IMPACT OF COVID SITUATION ON PRETERM BIRTH, BIRTH WEIGHT, MODE OF DELIVERY AND MATERNAL CO-MORBIDITIES AT CHATTOGRAM

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Roll no: 0120/13

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A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Public Health

One Health Institute

Chattogram Veterinary and Animal Sciences University

Chattogram-4225, Bangladesh

AUGUST 2022

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The Author

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List of Abbreviations and Symbols

Acronyms	Elaboration
AAP	American Academy Of Pediatrics
aOR	Adjusted Odds Ratio
BA	Bronchial Asthma
BB	Big Baby
BMI	Body Mass Index
BSMMU	Bangabandhu Sheikh Mujib Medical University
BW	Birth Weight
CI	Confidence Inrterval
COVID /nCOV	Coronavirus Disease
COVID -19	Coronavirus Disease 2019
CP	Cerebral Palsy
CS/ C-sec	Cesarean
D&C	Dilation And Curettage
DGHS	Directorate General Of Health Services
DM	Diabetes Mellitus
DNA	Deoxyribonucleic Acid
ELBW	Extremely Low Birth Weight
GA	Gestational Age
gm	Gram
Hb	Hemoglobin
HBW	High Birth Weight
HTN	Hypertension
icddr,b	International Centre for Diarrhoeal Disease Research, Bangladesh
ICN	Intensive Care Nursery
ICU	Intensive Care Unit
IOM	Institute of Medicine
IUD	Intrauterine Death
IUGR	Intrauterine Growth Restriction

Acronyms	Elaboration
IV	Intravenous Lines
IVH	Intraventricular Hemorrhage
kg	Kilogram
lb	Pound
LBW	Low Birth Weight
MERS	Middle East Respiratory Disease
NBW	Normal Birth Weight
NEC	Necrotizing Enterocolitis
NG	Nasogastric
NICU	Neonatal Intensive Care Unit
^{o}C	Celsius
OG	Orogastric
Oz	Ounce
PDA	Patent Ductus Arteriosus
PROM	Premature Rupture of Membrane
PTB	Preterm Birth
PTSD	Post-Traumatic Stress Disorder
RDS	Respiratory Distress Syndrome
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SARS	Severe Acute Respiratory Syndrome
SFD	Small For Date
SIDS	Infant Sudden Death Syndrome
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
US	United States
UTI	Urinary Tract Infections
VHBW	Very High Birth Weight
VLBW	Very Low Birth Weight
WHO	World Health Organization

Abstract

COVID -19 was first reported in Bangladesh in March 2020. Since then, 1,952,939 COVID cases have been reported, 29,127 cases of death and 1,898,603 have been recovered as of May 14, 2022. Preterm birth has an enormous effect on mother, family and finance. Many studies worldwide show either there is stability or reduction or increase of preterm birth during this pandemic. This study was performed on total 713 live births from 28 to 42 weeks of gestational age where 257 cases were from the pre-COVID time (June 2019-December 2019) and 456 cases were from COVID time (June 2020-December 2020). The cases admitted to Bangabandhu Memorial Hospital, Foy's Lake, Chattogram at Gynae and Obstetrics ward were considered in the study. Babies with intrauterine death (IUD), stillbirth, dilation and curettage (D and C), ectopic pregnancy, blighted ovum and threatened abortion were excluded from the analysis**.** Data were obtained from hospital-registered records. Preterm birth rate was 20% in pre -COVID time and 21% during COVID time. It was observed that there was no significant relation on term and preterm birth between pre-COVID and COVID time. Additionally, the rate of LUCS has increased from 61% to 73% during COVID time, while NVD decreased from 39% to 27%. The birth weight distributions were observed to be consistent in both study periods. Mothers of newborns with additional complexities (Diabetes Mellitus (DM), Hypertension (HTN), Premature Rupture of Membrane (PROM), Bronchial Asthma (BA), Hypothyroidism, Urinary Tract Infections (UTI) and Twin Pregnancy) were also considered in this study. Mothers with DM, HTN and PROM were observed to experience more preterm birth subsequently 44%, 50% and 100% during COVID time than pre-COVID period when the percentage were 20%, 37% and 70% consequently.

Key Words: COVID, Preterm birth, Gestational age, Birth Weight, DM, HTN, PROM, Chattogram

Chapter-1

1 Introduction

The first known infections from SARS-CoV-2 were reported in Wuhan, China, on 31 December 2019; WHO was advised of cases of pneumonia of unidentified cause in Wuhan City, China. (WHO, 2020). A new coronavirus was documented as the cause by Chinese authorities on 7 January 2020 and was temporarily named “novel coronavirus, nCoV” (WHO, 2020). Bangladesh reported the first 03 confirmed cases of coronavirus disease (COVID -19) in the country on Sunday, March 8 (WHO, 2020). Bangladesh confirmed its first death due to the coronavirus pandemic on 16th March 2020 (WHO, 2020). Till now, 1,952,939 COVID cases are found, 29,127 cases are dead, and 1,898,603 are recovered as of May 14, 2022, as per COVID -19 Dynamic Dashboard for Bangladesh of Directorate General of Health Services (DGHS, 2022) .

The fetus's gestational age is very significant when estimating the potential adverse effects of fetal exposure to toxins or illness. It also directly affects the planning of suitable medical therapy for such circumstances. There are two divisions of gestational age. i.e., fetal era and embryonic era. The fetal phase begins at the gestational age of week 10 and lasts until birth (Gomella, et al., 2020). It is preceded by the embryonic period. Gestational ages are related to prenatal development milestones. For instance, All the critical organs have started to form together with the bones and cartilage during the gestational age of 7 to 8 weeks. The genitalia has developed by the time a pregnancy is 9 to 13 weeks along, and the total fetus weighs around one ounce (0.06 pounds). The fetus's eyes have formed by weeks 21 to 23, and a stethoscope may detect the fetal heartbeat. Fetal development is finished by 40 weeks. Thus, a typical pregnancy lasts between 38 and 42 weeks, with 40 weeks regarded as full-term. Premature babies are those born earlier than the gestational age of fewer than 38 weeks and are subject to higher risks of disease and death.

Gestational age has much importance. For example, gestational age can be used, to identify if there is any effect on the fetus of any fetal toxin exposure, if there is any vertical

transmission of infection, to estimate delivery date, for prenatal care arrangement etc. Preterm, term or post-term birth categorization can also be done by calculating gestational age. Infant deaths and stillbirths are categorized to calculate numerous risk variables postnatally (after birth). Prenatal gestational age assessment can be measured by menstrual period, physical examination of the mother, history of assisted reproduction, ovulation date, ultrasound and laboratory data.

Preterm birth is defined as neonates born alive before 37 weeks of pregnancy are accomplished (WHO, 2018). Preterm birth happens for numerous causes. Most preterm births occur spontaneously, but some are due to early initiation of labour or caesarean birth, whether for medical or non-medical causes. Common causes of preterm birth include several pregnancies, infections and chronic situations (i.e. diabetes and high blood pressure). However, often no cause is identified. There could also be a genetic influence.

One of the frequent medical issues associated with pregnancy is hypertension, which greatly impacts maternal and perinatal morbidity and mortality. Maternal complications during pregnancy include labor, puerperium eclampsia, sepsis, preterm labor, accidental hemorrhage and Acute Respiratory Distress Syndrome (ARDS) etc. in pregnant women. It also causes fetal risk, such as intrauterine death, intrauterine growth restriction, asphyxia and prematurity. A study has been performed in pre-COVID time showed that mothers with HTN had a high risk of having preterm babies (Shulman, et al., 2017). In COVID - 19 same result was observed with mothers who had both COVID and preeclampsia (Papageorghiou, et al., 2021). Premature rupture of the membranes is the term used to describe any spontaneous membrane rupture that occurs after the 28th week of pregnancy but before the start of labor. Preterm labor and prematurity are two serious consequences of PROM. It also leads to infection of neonates after birth. According to previous study, preterm labour risk was 2.58 times higher for mothers who experienced PROM throughout pregnancy (Sari, et al., 2020).

Diabetes mellitus is a chronic metabolic condition brought on by either peripheral tissue resistance or a relative or absolute lack of insulin. Gestational diabetes mellitus (GDM) is one of the most common complications on pregnant women. It can cause perinatal loss, increased incidence of macrosomia, polyhydramnios, birth trauma and persistence etc.

Some studies showed that mothers in pre-COVID time with DM had a higher chance of lower uterine cesarean section (LUCS) and big baby (Persson, et al., 2018) than those with no DM. Another study showed that DM mother has a high risk of having preterm baby (Kong, et al., 2019).

During the global pandemic of coronavirus disease 2019 (COVID -19), Denmark and Ireland reported significant reductions in the rate of preterm delivery (Hedermann, et al., 2020) (Philip, et al., 2020), while this was not observed in the United Kingdom (Khalil, et al., 2020). Another study conducted in Bangladesh showed that pregnant women who are COVID -19-infected had a higher chance of having a cesarean section and having premature babies than pregnant women who did not have COVID -19 infection (Masud, et al., 2021).

The COVID-19 pandemic has a great impact on everyone's health. As pregnant women with co-morbidities are the most vulnerable group of people, it is important to investigate the influence of this new disease on them. There is no comprehensive research work has been done based on Chittagong considering this topic. So, the aim of this study is to investigate the impact of COVID situation on preterm birth, birth weight, mode of delivery and maternal co-morbidities in this area.

The objectives of this study are:

1. To determine the impact of COVID situation with preterm birth,
2. To analyze the impact of COVID situation on birth weight and mode of delivery,
3. To determine if other maternal co-morbidities of mothers have any impact on preterm birth in COVID situation.

Chapter-2

2 Review of literature

2.1 Origin of COVID-19

When unexplained pneumonia cases were discovered in the Chinese city of Wuhan, researchers first noticed the appearance of SARS-CoV-2 (Andersen, et al., 2020). The Wuhan Huanan Seafood Wholesale Market (hereafter referred to as the "Huanan market") was associated with the early cases during the first few weeks of the outbreak; cases were primarily documented in active dealers and vendors (Andersen, et al., 2020). The government shut the market down on January 1, 2020, to sanitize and disinfect the environment. The market, which mostly offered seafood and aquatic products as well as some products made from wild animals that were raised for food, was first thought to be the epicenter of the pandemic, indicating a situation where humans and animals came into contact. Investigations conducted in the past revealed further patients with disease onset in December 2019. yet not every case in the early stages mentioned a connection to the Huanan Market (Lloyed-Smith, et al., 2009). Although it was initially suggested that pangolins played a part in the COVID -19 outbreak and that civets served as intermediate hosts in the 2002–2004 outbreak of severe acute respiratory syndrome (SARS), further epidemiological and epizootic research has not supported these claims. SARS-potential CoV-2's intermediate host is still a mystery. A number of significant zoonotic viruses, including coronaviruses with significant genetic diversity, such as the Nipah virus, Hendra virus, and SARS-CoV, have been linked to bats as hosts (Boni, et al., 2020) (Shi, et al., 2020). The coronaviruses linked to the human outbreaks of SARS in 2002 and the Middle East respiratory disease (MERS) in 2013 are particularly important in relation to COVID -19 (Richard, et al., 2020). The COVID -19 causing virus was quickly identified from patients and sequenced; the findings from China were then shared and released in January 2020 (Munnink, et al., 2020). The research revealed that it was a positive-stranded RNA virus that was novel to humans and belonged to the Coronaviridae family (a subgroup B

beta coronavirus). Early research revealed considerable similarities between the genomic sequence of the new virus (SARS-CoV-2) and the coronavirus that was responsible for SARS from 2002 to 2004, namely SARS-CoV (another subgroup B betacoronavirus) (Richard, et al., 2020). Over the following year, a lot of work was done on sequences and phylogeny around the world, and the outcomes were shared and archived using the GIS-aided platform.

2.2 Spread of COVID-19

The COVID -19 coronavirus pandemic is the most significant public health issue of our time and the biggest obstacle since World War Two. The virus, with the exception of Antarctica, has spread to every continent since it first appeared in Asia late last year. Daily cases are increasing in Europe, the Americas, and Africa. As far as we know, person-to-person contact is how SARS-CoV-2 is transmitted. The virus primarily spreads by droplets produced during coughing or exhaling by an infected person. Sneezing is not typically a sign of COVID -19. People near one other experience the drops in their mouths or nostrils (within 6 feet, according to the CDC). The COVID -19 virus's incubation period contributes to the disease's rapid spread before being discovered. The WHO now estimates that COVID -19 takes one to 14 days to incubate, with five days being the most typical time. The period it takes for symptoms to appear after an infection permits germs to sneak across borders before being discovered. It is possible that visitors transiting through Wuhan were unwittingly coming into contact with COVID -19-caused SARS-COV-2 infected individuals. It's possible that these tourists went home without realizing they were afflicted. Individuals may also contact COVID -19 by touching objects or surfaces that have the virus on them (a surface that may be infected is referred to as a "fomite") and then touching their own eyes, nose, and mouth. SARS-CoV-2 can endure on plastic and steel surfaces for up to three days, according to research conducted by researchers at the US National Institute for Allergies and Infections Disease. Based on the evidence currently available, airborne transmission of COVID -19 has not been reported, and it is not thought to be a major transmission mode.

