting seven or more months), macrosomonia (excessive intrauterine growth beyond a specific threshold regardless of gestational age), stunting, and wasting. Stunting and wasting defined based on height-for-age and weight-for-age. This height-for-age and weight-for-age converted into z-scores (HAZ and WHZ, respectively) with the World Health Organization proposed growth reference. The stunting and wasting defines as HAZ and WHZ below -2 SDs, respectively. Pregnancy complication (health problem during pregnancy that adversely affect mothers and fetus), pregnancy terminations (termination of the embryo or fetus before capable of survive), cesarean delivery (surgical procedure to deliver a baby), anemia (hemoglobin level <110 g/dl)), menstrual irregularities (menstrual cycle does not vary between 21-35 days), exclusively breastfeeding (child receive only breast milk during first six months of life), genital sore (bumps and lesions around the vagina), genital discharge (discharge thick, pasty, thin, cloudy, bloody liquid from the vagina).

4.2.4 Covariates

This study considered different individual-, household-, and community- level characteristics as confounding adjustment. Individual level characteristics were maternal age (15-19, 20-24, 25-29, 30-34, 35-39, ≥40 years), maternal education (no education, primary, secondary and higher education), husband education (no education, primary, secondary and higher education), present working status (yes, no), and number of antenatal visits. Household socio-economic status (poorest, poorer, average, richer, richest) and household food security (never, sometimes, few often) was considered as household level characteristics. Community level characteristics were region (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, Sylhet) and place of residence (urban, rural).

4.2.5 Statistical Analysis

Descriptive statistics were presented as mean and percentage. For each outcome variables, we used the maximum sample size with available BDHS data. For comparison purposes, maternal childbearing age was classified into three categories (adolescent, young adult, and adult). We considered maternal childbearing age as continuous variables where possible, but most used three categories, for tables, figures, odds ratio, or risk ratio calculations. Multilevel Poisson regression analysis was performed to determine the relationship between exposure and outcome variables. We used multilevel analysis because individuals are clustered within the same households and households are clustered within communities in BDHS data. When lower levels are nested within higher levels, multilevel analysis produces more valid results. All analysis was account for probability sample design.

Multilevel Poisson Regression Model

The two level Poisson regression model (counts of events) with log (natural logarithm) link, fixed part $X\beta$ $(\beta 0 + \beta 1x1 + ... + \beta kxk)$ and community random effects (intercepts) $u \sim N(0,\sigma 2)$.

The equation for the linear predictor takes the form:

$\log(\lambda) = X\beta + u$, and given the random effects, the observed counts are independent and Poisson-distributed with mean λ.

The fixed part may include a term with a regression coefficient fixed at a value of 1 (often termed an offset), corresponding to the (logarithmic) population at risk.

By the linearisation method, the non-linear inverse link function (here, the exponential function) is approximated by a first order Taylor expansion which yields a single equation for the observed count Y containing both the random effect and a standardised error term e:

$Y \approx$ (fixed terms) + $u \exp(X\beta) + \lambda^{1/2} e$, where λ is evaluated at the mean of the random effects, i.e. $\lambda = \exp(X\beta)$.

From this equation it follows that

var $(Y) \approx \sigma 2\exp(2X\beta) + \lambda \equiv \sigma 2(2) + \sigma 2(1)$, say, where $\sigma 2(1) = \lambda$ and $\sigma 2(2) = \sigma 2\exp(2X\beta)$ may be interpreted as variance components at the lower (Individuals) and upper (community) levels, respectively (Stryhn et al., 2006). Stata version 13/SE (Stata Corporation, College Station, Texus, USA) was used for all statistical analysis.

4.3 Result

4.3.1 Study Characteristics

Table 4.1 presents the background characteristics of the study population by maternal childbearing age categories. This table show that the average age of the participants was around 26 years, average years of schooling of women was higher than her husband, age at first cohabitation was around 16 years and average children ever born of the respondent was around 3.9. This table also exhibits that the average weight, height and BMI of the respondent was around 52.2, 156.2 and 23.30 respectively.

Table 4.1: Background characteristics of the study population, BDHS 2011

Characteristics	Crude
Mean (SE)	
Age	25.65 (.07)
Year of schooling	5.53 (.04)
Husband year of schooling	4.59 (.03)
Age at first cohabitation	15.94 (.03)
Weight	52.2 (.77)
Height	156.2 (.76)
BMI	23.30 (.06)
Children Ever Born	3.93 (.01)

Table 4.2 presents the prevalence of different birth and health outcome by maternal childbearing age categories. In both developing and developed countries, birth weight remains an important factor affecting infant and child mortality, especially neonatal mortality. Determinants of birth weight especially low birth weight need to be studied in order to identify potentially modifiable risk factors. The study result shows that the prevalence of low birth weight (17%) and early neonatal mortality (2.6%). Perinatal mortality rate is an important indicator of community health status (Kiasari et al., 2009). Annually, 5.9 million perinatal deaths (stillbirth and death within the first week of life) occur worldwide, about 99% of which happen in developing countries. Reducing perinatal mortality rate and promoting neonatal health in health services are of utmost importance, and most countries aim their health development plans toward reduction of child mortality rates (under the age of five) (Skordis et al., 2005). In our study we show that the prevalence of perinatal mortality and still births were 2.8 and 1.3 respectively.

Table 4.2: **Prevalence of different adverse birth and health outcomes by maternal childbearing age, BDHS 2011.**

Characteristics	Prevalence (95% CI); Crude
Adverse birth outcome	
Low Birth Weight	17.1 (15.9 - 18.2)
Stunting	41.2 (39.6 - 42.9)
Wasting	15.5 (14.5 - 16.6)
Stillbirths	1.3 (1.1 - 1.5)
Macrosomonia	13.8 (12.8 - 14.9)
Perinatal mortality	2.8 (2.5 - 3.2)
Early neonatal mortality	2.6(2.3 - 3.1)
Adverse health outcome	
Pregnancy complication	66.6 (64.3 - 68.7)
Pregnancy termination	18.0 (16.9 - 19.1)
Caesarean delivery	13.9 (12.7 - 15.2)
Anemia	44.1 (42.2 - 47.6)
Menstrual irregularities	67.5 (66.0 - 68.9)
Exclusive breastfeeding	8.88 (8.1 - 9.7)
Genital sore	6.95 (6.5 - 7.5)
Genital discharge	10.5 (9.8 - 11.1)

SE: Standard error

Stunting is a major public-health problem in low and middle-income countries because of its association with increased risk of mortality during childhood (Organization, 2000; Sawyer et al., 2012). United nation for children's fund (Dangour & Uauy, 2006) reported that more than 200 million school-age children were stunted by the year 2000. In the same report, it was pointed out that the proportion of stunted school children with impaired physical and mental development will grow up to 1 billion by the year 2020 unless a tangible action is undertaken. A prevalence of stunting (41%) and wasting (15.5%) was observed in our study.

Globally researchers have gathered substantial evidence in favor of the fact that pregnancy complications among adolescents is associated with maternal complications, premature birth, low birth weight, perinatal mortality, increased infant mortality and maltreatment of children (Mapanga, 1997) . It is also emphasized by Mapanga that the health related disadvantage of adolescents who have become parents heavily outweigh any advantages that there may be (Mapanga, 1997). Complications during pregnancy and childbirth are the second cause of death for 15-19 year-old girls globally. Every year, some 3 million girls aged 15 to 19 undergo unsafe abortions. Babies born to adolescent mothers face a substantially higher risk of dying than those born to women aged 20 to 24 (Organization, 2015a). These studies observed that the prevalence of maternal health outcomes were pregnancy complication (66%), pregnancy termination (18%) and menstrual irregularities (68%).

The increasing worldwide cesarean delivery rate has become a concern in public health and obstetrics. Cesarean deliveries are reported to be associated with higher maternal morbidity and mortality when compared to vaginal deliveries (Schuitemaker et al., 1997). To lower the cesarean delivery rate, efforts have been made to explore the factors involved in the decision to perform a cesarean delivery. Many studies have demonstrated that cesarean delivery rates are influenced by maternal indications, a patient's socioeconomic status, specific aspects of the admitting medical institution, and the

attending physician's personal preferences (Dumont et al., 2002; Gould, Davey, & Stafford, 1989). A prevalence of Caesarean delivery (14%) was observed in our study.

Exclusive breastfeeding (EBF) of infants during their first six months of life is crucial to promote growth and development. Continuous breastfeeding complemented with additional food sources is recommended until the second year of life. Breastfeeding is the optimal way to feed newborns (Organization & UNICEF., 2003) having important benefits for mothers and their infants. Major infant benefits include: decreased risk of childhood infections (Gartner et al., 2005; Kramer & Kakuma, 2012), reduced postnatal mortality rates, decreased sudden infant death syndrome rates (Hauck FR et al. 2011), lowered probabilities of developing diabetes, improved cognitive and motor development (Bernard et al., 2013), among others. Maternal breastfeeding benefits include: lower risk of developing breast and ovarian cancers, adequate weight recovery (Hatsu, McDougald, & Anderson, 2008) and lactational amenorrhea which could be a natural birth control. In our study we showed that the prevalence of Exclusive breastfeeding (9%).

Anemia in pregnant women and adolescent girls has serious health implications. Severe anemia during pregnancy significantly contributes to maternal mortality and morbidity (Brabin, Hakimi, & Pelletier, 2001). There is evidence that severe anemia also increases perinatal morbidity and mortality by causing intrauterine growth retardation and preterm delivery (Prema K et al. 1981). Anemia in adolescent girls affects their physical work capacity and reproductive physiology (Gillespie, 1997). According to a World Health Organization (WHO) report (Organization & Organization, 1992), the global prevalence of anemia among pregnant women is 55.9%.The study also observed that the prevalence of anemia was 44% among adolescent.

4.3.2 Distribution of Maternal Childbearing Age

Maternal childbearing age is a phenomenon that has significant ramifications at personal, societal, and global levels. For the individual woman, childbearing at an early age can shape and alter her entire future life. From the perspective of communities and governments, adolescent pregnancy and childbearing have a strong and unwelcome association with low levels of educational achievement for young women, which in turn may have a negative impact on their position in and potential contribution to society (Division, 1995). Globally, the rates of population growth are more rapid when women have their first child before they are in their twenties (Senderowitz & Paxman, 1985). Numerous individual, family, and community characteristics have been linked to adolescent childbearing. For example, adolescents who are enrolled in school and engaged in learning (including participating in after-school activities, having positive attitudes toward school, and performing well educationally) are less likely than are other adolescents to have or to father a baby (Kirby, Lepore, & Ryan, 2005). Adolescent childbearing has been associated with increased risks for poor birth outcomes, including preterm delivery, low birth weight, and infant mortality. The childbearing age differ substantially by racial and ethnic group, and region of the country. Most adolescents who give birth are 18 or older; in 2014, 73 percent of all teen births occurred to 18- to 19-year-olds (Hamilton, Martin, Osterman, & Curtin, 2015). From the Figure 1 we observed that around 28% of women give birth in adolescent period (age 19 years or less), 67% in aged 25-34 years and 5% in aged 35 years or over.

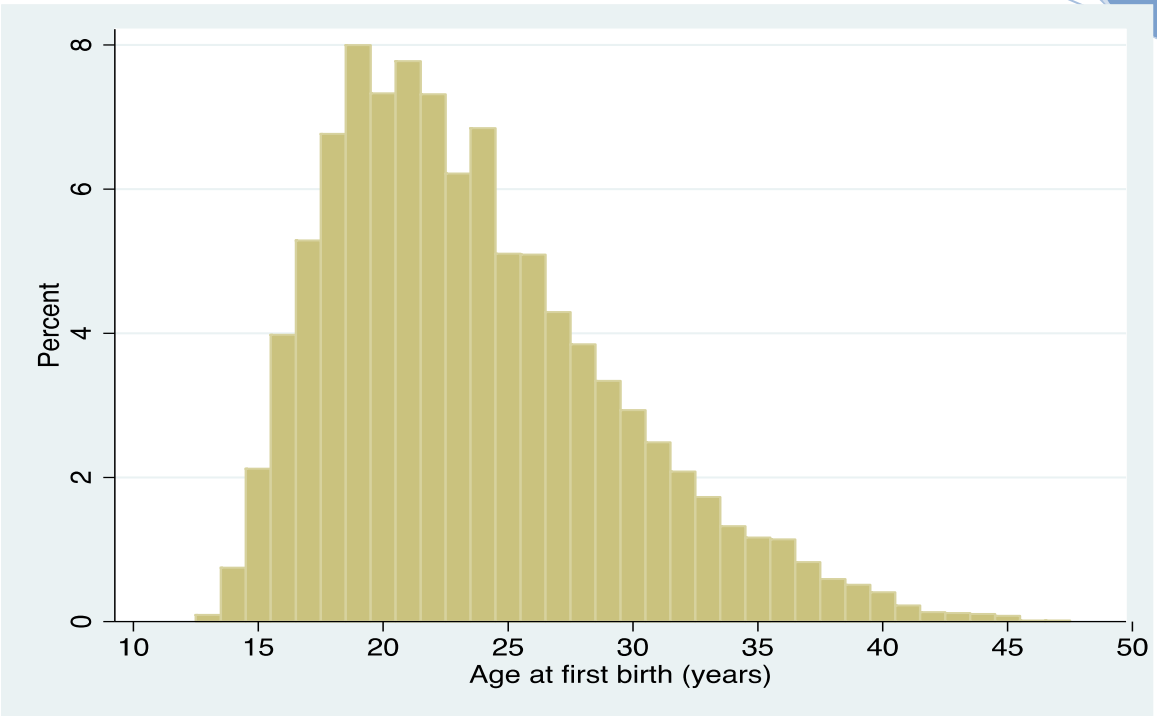

Figure 4.1: **Distribution of childbearing by women reproductive age groups, BDHS 2011**

4.3.3 Maternal Age and Birth and Health Outcomes: Multilevel Poisson Regression Analysis

To assess the association between maternal childbearing age and risk of adverse perinatal and health outcomes, we performed a series of unadjusted and adjusted multilevel Poisson regression models with random intercept household and community. The results of the unadjusted and adjusted models for specific birth and health outcomes are shown in Table 4.3 and 4.4 respectively.

