FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT INFANTS OF TEENAGE PREGNANCY IN TERENGGANU, 2018

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by

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LIST OF ABBREVIATIONS AND SYMBOLS

AOR: Adjusted odd ratio

BMI: Body mass index

CI: Confidence interval

GDM: Gestational diabetes mellitus

LMP: Last menstrual period

MCH: Mother and child health

OR: Odd Ratio

PIH: Pregnancy-induced hypertension

SES: Socioeconomic status

SGA: Small for gestational age

WHO: World Health Organization

>: More than

<: Less than

=: Equal to

≥: More than and equal to

≤: Less than and equal to

α: Alpha

β: Beta

%: Percentage

ABSTRAK

FAKTOR- FAKTOR YANG BERKAITAN DENGAN KELAHIRAN BAYI KURANG BERAT BADAN DALAM KALANGAN REMAJA HAMIL DI TERENGGANU, 2018

Latarbelakang: Kehamilan remaja sering dikaitkan dengan hasil yang negatif termasuk bayi kurang berat badan, kelahiran pramatang dan anemia. Mengenalpasti hasil dan faktor yang berkaitan dengan bayi kurang berat badan dalam kalangan kehamilan remaja boleh membantu untuk meningkatkan pencegahan dan pengurusan faktor ini, dan seterusnya memperbaiki hasil kehamilan.

Objektif: Kajian ini bertujuan untuk menentukan hasil obstetrik dan perinatal daripada kehamilan remaja, dan faktor yang berkaitan dengan kelahiran bayi kurang berat badan dalam kalangan remaja hamil di Terengganu pada tahun 2018.

Metodologi: Kajian keratan rentas dilakukan dari 1 Januari 2020 hingga 31 Mei 2020 dengan menggunakan data dari Buku Rekod Kesihatan Ibu dan Buku Daftar Program Ibu Hamil dan Pos Natal. Sumber populasi adalah semua remaja hamil yang hadir di klinik kesihatan kerajaan di Terengganu pada 2018. Analisa regresi logistik ringkas dan berganda telah digunakan untuk menganalisis faktor-faktor yang berkaitan dengan kelahiran bayi kurang berat badan dalam kalangan remaja hamil.

Keputusan: Kesemua 357 kes yang memenuhi kriteria kajian telah dimasukkan. Hasil obstetrik yang paling biasa dalam kalangan kehamilan remaja adalah anemia (41.5%), diikuti oleh pembedahan caesarean (10.9%), penyakit kencing manis gestasi (2.8%.), dan darah tinggi sewaktu mengandung (1.4%). Bayi kurang berat badan adalah hasil perinatal yang paling biasa dalam kalangan kehamilan remaja (19.3%). Ia diikuti oleh

kelahiran pramatang (9.0%) dan markah Apgar yang rendah dan kematian bayi sewaktu lahir, kedua-duanya adalah 1.4%. Faktor yang berkaitan dengan bayi kurang berat badan dalam kalangan kehamilan remaja di Terengganu adalah suami remaja (AOR 2.0; 95% CI: 1.01, 3.96; p = 0.047) dan tahap pendidikan ibu yang rendah (AOR 3.07; 95% CI: 1.20, 7.85; p = 0.019).

Kesimpulan: Suami berumur remaja dan tahap pendidikan ibu yang rendah adalah faktor signifikan yang perlu ditangani untuk menambahbaik hasil kehamilan remaja. Intervensi untuk memperbaiki faktor ini harus diberi dorongan secara berterusan.

KATA KUNCI: kehamilan remaja, hasil obstetrik, hasil perinatal, kurang berat badan.

ABSTRACT

FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT INFANTS OF TEENAGE PREGNANCY IN TERENGGANU, 2018

Background: Teenage pregnancy is known to be associated with negative outcomes including low birth weight infant, preterm birth and anaemia. Identifying these outcomes and factors associated with low birth weight infants of teenage pregnancy may help to improve the prevention and management of these factors, and subsequently improve the pregnancy outcomes.

Objective: This study aims to determine the obstetrics and perinatal outcomes of teenage pregnancy, and factors associated with low birth weight infants of teenage pregnancy in Terengganu in 2018.

Methodology: A cross-sectional study was done from 1st January 2020 until 31st May 2020 using data from the Maternal Health Record Book and Pregnant Woman and Postnatal Book Registry. The source population were all teenage pregnancies attending government health clinics in Terengganu in 2018. Simple logistic and multiple logistic regression analysis was used to analyse the factors associated with low birth weight infants of teenage pregnancy.

Result: All 357 cases that fulfilled the study criteria were included. The most common obstetric outcomes among teenage pregnancy was anaemia (41.5%), subsequently followed by caesarean section (10.9%), gestational diabetes mellitus (2.8%) and pregnancy-induced hypertension (1.4%). Low birth weight infants were the most common perinatal outcomes among teenage pregnancy (19.3%). It was followed by preterm birth (9.0 %) and both low Apgar score and stillbirth, 1.4% respectively.