2.3 Global Situation of COVID -19

COVID -19 has affected nearly 533,816,957 people and taken about 6,309,633 people's lives till July 14, 2022. The 228 countries and territories are affected by the coronavirus COVID -19. According to World Health Organization, USA is the top country to report the maximum number (91,060,225) of COVID-19 cases so far, whereas India (43,710,027), Brazil (33,142,158), France (32,795,874), Germany (29,569,943), UK (23,075,360) and Italy (19,887,543) ranked second, third, fourth, sixth and seventh sequentially (World Health Organization, 2022). Bangladesh lies is number 44th position considering the total number of cases till preparing the report (World Health Organization, 2022).

2.4 Situation of COVID -19 in Bangladesh

According to WHO, there were 1,993,382 confirmed cases of COVID -19 in Bangladesh between 3 January 2020 and 14 July 2022, where the number of fatality was 29,223. A total of 279,700,761 vaccine doses have been given as of July 11, 2022. Now the rate of spread is 12% (Directorate General of Health Services, 2022). The height number of cases were reported in the capital city Dhaka (9,32,849) where Chattogram (3,05,011), Rajshahi (1,20,249), Khulna (1,14,391), Sylhet (68,039), Rangpur (59,817), Barishal (45,192) and Mymensingh (39,935) are in second, third, fourth, fifth, sixth, seventh and eighth position consecutively (Directorate General of Health Services, 2022).

2.5 Hospital Situation in Bangladesh

As per reports from DGHS, from April 2021 COVID infected and serious patients increased and got admitted to hospitals in the whole country. At the same time rate of using high flow nasal cannula also increased. It was at its highest peak from July 2021 to September 2021, then gradually decreased but the increasing rate of COVID infected admitted patients were the same in that period (Directorate General of Health Services, 2022).

2.6 Maternal Health Care Situation

An estimated 2.4 million infants will be born in Bangladesh while the COVID -19 pandemic looms overhead. The total is 116 million worldwide. As health workers, including midwives, were engaged in treating COVID -19 patients, new mothers and newborns will face harsh realities, according to UNICEF, such as global containment measures like lockdowns and curfews, health centers overburdened with response efforts, supply and equipment shortages, and a lack of skilled birth attendants. "Millions of moms throughout the globe started their parenting journeys in the real world. They now have to get ready for the world as it is, where expectant moms are scared to go to health facilities for fear of contracting an infection or losing out on emergency care because of overworked medical facilities and lockdowns, according to Henrietta Fore, executive director of UNICEF. It is challenging to grasp the extent to which the coronavirus epidemic has redefined parenting. UNICEF is cautioning that COVID -19 containment efforts can disrupt life-saving health services like birthing care, placing millions of expectant mothers and their babies at significant risk. India (20.1 m), China (13.5 m), Nigeria (6.4 m), Pakistan (5 m) and Indonesia (4 m) are the nations with the greatest anticipated birth rates for the nine months following the pandemic proclamation (11 March). The United States ranks sixth considering the predicted birthrate. In terms of the highest anticipated birth rate for the nine months following the pandemic proclamation on March 11th, Bangladesh comes in at number 9. Before the pandemic, most of these nations had significant infant mortality rates, and COVID -19 circumstances might make those rates even higher. However, an analysis of data from the Directorate General of Health Services dashboard reveals that since the start of the COVID -19 crisis, there has been a significant decrease in the uptake of maternal and newborn health care services from the health facilities, despite the fact that the maternal mortality ratio and neonatal mortality rate have not changed significantly. The same source shows that, out of 63 district hospitals in Bangladesh, only 33 provide all essential components of emergency obstetric treatment. Despite the strain the COVID -19 crisis is putting on the healthcare system, ordinary life-saving services for expectant mothers and new moms must continue with effective infection prevention and control measures. According to Tomoo Hozumi, UNICEF's Country Representative in Bangladesh, UNICEF is collaborating with the Government of

Bangladesh to save lives by ensuring that expectant mothers and unwell newborns receive the necessary treatment in the coming months. UNICEF warns that nations must make sure pregnant women still have access to prenatal, delivery, and postnatal services even when research suggests that they are not more at risk for COVID -19 than other groups. Similarly, ill infants require emergency care since they are in danger of passing away. In order to start breastfeeding, acquire medications, shots, and nutrition to keep their newborns healthy, new families need support (UNICEF for every child, 2020).

2.7 Mode of delivery in COVID -19

An analysis of 36 studies has been done where 203 pregnant women with SARS-CoV-2 delivered babies. As previously discovered, there was a similar severity of disease in pregnant women compared to nonpregnant women. 68.9% of women gave birth through cesarean section, with COVID -19 status being a frequent cause. Although neonatal outcomes were largely favorable, maternal COVID -19 may potentially be linked to a higher risk of premature labor. Out of 206 infants, eight of them tested positive for SARS-CoV-2, thus, there is still no proof that the virus was transmitted vertically (Debrabandere, et al., 2020). In a study conducted in Bangladesh, the mode of delivery was statistically significantly linked with the participant's COVID -19 status (p-value< 0.001) and cesarean sections were much more frequent (71.4%) in the COVID -19-positive women than in their COVID -19-negative counterparts (42.1%) (Masud, et al., 2021).

2.8 Complication in Pregnant Women

People must wear masks indoors and in public in locations with a high COVID -19 Community Level in order to maximize protection from variations and prevent potentially spreading the virus to others. The use of a mask in public indoor spaces at the medium COVID -19 Community Level should be discussed with a healthcare provider by anyone who is pregnant or has any other circumstances that could accelerate their risk of getting a serious illness. Although the risks are generally minimal, women who are pregnant or have recently given birth are more likely than non-pregnant individuals to become seriously ill with COVID -19. Additionally, if a woman has COVID -19 while pregnant, she is more likely to experience difficulties that could harm her pregnancy and the unborn child.

The chance of being severely ill from COVID -19 during or soon after pregnancy can be substantially increased by having certain underlying medical disorders, as well as by other variables, such as age (for at least forty-two days following the end of pregnancy).

Pregnant or recently delivered individuals, as well as those who reside with or visit them, should take precautions to avoid contracting COVID -19.

2.8.1 Enhanced Chance of Serious Illness

Contrary to those who are not pregnant, those who are pregnant or just gave birth have a greater risk of developing extreme COVID -19 illness. The physical changes brought on by pregnancy may make it simpler to become ill from respiratory viruses like COVID -19. Even after delivery, the body can continue to undergo these changes. When suffering from a severe disease, a COVID -19 patient may require: hospitalization, admission into a hospital intensive care unit (ICU) and a ventilator or other breathing assistance device. Severe illness in COVID -19 patients can result in death.

2.8.2 Risk Increasing Factors

The likelihood of being seriously ill from COVID -19 during or soon after pregnancy might also be influenced by additional factors, such as: possessing a few underlying medical issues such as Cancer, Chronic kidney disease, Chronic liver disease, Chronic lung diseases, Diabetes (type 1 or type 2), heart conditions, HIV infection, immunocompromised condition or weakened immune system, overweight and obesity, physical inactivity, Sickle cell disease or thalassemia, smoking, stroke or cerebrovascular disease, substance use disorders, Tuberculosis, being over 25 years old, living or working in an area where COVID -19 instances are prevalent, living or working in an area where COVID -19 vaccination rates are low, working in environments where it is difficult or impossible to maintain a minimum distance of 6 feet between potentially contagious people, certain racial and ethnic minority groups, which have been put at higher risk of contracting COVID -19 due to the health disparities they experience.

2.8.3 Effect on the Results of Pregnancy

Contrary to those who do not have COVID -19 during pregnancy, those with COVID -19 are more prone to have difficulties that could harm both the developing fetus and the mother. For instance, having COVID -19 while pregnant raises the possibility of having a baby that is born prematurely (before 37 weeks) or stillborn. Other pregnancy issues may also be more common in people who have COVID -19 when pregnant.

2.9 Studies on Influence of COVID Situation on Neonates

A study published by Chen Wang, et al., (2020) shows that the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causes Coronavirus Disease 2019 (COVID -19), which was declared a global pandemic in March 2020.

Another study by Wastnedge, et al., (2020) found that pregnant women and newborns may be especially vulnerable to COVID -19 because the physiologic changes that occur during pregnancy affect the cardiorespiratory and immunological systems, potentially altering the response to SARS-CoV-2 infection. Pradip Dashraath, et al., (2020) observed that fetuses might be exposed to SARS-CoV-2 during critical periods of fetal development.

A different study by Noelle Breslin, et al., (2020), Miranda J. Delahoy, et al., (2020), Gynecol, et al., (2021), Pilar Díaz-Corvillón, et al., (2020), Jonathan Cohen, et al., (2020), Gilles Kayem, et al., (2020) shows that despite the findings of some recent observational research that patients with both asymptomatic and symptomatic COVID -19 as well as minor and severe infections, may all be caused by COVID and at risk of having an unfavorable pregnancy outcome.

Rebecca A.M. Pierce-Williams, et al., (2020) found that the fact that most studies have found a growth in preterm birth (PTB) in pregnant women with severe or critical coronavirus disease 2019 (COVID -19) infection at the population-level. But Gitte Hedermann, et al., (2020), RK Philip, et al., (2020) said that European reports provide contradictory information regarding a reduction or stability, as proved by Asma Khalil, Peter von Dadelszen, Tim Draycott (2020) in the overall rate of PTB throughout time the pandemic.

An inquiry of the medical records retrieved birth statistics at Thomas Jefferson University Hospital; two time periods were studied: 1st March to 31st July 2020 (during the COVID -19 pandemic) and 1st March to 31st July 2019 (before the onset of COVID -19 pandemic). The inclusion criteria were all births at 20 weeks gestation, including those with intrauterine fetal death, fetal anomalies, and multiple gestations. Individual charts were accessed for women who delivered preterm to confirm the indication for delivery. The primary outcome was the incidence of PTB between the 2 groups before and during the COVID -19 pandemic. Secondary outcomes included the incidences of late PTB (34 0/7 to 36 6/7 weeks gestation), early PTB (<34 weeks' gestation) and very early PTB (<28weeks' gestation), and perinatal death (fetal and neonatal death) between periods.

During the global pandemic of coronavirus 2019 (COVID -19), Gitte Hedermann, et al., (2020) and Roy K Philip, et al., (2020) discovered that in Denmark and Ireland have significant reductions in the rate of preterm birth while this was not observed in the United Kingdom by Asma Khalil, Peter von Dadelszen and Tim Draycott (2020). They report no reduction in the preterm birth rate in their hospital system in the United States during the COVID -19 pandemic. They had sufficient power to detect up to a 20% decrease in preterm birth, faraway less than the 70–90% decrease seen in Denmark and Ireland. There were no major differences in referral patterns for preterm delivery in the two time periods, with more than 90% of referrals happening from within their hospital system in both conditions. There were no changes in preterm birth (spontaneous vs. iatrogenic), implying that changes in prenatal support delivery during the pandemic did not alter iatrogenic preterm birth rates. The contradictory results may be partially explained by the fact that preterm birth rates and SARS-CoV-2 infection rates are much higher in the United States and their hospital system than in earlier international research. Cohort showed that Black, Hispanic, and publicly insured women have higher rates of SARS-CoV-2 infection, consistent with previous findings which were studied by Emeruwa, et. al. (2020); however, they did not find any decrease in preterm birth overall or in a demographic group.

In multicenter prospective research, the Spanish obstetric emergency group in 45 hospitals looked at the link between SARS-CoV-2 exposure and infection-related obstetric outcomes. They discovered this by utilizing multivariable models with confounding

variables that pregnant women infected with SARS-CoV-2, when compared to the general population, experienced more preterm births, premature rupture of membranes at term, and NICU admissions than pregnant women who had not been exposed.