Table 4.3: Results of multilevel poisson regression model for risk assessment of adverse birth outcomes in relation to maternal age, BDHS 2011

	Adolescent	Young Adult	Adult
Low birth weight			
n (%)	381 (18.5)	838(16.2)	76 (18.7)
RR (95% CI)	1.16 (1.02-1.30)	1.00	1.13 (0.91-1.41)
aRR (95% CI)	1.16 (1.02-1.31)	1.00	1.09 (0.86-1.38)
Stillbirths			
n (%)	30 (1.7)	62(1.4)	137 (1.2)
RR (95% CI)	1.19 (0.79-1.81)	1.00	0.84 (0.61-1.14)
aRR (95% CI)	1.13 (0.75-1.72)	1.00	0.43 (0.26-0.72)
Stunting			
n (%)	885 (42.9)	2046(39.6)	178 (43.8)
RR (95% CI)	1.04 (0.98 - 1.12)	1.00	1.07 (.93 - 1.21)
aRR (95% CI)	1.06 (0.98 - 1.14)	1.00	0.95 (0.83 - 1.09)
Wasting			
n (%)	312(15.1)	799(15.5)	73 (18.0)
RR (95% CI)	0.98 (.87 - 1.10)	1.00	1.15 (0.92 - 1.44)
aRR (95% CI)	0.92 (.81 - 1.05)	1.00	1.11 (0.88 - 1.40)
Macrosomia			
n (%)	298 (14.5)	749(14.9)	41(10.1)
RR (95% CI)	1.00 (0.87-1.15)	1.00	0.69(0.50-.94)
aRR (95% CI)	1.02(0.87-1.20)	1.00	0.72(0.52-1.00)
Perinatal mortality			
n (%)	76 (4.3)	178(4.0)	195(1.7)
RR (95% CI)	1.08 (.79 - 1.47)	1.00	0.45 (0.36 - .56)
aRR (95% CI)	0.94 (0.64 - 1.27)	1.00	0.67 (0.48 - .94)
Early neonatal mortality			
n (%)	46(2.6)	118(2.6)	60 (2.4)
RR (95% CI)	1.99 (1.45 – 2.72)	1.00	2.48 (1.64 – 3.71)
aRR (95% CI)	1.60 (0.85 – 1.27)	1.00	1.43 (0.76 – 2.68)

n:sample size; CI: confidence interval; RR: relative risk; aRR: adjusted relative risk

We performed a likelihood ratio test to choose the preferable models. The test compared random effect model against the fixed effects model and it is found statistically significant results (P<0.05). This implies that random effect models are necessary to assess the association between exposure (maternal age of childbearing) and outcomes (birth and health) variables. Adverse neonatal outcomes for all live births are summarized in Table 4.2. Neonatal born to adolescent mothers had higher risk of low birth weight (adjusted relative risk (aRR), 1.15; 95% CI, 1.00-1.33) than women of other age groups such as young adult and adult. The adjusted risk is also higher among women who have children with child stunting (aRR, 1.06; 95% CI, 0.98-1.14), and early neonatal mortality (aRR, 1.60; 95% CI, 0.85-1.27) than young adult and adult mothers. Relatively higher risk of stillbirth (RR, 1.37; 95% CI, 0.96-1.97) is also found among adolescent mothers compared to young adult mothers. The risk of giving wasting infant is lower in adolescents (aRR, 0.92; 95% CI, 0.81-1.05). It is also exhibited that the risk of perinatal mortality among adolescent mothers are comparatively higher than their counterparts. There was no significant difference in risks of macrosomia (aRR 1.02; 95% CI, 0.87-1.20) was found between adolescents and young adults mothers.

Table 4.4: Results of multilevel poisson regression model for risk assessment of adverse health outcomes in relation to maternal age, BDHS 2011

	Adolescent	Young Adult	Adult
Pregnancy complication			
n (%)	777 (66.8)	2069(68.3)	122 (65.6)
RR (95% CI)	.97 (0.92-1.02)	1.00	1.00 (0.87-1.14)
aRR (95% CI)	0.97 (0.92-1.03)	1.00	1.02 (0.90-1.15)
Pregnancy termination			
n (%)	212 (10.3)	1055(20.4)	117(28.8)
RR (95% CI)	0.54 (0.44 -0 .57)	1.00	1.41 (1.18-1.67)
aRR (95% CI)	0.56 (0.48 - 0.64)	1.00	1.31 (1.09-1.56)
Caesarean delivery			
n (%)	241 (11.7)	841(16.3)	49 (12.2)
RR (95% CI)	0.83 (0.72-.97)	1.00	.89 (0.63-1.25)
aRR (95% CI)	0.85 (0.73-.99)	1.00	1.35 (1.02-1.79)
Anemia			
n (%)	283 (42.2)	725(43.8)	65 (50.8)
RR (95% CI)	0.91 (0.81 - 1.03)	1.00	1.07 (0.86 - 1.32)
aRR (95% CI)	0.90 (0.79 - 1.04)	1.00	1.01 (0.81 - 1.26)
Menstruate irregularities			
n (%)	1394 (67.6)	3517(68.0)	299 (73.7)
RR (95% CI)	0.99 (0.96 - 1.03)	1.00	1.08 (1.01 - 1.15)
aRR (95% CI)	0.98 (0.94 - 1.02)	1.00	1.14 (1.06 - 1.23)
Genital discharge			
n (%)	331 (10.6)	1246(10.6)	289 (9.8)
RR (95% CI)	0.98 (0.86 - 1.10)	1.00	0.88 (0.77 - 1.02)
aRR (95% CI)	0.94 (0.82 - 1.09)	1.00	0.83 (0.68 - 1.03)
Genital sore/Ulcer			
n (%)	225 (7.2)	838(7.1)	171 (5.8)
RR (95% CI)	1.07 (.91 - 1.26)	1.00 ()	0.81 (0.68 - .97)
aRR (95% CI)	1.04 (0.86 - .1.25)	1.00	0.83 (0.64 - 1.09)
Exclusive breastfeeding			
n (%)	159 (7.7)	485(9.4)	23 (5.7)
RR (95% CI)	0.88 (0.75 - 1.02)	1.00	0.80 (0.56 - 1.14)
aRR (95% CI)	0.89 (0.75 - 1.06)	1.00	0.83 (0.57-1.20)

n: sample size; CI: confidence interval; RR: relative risk; aRR: adjusted relative risk

again multilevel poisson regression model has been used to know the adverse health outcomes among adolescent mothers compared with young adults and adults. Adverse maternal pregnancy and obstetrical outcomes for all live births are presented in Table 4.3. Adolescents had a significantly lower risk of caesarean deliveries than young adult women (aRR, 0.85; 95% CI, 0.73-0.99).When adjusted for all possible confounding factors, adolescents had a lower risk than adults of pregnancy termination (aRR 0.56; 95% CI 0.48-0.64), anemic (aRR, 0.90; 95% CI, 0.79-1.04), genital discharge (aRR,0.94; 95% CI, 0.82-1.09) and exclusive breastfeeding (aRR, 0.89; 95% 0.75-1.06). The risk of facing pregnancy termination and menstruate irregularities was significantly higher in adult mothers than young adult counterparts.

4.4 Discussion

With data from population-based cross-sectional studies in Bangladesh, this study, to our best knowledge, is one of the largest connecting maternal childbearing age and range of neonatal and maternal health outcomes with adjustment for multiple confounders. The study showed that around 35% of all live births result from adolescent pregnancy in Bangladesh. The study also demonstrated that adolescent pregnancy had an increased risk of low birth weight, stillbirth, stunting, and early neonatal mortality; however, adolescent females was protective against pregnancy termination and caesarean delivery.

Both in developed and developing countries, birth weight is probably the most important factor that affects the neonatal mortality (Karim, Flora, & Akhter, 2011). Our study demonstrated that overall prevalence of low birth weight was 18%. Higher proportion of low birth weight was found among adolescent (19%) than young adult mother (16%), which was almost consistent with other Asian countries including Maldives (22%), Nepal (21%), Sri Lanka (22%), and Pakistan (19%) (Salam, Haseen, Yusuf, & Torlesse, 2004). However, the prevalence of low birth weight was bit different in India (low birth weight, 30%) than other countries South Asian countries. Consistent with other studies (Ahmad et al., 2014; Golestan et al. , 2012), our multiple regression model indicated that adolescent pregnancy was associated with increased risk of delivering low birth weight

babies. Our study implies that the mechanisms of low birth weight in relation to adolescent partially differ (Weng, Yang, & Chiu, 2014). So, further investigations are required to clarify the difference. Childbearing during adolescent may impose the double set of nutritional demands, as she struggle to complete her own growth while also providing the nutrients needed for the development of the fetus (Salam et al., 2004).

Our study found on average, stillbirths were 12 per 1000 live births and early neonatal deaths were 26 per 1000 live births. These rates were relatively higher among adolescent mothers (stillbirths, 14 per 1000 lives births and early neonatal mortality, 26 per 1000 live births) than adult mothers (stillbirths, 12 per 1000 lives births and early neonatal mortality, 24 per 1000 live births). The multilevel regression analysis indicated that adolescent pregnancy had higher risk of stillbirths, stunting, perinatal and early neonatal mortality than young adult mothers. Consistent with other studies, after adjusting potential confounding factors, the association become insignificant for early neonatal mortality (Raymond, Cnattingius, & Kiely, 1994; Reddy, Ko, & Willinger, 2006). The exact biological mechanism of increased stillbirth and early neonatal mortality risk with early childbearing age is uncertain. This would probably be related to poor uterine vasculature, medical and obstetric complication among both the young (de Vienne et al., 2009; NAEYE, 1983; Shrim et al., 2011; Usta & Nassar, 2008). Similar to previous studies (Bayrampour & Heaman, 2010; de Vienne et al., 2009; Jahromi & Husseini, 2008). They found that adolescent pregnancy was associated with lower risk of caesarean delivery. But adolescent pregnancy in this study was associated with lower risk of pregnancy termination, and caesarean delivery after adjusted for potential confounding in multilevel models. Our study showed that a proportional decrease of macrosomia with an increase in maternal age. This findings is inconsistent with the previous study (Gu et al., 2012; Weng et al., 2014). So, further investigations are required to clarify the difference.

To the best of our knowledge, this is the first nationally representative study in Bangladesh that assessed the association between maternal age and risk of adverse neonatal, obstetric and maternal complications. The study includes appropriate statistical models to establish the association, which may conclude better findings. Despite this

strength, we acknowledge that the study has some limitations. The study failed to establish casual relationship between the observed associations due to cross-sectional nature. This study also based on the self-reported data about different adverse birth and health outcome, which are subject to participants' recall bias. However, the self-reported data may not affect much in our analysis because the prevalence of all the adverse neonatal and health outcomes variables were consistent with other Asian countries. To establish more valid association between adolescent pregnancy and adverse neonatal and health outcomes, large-scale prospective cohort studies is necessary.