Factors associated with low birth weight infants of teenage pregnancy in Terengganu were teenage husband (AOR 2.0; 95% CI: 1.01, 3.96; p =0.047) and mothers with low education level (AOR 3.07; 95% CI: 1.20, 7.85; p =0.019).

Conclusion: Teenage husband and low levels of mothers' education were the significant associated factors that need to be addressed to improve teenage pregnancy outcomes. Interventions to improve these factors should continue to be encouraged.

KEY WORDS: Teenage pregnancy, obstetric outcomes, perinatal outcomes, low birth weight

CHAPTER ONE

INTRODUCTION

1.1 **Teenage pregnancy**

Teenage or adolescent is defined as an individual at the age of 10 to19 years old (WHO, 2004b). Teenage contributes to 16 per cent of the world's population, with the total number of 1.2 billion (UNICEF, 2019). In 2018, there are about 5.5 million teenagers in Malaysia (NHMS, 2017). Teenage is one of the most critical phases of human development. During this period, there are a transition from childhood to adulthood through physical, neurodevelopment, psychological and social changes. The physical changes that occur include the increases of height and weight, the development of secondary sex characteristics, changes in the amount and distribution of muscle tissues and fat, and also changes in respiratory and circulation system. The development of secondary sex characters in female teenagers starts with the development of breasts and continues with pubic and axillary hair growth and menarche (Özdemir *et al.*, 2016).

Teenagers neural development is characterized by an imbalance between under develop prefrontal control system and the limbic systems, which developed earlier. These imbalance in brain changes are relevant to teenage behaviour, for the typical emotional reactive style of teenagers, and it may promote risky behaviour (Konrad *et al.*, 2013). Another change that occurs in female teenagers was psychosocial development, which includes self-identification and personality characteristic

development. Related to the hormonal and neurodevelopmental changes that are taking place, there are psychosocial and emotional changes and increasing cognitive and intellectual capacities. In the psychosocial development, teenagers are prone to have high-risk behaviour and experimentation. Besides that, the teenagers gradually become more concern about their freedom and their right, as well as begin to take on larger responsibility within the family. Teenagers also tend to explore their sexual behaviour by establishing a new relationship (Özdemir *et al.*, 2016). In National Health And Morbidity Survey (NHMS), 2017: Key Findings from the Adolescent Health and Nutrition Surveys also explained that teenage personality characteristics like attention-seeking and impulsive behaviour explain their health risk behaviours and social problems which include tobacco, alcohol and drug use, violence and unintentional injury, unhealthy dietary behaviours, suicidal behaviour, and lastly unsafe sexual behaviours which lead to teenage pregnancy (NHMS, 2017).

Teenage pregnancy refers to girls who are pregnant at the age of 10 to 19 years old (WHO, 2004a). A few studies have reported some factors associated with teenage pregnancy which include having teenage parents, inadequate parental supervision, low educational level, peer influence, poverty, low socioeconomic status, not engaging in extracurricular school activities, and involving in substance abuse (Horgan and Kenny, 2007; Mohd Azri *et al.*, 2015; Omar *et al.*, 2010). In addition, some reported factors leading to teenage pregnancy were ethnic differences, social deprivation, child marriage, low education, unplanned pregnancy, unprotected sex and reduced prevalence of contraceptive (WHO, 2004b).

Worldwide, it was reported that 16 million teenage pregnancy gives birth each year (UNFPA, 2015). The global population of teenagers continues to rise. Projections indicate the number of teenage pregnancies will increase globally by 2030, with the highest proportional increases in Eastern and Southern Africa and West and Central Africa (Franjić, 2018). In Malaysia, the prevalence of teenage pregnancy was 10.0 %, as stated by Kim *et al.* (2001) in 2001. Then the prevalence decreased to 5.0 % in 2010 and 1.1 % in 2013 (Maimunah *et al.*, 2012; Sulaiman *et al.*, 2013).However, the Malaysian Registry Department reported that deliveries among teenagers increased from 15,849 deliveries in 2004 to 17,600 deliveries in 2008 and up to 19,310 deliveries in 2012 (MOH, 2015b). There was an average of 1,500 new cases of teenage pregnancies registered per month in health clinics in Malaysia (MOH, 2015b). Even more alarmingly, 24% of the total number of pregnant teenagers is unmarried (MOH, 2015b).

In 2012, about 1.3 million teenage pregnancy died globally from preventable death (EWEC, 2015). The top causes of death in girls aged fifteen to nineteen years old were complications during pregnancy and childbirth (EWEC, 2015). The Global Strategy for Women's, Children's and Adolescents' Health aimed an end to preventable maternal, newborn, child and adolescent's death and stillbirth by 2030, aligned with the Sustainable Development Goals. Sexual and reproductive health education and services are identified as one of the interventions (EWEC, 2015). Gynaecological organ immaturity, socio-demographic characteristics like poverty and nutritional status example, malnutrition may predispose the teenage mother to poor obstetric and perinatal outcomes including the risks of eclampsia, puerperal endometritis, systemic

infections, low birth weight infant, preterm birth, severe neonatal conditions and spontaneous miscarriage (Franjić, 2018; Horgan and Kenny, 2007).