In Bangladesh, a study was experimented by a cross-sectional study from March to August (2021) in 3 tertiary hospitals, such as Dhaka Medical College and Hospital, Sir Salimullah Medical College and Hospital, and Mugdha Medical College and Hospital. These hospitals receive all types of patients from the whole country and have all types of facilities given by doctors and nurses. They took 140 pregnant women who tested negative for COVID -19 versus 70 pregnant women who tested positive for the virus. Preterm delivery and a cesarean section were more common in expectant mothers with COVID -19. The COVID -19 infection status of the respondents was found to be substantially correlated with gestational age (p=0.001), with the majority of COVID -19-positive women (52.9%) having premature deliveries compared to just 30.0% of COVID -19-negative women. The likelihood of having a baby with normal weight was shown to be somewhat different between COVID -19-positive (75.0%) and COVID -19-negative women (80.2 percent). Between women with and without COVID -19, there were no appreciable changes in birth weight, premature membrane rupturing, or the Apgar score at 1 or 5 minutes after delivery. COVID -19 was not present in any of the newborns born to COVID -19-positive moms. There is a link between participants' COVID -19 status and poor baby birth outcomes (preterm birth, CS delivery, and low birth weight). According to multivariable logistic regression, women with COVID -19 infection were 2.15 times (95 percent confidence interval, 1.06 to 4.37) more likely to deliver a preterm infant than women who did not have the infection. They employed Firth logistic regression to reduce the bias brought on by a small sample size and address the problem of complete separation for a multivariable logistic model. Women with COVID -19 infection were 3.27 times (95 percent confidence interval, 1.51 to 7.07) more likely to have a CS than women without COVID -19 infection after controlling for variables. The multivariable logistic regression model also revealed no connection between the pregnant women's COVID -19 status and the neonates' low birth weight (aOR, 1.56; 95 percent CI, 0.64 to 3.80). Women who tested positive for COVID -19 were older than those who tested negative for COVID 19, and there was a strong correlation between COVID -19 status and age groups (p-value <0.001). There were

somewhat more employed women in the COVID 19-infected group (22.9%) than in the COVID -19-uninfected group (20.0 percent). 40.7 percent of respondents in the non-infected group were first-time mothers, which was somewhat more. However, compared to women who did not have COVID -19, 40.0% of the COVID -19-positive women had a parity of three or more (26.4 percent). Additionally, the non-COVID -19 group experienced slightly more difficulties linked to pregnancy than the COVID -10 group (7.9 vs. 4.3 percent). Contrarily, more people with COVID -19 (14.3%) than without COVID -19 (3.6%) reported having comorbidities and having at least one comorbidity was statistically significantly linked with participants' COVID 19 infection status (p=0.004) (Masud, et al., 2021).

2.10 Gestational Age

Gestational age is defined by American Academy of Pediatrics (AAP) as the period between the 1st day of the mother's last menstrual cycle and the day of the delivery of the child. The fetus's phase of growth, as well as its mental and physical development, are related to gestational age.

2.10.1 Classifications of Gestational Age

Births can be categorized broadly based on gestational age. The following table shows the distribution of gestational age,

Table 1: Distribution of Gestational Age

Gestational Age	Weeks of Gestation (the number of weeks following the mother's previous menstrual period's first day)	Completed Weeks (number of 7-day intervals following the mother's previous menstrual period's start day)	Days (common medical terminology)
Extremely preterm	<28 weeks	On or before the end of the last day of the 28th week	<197 days
Very preterm	28 0/7 to 31 6/7weeks	On or after the first day of the 29th week through the last day of the 32nd week	197–224 days

Gestational Age	Weeks of Gestation (the number of weeks following the mother's previous menstrual period's first day)	Completed Weeks (number of 7-day intervals following the mother's previous menstrual period's start day)	Days (common medical terminology)
Moderately preterm	32 0/7 to 33 6/7 weeks	On or after the first day of the 33 weeks through the last day of the 34th week	225–238 days
Preterm	<37 weeks	On or before the end of the last day of the 37th week	<260 days
Late preterm	34 0/7 to 36 6/7 weeks	On or after the first day of the 35th week through the end of the last day of the 37th week	239–259 days
Early term	37 0/7 to 38 6/7 weeks	On or after the first day of the 38th week through the end of the last day of the 39th week	260–273 days
Full term	39 0/7 to 40 6/7 weeks	On or after the first day of the 40th week through the end of the last day of the 41st week	274–287 days
Late-term	41 0/7 to 41 6/7 weeks	On or after the first day of the 42nd week through the end of the day of the 42nd week	288–294 days
Post-term	42 0/7 weeks or more	On or after first day of the 43rd week	≥295 days

Source: (Gomella, et al., 2020)

2.11 Preterm Birth

Regardless of birth weight, a preterm birth (PTB) is one that happens before the end of 37 menstrual weeks of gestation. The potential for growth may be typical and suitable for the gestational age (10^{th} to 90^{th} percentile) (Dutta, 2015)

2.11.1 Causes of Preterm Birth

In 50% of cases, causes are unknown. Other causes are; fetal distress, multiple gestations, erythroblastosis; placental dysfunction, placenta previa, abruptio placentae; bicornuate uterus, incompetent cervix (premature dilatation); teenage mother, preeclampsia, chronic medical illness (e.g., cyanotic heart disease, renal disease), infections (e.g., UTI, chorioamnionitis), use of tobacco, previous history of induced or spontaneous abortion or preterm delivery, maternal stress; premature rupture of membranes, polyhydramnios and iatrogenic (DM and Rh incompatibility).

2.11.2 Incidence of Preterm Birth

Two-thirds of low birth weight newborns are preterm infants. About one in ten babies have low birth weight. 30 to 40 percent in developing nations, thus, about 20 to 25 percent of babies are born preterm. In developed and wealthy societies, the former is less common, less than 10% (Dutta, 2015).

Preterm births (births that occur before 37 full weeks of gestation) are thought to affect 15 million babies annually, and the number is growing. It means 1 in 10 babies. The main cause of death for children under the age of five is preterm birth complications, which contributed to around 1 million deaths in 2015. With today's cost-effective solutions, three-quarters of these deaths may be avoided. The percentage of newborns born preterm varies from 5 to 18 percent across 184 nations. In a study of icddr,b, it was found in 2014 that the preterm birth rate was 12.5% (icddr,b, 2014). Prematurity was the primary factor in infant mortality in Bangladesh in 2015 (29.7 percent) (UNICEF).

Preterm birth is a problem that affects the entire world, while more than 60% of preterm births occur in Africa and South Asia. On average, 12 % of babies are born prematurely in lower-income nations, compared to 9 percent in higher-income nations. Families with lower incomes face greater danger within nations (Anon., 2018).

The ten countries where preterm births occur most frequently are India (35,19,100), China (11,72,300), Nigeria (7,73,600), Pakistan (7,48,100), Indonesia (6,75,700), USA (5,17,400), Bangladesh (4,24,100), Philippines (3,48,900), DRC (3,41,400) and Brazil (2,79,300) sequentially as per WHO. In the other hand the same source shorted the ranks

of the countries where preterm birth occurs more frequently in 100 live births are as per following order, Malawi (18.1%), Comoros (16.7%), Congo ((16.7%), Zimbabwe (16.6%), Equatorial Guinea (16.5%), Mozambique (16.4%), Gabon (16.3%), Pakistan (15.8%), Indonesia (15.5%) and Mauritania (15.4%).

All but three of the 65 nations with accurate trend data show an increase in preterm birth rates over the past 20 years. Better measurement, rising maternal ages and underlying maternal health issues like diabetes and high blood pressure, increased use of infertility treatments leading to higher rates of multiple pregnancies, and changes in obstetric practices like an increase in preterm births by caesarean section are some potential causes.

2.11.3 Indication For Hospitalization of Preterm LBW Infants

There are some indications for a preterm low birth weight baby to admit to a hospital. These are if birth weight <1800 gm, gestational age <34 weeks, baby is not able to take feed from breast/cup and spoon, any sick neonate irrespective of birth weight/gestation (Khan & Rahman, 2011).

2.11.4 Complications of Preterm Baby

Preterm babies may have some early and late complications. The early complications are intrauterine hypoxia, respiratory difficulties, birth asphyxia, meconium aspiration, Hyaline membrane disease, apneic attack, feeding difficulties, symptomatic hypoglycemia, hypothermia, hyperbilirubinemia, infection, necrotizing enterocolitis, congenital malformations, hemorrhage (intraventricular, pulmonary). The late complications are Cerebral palsy, hearing and vision problems, learning disabilities, poor growth and retinopathy of prematurity.

2.11.5 Prognosis of Preterm Baby

There is a chance of high mortality. The survival percentage of infants weighing between 1,000 grams and 1,500 grams in NICU is greater than 90%. The endurance rate of infants born at 26 weeks is roughly 80% when surfactant is used. If there is no perinatal infection, then prognosis is good (Dutta, 2015).

2.11.6 Complications on Mother Triggered by Preterm Birth

Premature birth can have a profound emotional effect on the mother and the entire family. Preterm laboring women are more likely to have anxiety, postpartum depression, post-traumatic stress disorder (PTSD) and problems bonding with their babies.

2.12 Birth Weight

The body weight of a newborn is referred to as birth weight. The fetal, placental and maternal environments are all reflected in birthweight (BW). Due to the loss of extracellular free water, both term and preterm neonates lose weight soon after birth (up to 10% in preterm newborns). Preterm infants may take longer to acquire weight than term infants, who typically do so in 7 to 10 days. Regaining birth weight takes 10 to 15 days, or even longer, in cases of extremely low birth weight (ELBW)infants. Average daily weight increase after BW should be 14 to 20 gm/kg/day, 20 to 30 gm/day for term babies and 20 to 30 gm/day for preterm babies. During the first week of life, a weight loss of more than 15% of birthweight should be regarded as excessive, and the body's water balance should be thoroughly reevaluated (Gomella, et al., 2020).

2.12.1 Relation of Birthweight to Gestational Age

Between 3000 and 4000 gm was the average weight of a baby. According to the percentile fetal birth weight curves for gestational age, fetal birth weight grew as gestational age increased. Typically, male babies were found to be heavier at birth than female babies. When their findings were compared to those of earlier research, it became clear that their study's 10th percentile values were greater but the 90th percentile values were comparable to those of earlier research (Topçu, et al., 2014).

2.12.2 Birth Weight Recording

Once the newborn is stable, every infant should be weighed on a minimum 5 gm sensitivity scale. The newborn should be positioned on the weighing scale with a sterile cloth towel or single-use paper towel below them. The weighing scale needs to be calibrated on a regular basis (at least once per week) (Department of Neonatology of BSMMU, 2016).

2.12.3 Importance of Birth Weight

Some complications may arise if a baby is born with low birth weight. There are some importance of birth weight such as- the second most common reason behind newborn death is low birth weight. Low birth weight is a crucial indicator of a child's health because it is linked to both short- and long-term effects like a higher risk of delayed motor and social development as well as the emergence of cardiovascular disease in later life. Low birth weight has also been associated with a greater demand for medical attention and a higher expense of medical care. Low birth weight rates have risen recently, underlining the need for greater focus (Gomella, et al., 2020).

2.12.4 Relation of Maternal Nutritional Status with Fetal and Postnatal Growth

The diet of the mother influences fetal and postnatal growth. Prenatal obesity and fetal adiposity are more likely among women with high BMIs and pre-pregnancy weights and those who gain too much weight during pregnancy. In contrast, higher prenatal weight loss in healthy women with normal BMI raises the risk of having babies that are too small for their gestational age. Omega-3 fatty acids in particular, which are supplements to the maternal diet, may increase the mother's BW, length, and gestational period. Antenatal maternal micronutrient supplementation including iron and folic acid may affect fetal growth, weight, and gestational age and reduce infant morbidity. Early weight gain of 6 weeks or more in neonates may raise the risk of obesity. Accelerated weight gain in infants with IUGR raises the risk of "adiposity rebound" and ensuing metabolic and cardiovascular disorders (Dutta, 2015).

2.12.5 Causes of Neonatal Birthweight Loss

The prime causes of neonatal birthweight loss are inadequate breastfeeding, incorrect latch for breastfeeding, and infant's inability to latch. The infant can have trouble latching on if the mother has excessively engorged breasts, big nipples, flat nipples, or inverted nipples. Physical or neurological problems might also hamper babies' ability to latch on to the breast correctly. Without a good latch, the baby won't be able to consume enough milk, improper application of a nipple shield, sleepiness, production of milk begins slowly, real

milk shortage and diseases like congenital heart diseases, congenital hypothyroidism, hyponatremia, dehydration, hypothermia, failure to thrive.

2.12.6 Classification of Birth weight

Genetics, maternal health, stress, racial stress, environmental factors have effects on birth weight. There are 7 types of birth weight for neonates namely, Incredibly LBW or Micro Preemie, Extremely Low Birth Weight (ELBW), Very Low Birth Weight (VLBW), Low Birth Weight (LBW), Normal Birth Weight (NBW), High Birth Weight (HBW) or Big Baby, Very High Birth Weight (VHBW).