4.5 Conclusion

In Bangladesh, adolescent motherhood is casually related with increase adverse reproductive health problems and delivery reported issues, premature delivery, higher incidence of low birth weight, still birth and perinatal mortality. Moreover, adolescent motherhood has negative socio-economic and health consequences for mothers and their children. In this study the large population-based study suggested that adolescent pregnancy was associated with increased risk of low birth weight, childhood stunting, stillbirths, perinatal and early neonatal mortality in Bangladesh. However, pregnancy termination and cesarean delivery were considerably lower among adolescent as compared with young adults. Social awareness and available information about adolescent reproductive and sexual health as well as adverse birth and health outcomes for the consequences of early childbearing to premature birth, death, and disability etc. Scale up childbearing to young adult pregnancy necessary to avoid premature birth, deaths, and other neonatal disability in low-income settings like Bangladesh.

Chapter Five

Adolescent Childbearing Age and Risk of Adverse Birth and Health Outcomes: A Systematic Review and Meta-Analysis

5.1 Introduction

Adolescent pregnancy and childbearing is still more prevalent in South Asian region especially in Bangladesh, India, Pakistan, Sri Lanka, Nepal, and Afghanistan. Adolescent pregnancy may be a potential threat of mother and newborn offspring. Ensuring good health for all citizens is the main mission in newly adopted Sustainable Development Goals. Therefore, pool assessment regarding perinatal outcomes in connection with adolescent necessary to trace the progress of development in a country. The world now observed the highest number of adolescent, as the global fertility continue to decline. In 2009, around 1.2 million adolescence is forming 18% of the world populations. With 60% of the world population lived in Asian countries and half of adolescent in South Asian region. Around 50% of the world adolescent pregnancy also reported in this region.

Some important factors strongly influenced the adolescent pregnancy worldwide as well as the Asian countries. The first factor is the declined age at menarche. Historical data in the Asian countries show a clear secular trend, with age at menarche declined at a rate of 3-4 month per decades (Wellens et al., 1990). This declined of menarche is mostly attributed to improved diet, lower rate of infection and improved environment (A. A. Chowdhury, Huffman, & Curlin, 1977). Besides these, cultural adulteration in all stage of society worked as another important role to increase the existing higher rate of adolescent marriage as well the pregnancy (Xu & Burleson, 2001). The another factor is low rate of contraception use among adult and as well as adolescent. Although, knowledge and use of contraception has been increasing globally, many adolescent have inadequate

protection against pregnancy and contraception use among adolescent is still very low. For example, only 60% of adolescent consistently use in contraception of Asia. This may be related to lacking of education about contraception, and less access to contraceptives and emergency contraception (Chen et al., 2007).

Adolescent childbearing has consequences of both adverse birth and health outcome and individual socioeconomic development. At the society level, adolescent pregnancy hampered to continuation of school or the economic activity (Ashcraft, FernándezVal, & Lang, 2013). Increasing percentage of healthcare costs, incarceration, foster care, and lost productivity are also attributed to adolescent pregnancy (Ashcraft et al., 2013). Giving birth during adolescent is also accounted for adverse consequences like lower educational performance and poor nutritional statuses which negatively affect the future well-being of the mothers and infant health (Evans, Li, & Whipple, 2013).

Heath consequences of the adolescent pregnancy are also noticeable. Worldwide, previous studies have reported an increased incidence of adverse maternal and perinatal outcomes, such as low birth weight (C. W. Chen et al., 2010; Chen et al., 2007; de Vienne et al., 2009), preterm birth (X.-K. Chen et al., 2007; de Vienne et al., 2009), perinatal death (X.-K. Chen et al., 2007; Mukhopadhyay et al., 2010) and maternal death (Conde-Agudelo et al., 2005; Granja et al., 2011). However, there were conflicting findings from previous studies as to whether the adverse pregnancy outcomes among adolescent mothers were caused by their biological immaturity (Conde-Agudelo et al., 2005), or poor socio-environmental factors (Raatikainen et al., 2006).This may be explained by the heterogeneity between study settings, small sample size, especially for younger adolescents (i.e.≤15 years), and the quality of medical services and women's social and cultural backgrounds.

Because of higher number of adolescent pregnancy in South Asia, any adverse effect of adolescent pregnancy on birth and health outcomes, it creates a question of public health implication. However, studies on adolescence pregnancy outcome yielded conflicting result, and opinion of different authors vary in this regard. (Chhabraet al.,2004 and

Hossain et al.2006) reported adolescent pregnancy was significantly associated with low birth weight. On the contrary, (Goonewardene & Waduge, 2009) conclude that adolescent pregnancy was not significantly associated with low birth weight. Nevertheless, among others studies, few of them addressed adolescent pregnancy is a risk factors of perinatal mortality (Yadav et al.,2008) and SGA (Sharma et al., 2008). However, (N. Nahar et al., 1998) and (Fikree & Gray, 1996) found the lower risk of low birth weight among the adolescent pregnancy. (Yadav et al., 2008) did not find any significant association regarding adolescent pregnancy and small for gestational age.

To date, there is no comprehensive systematic review with meta-analysis on early pregnancy and risk of perinatal outcomes in resource-limited region like South Asia. Due to the above mentioned conflicting results from original studies and lack of pool results, we performed a systematic review and meta-analysis of the studies published in the South Asian region to clarify the controversies of adverse birth and health outcome in connection with adolescent pregnancy and adolescent childbearing.

5.2 Method and Materials

We performed the systematic review and meta-analysis following the PRISMA consensus statement on the conduct of meta-analysis of observational studies. Relevant and available related to the adverse birth and health outcome that are associated with adolescent pregnancy in South Asian countries were included.

5.2.1 Search Strategy

Systematic computerized literature search of the world renewal PubMed, Web of Science, and Chinal databases was conducted on February 13, 2016. Individual and comprehensive search strategy was used. We developed search strategies consisting of a combination of free text words, words in titles/abstracts and medical subject heading for participants, exposure, and settings. Further search for eligible studies was conducted by reviewing the reference within the identified papers and relevant journal. No time, language and outcome restrictions have been set.

5.2.2 Study Eligibility Criteria

We included the study if it was a comparative study on adverse birth and health outcome in connection with early childbearing. Adolescent women were defined as the exposure variable and raw data were presented. No restriction was predetermined in case of study design and language. The outcome variable were low birth weight (LBW) (<2500 g), preterm birth (PTB) (<37 weeks), still births (baby born with no signs of life at or after 28 weeks' gestation), perinatal mortality (sum of stillbirths and the deaths in the first weeks of life), neonatal mortality (death within first month of birth), stunting (child is shorter than for age), wasting (weight is low compared to height), anemia (hemoglobin (Hb) values <11 g/dl), small for gestational age (SGA) (defined as birth weight below the tenth percentile of the gestational age and sex), preeclampsia (defined as disorder of pregnancy characterized by high blood pressure and a large amount of protein in the urine) and cesarean delivery (defined as the delivery through the surgical procedure).

We did not search unpublished papers. We exclude duplicates publications and studies published only as abstract. For the multiple publications from the same study, if they refereed to same exposure and outcome variable, only one publication was included.

5.2.3 Study Selection

Two assessors (Alam M.R and Roy TK) independently performed the title and abstract screening. The full-text article was retrieved if either reviewer considered the citation potentially relevant. Each full-text article was independently evaluated. Disagreements were settled by discussion and consensus, with a third person (Rahman M.M) available as an adjudicator.

5.2.4 Data Collection Process and Data Items

Prior to tabulating the final data, a data extraction form was designed, trailed and modified. Two reviewers (Alam M.R and Roy TK) independently extracted the following data from full-text articles: country of origin, year of study, study design, participants, exposure, outcomes, confounders and measure of association based on information available from publications. Inconsistencies were checked and resolved through the

consensus process described above, with a third person (Rahman M.M) available as an adjudicator.

5.2.5 Data Synthesis

The odds ratios (Ors) as the effect measure were extracted from each study. If the OR was unavailable, unadjusted OR with 95% CI was estimated from raw data. Fixed-effects or the random-effects model were used to obtain the summary estimate based on the heterogeneity index (I^2). I^2 statistics with P-value was estimated for each meta-analysis to describe the extent of heterogeneity. When the test heterogeneity was moderate (50%) and high (75%), the pooled estimates of ORs were computed by using the random-effects meta-analysis.

We explored the sources of heterogeneity through the subgroup and meta-regression analysis. We used the pre-specified subgroups based on studies characteristics: country, study design, confounding factor and sample size. The Stata version 13.1 software was used for statistical analyses.

5.3 Results

5.3.1 Literature Search

Figure 1 shows that the results from the literature search and study selection process. We identified a total of 2650 potentially eligible citations. An additional 8 reference have been identified from the reference lists of selected articles and renewal journal database. Detailed review of the identified full text papers yielded 24 studies. Of these 24 studies, 4 case-control, 8 cross-sectional, and 12 cohort study. Around 10 studies (41.67%) were from India, 6 studies (25.0%) were from Bangladesh, 2 studies (8.33%) were from Pakistan, 4 studies (16.67%) were from Nepal, and 2 studies (8.33%) were from Sri Lanka. We did not find any related study conducted in to Afghanistan, Bhutan and Maldives.

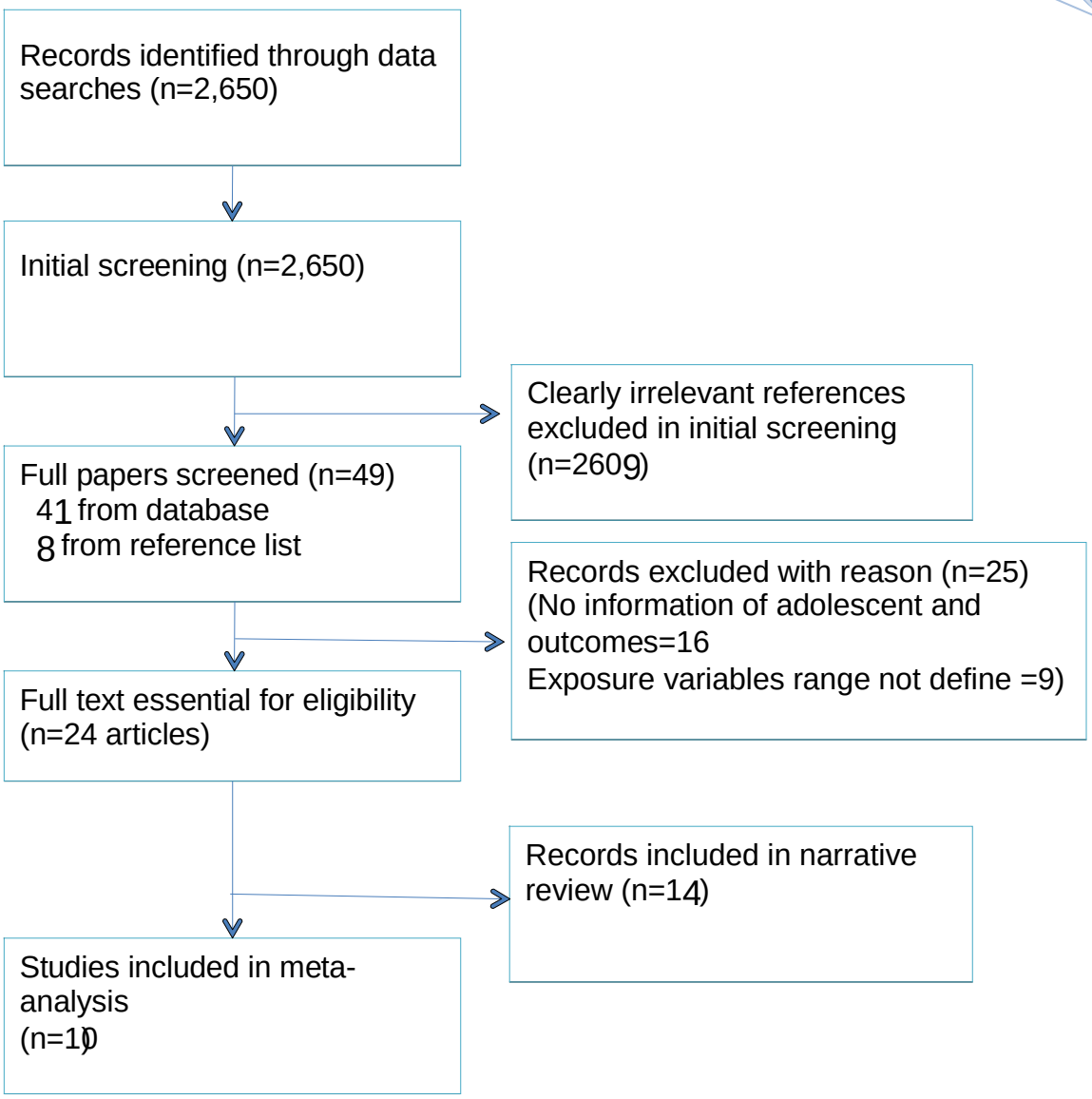

Figure 5.1: Study selection of PRISMA flow chart

5.3.2 Study Characteristics

The basic characteristics of the 24 studies included in our systematic review are presented in Table 5.1. Among of them 10 studies goes to the meta analysis and 14 papers goes to the narrative review. The 10 included studies examined a total of 34,060 participants among them 8404 women were adolescent and rest of them were young adult and adults. This included 2492 women with an LBW infant, 53 women with a perinatal mortality infant, 3622 women with an SGA infant, 1298 women with a preterm birth infant, 250

women with a neonatal mortality infant and 89 women with a caesarean delivery, 172 women with a anemia, 19 women with a gestational hypertension and 7 women with a pre-celampsia. Included studies arose from populations in SAARC countries spanning 5 continents, with most studies originating from Bangladesh (11%), India (9%), Nepal (42%), Pakistan (19%), and Sri Lanka (19%). Sample sizes ranged from 350 to 10475 participants. In women who experienced IPV during pregnancy, rates of PTB, LBW, and SGA were 2.5–70.4%, 3.3–68.8%, and 6.3–27.2%, respectively. In women who were experience adolescent, rates of LBW, PTB, SGA, prenatal mortality, neonatal moratlity and caesarean delivery were 11–59%, 11–21%, 18–64%, 3-20%, 0.7-7% and 5-9% respectively. In women who were experience young adult and adult, rates of LBW, PTB, SGA, prenatal mortality, neonatal moratlity and caesarean delivery were 6-39%, 6-16%, 16-56%, 1.4 – 22%, 0.4 -4.6%, and 5-12% respectively.