1.2 **Low birth weight**

Low birth weight infant is defined as an infant who is born with birth weight less than 2500 grams (WHO, 2015). World Health Organization documented that the global prevalence of low birth weight infant was 15% (WHO, 2004c). About twenty million low birth weight infants born each year, mostly in developing countries (WHO, 2004c). The highest incidence of low birth weight was reported in South-Central Asia countries like Afghanistan, Bangladesh and India (WHO, 2004c). Generally, the prevalence of low birth weight in Malaysia was 10% in 2000, both 11.3 % in 2012 and 2015 (UNICEF-WHO, 2019).

The common causes of low birth weight were restricted intrauterine foetal growth or intrauterine growth retardation (IUGR), small for gestational age (SGA), foetal malnutrition and preterm birth (Alam, 2009; Belfort *et al.*, 2018). Birthweight was one of the predictors for foetal growth. It was a significant determinant of mortality and morbidity in infancy and childhood. Low birthweight can predict short-term survival and influence the long-term health of the new-born (Risnes *et al.*, 2011). A systematic analysis found evidence that lower birth weight was associated with increased adult morbidity and mortality. The results also showed strong evidence that low birth weight had a strong association with type 2 diabetes mellitus, hypertension, coronary heart disease and cancer (Alam, 2009; Risnes *et al.*, 2011). There were studies in Malaysia and other countries that found that teenage pregnancy had higher risk to get low birth

weight infant (Franjić, 2018; Ganchimeg *et al.*, 2014; Harville *et al.*, 2012; Omar *et al.*, 2010; Saba *et al.*, 2013; Sulaiman *et al.*, 2013).

1.3 **Management of teenage pregnancy**

Prevention and management of teenage pregnancy play an significant role, as teenage pregnancy can lead to mother and child morbidity and mortality. Ministry of Health Malaysia had established several policies regarding teenager's health. Primary prevention of teenage pregnancy starts with sexual and reproductive health education. A study on Reproductive Health and Sexuality 1994/1995 stated that the majority of adolescent lack knowledge on reproductive health (MOH, 2007). Sex education syllabus in school and Ministry of Health programs such as Adolescent Health Services at health centres were a platform to increase knowledge and to promote sexual and reproductive health among teenagers. Comprehensive sex education programs emphasis on improving reproductive health outcomes such as preventing unwanted pregnancy, premarital conception or increasing sexual transmitted disease knowledge. Promote abstinence, safe sex and contraception for teenagers are also crucial in preventing teenage pregnancy. Contraception use and provision are targeted for teenagers that are already sexually active to prevent unwanted pregnancy and sexually transmitted disease like HIV. However, there were same issues arise regarding sex education syllabus in Malaysia. The implementation of sexual education in Malaysia is time-consuming as long-term training of educators and policy negotiations are needed. The Ministry of Health also has difficulties in establishing the subject in the school curriculum due to the fact that educators have been adapting the existing traditional style for too long (Fazli Khalaf *et al.*, 2014).

Awareness about the importance of early booking, antenatal care and complication of teenage pregnancy are essential to teenagers. Late booking and poor antenatal care were the most prominent problem among teenage pregnancy. This awareness can be given during pre-pregnancy counselling care. Pre-pregnancy care and counselling can reduce maternal and child morbidity and mortality (MOH, 2013b). Ministry of Health already establishes a pre-pregnancy clinic in the health clinic. However, the clinic also covered thalassemia screening program, premarital counselling courses, HIV screening, and screening for medical conditions (MOH, 2013b).

Once a teenager becomes pregnant, comprehensive antenatal care is essential to avoid poor outcomes. Pregnant teenagers are encouraged to come to health care for early booking and antenatal check-up. Every teenage pregnancy case will be registered in Teenage pregnancy list and Pregnant Woman and Postnatal Book Registry. During the first booking, detail history taking, physical examination and proper investigation will be done. Patient confidentiality will always be maintained, and health professional should be not judgemental. As for every patient, socio-demographic data will be obtained, including marital status, age of husband, ethnicity, employment status and education level. Proper physical examination, including baseline blood pressure and nutritional status like body mass index (BMI), was taken. Teenage mother will be screened for anaemia, gestational diabetes and infectious diseases like syphilis and HIV. Early booking is encouraged for every teenage mother so that that early screening can be done. There will be a regular health check-up for each trimester or referred as antenatal visit. The aim is to monitor the conditions of the mother and the foetal, like

maternal blood pressure and weight gain, mother haemoglobin level, and foetal growth (Borhan, 2019). Subsequently, the care continues with continuous education about mother and foetal care, nutrition advice and providing adequate supplements to mothers. All these interventions are crucial as anaemia, pregnancy-induced hypertension (PIH) and nutritional status can lead to poor outcomes like low birth weight infant.