2.12.6.1 Incredibly LBW or Micro Preemie

If a newborn having birth weight <800 grams is defined as incredibly low birth weight. They are born within 24 to 26 weeks, have premature organs, and need NICU care to complete 39 weeks and 1800 grams at least (Gomella, et al., 2020). In NICU, they may need these supports like respiratory support, intravenous lines (IVs), monitoring equipment, NG/OG tubes. Babies who born very early are at risk for several medical issues. Some have short-term effects such as Intraventricular hemorrhage (IVH), Necrotizing enterocolitis (NEC), Patent ductus arteriosus (PDA), Respiratory distress syndrome (RDS) and sepsis. If babies are admitted in NICU for long-term they might have lifelong health issues such as cerebral palsy, chronic lung disease, cognitive problems, digestive problems and vision or hearing loss.

2.12.6.2 Extremely Low Birth Weight (ELBW)

Newborns having a birth weight of less than 1000 gm are considered to be extremely low birth weight (ELBW) babies (2 lb, 3 oz). The youngest premature newborns, typically born at 27 weeks or less of gestation, are also those with extraordinarily low birth weights (Gomella, et al., 2020).

2.12.6.3 Very Low Birth Weight (VLBW)

Infants with a very low birth weight (VLBW), or less than 1500 g at birth, which accounts for just approximately 1% of all births, yet accounts nearly 50% of newborn fatalities (Marcdante & Kliegman, n.d.). Babies with very low birth weight frequently arrive before

30 weeks of pregnancy. A premature baby's time to develop and put on weight is reduced. The later stages of pregnancy are when a baby gains the majority of its weight. A baby does not grow well throughout pregnancy is another factor in very low birth weight. Intrauterine growth limitation is what this is (IUGR). Birth abnormalities, placental issues, or the mother's health could all be contributing factors. Most kids with IUGR who have very low birth weight are also delivered prematurely. They are typically physically underdeveloped and somewhat petite. In comparison to young children, LBW newborns that weigh less than 2500 gm have a 40-fold higher risk of dying than the neonatal stage; the danger of newborn mortality is 200 times higher for VLBW infants (Vilanova, et al., 2019).

Very low birth weight babies might have many risks like becoming infected during pregnancy, pregnancy without gaining enough weight, having had a low-birth-weight baby during a prior pregnancy, smoking, using alcohol or illicit substances, being either under the age of 17 or over the age of 35 and being African, American women.

Here are a few of the most typical issues that VLBW babies experience like blood sugar levels that are low at birth, an eye condition called retinopathy of prematurity that can result in blindness, low oxygen levels at birth, difficulty in keeping warm, having issues eating and gaining weight, infection, breathing issues brought on by developing lungs (respiratory distress syndrome), issues with the nervous system, such as bleeding inside the brain or damage to the white matter of the braid, significant digestive issues, such necrotizing enterocolitis and Infant sudden death syndrome (SIDS).

For infants with VLBW, the risk of long-term issues and disability is higher. Long-term issues could include cerebral palsy, blindness, deafness and delay in development.

The course of treatment depends on the child's age, symptoms, and general health. Furthermore, it will vary on how serious the problem is. Infants with VLBW could require neonatal intensive care unit (NICU) treatment, beds with temperature control, specialized feedings, often with a stomach tube inserted if the infant is unable to suck and alternative therapies for complications.

2.12.6.4 Low Birth Weight (LBW)

If the birth weight falls <2500 grams. Premature birth or intrauterine growth retardation could have caused the newborn to be LBW. Although approximately 6–7% of all births are LBW infants, they are responsible for more than 70% of neonatal fatalities (Marcdante & Kliegman, n.d.). An LBW baby due to IUGR is also known as a small-for-date (SFD) baby. The gestation may be full term or preterm, but the infant is malnourished and LBW as a result. This group includes two-thirds of infants with LBW. An LBW newborn may occasionally be both premature and SFD. Low birth weight can be prevented by maintaining a balanced diet when pregnant and not doing drugs, smoking, or drinking alcohol.

2.12.6.5 Normal Birth Weight (NBW)

It is called normal birth weight if birth weight is 2500 gm to 3999 gm. Immediately following birth, it's normal for newborns to lose about 10% of their body weight (Gomella, et al., 2020). This decline is primarily the result of fluid loss and is typically unimportant. The majority of newborns regain this weight within a week. A number of things affect a newborn baby's weight, such as food and weight before and throughout pregnancy (if one is overweight, her baby might be bigger; if she doesn't get enough nutrition when she is pregnant, her kid might be smaller); pregnancy health, such as whether anyone uses alcohol or tobacco or have diabetes; own birth weight combined with heredity (mother’s size at birth along with both of parents current sizes can both be factors); age (teen mothers tends to have smaller babies); gender (no matter if it's a boy or a girl); if the mother is primi (they tend to be smaller than subsequent children); whether child is a twin, triplet, or more (multiples tend to be smaller than singletons).

2.12.6.6 High Birth Weight (HBW) or Big Baby

If a newborn’s weight is between 4000 gm (8 lb 13.1 oz.) to 4500 gm (9 lb 14 oz.) it is called as big baby (Gomella, et al., 2020). But there are some causes that can make having a huge baby more likely. These consist of if a mother is diagnosed with type 1, type 2 diabetes or gestational diabetes during pregnancy. This is particularly true if mother’s diabetes is poorly controlled, being overweight or developing excessive weight when

pregnant. When women who had healthy weights before getting pregnant gain more than 35 pounds or those who were obese gain more than 20, macrosomia is more likely to occur if the mother had a macrosomic child in the past. Every pregnancy raises the risk of macrosomia, being more than 40 weeks pregnant.

Complications arising from having big babies are that babies delivered vaginally may be more susceptible to shoulder dystocia, a condition in which the baby's shoulder becomes caught behind the mother's pelvic bone. If the doctor suspects shoulder dystocia, he or she may try to move mother or her baby about to urge her to change positions. If that doesn't work doctor can suggest an emergency C-section or employ a vacuum or forceps equipment. Larger newborns might occasionally result in more vaginal tears or bleeding following birth. An uncommon but deadly problem where the uterus bursts open along scar line is called uterine rupture, and mothers who have previously had a C-section are more likely to experience it. A macrosomic newborn is more likely to need a brief hospital stay after birth due to low blood sugar or jaundice or respiratory distress soon after birth.

2.12.6.7 Very High Birth Weight (VHBW)

Very High Birth Weight (VHBW) is also called fetal macrosomia if birth weight is >4500 grams. High birth weight infants were more likely to require a Caesarean section and to experience fetal mortality. Causes of fetal macrosomia can be brought on by genetic reasons as well as maternal diseases like diabetes or obesity. Rarely a newborn may have a health issue that causes them to grow bigger and faster. Sometimes the reason why a newborn is bigger than typical is unknown.

Risk factors for VHVW are maternal diabetes, a background with fetal macrosomia, maternal obesity, excessive weight gain during pregnancy and overdue pregnancy if mother’s age is more than 35. The average birth weight for each time of successive pregnancy up to the fifth usually rises by up to 4 ounces (113 gm). Infant boys often weigh a little bit more than infant girls. Males make up the majority of newborns who weigh more than 9 pounds, 15 ounces (4,500 gm).

Fetal macrosomia may cause certain potential maternal complications such as labor problems, genital tract lacerations, bleeding after delivery and uterine rupture. Newborns

and children may have risks of lower blood sugar levels, childhood obesity and metabolic syndrome. Fetal macrosomia might not be something that can be stopped, but we can encourage a healthy pregnancy. According to research, a low-glycemic diet and exercise during pregnancy can lower the incidence of macrosomia. For example, making a preconception appointment, observing weight, controlling diabetes, and doing low-impact workouts.

2.13 Maternal Comorbidities

2.13.1 Diabetes Mellitus During Pregnancy

Diabetes mellitus is a chronic metabolic condition brought on by either peripheral tissue resistance or a relative or absolute lack of insulin. Chronic low-grade inflammation characterizes pregnancy. C-reactive protein (CRP) and interleukin-6 levels are elevated in the blood. These two things make people more resistant to insulin. Insulin secretion and action both exhibit abnormality. Hyperglycemia is the final result. There are four types of DM. These are, Type -1 DM, Type -2 DM, Gestational Diabetes Mellitus (GDM) and Others (Genetic, Drugs). Diabetes mellitus complicates pregnancies in between 1 and 15% of cases, 90% of which are gestational diabetes mellitus (GDM). Between five and twenty years, over half of the women with GDM will develop overt type-2 diabetes (Dutta, 2015). GDM is characterized by carbohydrate intolerance of varying degrees beginning during the current pregnancy or being initially noticed. In the third or late second trimester, the entity typically manifests. Some complications may happen due to GDM, like, as fasting hyperglycemia leading to perinatal loss, increased incidence of macrosomia, polyhydramnios, birth trauma and persistence of GDM in 50% of cases. There may be maternal and fetal and neonatal consequences of a diabetic mother. Maternal complications during pregnancy are abortion, preterm labor (26%), infection, increased incidence of preeclampsia (25%), polyhydramnios (25–50%), maternal distress, diabetic retinopathy, diabetic nephropathy, coronary artery disease, ketoacidosis. Maternal complications during labor are- prolonged labor, shoulder dystocia, injuries to the perineum, postpartum bleeding and operative interference. Fetal hazards are- fetal macrosomia (40–50%), congenital malformation (6–10%), birth injuries, growth restriction (less common) and fetal death (Dutta, 2015). Neonates may face hypoglycemia,

respiratory distress syndrome, hyperbilirubinemia, polycythemia, electrolyte imbalance, cardiomyopathy, childhood obesity, neuropsychological effects and diabetes.

2.13.2 Disorders of Hypertension During Pregnancy

One of the frequent medical issues associated with pregnancy is hypertension, which greatly impacts maternal and perinatal morbidity and mortality. The diagnosis of this clinical condition and its successful care greatly impact how the pregnancy turns out for both the mother and the fetus. There are many types of hypertension in pregnancy. These are- hypertension, proteinuria, gestational hypertension, preeclampsia, eclampsia, HELLP syndrome, chronic hypertension, superimposed preeclampsia or eclampsia, chronic hypertension with superimposed preeclampsia and eclampsia. Here preeclampsia is described as it is commonly found in pregnant women. A previously normotensive and nonproteinuric lady develops hypertension to the level of 140/90 mm Hg or greater, which is a symptom of preeclampsia and it is a multisystem illness with an unclear origin. Preeclampsia incidence in hospital settings ranges considerably from 5% to 15%. About 10% of primigravidae and 5% of multigravidae experience the condition (Dutta, 2015). Complications are more likely to happen if the patients are not treated and taken care of. It includes maternal and fetal complications. Maternal complications during pregnancy include labor, puerperium eclampsia, sepsis, preterm labor, accidental hemorrhage, oliguria and anuria, vision impairment, blindness, cerebral hemorrhage and acute respiratory distress syndrome (ARDS). Preeclampsia severity, disease duration, and proteinuria level affect fetal risk, such as intrauterine death, intrauterine growth restriction, asphyxia and prematurity.

2.13.3 Asthma During Pregnancy

Due to progesterone's influence and the decline in arterial CO_2 tension, some degree of breathlessness is common throughout pregnancy. This type of breathlessness is considered normal when oxygen saturation is greater than 95%. Due to its hypersensitivity to many stimuli, asthma is chronic airway inflammation. An average of 5-8% of pregnant women have asthma (Dutta, 2015). Preterm labor, PROM, hypertension, low birth weight, and neonatal hypoxia are more common. Status asthmaticus raises the risk to the mother.

Pneumothorax, cor pulmonale, cardiac arrhythmias, and respiratory failure are all life-threatening consequences.

2.13.4 Thyroid Dysfunction in Pregnancy

2.13.4.1 Hyperthyroidism

Pregnancy-related physiological changes such as increased heart rate, oxygen consumption, and body temperature can resemble moderate thyrotoxicosis. About 2 out of every 1,000 pregnancies result in hyperthyroidism (Dutta, 2015). Maternal complications in untreated hyperthyroidism are miscarriage, preterm delivery, preeclampsia, congestive cardiac failure, placental abruption, thyroid storm and infection. Fetal and neonatal complications in untreated hyperthyroidism are IUGR, prematurity, stillbirth, hypothyroidism, and increased perinatal morbidity and mortality.

2.13.4.2 Hypothyroidism

It may be subclinical or overt. Early-stage pregnancy hypothyroidism that is left untreated results in a high rate of fetal loss in the form of miscarriage, stillbirth, premature birth, and intellectually delayed offspring. Preeclampsia and anemia are two common pregnancy problems.

2.13.5 Premature Rupture of Membranes (PROM)

Premature rupture of the membranes is the term used to describe any spontaneous membrane rupture that occurs after the 28th week of pregnancy but before the start of labor. Preterm PROM refers to membrane rupture that happens before 37 full weeks of pregnancy, while term PROM refers to membrane rupture that occurs after 37 weeks but before the start of labor. Membrane rupture that lasts more than 24 hours before delivery is referred to as extended membrane rupture. It occurs in approximately 10% of all pregnancies (Dutta, 2015). Preterm labor and prematurity are two serious consequences of PROM. It also leads to infection of neonates after birth.