Table 5.1: Background Study population in South Asian Countries

Study (location)	Sample	Study design	Mean age (years)	Outcome	Confounding adjustments
(Fariha Anjum, 2011) (Pakistan)[a]	360	Case-control	26.46	LBW	Unadjusted
(Baqui et al., 2011) (Bangladesh)[b]	1748	Case-control	N/A	Still Births	Unadjusted
(Chhabra et al., 2004) (India)[b]	909	Cross-sectional	23.9	LBW	Unadjusted
(M. E. Chowdhury, Akhter, Chongsuvivatwong, & Geater, 2005) (Bangladesh)[b]	1019	Prospective cohort	N/A	Neonatal mortality	Unadjusted
(Fall et al., 2015) (Multi-country)[a]	22188	Prospective cohort	26.0	LBW, preterm birth,stunting, wasting	Sex, socioeconomic factors maternal height, breastfeeding,and parity
(Fikree & Gray, 1996) (Pakistan)[b]	6445	Cross-sectional	N/A	Perinatal mortality	Unadjusted
(Ganatra & Hirve, 2002) (India)[a]	1717	Cross-sectional	N/A	Induced abortion	Unadjusted
(Goonewardene & Waduge, 2009)	6500	Prospective	N/A	LBW, anemia,	Unadjusted

(Srilanka)[b]		cohort		Precelampsia,GH, C-delivery, preterm birth	
(Hirve & Ganatra, 1994) (India)[b]	1922	Prospective cohort	N/A	LBW	Unadjusted
(Hosain et al., 2006) (Bangladesh)[b]	350	Prospective cohort	26.5	LBW	Unadjusted
(Jananthan, Wijesinghe, & Sivananthewerl, 2010) (Sri Lanka)[a]	563	Retrospective cohort	28.2	LBW	Unadjusted
(Karkee, Lee, Khanal, & Binns, 2014), (Nepal)[a]	639	Prospective cohort	N/A	Exclusive Breastfeeding	Unadjusted
(Kochar, Dandona, Kumar, & Dandona, 2014)(India)[a]	15130	Cross-sectional	N/A	Still birth, pregnancy termination	Unadjusted
(Kushwaha, Rai, Rathi, Singh, & Sirohi, 1993) (India)[a]	430	Cross-sectional	N/A	LBW, Neonatal mortality and pregnancy termination	Unadjusted
(Metgud, Naik, & Mallapur, 2012) (India)[a]	1138	Cohort study	N/A	LBW	Adjusted

(S. Nahar, Rahman, & Nasreen, 2013) (Bangladesh)[b]	676	Prospective cohort	24.1	Still birth	Unadjusted
(Negandhi et al. 2014),(India)[a]	384	Case-control	24.1	LBW	Unadjusted
(Noronha et al. 2010),, (India)[a]	1077	Cohort study	N/A	Anemia	Unadjusted
(Rahman, Nessa, Ali, & Ali, 1989) (Bangladesh)[a]	6588	Cross-sectional	N/A	Stillbirth, pregnancy termination	Unadjusted
(Riley, 1994),(Bangladesh)[a]	382	Cohort study	N/A	Still birth	Unadjusted
(Sharma et al., 2008),(Nepal)[b]	10475	Case-control	N/A	LBW, Preterm birth, SGA,,noonatal mortality	Unadjusted
(Suwal, 2012),(Nepal)[a]	100	Cross-sectional	N/A	C-delivery,perinatal mortality	Unadjusted
(Toteja et al., 2006),(India)[a]	6923	Cross-sectional	N/A	Anemia	Unadjusted
(Yadav et al., 2008), (Nepal)[b]	4101	Retrospective cohort	21.91	LBW, preterm birth, SGA,C-delivery, still birth and neonatal mortality	Ethnic group and parity

Note: [a] goes narrative review, [b] goes to meta analysis, LBW: Low Birth Weight, PTB; Preterm Birth, SGA; Small for gestational age

5.3.3 Meta-Analysis Pool Results

Adverse Birth Outcomes

Forest plot 5.2 shows the summary results of low birth weight, preterm birth and small for gestation age**.** Six studies reported adolescent childbearing as a risk factor of low birth weight. Summary estimate also reported significant higher risk of low birth weight (OR, 1.50; 95% CI, 1.27-1.78) among the adolescent maternal women. From this estimate, we also reported higher level of heterogeneity (I^2 = 62%). To find out the sources of heterogeneity, we performed the subgroup analysis. From this subgroup analysis, we found the significant higher risk of low birth weight among the studies whose sample size was less than 5514. Significant higher risk of LBW among adolescent also reported all the studies regardless of study design. Around 1.46 times (OR, 1.46; 95% CI, 1.19-1.79) and 1.72 times (OR, 1.72; 95% CI, 1.31-2.24) higher risk of low birth weight reported among the adolescent mothers when we considered the unadjusted to adjusted model.

Three studies reported on the association between adolescent childbearing age and preterm birth. The pooled analysis showed the significant higher risk of preterm birth among adolescent mothers (OR 1.49; 95% CI 1.15 – 1.93).Two studies reported on the association between adolescent childbearing age and small gestational age. The pooled analysis shows that the significant higher risk of small gestational age (OR, 1.33; 95% CI, 1.13-1.56) among adolescent mothers compared to the adult maternal women.

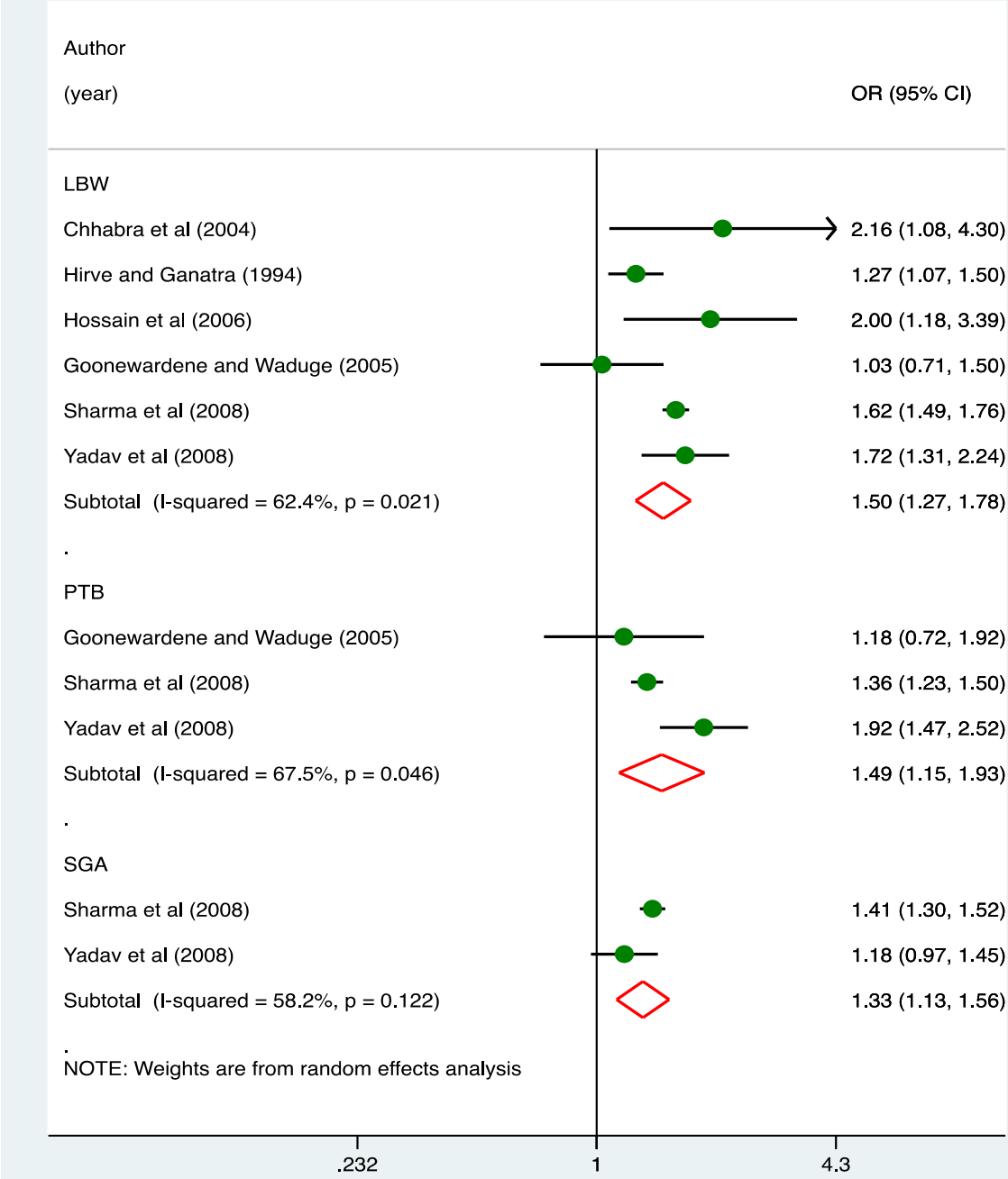

Figure 5.2: Adolescent pregnancy and risk of low birth weight, preterm birth and small for gestational age

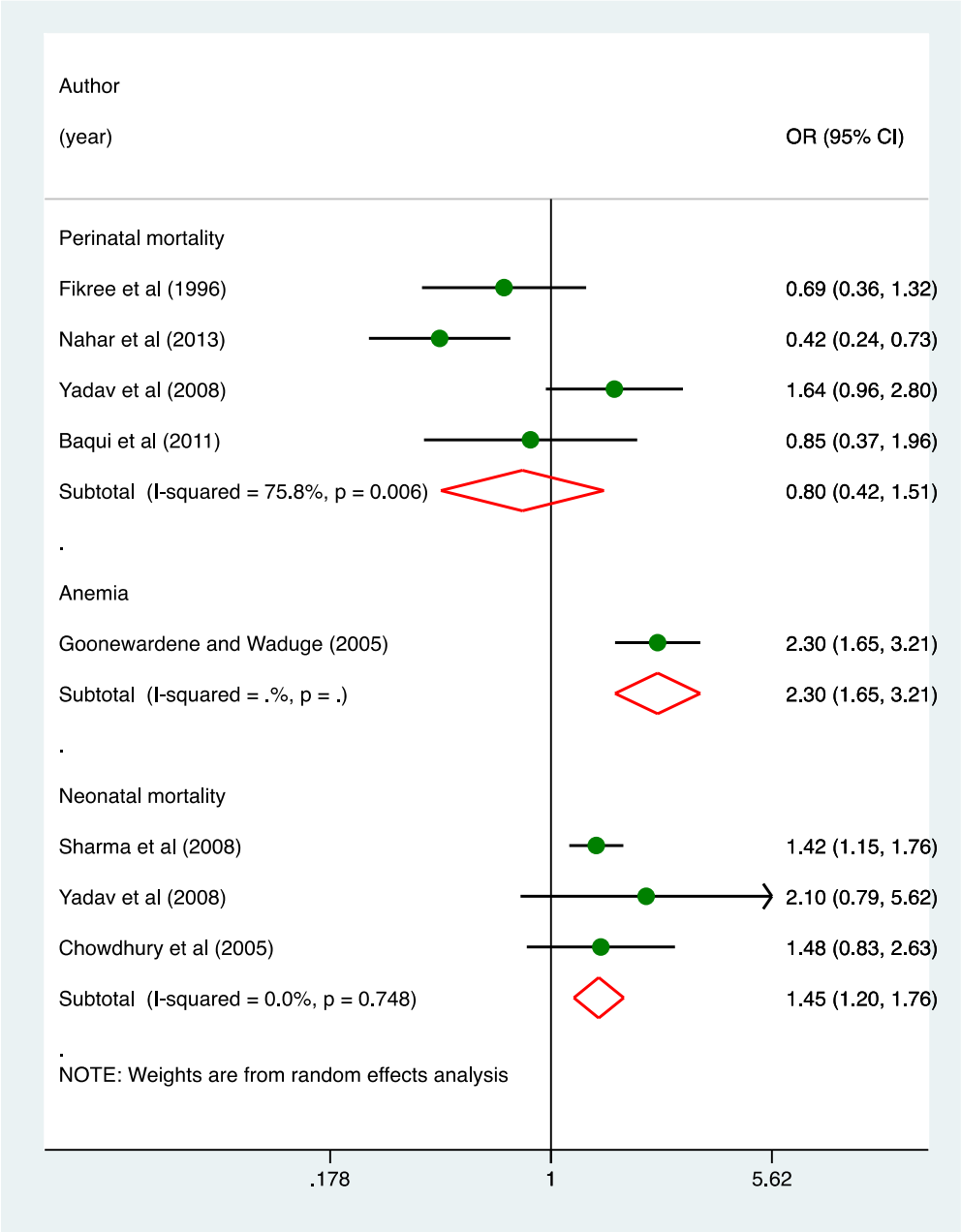

Figure 5.3: Adolescent pregnancy and risk of perinatal mortality, neonatal mortality and anemia