Ministry of Health Malaysia had established a personalized health care system for maternal and child health in all health clinics in Malaysia. The concept of personalized health care involves specific nurses and medical officers that will be provided to care and responsible for monitoring family health status in the care area and provide health care plan holistically according to individual needs (Simmons *et al.*, 2016). The personalized care needs to continue in the antenatal care of the teenage mother. WHO recommends that midwife or nurses need to support the teenage mother throughout the antenatal, intrapartum, and postnatal period (Vogel *et al.*, 2013). Every teenage pregnancy needs to deliver at a tertiary hospital as complications during delivery and postnatal is anticipated. After delivery, postpartum care will be continued by giving support to this young mother in taking care of baby and breastfeeding. These include mental health support and social support. Contraception counselling is also essential to help the mother to recover and to continue their education later (Marino *et al.*, 2016).

1.4 **Statement of problem**

Teenage pregnancy is currently categorized as a high-risk pregnancy. In Perinatal Care Manual 2013 (3rd edition), teenage pregnancy was tagged as yellow tagging. Teenagers who are pregnant need to be referred to an obstetrics and gynaecology specialist or family medicine specialist for optimum management (MOH, 2013b). Teenage pregnancy was a significant risk factor for maternal and perinatal morbidity and mortality (WHO, 2018). It was associated with poor outcomes including stillbirth, low birth weight infant, preterm delivery, antenatal complications like PIH, and maternal death (Omar *et al.*, 2010; Sulaiman *et al.*, 2013). In Malaysia, a study had reported that low birth weight infant was among the commonest perinatal outcomes of teenage pregnancy (Omar *et al.*, 2010). However, there was limited information on the factors associated with low birth weight as the outcomes of teenage pregnancy.

Low birth weight infant becomes the leading causes of neonatal death. It leads to nearly 80% of all neonatal deaths (WHO, 2004c). Low birth weight infants were also associated with many complications such as hypothermia, respiratory problems, digesting problems like necrotizing enterocolitis, anaemia, impaired nutrition and poor weight gain, neurological problem and sudden infant death syndrome (Abdullah *et al.*, 2014; Stanford Children's Health, 2019). Thus, the World Health Assembly Resolution 65.6 endorsed a policy that targets of reduction in low birth weight prevalence between 2012 and 2025, by 30% (WHO, 2014). Malaysia is still struggling to achieve this target as our progress in reducing low birth weight has been stagnant since 2000; thus, more understanding of the factors leading to low birth weight is needed.

In Malaysia, the percentage of low birth weight infant admitted to neonatal intensive care units were increasing in trend from the year 2012 to 2016, 32.8% in 2012, 37.3% in 2013, 37.5% in 2014 and 38.6% (MNNR, 2016; MNNR, 2017; MNNR, 2018; MNNR, 2019). This will burden the hospital and the Ministry of Health to provide optimum treatment with limited resources. Thus, it is very important to reduce the incidence of low birth weight. Other studies elsewhere had reported the association between teenage pregnancy and low birth weight. The similar association in our local setting is yet to be determined. In addition, it is crucial to know the factors leading to low birth weight among teenage pregnancy, to help in targeting suitable strategies for its prevention.

1.5 **Rationale of the study**

Teenage pregnancy is a global problem that arises in high, middle, and low-income countries (Franjić, 2018). Therefore, it is essential to know the outcomes of teenage pregnancy and its burden. Studies have shown various poor obstetric and perinatal outcomes of teenage pregnancy. However, the outcomes in our setting are yet to be explored. Identifying these outcomes may help in prioritizing health services and strategies.

In view of very limited studies on teenage pregnancy in Malaysia, and especially on factors associated with low birth weight infants among teenage pregnancy, this study may provide valuable information on the existing problems in our local setting. Identifying factors associated with low birth weight infants of teenage pregnancy may help to improve the prevention and management of these factors, and subsequently

improve the pregnancy outcomes. The preventable factors can be acted upon and may subsequently lead to a reduction in low birth weight among teenage pregnancy.

Furthermore, by reducing low birth weight prevalence among teenage pregnancy, it will help reduce the number of admissions to the neonatal intensive unit. Subsequently, it will decrease the burden of workload and resources incurred by the Ministry of Health in managing infants with low birth weight and its complications. Additionally, this study may suggest some strategies to be conducted in order to reach the target of 30% reduction in low birth weight prevalence between 2012 and 2025. This can be achieved by doing focus interventions to the factors associated with low birth weight in teenage pregnancy. Finally, by reducing the prevalence of low birth weight, it may help to reduce perinatal, neonatal and child mortality and morbidity in Malaysia.