2.14 Studies on Influence of COVID Situation on Maternal Co-morbidities in Neonates

A study by Person, et al., (2018) shows that there were 78,126 singleton eligible newborns between January 1, 2007, and December 31, 2015, of which 76,360 (95.7%) had information on maternal diabetes; 3280 (4.3%) infants were born to mother who had the disease. Moms with diabetes were older, had more hypertensive problems, received prenatal corticosteroids more frequently, and delivered their babies through cesarean section more frequently than mothers without diabetes (p-value <0.05). The GA and birth weight of children born to mothers with diabetes were greater than those born to mothers without diabetes. Another study by Kong, et al., (2019) showed that premature birth rates were 37.1% (1483) for mothers with type 1 diabetes using insulin, compared to 10.1% (376) for mothers with type 2 diabetes. Preterm birth rates were very similar for mothers with gestational diabetes (5.1% [5023]) and mothers without diabetes (5.3% [28 661]).

In (2017), a study by Shulman, et al., showed that mothers having hypertension have a high risk of giving birth to preterm babies (average GA 26 weeks) and very low birth weight infants (aOR, 7.74; 95% CI, 6.92–8.67; $P < .001$). Another study observed that women who were diagnosed with eclampsia during pregnancy had a significantly higher risk of giving birth to very low birth weight babies (birthweight 1,499 gm; risk difference (RD) = 6.7%), moderately low birth weight babies (birthweight 1,500-2,499 gm; RD = 14.6%), very preterm babies (gestational age 33 weeks; RD = 7.1%), and moderately preterm babies (33-36 weeks; RD (Ananth, et al., 1995). Preeclampsia had another unfavorable effect in those women who had both COVID -19 and preeclampsia had RRs for preterm birth that was higher than 4.05 (95% confidence interval, 2.99-5.49) and 6.26 (95% confidence interval, 4.35-9.00) for nulliparous women (Papageorghiou, et al., 2021).

In 2020 a study was conducted by Ita Marlita Sari, et al., (2020) and they observed the overall rate of PROM in preterm laboring women was 56.2%, while the rate in at-term laboring women was 66.3% (odds ratio (OR) of 2.97 (95% confidence interval [CI], 1.92 to 4.59).

Chapter-3

3 Materials and Methods

3.1 Study Area

After Dhaka, Chattogram is the second-largest city in Bangladesh. Located at 22°20′06″N 91°49′57″E. It occupies around 168.1 km² area. The study was performed based on the patient who got admitted in Gynae and Obstetrics department of Bangabandhu Memorial Hospital, Foy's Lake, Chattogram due to pregnancy and baby delivery. It accommodates between 700 and 1,000 patients each day in its 220 beds and 15 wards.

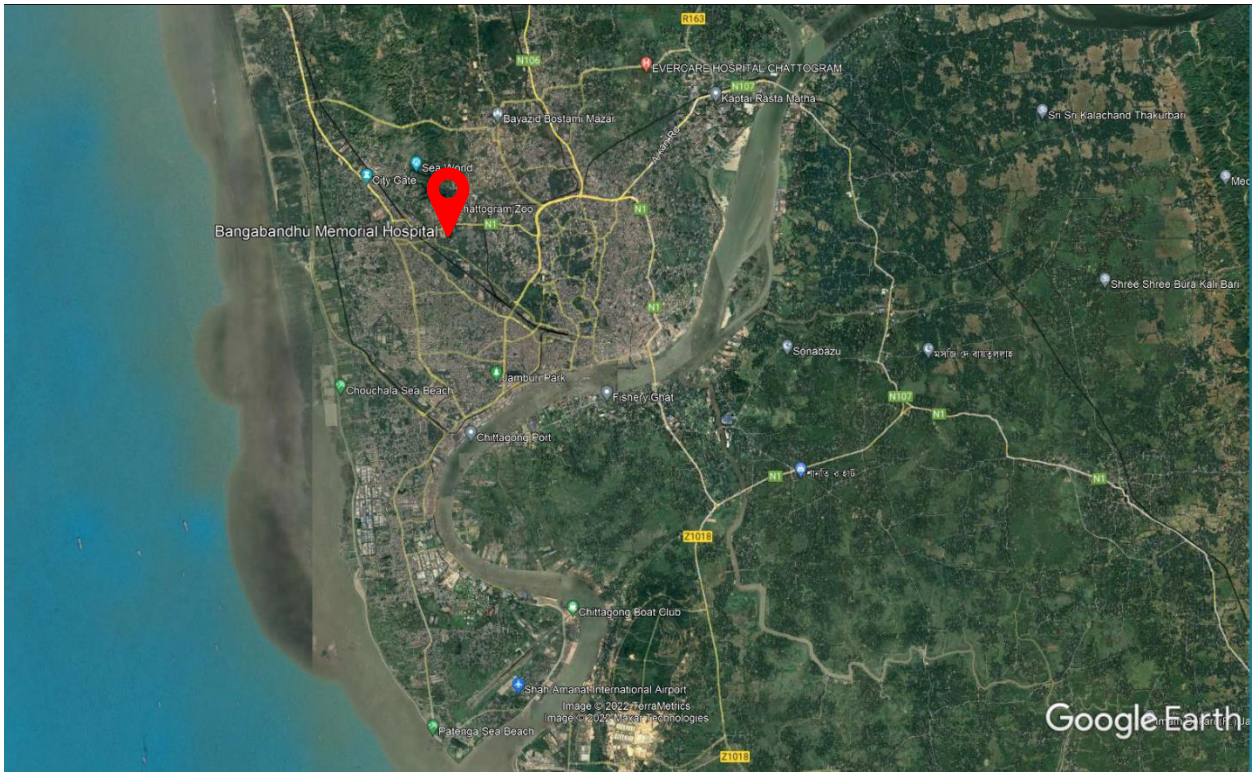

Figure 1: Study Area, Chattogram City and Surroundings (Source: Google Earth)

Patients from all over Chattogram city and its surrounding localities come here for treatment. So, it's safe to say the study covers representative samples from the whole Chattogram territory.

3.2 Study Design

The observational study was done to find if there is any relationship of COVID -19 pandemic with gestational age and birth weight of newborn, again if there is any association between the pandemic with the mode of delivery of a woman, and also to observe if other complications of mother have any impact on gestational age and weight of newborn. A convenience sampling technique was used in sample design. Routinely kept records from hospital register book was collected for this research. To study the complications, Diabetes Mellitus (DM), Hypertension (HTN), Premature rupture of membrane (PROM), Bronchial asthma (BA), Hypothyroidism, twin pregnancy, preeclampsia, Urinary tract infection (UTI) were considered. The data collected from the hospital can be considered as representative of general sample of different classes of people as this hospital is within reach of all socio-economic classes. The statistical analysis to define the correlation between events and cases was standard and widely used. Various checks and back calculations have also done to confirm the correctness of the calculations.

3.3 Study Population

Total 733 nos. of cases were collected from the admission record of Bangabandhu Memorial Hospital, Foy's Lake, Chattogram at Gynae and Obstetrics ward. Babies (20 nos.) with intrauterine death (IUD), stillbirth, dilation and curettage (D and C), ectopic pregnancy, blighted ovum and threatened abortion were excluded from the analysis. This study was performed on 713 live births only from 28 to 42 weeks of gestational age where 257 cases were during the pre-COVID time (June 2019-December 2019), and 456 cases were during COVID time (June 2020-December 2020).

3.4 Development of Questionnaire

As COVID -19 is a very recent topic, not a lot of research in this field is available. Search and read available research and review journal articles regarding the scope of the study to generate the idea about works and studies being done on this and associated topics. With the existing research ideas and knowledge a draft questionnaire was generated focusing the expected area of the study and availability of data. Followed by vetting by the

supervisor, the approval from the ethical committee and study site were collected. The sample size was determined considering the hospital record book data. Addition and extraction criteria have been determined followed by the finalization of the questionnaire.

3.5 Data Collection

Data were obtained from hospital registered records. Healthy alive babies whose gestational age was between 28 weeks and 36 weeks were considered to be preterm and 37 weeks and 42 weeks were terms as per the Management Protocol of Newborn Doctor's Handbook published by Bangabandhu Sheikh Mujib Medical University (BSMMU).

3.6 Data Analysis

The collected data from hospital sources were recorded into Microsoft Excel software and palatable and unpalatable data were segregated. The pre-COVID and COVID data were tabulated in separate excel sheets. Analysis and calculation were done using Microsoft Excel software. A comparison was done between the gestational age of two groups to determine the association of COVID -19 with preterm birth in the Chattogram metropolitan area and its surrounding factors. Additionally, a comparison of the mode of delivery and birth weight between two groups was done to find other impacts on childbirths during the study period. Mothers with complications with Diabetes Mellitus (DM), Hypertension (HTN), Premature rupture of membrane (PROM), Bronchial asthma (BA), Hypothyroidism, twin pregnancy, preeclampsia and Urinary tract infection (UTI) were considered to observe the association of COVID -19 time with preterm birth and birth weight.

A Chi-square test was accomplished to check the validity of the hypothesis where the significance limit was considered up to 0.05 and the P-value was also considered to countercheck the authenticity of the analysis and statements.

Chapter-4

4 Results

The study comprises 713 numbers of cases in pre-COVID and COVID periods to find if there is any association of COVID with preterm birth. Among the cases, 257 were in pre-COVID (June 2019-December 2019) and 456 cases were in COVID (June 2020-December 2020) time. Alive babies whose gestational age was between 28 weeks to 42 weeks were included in this study. Twin babies were considered separate individual cases. Babies with intrauterine death (IUD), stillbirth, dilation and curettage (D and C), ectopic pregnancy, blighted ovum and threatened abortion were excluded from the analysis.

In the pre-COVID time in BBMH, a total of 257 babies were born. Among them, 56% (144/257) were male and 44% (113/257) were female. In COVID time total 456 neonates were born. Male-female ratio of newborns was 50:50. The age distribution of mother's age in pre-COVID time ranged between 15 and 37 years, where the average age was 25 (SD 4.68) and in COVID time, the range was between 18 and 40 years, where the average age was 25 (SD 5.03).

4.1 Preterm-term Comparison

Preterm birth rate was 20% (52/257) in pre -COVID time and 21% (97/456) during COVID time refer to Figure 2, Figure 3 and Table 2. It was observed that there was no significant relation of COVID with preterm birth between pre-COVID and COVID time; in the calculation, the P-value is 0.16006, which supports the statement.

The table below represents the distribution of cases considered in the study.

Table 2: Preterm-term ratio in pre-COVID and COVID time

Particulars/Period	Pre-COVID	COVID	P Value*
Preterm	52 (20%)	97 (21%)	0.16006
Term	205 (80%)	359 (79%)	

*P value < 0.05 is significant.

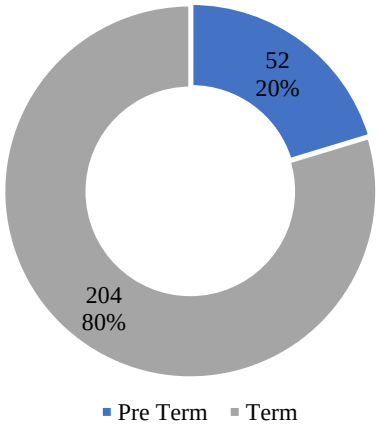

Figure 2: Gestational Age in pre-COVID period

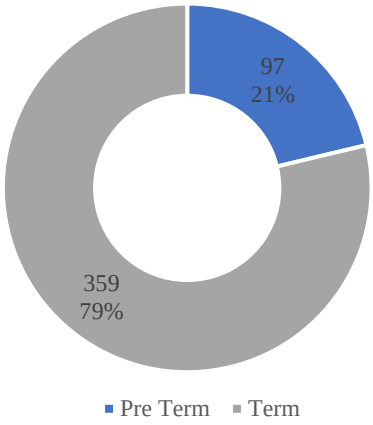

Figure 3: Gestational Age in COVID period

4.2 Mode of Delivery Comparison

The study also comprises a comparison of the trend of normal delivery (NVD) and cesarean section delivery (LUCS) difference between the two considered situations. It was observed that NVD was done more in pre – COVID time compared to COVID time and the rate of cesarean section was increased in covid time.

Table 3: NVD-LUCS ratio in pre-COVID and COVID time

Particulars/Period	Pre-COVID	COVID	P Value*
NVD	100 (39%)	123 (27%)	0.20864
LUCS	157 (61%)	333 (73%)	

*P value < 0.05 is significant.

Among the cases, NVD was done 39% (100/257) and 27% (123/456) during pre-COVID and COVID time respectively; were cesarean section delivery was 61% (157/257) and 73% (333/456) in pre- COVID and COVID time respectively as shown in Figure 4 and Figure 5 and Table 3.