Anemia and Mortality

The summary results of anemia, perinatal and neonatal mortality is presented in Figure 5.3. Summary estimate of perinatal mortality also found the lower risk among the adolescent maternal women. Significant higher level of heterogeneity also reported in summary estimate. To find out the sources of heterogeneity, we further conduct the subgroup analysis. From this study, we found cohort study and the adjusted model reported the higher risk of perinatal mortality and the resulting reported the lower risk of perinatal mortality. However, all the findings were statistically insignificant.

Summary estimate also reported around 1.45 times (OR, 1.45; 95% CI, 1.20-1.76) higher risk of neonatal mortality among the adolescent maternal women as compared to the adult maternal women. We did not found any heterogeneity among this summary result.

Maternal Adverse Health Outcomes

The summary results of caesarean delivery, gestational hypertension and preeclampsia in connection to maternal age at birth is presented in Figure 5.4.From the summary result we found that around 23% lower risk of cesarean delivery among the adolescent maternal women. Only one study reported around 1.95 times (OR, 0.84; 95% CI, 0.84-4.51) and 1.88 times (OR, 1.88; 95% CI, 0.48-7.33) higher risk of gestational hypertension and preeclampsia among the adolescent maternal women compared to the adult maternal women.

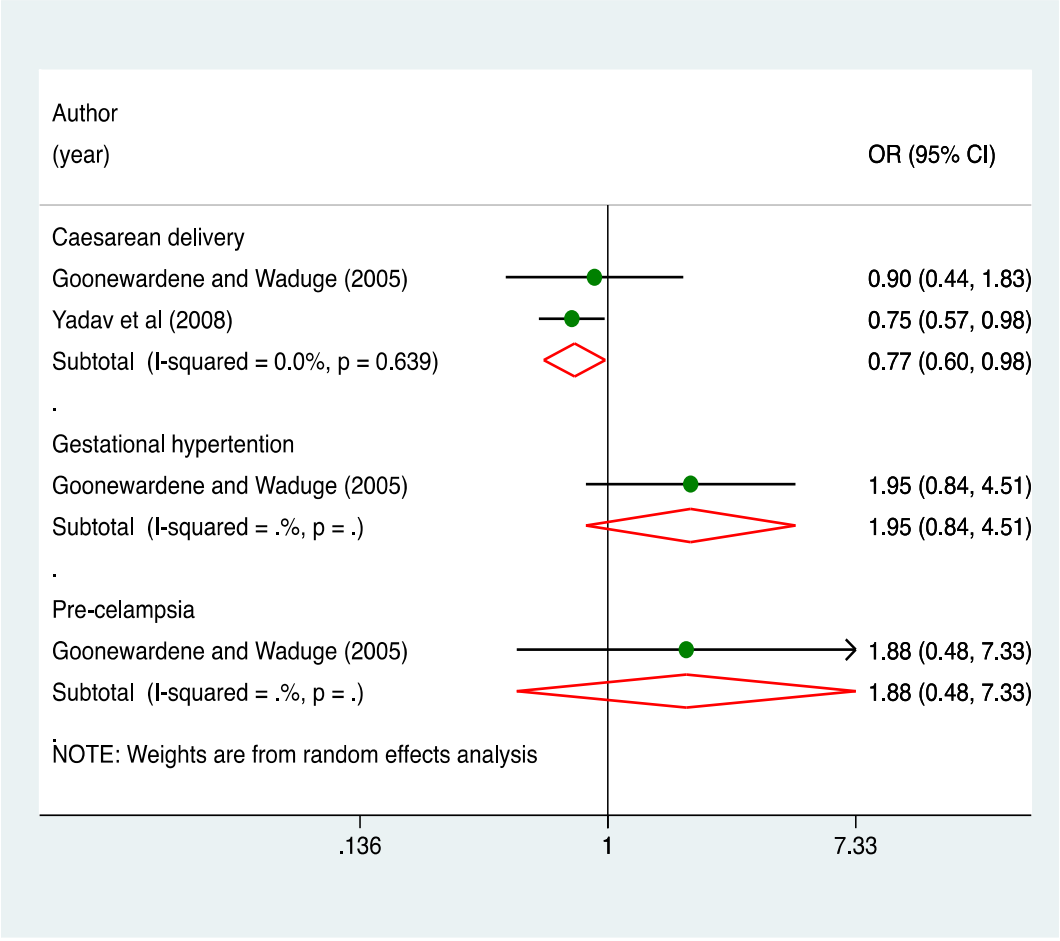

Figure 5.4: **Adolescent pregnancy and risk of caesarean delivery, gestational hypertension, and preeclampsia**

5.3.4 Narrative Review Summary Results

The study which have been meet the inclusion criteria for meta-analysis, and those which have not been meet goes to narrative review. The summary result of narrative review is presented in Table 5.2. Four studies reported association between adolescent childbearing and perinatal mortality. Among these four studies, three studies (Baqui et al., 2011; Fikree & Gray, 1996; S. Nahar et al., 2013) reported the lower risk of perinatal mortality and only one study found the higher risk (Yadav et al., 2008) of perinatal mortality.

Table 5.2 Narrative review for adolescent pregnancy and birth and health outcomes

Authors and years of study	Study design, country	Population	Results
Anjum et al. 2011	Case control, Pakistan	360 maternal women included in this studies for 5 months hospital observations	Adolescent pregnancy found to be strongly associated with LBW
Fall et al. 2015	Cohort study, (Brazil, Guatemala, India, Philipines, South Africa)	22188 respondent extracted from five cohort on which 7530 from India	Lower maternal age increased the risk of LBW (OR, 1.18; 95% CI, 1.02-1.36), PTB (OR, 1.26; 95% CI, 1.03-1.53) and childhood stunting (OR, 1.46; 95% CI, 1.25-1.70).
Ganatra and Hirve. 2002	Cross-sectional, India	1717 married women were included in this study from the 18 months observation during 1996-1998	Lower risk of abortion reported among the adolescent mothers. Lower role of decision making about abortion among adolescent are also reported in this study.
Kushwaha et al . 1993	Cross-sectional, India	430 married adolescent included in this study of which 242 were become pregnant	Higher rate of abortion, live births, still births, neonatal death among adolescence mothers reported in this study
(Jananthan et al., 2010)	Retrospective cohort, Sri Lanka	2056 respondents were selected from the antenatal pregnant among 563 births	LBW deliveries the best predictor is maternal BMI of 23.7 kg m-2 at or below 13 weeks of gestation
Karkee et al 2014	Prospective cohort, Nepal	639 recently delivered mothers during breastfeeding information	Urban mothers also exclusively breastfed shorter than rural mothers

Kochar et al. 2014	Cross-sectional, India	1017 respondent were included among them 772 rural and 245 urban areas	The higher induced abortion in the more developed districts
Metgud et al. 2012	Cross sectional, India	1138 pregnant women were included in this study from 1.5 years observation	Unadjusted odds gives the higher risk of LBW, however, after adjusted the possible confounding factors this risk were lower.
Negandhi et al. 2014	Case control, India	384 respondent s were included in this study	Around 1.96 times higher risk of LBW reported among the child of adolescent mothers
Noronha and Kamath 2010	Cohort study, India	2077 respondents were included in this study, of which 1077 were antenatal period and 1000 were post natal period	Higher risk of anemia reported in this study among the respondents whose marriage took place before reaching age 18
Rahman et al. 1989	Cross-sectional, Bangladesh	6588 respondents included in this study from ten unions of two different Upazilas	Mortality rate for the 13-17 years were 5.8/1000 compared to 1.8/1000 for 18-23 years old
Riley 1994	Cohort study, Bangladesh	382 respondent were included in urban and rural area	Nutritional status of adolescents and young adult women may lead to a small decrease in age at first birth
Suwal A 2012	Cross-sectional, Nepal	100 respondents were included in this study from hospital settings over the two years period	Risk of preterm birth, birth weight and pre-eclampsia found to be associated with adolescent pregnancy
Toteja et al. 2006	Cross-sectional, India	6923 respondents were included in this study from the 16 district by two stage random sampling methods	Risk of anemia found to be more prevalent among the adolescent mothers

Only one study (Goonewardene & Waduge, 2009) reported around 2.30 times (OR, 2.30; 95% CI, 1.65-3.21) higher risk of anemia among the adolescent maternal women as compared to the adult women. Higher risk of neonatal mortality among adolescent mother reported in three different studies (M. E. Chowdhury et al., 2005; Sharma et al., 2008; Yadav et al., 2008).Two studies (Goonewardene & Waduge, 2009; Yadav et al., 2008) reported the lower risk of cesarean delivery among the adolescent maternal women.

5.4 Discussion

In the systematic review and meta-analysis, we investigated the effect of adolescent pregnancy on the adverse birth and health outcome including low birth weight, preterm birth, small for gestational age, perinatal and neonatal mortality, anemia, cesarean delivery, gestational hypertension and pre-eclampsia. This is the first comprehensive report to systematically evaluate the scientific literature to assess the proportion of birth and health outcomes attributed to adolescent maternal women in South Asian region. The meta-analysis demonstrated a significant higher risk of low birth weight, preterm birth, small for gestational age, anemia and neonatal mortality among adolescent women than adult or young adult women. However, adolescent women had lower risk of cesarean delivery than adult or young adult women. Meta-analysis also found the higher risk of gestational hypertension and preeclampsia, but lower risk of perinatal mortality among adolescent women as compared to adult women; however, the result was not statistically significant.

We found that adolescent mothers increase the risk of low birth weight. Previous cohort study (Imtiaz et al., 2016) and meta-analysis (Sukhato et al., 2015) also found the similar result. The occurrence of this unfavorable outcome among adolescent mothers may be attributed to the biological immaturity. Previous studies argue that the biological prospective suggest that, adolescent mothers suffer from the incomplete blood supply to the cervix and the uterus, the proximal causes of low birth weight of infants (Miller, Lesser, & Reed, 1996). Several studies also interpreted that adolescent mothers having low birth weight babies is competition between the fetus and young mothers for nutrients

(Scholl, Hediger, Schall, Khoo, & Fischer, 1994). Adolescent pregnant mothers show most of their gestational weight gain during the first half of their pregnancy (Roth, Hendrickson, Schilling, & Stowell, 1998). This early weight gain goes primarily into preparing the young women's body to accommodate the developing fetus whose energy requirement become pronounced during the second half of gestation (Roth et al., 1998). This factor contributes more likely to deliver low births weight babies.

This study demonstrated that an increased risk of preterm birth among the infants born to adolescent mothers, which was consistent with several previous studies (X.-K. Chen et al., 2007; Hediger et al.,1989). Around 15 million babies were born in preterm, 11.1% of all live births worldwide. More than 60% of the preterm babies were born in South Asia and Sub-Saharan Africa (Blencowe et al., 2012). Higher percentage of preterm birth contribute around 3.1 million death a year, responsible for 35% infant death in South Asia (Blencowe et al., 2013). There are different factors causing to born in preterm birth. Maternal age is the strong risk factors to deliver the preterm baby. Young and aged mothers suffer from different form of nutritional deficiency which contributed to increased risk to deliver preterm delivery (Blencowe et al., 2013). Underlying maternal condition (i.e blood transformation from uterus to cervix, gestational weight gain) are also increase the risk of maternal complication and medically indicated preterm birth (PTB) (Blencowe et al., 2013). Some others important causes of PTB were infection, pre-eclampsia, placental abruption, cholestasis, fetal distrees and fetal growth restriction which are more prevalent among adolescent mothers (Blencowe et al., 2013; Chang et al., 2013; Romero, Dey, & Fisher, 2014).