1.6 **Research questions**

1. What are the obstetric and perinatal outcomes of teenage pregnancy in Terengganu in 2018?
2. What are the factors associated with low birth weight infants of teenage pregnancy in Terengganu in 2018?

1.7 **Objectives**

General objective

To determine the outcomes of teenage pregnancy and factors associated with low birth weight infants of teenage pregnancy in Terengganu in 2018

Specific objectives

1. To describe obstetric and perinatal outcomes of teenage pregnancy in Terengganu in 2018
2. To determine factors associated with low birth weight infants of teenage pregnancy in Terengganu in 2018

1.8 **Research hypothesis**

There are significant associations between socio-demographic characteristics, obstetrics characteristic and nutritional status with low birth weight infants in teenage pregnancy.

CHAPTER TWO

LITERATURE REVIEW

2.1 Prevalence of low birth weight in Malaysia

There are a few studies on low birth weight done in Malaysia. In 1991, a study was done among live births at the Maternity Hospital Kuala Lumpur. The prevalence of low birth weight infant was 13.5% (Tahir *et al.*, 1991). Another study was done at the Lundu Hospital in Sarawak. The study reported the incidence of low birth weight to be 11.8% among live births at the hospital (Yadav, 1994). A case-control study carried out at Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan over a six-month period found the prevalence of low birth weight was 10.9% (Fuad, 2015). Recently, a cross-sectional study of low birth weight was done among women in the rural and urban area in Selangor. The study reported that the prevalence of low birth weight infants was 6.4%. Women who live in a rural area had more low birth weight infants than urban women (9.8% vs 2.0%, p = 0.03) (Kaur *et al.*, 2019).

2.2 Low birth weight as the outcome of teenage pregnancy

The most common perinatal outcome of teenage pregnancy was the low birth weight infant. Teenage parents are more likely to give birth to low birth-weight babies, unemployed and live in poverty (Franjić, 2018). There were a few studies in other countries reported the prevalence of low birth weight in teenage pregnancy. One of the studies was done using data from the National Longitudinal Study of Adolescent

Health, United States. Outcomes of pregnancies were reported by comparing data between female cases who described a first singleton livebirth among teenagers and those who were 20 years of age or older. Prevalence of low birth weight among female participants less than 20 years old was 8.5% (Harville *et al.*, 2012). Another study was a descriptive study carried out in a district teaching hospital in Pakistan. Prevalence of low birth weight in this study was 7% (Saba *et al.*, 2013). A World Health Organization multi-country study that involves twenty-nine countries in Asia, Latin America, Africa and the Middle East was done in 2013. This study objective was to investigate the risk of adverse pregnancy outcomes among teenagers in twenty-nine countries. The result showed significant low birthweight as perinatal outcomes in teenage pregnancy (AOR = 1.17; 95% CI, 1.01–1.37, p-value < 0.01) (Ganchimeg et al., 2014).

In Malaysia, a case-control study was conducted in 2008, at two main hospitals in urban population that were Kuala Lumpur General Hospital and Universiti Kebangsaan Malaysia Medical Centre. This study reported the highest prevalence of low birth weight in teenage pregnancy that was 37.3% with a significant difference compared to adult pregnancy (Omar *et al.*, 2010). The teenage group had a higher rate of low birth weight (24.1%) than the adult group (7.0%). Furthermore, another study reported that 4.5% of teenage mothers delivered babies of very low birth weight that was less than 1500 grams (Sulaiman *et al.*, 2013).

2.3 **Pathophysiology of low birth weight in teenage pregnancy**

Birthweight is greatly affected by the mother's growth, foetal growth and her nutritional intake from birth to pregnancy; thus, baseline body composition was very important. Mothers with poor socio-economic conditions frequently have low birth weight infants. The uses of energy by physically demanding work during antenatal also contributes to poor foetal growth (WHO, 2004c).

The biological factor proposes that the blood supply to the cervix and uterus does not develop completely during the physical development of a teenager. Inadequate blood supply may predispose some teenage mothers to infections which sequentially may precipitate preterm labour and preterm birth, which are the leading cause of low birth weight in infants. Most of the teenagers need at least three years to develop a matured ovulatory cycle; this will lead to low levels of gonadal hormones during teenage pregnancy that may compromise proper attachment of the foetus to the uterine wall and causing vaginal bleeding leading to premature contractions (Roth *et al.,* 1998).

There was a hypothesis that teenagers are still growing physically and need adequate nutrition for their own development. This mother's physical development may compete with the foetus for nutrients, which may result in impaired foetal growth and causing low birth weight infants (Marvin-Dowle *et al.,* 2018; Roth *et al.,* 1998).