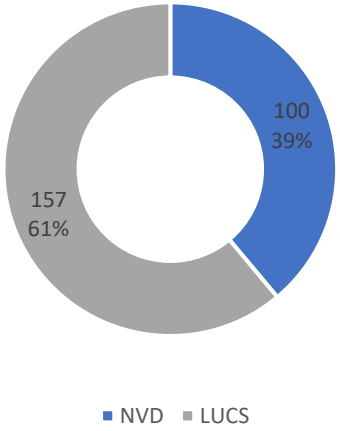

Figure 4: Mode of delivery in pre-COVID period

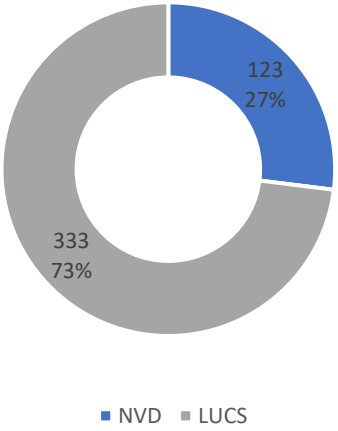

Figure 5: Mode of delivery in COVID period

4.3 Birth Weight Comparison

Normal birth weight cases were 72% (185/257) in pre-COVID time, whereas it was 71% (323/456) in COVID time. Low birth weight babies were born 26% (68/257) and 28% (126/456) in pre – COVID and COVID time subsequently.

Table 4: Comparison of NBW, LBW and BB in pre-COVID and COVID time

Particulars/Period	Pre-COVID	COVID	P Value*
NBW	185 (72%)	323 (71%)	0.11632
LBW	68 (26%)	126 (28%)	
BB	4 (2%)	7 (1%)	

*P value < 0.05 is significant.

Lastly, there were 2% (4/257) of babies born as big babies in pre-COVID time, whereas it was 1% (7/456) in COVID time, as shown in

Figure 6, Figure 7 and Table 4.

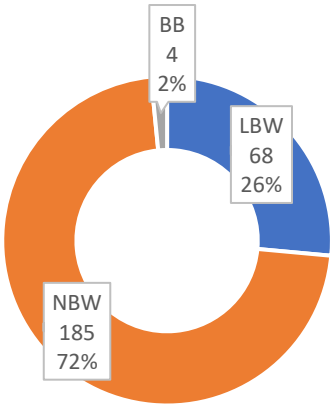

Figure 6: Birth weight distribution in pre-COVID period

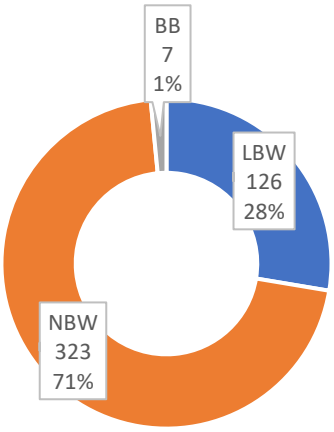

Figure 7: Birth weight distribution in COVID period

In these three categories, P-value is always more than 0.05, which also supports chi-square test that approves the null hypothesis, which indicates that there is no association of preterm birth with COVID 19 and other factors considered in the analysis.

4.4 Prevalence of Diseases

In this study some diseases or maternal condition which can have effect on newborn was investigated. It was found that in pre-COVID period, HTN mother (6.23%) was more prevalent than DM mother (3.89%) and mother who faced PROM during pregnancy (3.89%) and went through premature labour. In COVID time, the percentage of mother with HTN (4.39%), DM (3.51%) and PROM (2.19%) all were observed to be less in comparison with pre-COVID period. During COVID time, other diseases like bronchial asthma, hypothyroidism, preeclampsia and UTI were also found in minimal amounts.

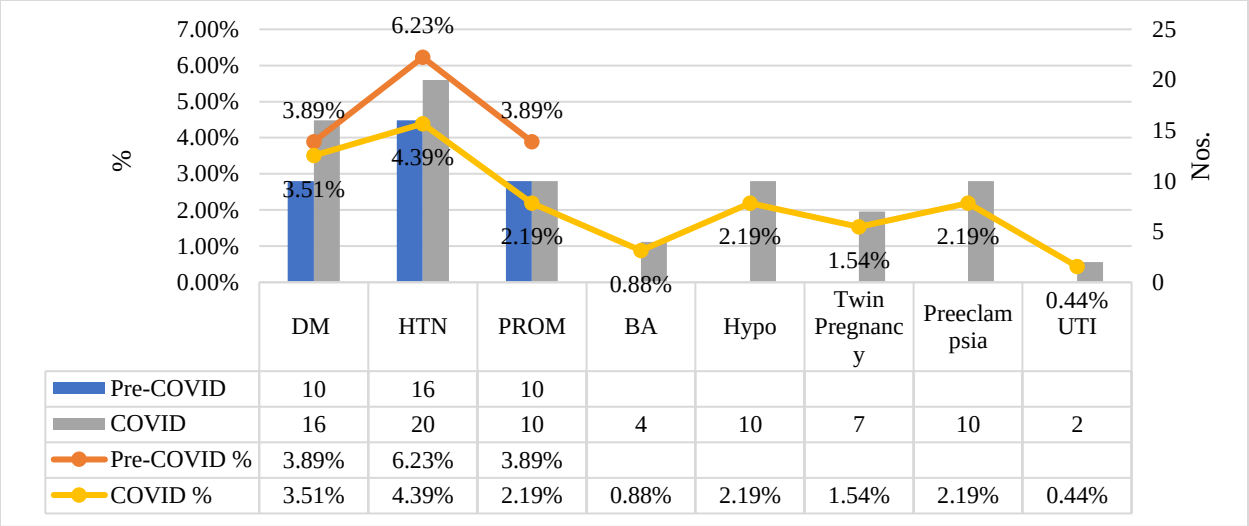

Figure 8: Prevalence of diseases

4.5 Comparison of Preterm, Term and Weight of Babies of DM Mothers

The preterm birth rate of babies of DM mothers cases was 20% (2/10) in pre-COVID time, but in COVID time, it became 44% (7/16). Term birth rate of babies of DM mothers was 80% (8/10) in pre-pandemic time, and during COVID it became 56% (9/16).

Table 5: Comparison of Preterm, term and weight of Babies of DM mother

Particulars/Period	Pre-COVID	COVID	P Value*
Total Cases of Babies of DM mother	10	16	
Preterm	2(20%)	7(44%)	0.22
Term	8(80%)	9(56%)	
Average Weight of Babies of DM mother	2.82	2.47	0.92
Average Weight of all Babies	2.69 (SD 0.53)	2.66 (SD 0.63)	

*P value < 0.05 is significant.

It is evident that the Preterm birth rate has increased in COVID time. However, the result of p-value doesn't support the significance of the statement. These are shown in Table 5.

It was also observed that babies of DM mothers' average weight were 4.70% higher than the average weight of all babies in pre-pandemic time. But in COVID time, it was decreased to 7.27%, which is shown in Figure 9.

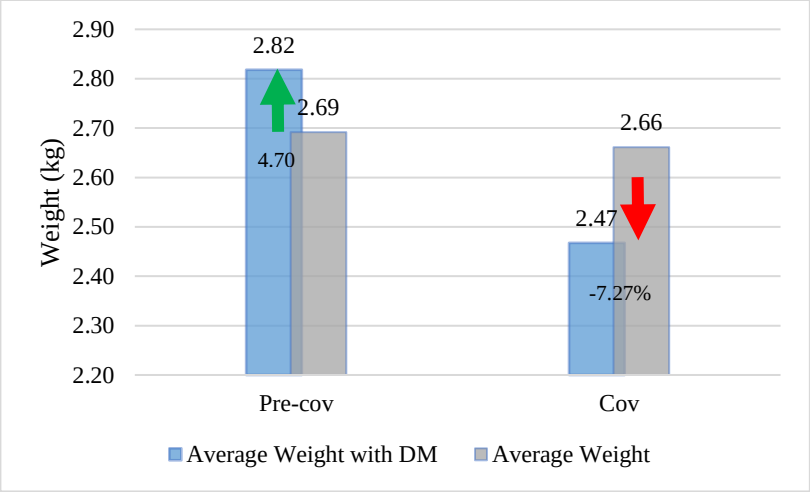

Figure 9: Weight variation of babies of DM mother

4.6 Comparison of Preterm, Term and Weight of Babies of HTN Mothers

The preterm birth rate of babies of HTN mothers cases was 37% (6/16), and the term birth rate of babies of HTN mothers was 63% (10/16) in pre-pandemic time.

Table 6: Comparison of Preterm, term and weight of Babies of HTN mother

Particulars/Period	Pre-COVID	COVID	P Value*
Total Cases of Babies of HTN mother	16	20	
Preterm	6(37%)	10(50%)	0.45
Term	10(63%)	10(50%)	
Average Weight of Babies of HTN mother	2.37	2.36	1.00
Average Weight of all Babies	2.69 (SD 0.53)	2.66 (SD 0.63)	

*P value < 0.05 is significant.

Whereas, in COVID time, preterm and term birth rates of babies of HTN mother cases were 50:50. This scenario also shows an increase of preterm birth in COVID time due to HTN. Though the result of p-value doesn't support the significance of the statement. Table 6 illustrates the statistics of comparison of preterm, term and weight of babies of HTN mothers.

It was also observed that babies of HTN mother's average weight in pre-COVID, and COVID time was similarly less than the average weight of all babies which is shown in Figure *10*.

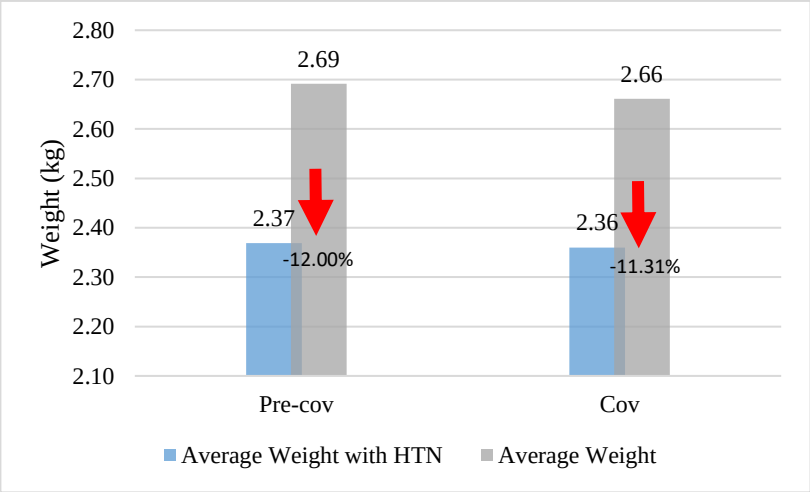

Figure 10: Weight Variation of babies of HTN mother

4.7 Comparison of Preterm, Term and Weight of Babies of PROM Mothers

The preterm birth rate of babies of mothers who had PROM cases were 70% (7/10), and the term birth rate of babies of mothers who had PROM was 30% (3/10) in pre pandemic time. During COVID time preterm birth rate of babies of mothers having PROM cases was 100% (10/10).

Table 7: Comparison of Preterm, term and weight of Babies of PROM mothers

Particulars/Period	Pre-COVID	COVID	P Value*
Total Cases of Babies of PROM mother	10	10	
Preterm	7(70%)	10(100%)	0.06
Term	3(30%)	0	
Average Weight of Babies of PROM mother	2.16	1.68	0.86
Average Weight of all Babies	2.69 (SD 0.53)	2.66 (SD 0.63)	

*P value < 0.05 is significant.

It indicates that PROM cases were much higher during COVID time. **Table *7*** illustrates the comparative statements of preterm, term and weight of babies of PROM mothers.

It was also observed that in babies of mothers who had PROM, their average birth weight was 19.62% less than the average weight of all babies in pre-pandemic time. During COVID time, it was decreased to 37.06% than all babies' average weight, indicating that low birth weight babies were born more than in pre-COVID time, as shown in Figure *11*.