Our study also found the higher risk of small for gestational age among the infants born to adolescent mothers, which is consistent with the previous studies (X.-K. Chen et al., 2007; Conde-Agudelo et al., 2005; Gortzak-Uzan et al., 2001). However, two previous studies found the risk of small for gestational age was not associated with adolescent pregnancy (Gortzak-Uzan et al., 2001; Olausson et al., 1997) . Both of these studies, the adequacy of perinatal care were not controlled in the multivariate model, which was considered as important confounders in the associations between adolescent pregnancy

and small for gestational age. Due to this little discrepancy of the results for small gestational age, future large scale prospective cohort study is necessary to confirm the association.

Consistent with the previous study (Chen et al., 2007; Gortzak-Uzan et al., 2001; Olausson et al., 1997), we found that adolescent pregnancy was associated with the increased risk neonatal mortality. Increased risk of neonatal mortality among adolescent could largely be explained by the higher rate of preterm delivery and low birth weight in adolescent mothers. However, a hospital based study found that the neonatal mortality was not increased in infants born to adolescent mothers after adjustment of maternal race, prenatal care status and major malformations (Satin et al., 1994). This might be explained by the section bias and small sample of the hospital studies.

Our study found the significant lower risk of cesarean delivery among the adolescent maternal women. We are not able to justify our findings with any others pooled estimate due to absence of literature. However, this lower rate of cesarean delivery may be explained by the South Asian region socio-economic condition. In the last decades, the rate of cesarean delivery increases dramatically in South Asia most among the higher socio-economic class household, educated and urban women (Betrán et al., 2007; Lumbiganon et al., 2010). Similar studies reported the lower risk of caesarean delivery among adolescent age group (Reed & Edin, 2005; P. K. Singh et al., 2012).

The key strength of this study is included quite a large number of studies, which in turn allowed us to determine the number of outcomes attributed to adolescent pregnancy and finally to arrive at reasonable conclusion. To report this systematic review study, we followed PRISMA guide line which may increased the quality of the paper. In this study, we did not apply any times, language or outcome restrictions which may avoid related time or languages. Limitations of our study should not be overlooked. In this study, we performed only three database searched, there may possible to over look some articles. To avoid missing studies, we comprehensive search Google, Google Scholar, and hand search. This may reduce the change of bias related missing paper. We include only the

study conducted within the south Asian countries; therefore, this study finding may not generalize for other countries. These restrict our work to draw the conclusion representing worldwide.

5.5 Conclusion

The relationship between adolescent pregnancy and the risk of adverse birth and health outcomes has been assessed among adolescent women a wide distribution of different geographical areas and socio-economic backgrounds. Whereas the association of adolescent pregnancy with different birth outcomes particularly low birth weight, perinatal mortality and neonatal moratlity has been examined in numerous studies, few studies have focused on the preterm birth, small for gestational age, anemia, caesarean delivery and gestational hypertension. In conclusion, pregnancy during adolescent is associated with the increased risk of adverse birth and health outcome. Late aged marriage and aware the general people about the adverse birth and health outcome with adolescent pregnancy would be suggested to improve the maternal health and control of higher proportion of low birth weight, preterm birth, small for gestational age and neonatal mortality. The above study findings will provide information to health researchers and demographers to know about adverse birth and health outcomes occurring in adolescent age. It should avoid adolescent pregnancy to rich and fruitful adolescent reproductive health.

Supporting results: Subgroup analysis

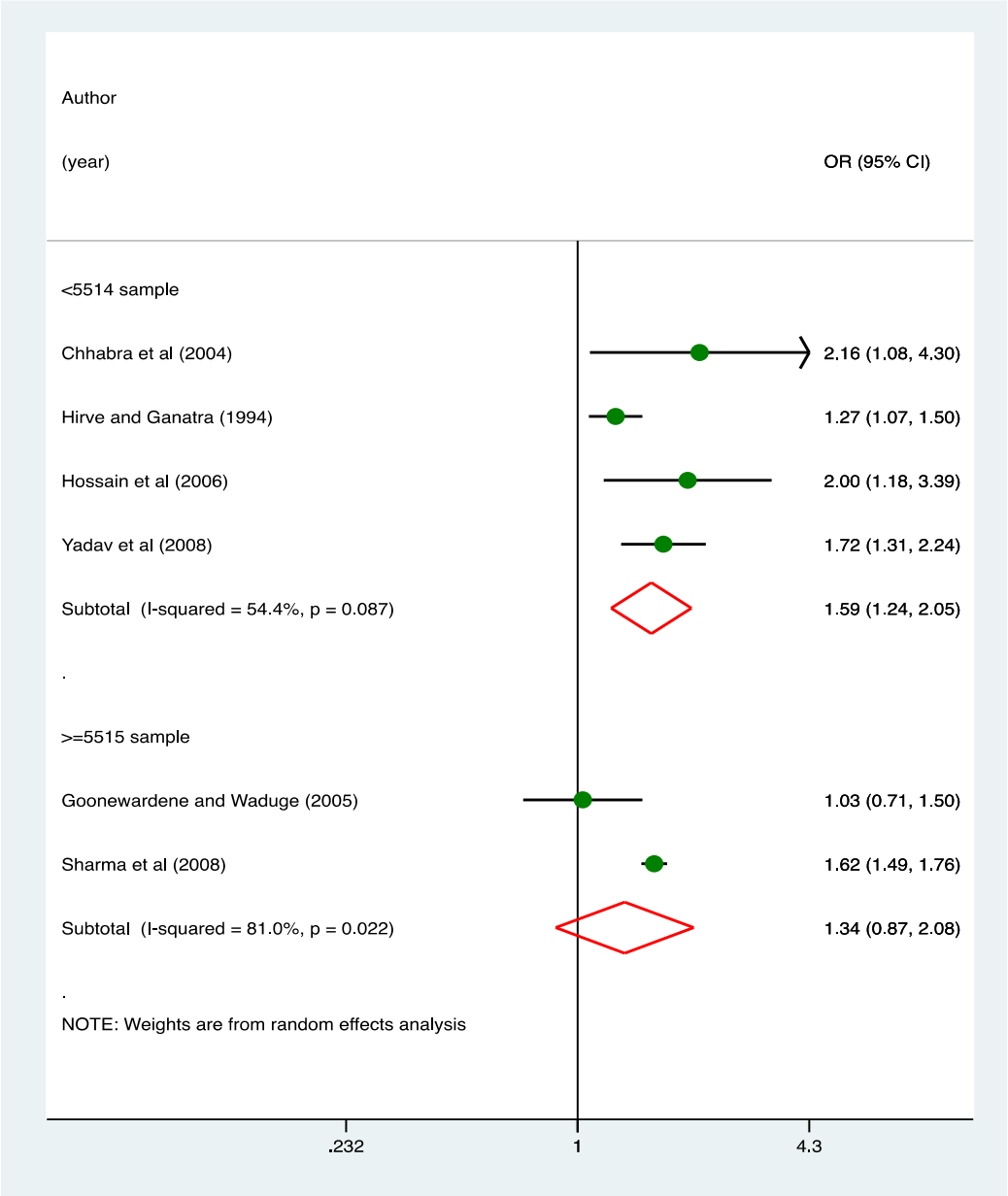

Figure 5.5: Adolescent pregnancy and risk of low birth weight by study sample size (Meta-regression test: p= 0.47)

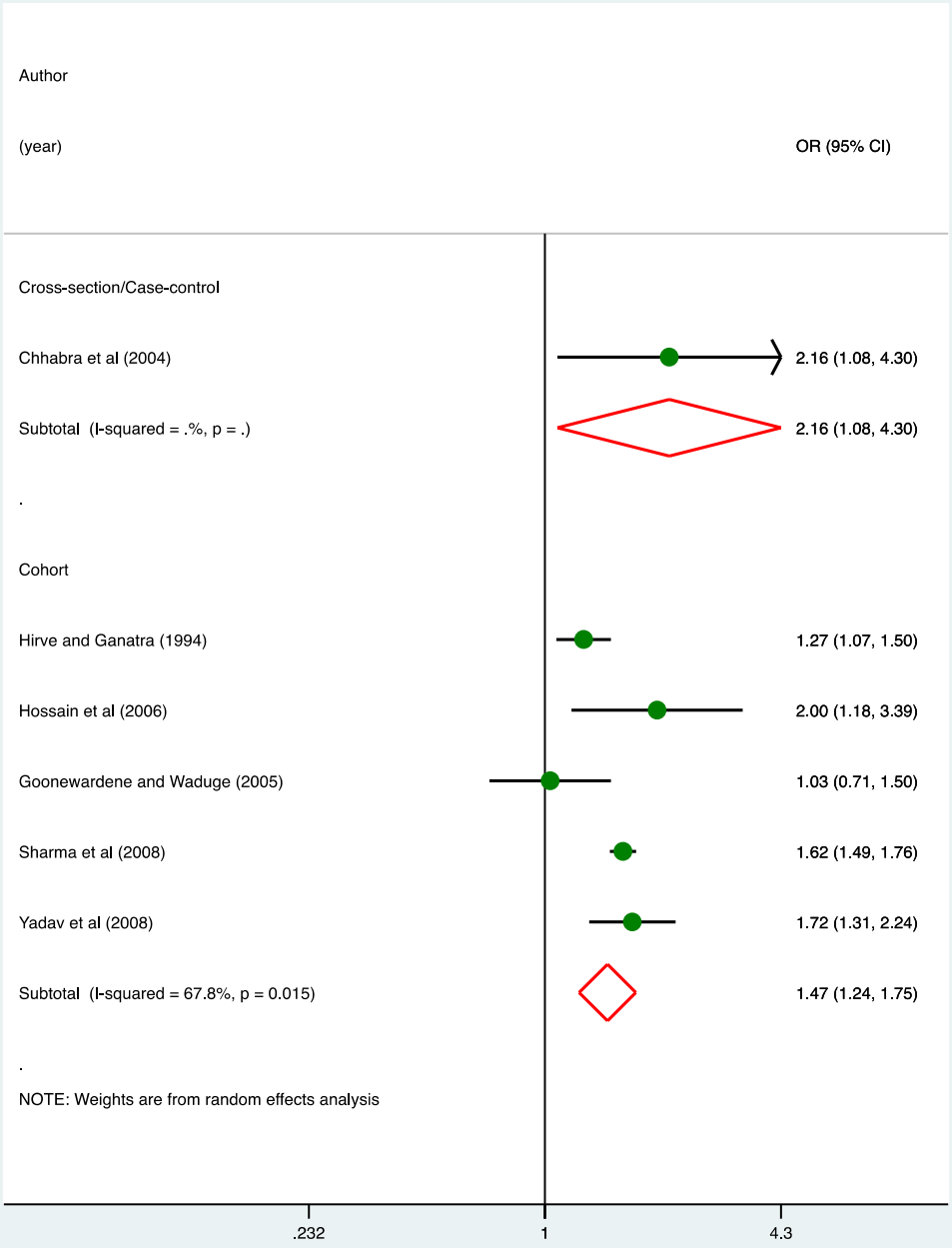

Figure 5.6: Adolescent pregnancy and risk of low birth weight by study design (Meta-regression test: p= 0.33)