2.4 **Other obstetric and perinatal outcomes of teenage pregnancy**

Currently, teenage pregnancy still represents a high-risk pregnancy. Giving birth during teenager was not only a risk factor for poor obstetric outcomes but also poor perinatal outcomes (Ganchimeg *et al.*, 2014). Pregnancy in teenagers has been associated with increased poor obstetric outcomes such as maternal mortality, anaemia in pregnancy (PIH), pre-eclampsia or eclampsia, gestational diabetes mellitus (GDM), caesarean section and postpartum haemorrhage (Althabe *et al.*, 2015; Fayed *et al.*, 2017; Ganchimeg *et al.*, 2014; Horgan and Kenny, 2007; Marino *et al.*, 2016; MOH, 2016). Previous studies also had reported an increased incidence of poor perinatal outcomes, such as low birth weight infant, preterm birth, low Apgar score and stillbirth (Fayed *et al.*, 2017; Franjić, 2018; Ganchimeg *et al.*, 2014; Horgan and Kenny, 2007; Marino *et al.*, 2016; Sulaiman *et al.*, 2013).

2.4.1 **Maternal outcomes**

a) Maternal mortality

Confidential Enquiries into Maternal Deaths (CEMD) Malaysia National Committee reported a total of 264 pregnancy-related deaths in 2017. Teenage maternal mortality was increasing in trend from 2014 to 2016. Teenage maternal mortality 2014 to 2016 were 11.8, 12.4 and 57.8 per 100000 live birth, respectively. In 2017, teenage maternal death reduced to 15.0 per 100000 live birth (MOH, 2014; MOH, 2015a; MOH, 2016; MOH, 2017a).

b) Maternal anaemia

A study done in Malaysia in 2010 showed that anaemia in teenage pregnancy was 46.9% and supported with another study in 2015, with a prevalence of 53.1% (95% CI: 46.0, 60.0) (Jusoh *et al.*, 2015; Omar *et al.*, 2010). A latest cross-sectional study done in Australia from 2004 to 2006 revealed that teenage pregnancy was more likely to be associated with anaemia (14%) (Lewis *et al.*, 2009). Studies in other countries showed a higher prevalence of anaemia among teenage pregnancy. The prevalence of anaemia in Kenya was 61% (Shipala *et al.*, 2013). Another study in Pakistan, the prevalence of anaemia among teenage pregnancy was 67% (Saba *et al.*, 2013). However, study of anaemia in general population showed that prevalence of anaemia in pregnancy higher in advance maternal age more than 35 years old was 47% compare to 25 to 34 years old mothers (23.1%) and 15 to 24 years old mothers (29.9%) (Hasswane *et al.*, 2015).

In a normal pregnancy, there is an increase in plasma volume and the subsequent decrease in haemoglobin concentration and haematocrit, thus complicate the assessment of anaemia. Generally, teenage pregnancy alone is not the cause of anaemia. Anaemia in pregnancy is frequently caused by nutritional deficiencies, especially of iron and folic acid or infestation by malaria and intestinal parasites like hookworm. In developing countries, frequently children and female teenagers suffer most from underprivileged environmental and social circumstances, including inadequate diet, and this often leads to nutritional deficiencies causing anaemia (Shipala *et al.*, 2013; WHO, 2004b). Teenage pregnancy often receives inadequate antenatal care and poor access to health services; consequently, they lack supplement

intake like hematinic that provided during antenatal care (Jusoh *et al.*, 2015; Shipala *et al.*, 2013). A teenage mother is predominantly susceptible to anaemia because of their rapid growth and associated high iron requirements.

c) Hypertensive disorder of pregnancy

In addition, pregnancy-induced hypertension, pre-eclampsia and eclampsia are the commonest hypertensive disorders in pregnancy. Most of the studies included PIH as the maternal outcomes of teenage pregnancy. Study of distribution of maternal risk factors, pregnancy characteristics and outcomes in adult and teenage women in Australia by Lewis *et al.* (2009) also showed that 10% of the teenage mothers had PIH. Another study in India also had 10% of PIH among teenage mothers with OR 2.21, 95% CI (1.5–3.2) compared to adult mothers (Mahavarkar *et al.*, 2008). PIH outcome was lower in a study in Thailand by La-Orpipat and Suwanrath (2019) that was 4.5%. These studies by La-Orpipat and Suwanrath (2019), Mahavarkar *et al.* (2008) and Lewis *et al.* (2009) only included PIH which is hypertensive disease disorder as a maternal outcome among teenage pregnancy their studies.

Studies by Pergialiotis *et al.* (2015) and Fayed *et al.* (2017) included both PIH and pre-eclampsia in their study. They found the prevalence of PIH was 0.6% and 0.7%, and pre-eclampsia was 0.4% and 2.4%, respectively. A study by Sulaiman *et al.* (2013) listed only pre-eclampsia in the study. Prevalence of pre-eclampsia among teenage pregnancy in Malaysia by Sulaiman *et al.* (2013) was 1.1%. Meanwhile, a study by Ganchimeg *et al.* (2014) included pre-eclampsia and eclampsia outcomes, but they

divided the teenage mothers by age groups of ≤ 15 years, 16 to 17 years, 18 to 19 years and control group were 20– 24 years. The prevalence of pre-eclampsia in this study was 3.8 % among the age of ≤ 15 years, 2.5% among the age of 16 to 17 years, 2.0% among the age of 18 to 19 years and 1.8% among the control group. Prevalence of eclampsia were 1.0%, 0.9%, 0.7% and 0.3%, respectively. Therefore, this study showed that the prevalence of pre-eclampsia and eclampsia were higher among those in younger age groups.