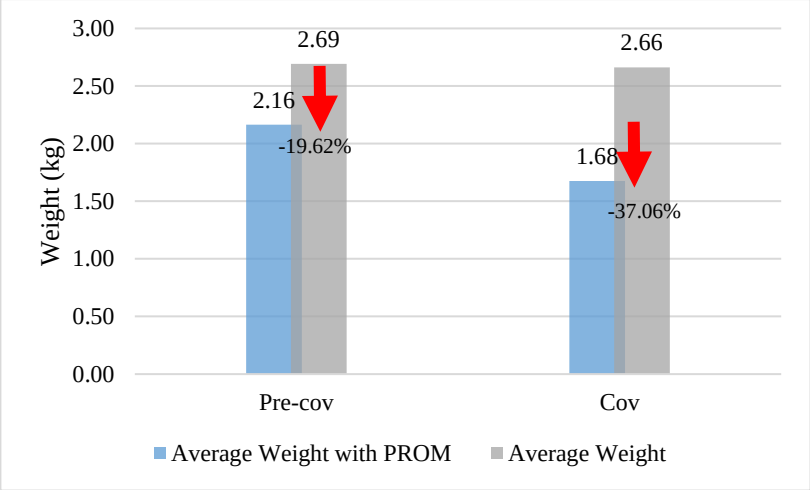

Figure 11: Weight Variation of babies of PROM mother

4.8 Situation of Childbirth from Mothers with Other Complicacies

Term birth rate of babies of bronchial asthma mother cases was found 100% (4/4) while no preterm baby was found in COVID time. No data regarding BA was found in pre-COVID time during the study period. For the case of hypothyroidism mothers, the preterm birth rate and term birth rate of babies were the 50%-50% in COVID time. No data was found in pre-COVID time during the study period.

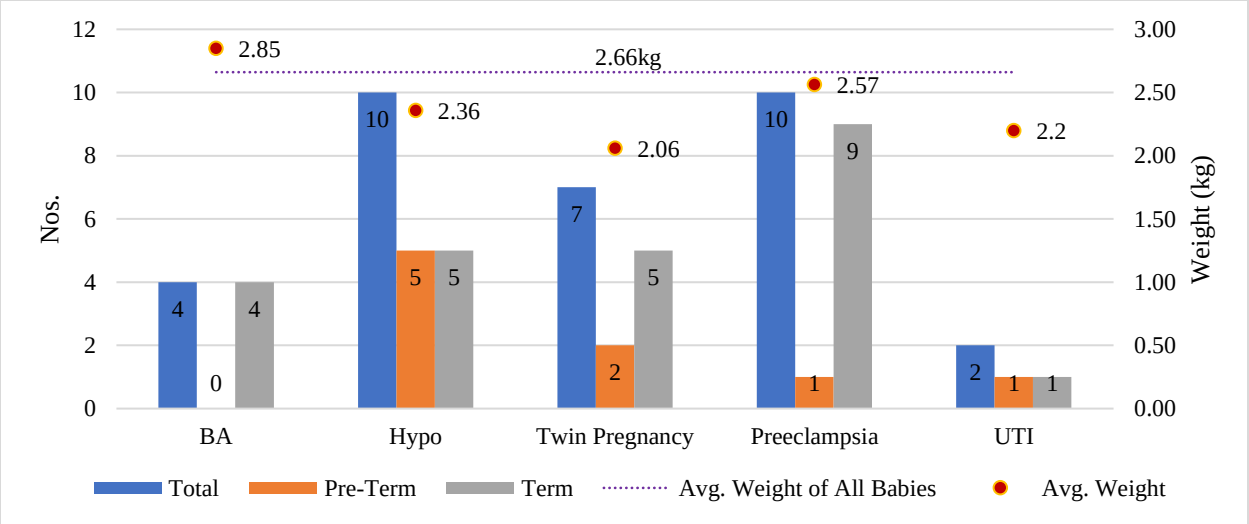

Figure 12: Situation of childbirth from mothers with other complicacies

It was also observed that babies of mothers who had hypothyroidism, their average weight was 19.62% less than the average weight of all babies during the pandemic time. The preterm birth rate of babies of mothers with twin pregnancy cases was 29% (2/7) and the term baby birth rate was 71% (5/7) during the pandemic time. There was no data about twin pregnancy of pre-COVID time during the study period. The average weight of twin pregnancy babies was also decreased by 22.59% of than average weight of all babies. It is observed in the study that mothers who had preeclampsia had term babies in 90% (9/10) of the time and preterm babies in 10% (1/10). The average weight of babies of mothers with preeclampsia decreased to 3.61% compared to all babies in pandemic time.

Chapter-5

5 Discussion

1st case of COVID 19 was reported in Wuhan, China, on 31st December 2019 (WHO, 2020). It has been more than 2 years of this deadly pandemic. It has affected nearly 533,816,957 people and taken about 6,309,633 people's life (Anon., 2022). Vaccine for COVID 19 was invented in 2021, and initial immunization has been expedited in each country for those at the highest risk of infection, such as health care professionals, the elderly and individuals with other compromised health conditions, according to WHO. It's essential to get vaccinated as soon as possible and to continue to take other precautions. In Bangladesh, 27.78 million people got fully vaccinated against COVID 19 with 3 doses until July 2022 (DGHS, 2022). COVID 19 has a huge impact on the economy of Bangladesh. As social distancing and isolation were maintained strictly; offices, garments and industries had to reduce their manpower and limit operations. Many have lost jobs and had to shift their house to mitigate costs. This financial crisis might affect a lot of women during pregnancy periods. People possibly would try to deduct their costs by delivering the baby at home. That may caused many births to remain unregistered.

Many studies have been conducted to understand if there is any increase or reduction in preterm birth during COVID 19. Denmark and Ireland reported significant reductions in the rate of preterm delivery (Hedermann, et al., 2020) (Philip, et al., 2020) while a stable ratio of preterm birth has been reported in a study in United Kingdom (Khalil, et al., 2020). This study was conducted during the pre-COVID time (June 2019-December 2019) and COVID time (June 2020-December 2020) to understand whether there is any association between preterm birth, birth weight, mode of delivery and other associated factors of mothers with COVID 19. Among 715 cases, 20% of preterm birth was observed in the pre-COVID period and 21% of preterm births were observed in the COVID time. No association was found there.

The worldwide recommended standard of national caesarean rate has been proposed 10-15% (WHO, 2015). The population level caesarean section rate should not exceed 19%,

according to a more recent multi-country survey carried out in 178 WHO member states, as higher levels of neonatal and maternal death have been documented above this threshold (Molina, et al., 2015). Unnecessarily high caesarean rates also have a negative impact on women's health, cost of healthcare, and the effective use of resources at the individual, family, and societal levels. According to the 2014 Bangladesh Demographic Health Survey (BDHS), 63% of births take place at home, primarily with untrained delivery attendants (NIPORT; MaA; ICF International, 2015). Despite making little headway toward a high skilled attendance rate the caesarean section rate's growth from 4% in 2004 to 23% in 2014 (NIPORT; MaA; ICF International, 2015). In this study, it was observed that NVD was done more (39%) in pre – COVID time compared to COVID time (27%), and the rate of cesarean section was increased in covid time from 61% to 73%. Only the serious patients found their way to the hospital. Those who could not afford to overcome the hurdles tried to make the delivery on their own arrangement at home. The causes of less NVD at the hospital during COVID time could be, there was refusal from hospital admission of pregnant mothers who were COVID positive or suspected, hospitals made mandatory requirement of RT-PCR test prior to admission, isolation of COVID positive and suspected cases, economic crisis due to COVID lockdown, misinformation of COVID spread and less antenatal visit etc. So, many vaginal deliveries occurred at home and these are not recorded at hospital data.

In a study conducted by Masud, et al., (2021) in Bangladesh that compared non-COVID and COVID-affected mothers, it was found that expectant mothers who were COVID-affected had a high chance of having preterm babies through caesarean section. In this study, a comparison between pre-COVID and COVID time was done and found that in COVID period, the cesarean section rate was higher than pre-COVID time, but there was no linkage of preterm birth rate between the two times. Masud, et al. (2021) also found no variation in birth weight and PROM. The same observation about the birth weight is sustained in the current study result, but the rate of preterm babies of PROM mothers was much higher than in pre-COVID time.

A study by Persson, et al., (2018) showed that in pre-COVID time, a mother with DM had a higher chance of cesarean section and big baby. Another study showed the opposite that

DM mother had a high chance of having preterm baby (Kong, et al., 2019). In this study, it was found that the rate of big babies was similar in both periods, and DM mothers always had term babies, and birth weight was higher than other babies.

Another study was performed in pre-COVID time, and it showed that mothers with HTN had a high risk of having preterm babies (Shulman, et al., 2017). In COVID-19, the same result showed with mothers who had both COVID and preeclampsia (Papageorghiou, et al., 2021). In the current study, hypertensive mothers had more preterm babies (37%) than other average mother (20%) observed in the cases of pre-COVID time. During COVID time, the preterm rate was even increased (50%) than pre-COVID time. Again, hypertensive mothers had low birth weight babies than others in both periods.

A study showed that mothers with PROM had more preterm babies (Sari, et al., 2020). In this study, in both periods, preterm babies of PROM mothers were more than term babies, and their birth weights were lesser than average of other babies.

Chapter-6

6 Conclusions

The study clearly shows that there is no evidence of association of preterm birth with COVID 19 in the study population. The study further confirms that there is no role of COVID 19 in birth weight distribution of child. It is evident that there is a little hike in LUCS mode of delivery than normal according this study which maybe caused due to difficulties to reach at hospitals, only the serious patients found their way to the hospital. So, when the patients arrived at the hospital in unavoidable situation, emergency LUCS was done while NVDs done at home remained unregistered. An increasing trend of preterm babies of mothers with DM, HTN and PROM during COVID time was recorded in this study, while the average birth weight of these babies was less than the birth weights of other babies born during the same period. The cases of mothers with hypothyroidism, twin pregnancy and urinary tract infection (UTI) was observed to have a tendency to have more preterm babies than other mothers without these kind of complexities. Again, the average weight of babies of mothers with these conditions was found to be less than the average birth weight of other babies of mothers without these conditions born in the same period. No association of COVID situation with term, preterm and birth weight was observed for the cases of mothers with bronchial asthma and preeclampsia. As preterm and low birthweight babies are few of the most concerning issues, it's important to investigate if this new emerging disease COVID-19 has any influence to trigger these issues further. Also, it's important to know how this disease impacts different groups of people. Pregnancy itself is a vulnerable condition, some women encounter some diseases such as hypertension, diabetes mellitus, asthma, hormonal problems, premature rupture of membrane etc. These diseases also affect fetal risk, intrauterine death, intrauterine growth restriction, asphyxia and prematurity. The COVID-19 pandemic has great impact on human health. As pregnant women with co-morbidities are the most vulnerable group of people, it is important to investigate the influence of this new disease on them. The findings of this study can be useful to understand the role of COVID-19 of mothers and babies. This study produced a considerable data set assembled on different particulars of

mothers and babies pre-COVID and COVID time. Accordingly, the data offer a number of important follow-up research opportunities in this field which may open a bigger window for future research. More research works should be done to understand all the features of this situation profoundly.

Chapter-7

7 Limitations

The world is now recovering from its most significant health crisis of recent time. Features and developments of this virus are still under observation. Enormous amount of study to investigate different impacts and effects of this disease is in progress. The main strength of this study is that it included a large set of data from both pre-COVID and COVID periods and the distribution of data covered all over Chattogram city and its vicinity. Moreover, the involvement of trained personnel in the medical field in collecting and recording history of patients provided a new dimension to this study. Along with its strengths, this study has several limitations that we should mention here. The association of term and preterm birth with COVID-19 positive mother could not be assessed in this study. As suspected pregnant women were isolated first and when COVID test came positive they were referred to COVID dedicated hospital. As the new pandemic has created an enormous stress situation among people, especially on expecting mothers, the current study primarily based on hospital registry data didn't cover this. The stress factors may vary among the group of people from different socioeconomic conditions, maternal age, educational qualification, employment status, etc. The current study couldn't consider these factors, which is a notable limitation of this study. A future research addressing these factors can bring a clearer view of the influence of the ongoing COVID situation. As people from very low economic status couldn't afford to make their way to the hospital during labour, this group of people is noticeably absent in this study.

Chapter-8

8 Recommendations and Future Perspective

Every now and then we are learning new knowledge about COVID-19 and the process should continue. More studies with bigger data set, different demography, various ethnic groups, age groups, different social and economic class, different physical and medical conditions can be done. The association of term and preterm birth with COVID-19 positive mother is also a scope of future study. Further development and complications in the children from COVID-positive mothers can be a topic of future study. Consideration of the mental stress, socioeconomic conditions, maternal age, educational qualification, employment status and their co-relation with COVID-19 could improve the study range in future. International collaborative efforts will be vital to incorporating sources of variation in innovative global evaluations to study further the link between COVID-19 mitigation measures and preterm births. Identifying the underlying strategy is an essential next step, which will require exploring differential impact between spontaneous and induced preterm deliveries and across demographic strata, including socioeconomic status and ethnicity. These investigations are key to informing the development of much needed novel preventive approaches for preterm birth.

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Appendices

Appendix A

Case Record Form

Impact of Covid Situation on Preterm Birth, Birth Weight, Mode of Delivery And Maternal Co-Morbidities at Chattogram

Disclaimer: The data from the survey will be used for a thesis project for the degree of Master of Public Health under One Health Institute of Chattogram Veterinary and Animal Sciences University Chattogram-4225, Bangladesh. All the data will be used anonymously. No personal information will be disclosed without consent.