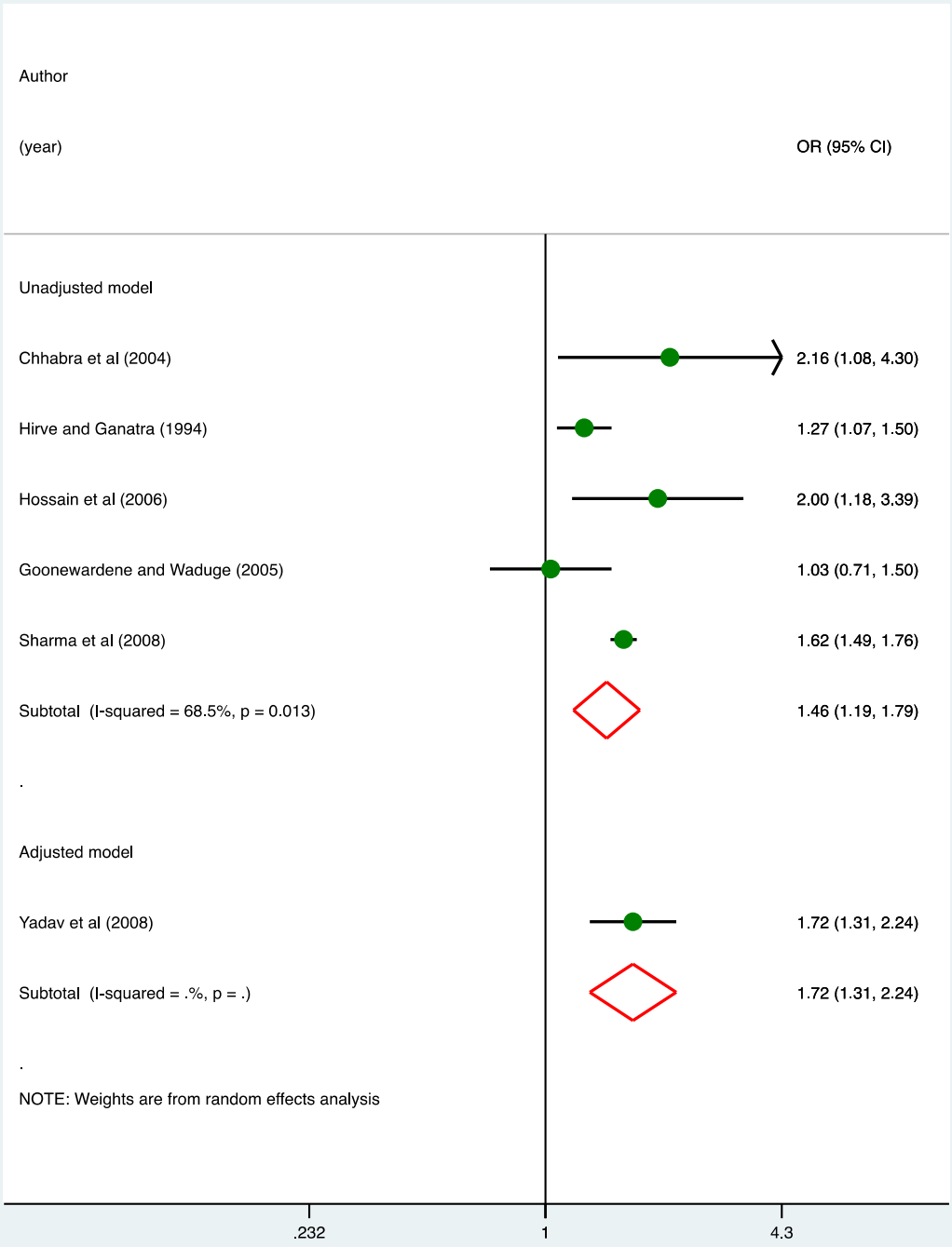

Figure 5.7: Adolescent pregnancy and risk of low birth weight by confounding adjustment (Meta-regression test: p= 0.50)

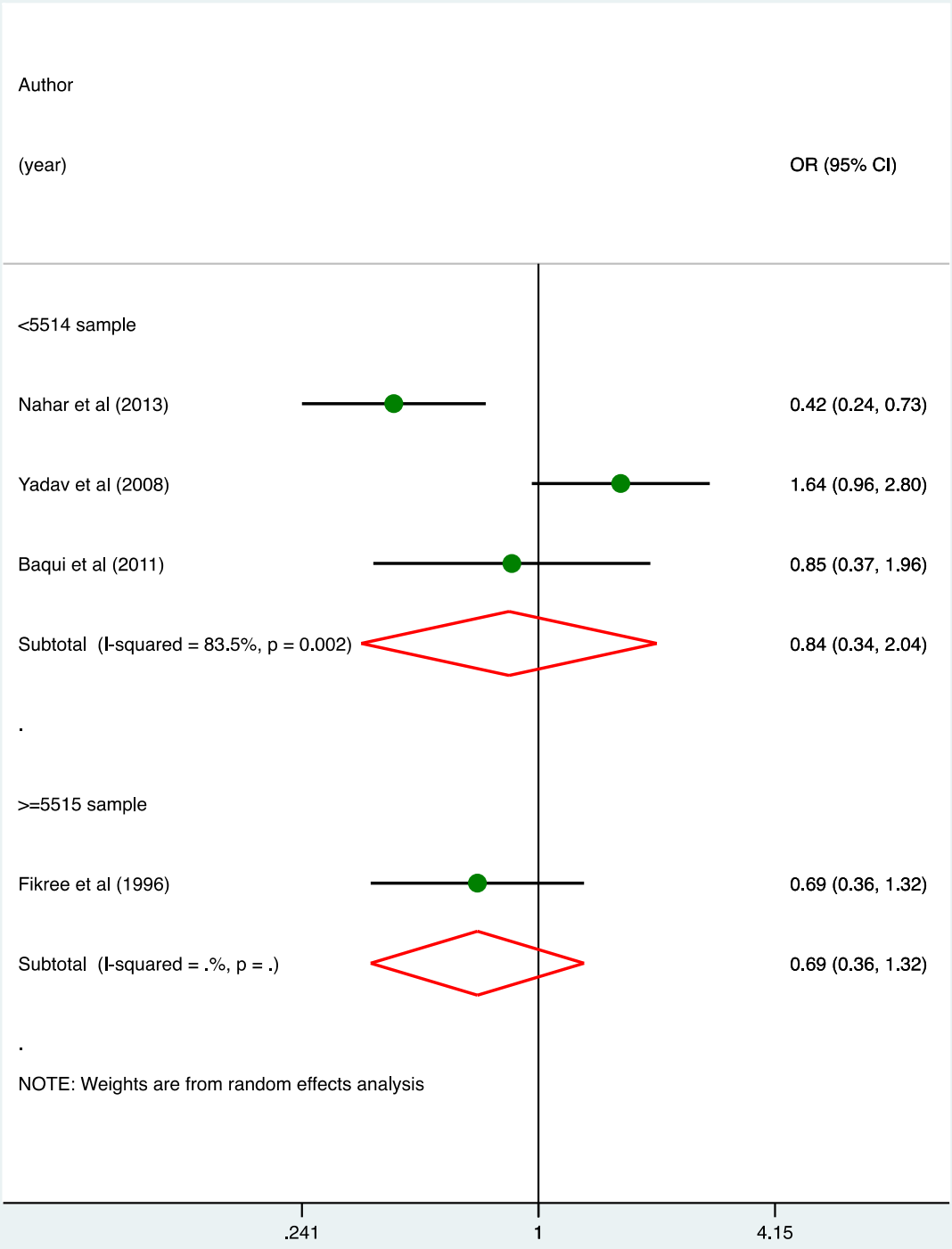

Figure 5.8: Adolescent pregnancy and perinatal mortality by confounding adjustment (Meta-regression test: p= 0.83)

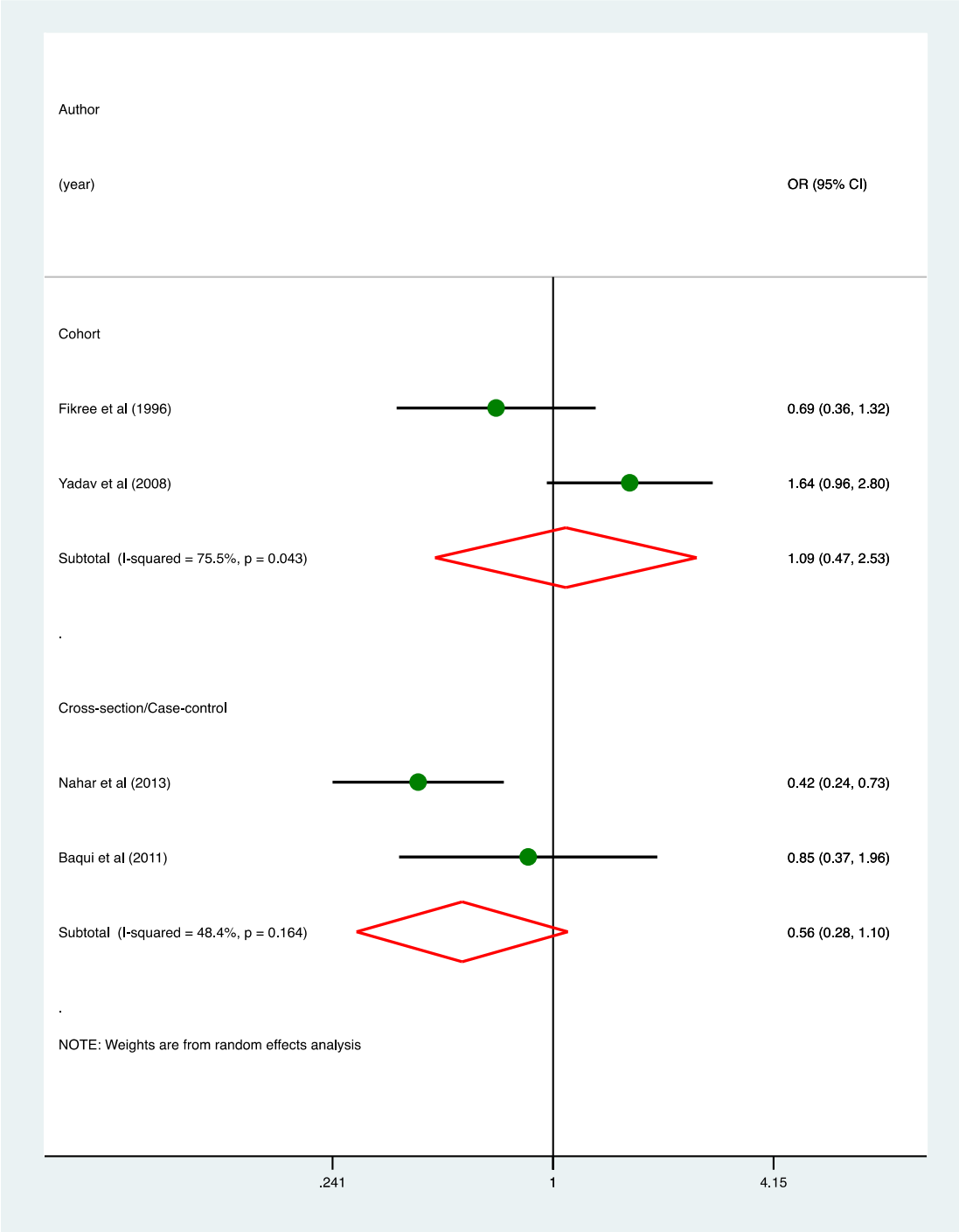

Figure 5.9: **Adolescent pregnancy and perinatal mortality by study design (Meta-regression test: p= 0.25)**

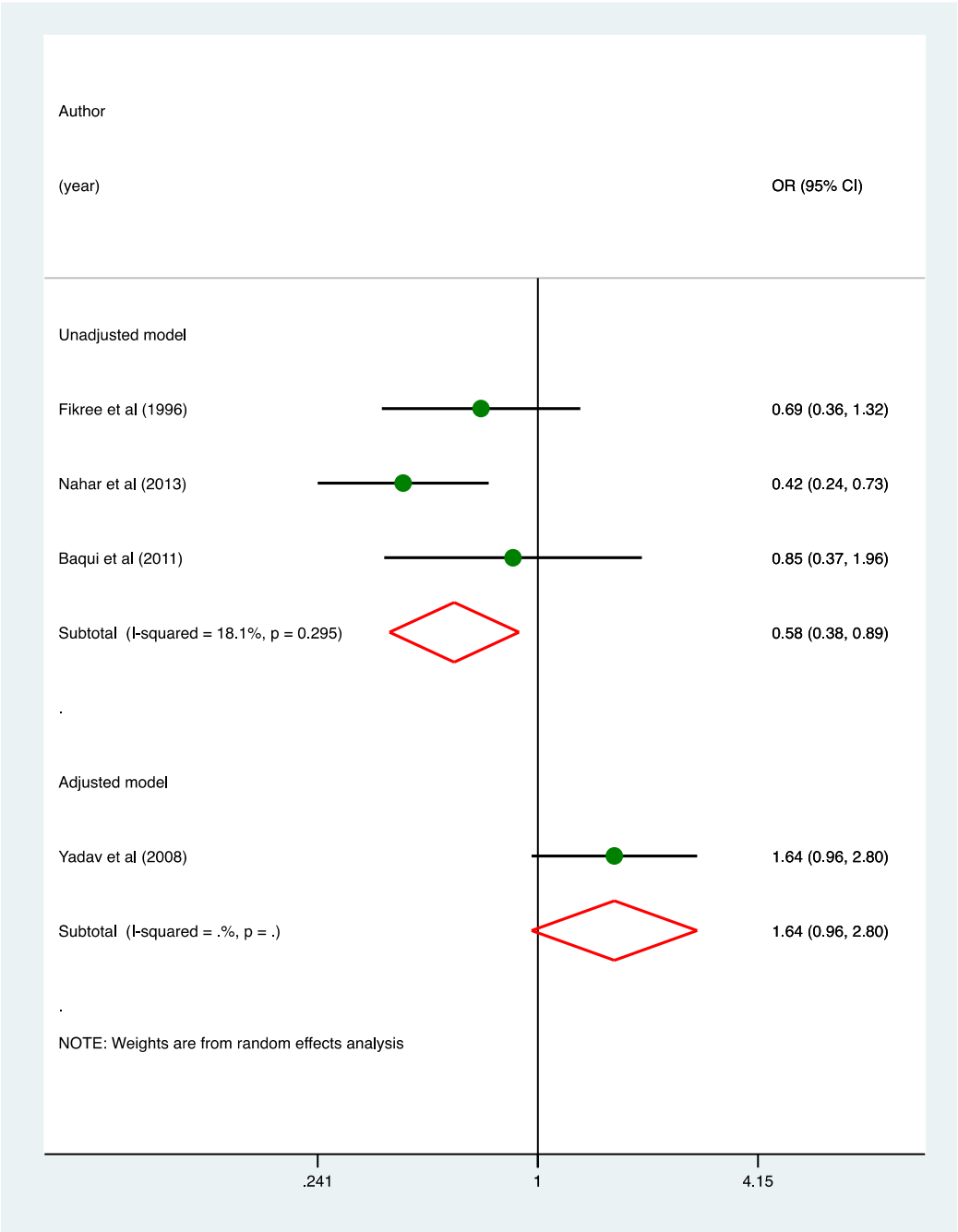

Figure 5.10: **Adolescent pregnancy and perinatal mortality by confounding adjustment (Meta-regression test: p= 0.01)**