Over the years, the physiopathology of hypertensive disorder in pregnancy has not been totally explained. The pathophysiology of hypertensive disorder in teenage pregnancy are not different from the rest of the affected population. Several factors have been concerned in the pathophysiology of hypertensive disorder in pregnancy. Potential mechanism started with abnormal cytotrophoblast invasion of spiral arterioles subsequently lead to reduced uteroplacental blood flow. Placental ischemia occurred result from reducing blood perfusion and then causing extensive dysfunction of the maternal vascular endothelium. Dysfunction of the maternal vascular endothelium will enhance the formation of endothelin and thromboxane, increased vascular sensitivity to angiotensin II, and decreased formation of vasodilators such as nitric oxide and prostacyclin. These endothelial abnormalities, sequentially, cause chronic hypertension by impairing renal pressure natriuresis and increasing total peripheral resistance. Besides the above postulation, there are also other factors predisposing to hypertensive disorder in pregnancy, such as extreme ages which are teenagers and elderly, nulliparity, obesity, smoking, quality of health care system,

accessibility to health care and history of pre-eclampsia in a previous pregnancy (Granger *et al.*, 2001; Rosales-Ortiz *et al.*, 2019).

d) Gestational diabetes mellitus

Another maternal outcome of teenage pregnancy was gestational diabetes mellitus (GDM). A study of demographic profile and pregnancy outcomes of adolescents and older mothers was done in Saudi Arabia in 2017. In this study, the prevalence of GDM in teenage mother was 17.7% compare to 20 to 29 years old mother (19.4%), 30 to 34 years old mother (26.4%), 35 to 39 years old mother (30.4%) and lastly, more than 40 years old mother (33.9%) (Fayed *et al.*, 2017). The prevalence of GDM in teenage pregnancy was high as compared to other previous studies, 0.85% in 2011, 5.4% and 1.18% in 1998 (Karcaaltincaba *et al.*, 2011; Lao *et al.*, 1998; Lemen *et al.*, 1998). However, a systematic review and meta-analysis reported that GDM risk increases linearly with maternal age. Teenage had a significantly lower risk for GDM than older mother (Li *et al.*, 2020).

Throughout normal pregnancy, the mother's body undergoes a series of adaptations or physiological changes in order to provide the nutritional demands for the growing foetus. One important physiological change is insulin sensitivity. Over the progression of gestation, insulin sensitivity changes depending on the requirements of pregnancy.

During early pregnancy, the body needs to prepare for demands on the late gestation of pregnancy; thus, insulin sensitivity increases, encouraging the uptake of glucose into adipose stores, that later change to energy. However, as the pregnancy progresses, there will be an increase of local and placental hormones, including estrogen, progesterone, cortisol, leptin, placental lactogen, and placental growth hormone together, causing a state of insulin resistance. Consequently, blood glucose is slightly elevated, and this glucose is readily transported across the placenta to support the growth of the foetus. This mild state of insulin resistance also encourages endogenous glucose production and the breakdown of fat stores, thus will lead to an increase in blood glucose and free fatty acid. Pregnant women will compensate for these changes through increased glucose-stimulated insulin secretion, as well as hypertrophy and hyperplasia of pancreatic β-cells. If the normal metabolic adaptations to pregnancy do not sufficiently occur in the pregnancy, this will cause GDM.

e) Other maternal outcomes

One of the complications that may occur during delivery was a caesarean section. Studies in Malaysia showed 9.8% of teenage mothers would end up with a caesarean section compare to adult 12.7% (Omar *et al.*, 2010; Saba *et al.*, 2013). Study in among teenage pregnancy in Pakistan reveal 6.6% of the teenage pregnancy had caesarean section as outcome. The most common indication for caesarean section was foetal distress, followed by cephalopelvic disproportion. Indication for caesarean section in foetal distress and pre-eclampsia was more commonly found among the teenage mothers than among the adult mothers. The possible reasons could be due to underdevelopment of pelvis in younger mothers and occurrence of cephalopelvic

disproportion more frequently in teenage mothers; consequently, the number of instrumental deliveries and caesarean sections was also higher (Mukhopadhyay *et al.*, 2010).