Serial No:

1. General Information

Name	
Age (years)	
Area	
Date of Admission (dd/mm/yy)	
Date of Discharge (dd/mm/yy)	
Para (nos.)	
Gravida (serial)	

2. What was the gestational age?
    a) 28 to 36 weeks
    b) 37 to 42 weeks.
3. What was the gender of the baby?
    a) Male,
    b) Female.

4. What was the baby's birth weight?

    a) Less than 1800 gram,

    b) 1800 to 2500 gram,

    c) 2500 to 4000 gram,

    d) More than 4000 gram

5. Mode of delivery?

    a) NVD,

    b) LUCS

6. Does the patient have any preterm children?

    ☐ Yes ☐ No

7. Is there any history of abortion?

    ☐ Yes ☐ No

8. Did the patient go to the doctor for a regular antenatal checkup?

    ☐ Yes ☐ No

9. Does the patient have any other disease?

    ☐ Yes ☐ No

10. If yes, then which one?

☐ DM ☐ HTN ☐ BA ☐Hypothyroidism

☐ Hyperthyroidism ☐ UTI ☐Heart disease

11. If DM, is it before pregnancy or gestational DM?

    ☐ Before Pregnancy ☐ Gestational DM

12. Did the patient take any medicine for DM?

    ☐ Yes ☐ No

13. Was there any big baby due to DM?

☐ Yes ☐ No

14. Is DM controlled or uncontrolled?

☐ Controlled ☐ Uncontrolled

15. If HTN, is it before pregnancy or gestational HTN?

☐ Before Pregnancy ☐ Gestational HTN

16. Did the patient take any medicine for HTN?

☐ Yes ☐ No

17. Was there any Preterm delivery due to GHTN?

☐ Yes ☐ No

18. Is HTN controlled or uncontrolled?

☐ Controlled ☐ Uncontrolled

19. Does the patient have any asthma during pregnancy?

☐ Yes ☐ No

20. Does she take any inhaler for this?

☐ Yes ☐ No

21. If Yes, does she has any thyroid disorder?

☐ Yes ☐ No

22. If the answer of 22 is yes, what type of thyroid disorder?

☐ Hypothyroidism ☐ Hyperthyroidism

23. If Hypothyroidism, is it diagnosed pre-pregnancy/during pregnancy?

☐ Pre-Pregnancy ☐ During-Pregnancy

24. Does she take any medication for this?

☐ Yes ☐ No

25. If Hyperthyroidism, is it diagnosed pre-pregnancy/during pregnancy?

☐ Pre-Pregnancy ☐ During-Pregnancy

26. Does she take any medication for this?

☐ Yes ☐ No

27. Did the patient have UTI in any trimester?

☐ Yes ☐ No

28. If Yes, did she take antibiotic for this?

☐ Yes ☐ No

29. Does she have any multiple pregnancies?

☐ Yes ☐ No

30. If Yes, then it is twin/ triplet/quadruplet?

☐ Twin ☐ Triplet ☐ Quadruplet

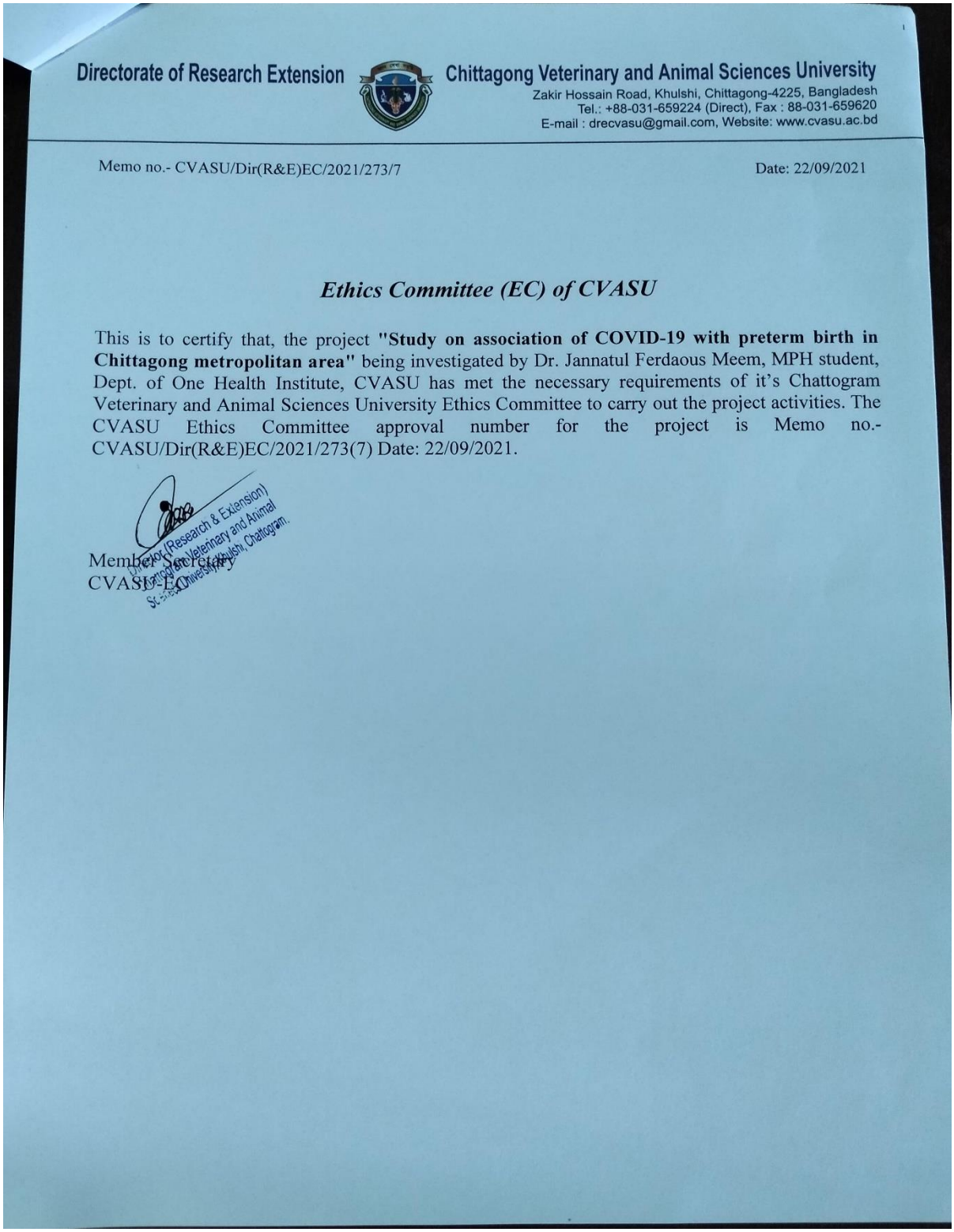
31. Due to multiple pregnancies, was there any preterm delivery?

☐ Yes ☐ No

32. Was there any history of PROM?

☐ Yes ☐ No

Appendix B



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Memo no.- CVASU/Dir(R&E)EC/2021/273/7 Date: 22/09/2021

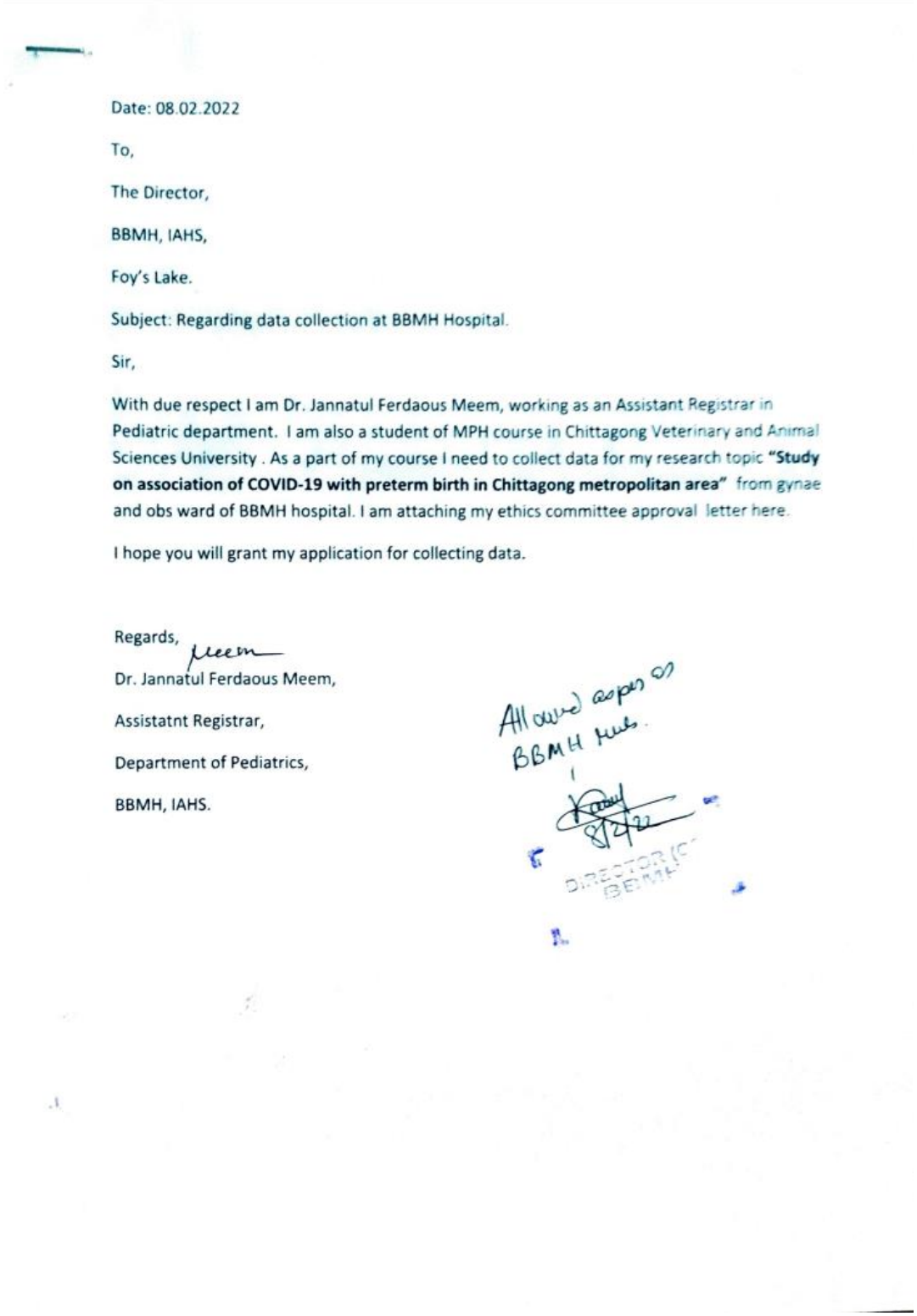
Ethics Committee (EC) of CVASU

This is to certify that, the project **"Study on association of COVID-19 with preterm birth in Chittagong metropolitan area"** being investigated by Dr. Jannatul Ferdaous Meem, MPH student, Dept. of One Health Institute, CVASU has met the necessary requirements of it's Chattogram Veterinary and Animal Sciences University Ethics Committee to carry out the project activities. The CVASU Ethics Committee approval number for the project is Memo no.- CVASU/Dir(R&E)EC/2021/273(7) Date: 22/09/2021.

Director (Research & Extension)
Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram.

Member Secretary
CVASU-EC

Figure 13: Ethical Committee Approval



Date: 08.02.2022

To,

The Director,

BBMH, IAHS,

Foy's Lake.

Subject: Regarding data collection at BBMH Hospital.

Sir,

With due respect I am Dr. Jannatul Ferdaous Meem, working as an Assistant Registrar in Pediatric department. I am also a student of MPH course in Chittagong Veterinary and Animal Sciences University . As a part of my course I need to collect data for my research topic **"Study on association of COVID-19 with preterm birth in Chittagong metropolitan area"** from gynae and obs ward of BBMH hospital. I am attaching my ethics committee approval letter here.

I hope you will grant my application for collecting data.

Regards,

Dr. Jannatul Ferdaous Meem,

Assistatnt Registrar,

Department of Pediatrics,

BBMH, IAHS.

Allowed as per of BBMH rules.

8/2/22

DIRECTOR (C
BBMH

Figure 14: Approval of Data Collection from BBMH

Biodata

Jannatul Ferdaous Meem was born on April 11,1992 in Dhaka. She was raised in Chattogram and obtained SSC and HSC degrees in 2008 and 2010 respectively from Chattogram University of Engineering and Technology School and College. She obtained her MBBS degree in 2016 from Sylhet M A G Osmani Medical College and Hospital. Now she is a candidate of MPH degree under One Health Institute. She loves to travel within country.