Chapter Six

Summary and Policy Implications

6.1 Introduction

In most cultures and individuals, adolescence begins with the appearance of overt physical signs of puberty and ends with the acquisition of the statute of adulthood and / or parenthood, the whole process leading to greater emotional and social autonomy (Patton and Viner 2007). Adolescence is largely shaped by biological and socio-economic factors. Adolescents have been a major focus in recent global approaches to reproductive health. Societal transformation (including cultural and social norms) and behavioural patterns create a situation of unique vulnerabilities as well as opportunities to build on adolescents reproductive health. However, one of the most important challenges facing reproductive health programs in Asia is how to address the needs of adolescents as they initiate the risk of birth and health outcomes among adolescents. Most of the developing countries adolescents face lacking above information about their reproductive health.

The aims of this study are to find out the determinants of adolescent childbearing in Bangladesh related to reproductive behavior of adult (as comparison group). This study also finds out the risks of adverse birth and health outcomes among adolescent related to young adult and adult (as comparison group). For this purpose, Bangladesh Demographic and Health Survey (BDHS) 2011 data have been used. The multilevel logistic and poisson regression model have been used to find out the determinants of adolescence childbearing risks factors of adverse birth and health outcomes.

Reproductive health care encompasses a wide variety of issues like safe motherhood, family planning, early childbearing, maternal nutrition, abortion care against adolescents. As such reason adolescent faces difficult challenges caused by poverty, malnutrition, poor health, poor performance of health system, and inadequate and/or unsustainable

health care financing. Information on how adolescents in Bangladesh make decisions about reproductive health needs and reproductive behaviour are also lacking. At last, public health implications of our study findings and make several recommendations for future research directions were mentioned.

6.2 Summary Findings

The whole thesis is divided into two parts. In the first part, we have performed empirical data analysis and the second part we have executed systematic review and meta-analysis. Detailed descriptions of the study findings have been presented in each result sections of the corresponding chapter. We briefly discuss here an overview of the key findings of the whole thesis.

6.2.1 Determinants and Risk Factors of Maternal Age of Childbearing

This study provides empirical evidence that the adolescent by various socio demographic factors is precious for adolescent in several dimensions. We have found different individual, household and community level characteristics contribute to the increasing rate of adolescent childbearing. The individual level characteristics particularly education is found to be the most significant factor, with the strongest and most consistent effect on delaying adolescent childbearing in Bangladesh. The study result indicates that women primary and secondary education both have higher risk of childbearing than women with no education. It may be that adolescents who are no education are usually involved NGO activities and NGO runs different programs about women reproductive health and marriage. Religion is an important determinants adolescent childbearing. Most the people in Bangladesh are Muslims and muslims have higher risk than non-muslims adolescent to bear early childbearing. Early marriage tends to early pregnancy. Early pregnancy has been investigated at both individual and at a broader social context. The high rates of marriage at very young ages, girls in rural Bangladesh attain significantly less schooling and experience more frequent reproductive health complications. Demographers have estimated that if marriage was postponed from 16 to 20-21 years, the number of births would decrease by 20-30%. The study result exhibits that the adolescent who are married before 15 years of age have almost double risk than the adolescent who married after 15

years of age. All of the individual characteristics have significantly associated with adolescent childbearing age.

The study considered household characteristics such as socioeconomic status and food security. The prevalence of socioeconomic status such as poorest has highest prevalence and richest have lowest prevalence among adolescent and the same direction is seen in logistic regression model. In our study since most of the adolescents were lower socioeconomic status, lived in rural areas and their educational status was not appropriate for their age. The socio economic status is significantly associated with adolescent childbearing age but another household characteristics food security is insignificantly associated with adolescent childbearing age.

Regional variation contributes to the increasing rate of adolescent childbearing. Different region have seen different prevalence and determinants of adolescent childbearing. The lowest prevalence is found in Syhlet division and highest in Rangpur division and the same result is also seen in multilevel logistic regression model. In community characteristics region have significantly associated with adolescent childbearing and place of residence have insignificantly associated with adolescent childbearing.

The overall prevalence of maternal age by various socio-demographic variables have been observed. The finding exhibits that the prevalence of adolescent is 27.6%, young adult 67.3% and adult 5.2%. The average years of schooling was 5.54 years, antenatal visits 2.4, age at first marriage 15.94 years, maternal age 25.52 years and children ever born 2.53 for overall respondent of the study population. All the socio-demographic variables have significantly associated with adolescent childbearing age except place of residence and food security.

To know the risks among adolescent age of childbearing and to assess the adverse effects of birth and health outcomes through multilevel poisson regression, we have used 2011 Bangladesh Demographic and Health Survey (BDHS) data. The empirical results show that around 44% of women are found to be anemic, 67% suffer from pregnancy complications and 68% suffer from menstrual irregularities, 17% mother give low birth

weight and 3% mother give neonatal mortality. Multi-level poisson regression analysis indicates that the risk of menstrual irregularities, pregnancy complications and termination, caesarean delivery, perinatal mortaliy, wasting and anemia are relatively lower among the adolescent than adult. The model also suggested that adolescent had higher risk of low birth weight, still births, stunting and early neonatal mortality.

6.2.2 Adolescent Childbearing and Adverse Birth and Health Outcomes

The systematic review and meta-analysis results indicate that the risk of low birth weight, preterm birth, small for gestational age, anemia and neonatal mortality are significantly associated among the adolescent compared to adult. The risk of preeclampsia and gestational hypertension are also higher among the adolescent but the risk is not statistically significant. Caesarean delivery and perinatal mortality have been seen lower significant effect among adolescent compare to adult. Subgroups analysis indicates that sample size, cohort study and unadjusted and adjusted model among adolescent had the significantly higher risk of low birth weight. However, the cross-sectional study had statistically insignificant higher risk among adolescent than others. Another subgroups analysis indicated that sample size and cross-sectional study had the insignificant lower risk of perinatal mortality among adolescent, cohort and adjusted model study had insignificant higher risk and unadjusted model lower significant risk among adolescent.

6.3 Policy Implications and Recommendation

Bangladesh as well as the Asian countries currently contains and faces around 67% of the total world adolescent population and meeting the problems of their adolescent health. In this perspective, this study has reported the determinant factors of maternal age at birth according to the major socio-economic and demographic variables which provide the clear idea regarding the subgroups of women who are most likely to give birth at adolescent age. Information regarding such vulnerable adolescent group will be helpful to the policy maker to identify properly that group which is more likely to give complicated and adverse outcomes than young adult and adult women. Thus child birth before age of 20 years is more dangerous to mother and infant and it is also for older mothers. Pregnancy during the adolescent poses an increased risk of maternal and infant mortality

and morbidity resulting in an increase in cumulative fertility and restricts the opportunity for socio-economic advancement. Adolescent mothers have a higher incidence of low birth weight which is associated with birth injuries, serious childhood illness and mental and physical disabilities (Islam et al., 1995).

The study represents that several adverse birth and health outcomes have been observed maternal adolescent, adult and young adult women. From the public health perspectives, information on these adverse outcomes should be helpful to general public and medical professionals as well as care providers. Meanwhile, health professional should be aware about the adolescent pregnancy and provide effective support to reduce its adverse effects. This study also provides the strong evidence for policy makers and health care agencies to make the prevention plans and programs by giving the special priority to reduce early marriage and early childbearing. Early marriage leads to early childbearing are associated with less education and lower future income of young mothers, programs that keep girls in school should be promoted. The attainment of higher level of education by young women can be expected to yield a greater use of reproductive health services and better employment prospects. Develop a core reproductive health curriculum which is adaptable to the concerns of adolescents at different ages and life stages: puberty and sexual development for younger adolescents and relationships with the opposite sex for older adolescents. The curriculum must be developed as a joint effort of all stakeholders parents, teachers, health care professionals and adolescents. A training course on how to use, adapt and expand this curriculum for meeting the different needs of adolescents should be developed.

Finally governments should ensure the protection and promotion of the human rights of adolescents, including their reproductive rights. This could be done through the following recommendation:

- The social pressures on girls to get married early and to have a child soon after marriage have to be removed. This could be done through social information, communication and education. In this context, our basic education system and its curriculum should be redesigned to meet the need of the present days. These

include education of family life, human sexuality, demographic, health, socio-economic development and the role of women in the society.

- Awareness must be created against early marriage so that age at marriage for female does not come below the legal age (i.e 18 years) and to present child marriage and discourage adolescent pregnancies ensuring it execution.
- Raising awareness regarding reproductive health, leading to informed choices and reproductive decisions free from coercion;
- Promoting legal literacy and education concerning women's reproductive rights and entitlements; and
- Ensuring easy access about reproductive health services and information are available to adolescents.
- Retaining pregnant girls in schools: Legislative and policy changes may be needed to secure continued education of adolescent girls who become pregnant, and after they have had an abortion or delivered a baby.

6.4 Strengths and Limitations

The thesis has four key strengths. First, this study were the availability of a large, nationally representative dataset providing the sufficient power to investigate the effect of adolescent age of childbearing on adverse health and birth outcomes. The study used appropriate statistical tools to analyze the data. For instance, to account clustering and dependency problem, we performed multilevel regression models. The study conducted systematically review and meta-analysis to find research gap, and update information on this specific topics.

Despite these strengths, the study also has some limitations. First, this study include the range of averse birth and health outcome which were occurring within five year preceding the survey which may increased the risk of recall bias. Second, this study also fail to establish the causal relationship between the outcome variable and the maternal age due to the cross-sectional nature of the data. Third, in systematic review part, we can't search all database due to money and time constrain. The study search only limited to PubMed, Web of Science and Chinal databases. However, these entire three data base cover almost 90% of literature in public health research. Furthermore, we also performed

Goggle, Google scholar, and hand search to identify missing articles. Therefore, the final selected study may not affect sampling bias.

6.5 Future Research Directions

This study examined the determinants factors of adolescent childbearing and the risk of adolescent childbearing on adverse birth and health outcomes using cross sectional data. A number of recommendations for the future works can be made on the basis of the research findings of this study as follows:

This study shows that adolescent age of childbearing can influence pregnancy complications. But the study was not able to identify the specific pregnancy complications that would be attributed to the adolescent age of childbearing and what were the most common. So that more studies should be done to confirms the sort of pregnancy complications and what would be the most common.

This study found the effect modifications of several socio-economic and demographic factors on the association between adolescent age of childbearing and risk of adverse birth and health outcomes. The effect alteration is an important but it is complex topic, it is necessary to the future studies to confirm the effect modifications. It is necessary and efficient to use longitudinal data to assess relation between adverse birth and health outcomes with adolescent age of childbearing instead of cross-sectional study data. However, lack of data in this perspective was recorded. Expanding the data sources and collecting the more information on confounding factors are both needed in future studies. For example, instead of using cross-sectional data, a cohort study particularly perspective cohort study or panel study could be conducted to observe effect of adolescent age of childbearing on different adverse outcomes.

Finally, it is clear from this study adolescent childbearing had an increased risk of adverse perinatal outcomes in low-income countries like Bangladesh. Thus, to establish more valid association between adolescent pregnancy and adverse birth and health outcomes, large-scale prospective cohort study is necessary in Bangladesh.

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