In addition, teenage pregnancy was also at risk to have postpartum haemorrhage. The previous study in Pakistan by Saba *et al.* (2013) reported a higher percentage of postpartum haemorrhage (18.6%) as compared to study done at South Asian Sites, in which only 0.7% of postpartum haemorrhage in teenage mothers (Althabe *et al.*, 2015; Saba *et al.*, 2013). However, another study found the prevalence of postpartum haemorrhage among teenage mothers was lower (8.7%) compared to adult aged between 21-25 years old (49.6%) and older mothers aged 26-30 years old (33.9%) (Kodla, 2015). Nevertheless, the commonest risk factor for postpartum haemorrhage was anaemia with 41.7%, in which anaemia was also the highest outcome in teenage pregnancy with 53.1% (Jusoh *et al.*, 2015). There was a study supported that anaemia in pregnancy increased risk of postpartum haemorrhage; the patients with haemoglobin of 7 g/dl or less were more likely to have postpartum haemorrhage due to uterine atony, as compared to patients with Hb 7.1 to 10 g/dl (Frass, 2015).

2.4.2 **Perinatal outcomes**

In addition to low birth weight, preterm birth is also one of the perinatal outcomes in teenage pregnancy. There were increased risks of premature delivery, restricted foetal growth and abortion in teenage pregnancy (Franjić, 2018). A study by Sulaiman *et al.* (2013) showed significant preterm birth complication in teenage pregnancy (24.3%).

This preterm birth of teenage pregnancy was also supported by another study in Saudi Arabia, with adjusted OR 1.5, 95% CI = 1.1 to 2.1, a p-value less than 0.05 (Fayed *et al.*, 2017).

The association between teenage pregnancy and the adverse perinatal outcomes has been attributed to gynaecological and growth immaturity and also the nutritional status of teenage pregnancy. Preterm birth was also at higher risk to get a low Apgar score and low birth weight infant (Ogawa *et al.*, 2019). These are because low birth weight infant in teenage pregnancy share the same pathophysiology that causing preterm birth and lead to low birth weight infant.

Teenagers growth like height, weight and BMI continues until 18 to 19 years of age. Shorter maternal height and underweight would reflect such physical immaturity in teenagers. Shorter height and underweight are also known to increase risk of poor perinatal outcomes such as small for gestational age (SGA), preterm delivery, and pre-eclampsia among mature adults (Girsen *et al.*, 2016; Ogawa *et al.*, 2019).

The biological factor proposes that the blood supply to the cervix and uterus does not develop completely during the physical development of a teenager and a hypothesis that teenagers are still growing physically and need adequate nutrition for their development precipitate low birth weight and preterm birth. Low levels of gonadal hormones also may compromise proper attachment of the foetus to the uterine wall

and causing vaginal bleeding leading to premature contractions (Marvin-Dowle *et al.*, 2018; Roth *et al.*, 1998).

Study in Malaysia also revealed that teenage pregnancy also had a significant risk for low Apgar score,10.8% (Omar *et al.*, 2010). Prevalence of low Apgar score among teenage pregnancy in another study in Saudi Arabia was 1.9% (Fayed *et al.*, 2017). Preterm birth was reported to be a strong association for low Apgar score (Svenvik *et al.*, 2015). Thus, most of the risk factors that can cause preterm birth can lead to low Apgar score infant.

There was a study that observed maternal height as a significant association between adolescent pregnancy and preterm birth, low birth weight and low Apgar score. The result in the study supports a hypothesis that shorter height of mother, which relates to smaller pelvic size among teenagers was partly responsible for increased risk of preterm birth. Preterm infants were also at a higher risk to get a low Apgar score and low birth weight infant (Ogawa *et al.*, 2019).

The rate of stillbirth among teenage mothers in Australia had increased from 9.5/1000 births to 15.0/1000 from 1991 to 2009 (Marino *et al.*, 2016). The prevalence of stillbirth among teenage pregnancy in Malaysia was 0.6%. Poor social environment and low education have been proven strong indicators for stillbirth (Olausson *et al.*, 1999).

2.5 **Factors associated with low birth weight infant among teenage pregnancy**

Current review found five research done to determine the association between low birth weight infant and teenage mothers, as well as their risk factors which were studied by Roth *et al.* (1998), Harville *et al.* (2012), Guimaraes *et al.* (2013), Dennis and Mollborn (2013) and Belfort *et al.* (2018). In view of the limited literature on factors associated with low birth weight among teenage pregnancy, this section also included those factors found from studies conducted among the general population. Even though the populations were different, the factors might influence the occurrence of low birth weight in both groups and provide important guidance for this study. The factors can be divided into socio-demographic factor, obstetric factor and nutritional status factor.

2.5.1 **Socio-demographic factors**

Socio-demographic factors include marital status, husband age, ethnicity, employment status and education.

a) Marital status

Many studies showed that unmarried teenage mother or single mother was significantly associated with low birth weight infants (Belfort *et al.*, 2018; Shah *et al.*, 2011). The previous study in Brazil hospital also documented the same result. Teenage mothers without her partner had a risk of low birth weight three-times higher than adult mothers (Guimaraes *et al.*, 2013).