Chapter 1

Introduction

Symphysis-fundal height or fundal height (FH) measurement in centimeters (cm) has been a routine practice in antenatal care units for ages[1, 2] because it comprises a simple, safe, easy and costless method[3, 4] with the purposes of evaluating fetal growth and abnormal screening such as intrauterine growth restriction (IUGR), small for gestational age (SGA) fetus, and large for gestational age (LGA) fetus.[4-9] Moreover, fundal height can manifest approximate fetal size and weight[6, 7] and evaluate any abnormal findings such as oligohydramnios, polyhydramnios, twins as well as tumor in uterus.[10] Normally, abnormal findings are determined by comparing the actual measured fundal height with normal baseline of specific gestational age (GA) and observing the variability of the fundal height pattern. When fundal height is lower than the lower boundary from normal baseline such as -1SD,-2SD, 5th percentile, 10th percentile or the pattern of fundal height tends to decrease, become stable or increase lower than normal baseline. These may indicate SGA fetus[8, 11, 12] or IUGR fetus, which may lead to low birth weight (LBW) infants and birth weight less than 2,500 g. On the other hand, when fundal height is higher than normal baseline, it may indicate LGA fetus.[8, 13] Therefore, when healthcare providers can detect these abnormal findings early, they will be able to provide care for the pregnancy effectively and decrease morbidity and mortality in both mother and fetus.

Ultrasound (US) can detect abnormal conditions better than FH measurement.[13-15] However, in antenatal care units especially at primary level in developing countries, US is not fully available due to high cost and only doctors or obstetricians can use this machine.[4] Therefore, FH measurement is still used to detect any abnormal conditions.[9] The West Midlands Perinatal Institute (WMPI)'s study[16] showed that FH measurement was useful to screen abnormal fetal growth especially SGA fetus, which becomes more accurate when the examiner measures fundal height with correct technique, plots FH in centimeters on customized growth charts adjusted for normal curve by maternal weight, height, parity, and ethnic group[4, 16, 17] and provides clear guidelines based on WMPI, British Royal College of Obstetricians and Gynecologists (RCOG)'s suggestions.[18] Thus, these techniques are recommended to be performed in every antenatal care visit starting from 24 weeks of gestation. In addition, they were added to the RCOG's guidelines since 2002 until present.[18, 19] Therefore, fundal height measurement is now used to detect any abnormal fetal growth early in both developed and developing countries. Furthermore, from reviewing Cochrane's study, still no evidence exists that can be used to currently convince changing any part of the fundal height measurement method.[9]

Nevertheless, systemic reviews and meta-analyses regarding the ability of fundal height to detect the IUGR, SGA and LGA fetus have revealed a difference in sensitivity from 17% to 86%.[8, 20] These might have been caused by differences in GA calculation, measurement method, IUGR, SGA, and LGA diagnostic guideline, and cutoff point of abnormal fundal height.[20]

Therefore, many studies have recommended how to improve the ability of fundal height measurement method to detect abnormal intrauterine growth by the guidelines described below.[2, 4, 11, 21-23]

1. Create devices that suit the particular characteristics of each population and people when standard norm used by the normal population is not applicable.
2. Plot FH in centimeters on suitable standard FH growth curves in every antenatal care visit and frequently standardize fundal height measurement method.
3. Investigate proper guidelines to screen any abnormal conditions in specific populations.

Establishing a local FH growth curve is appropriate for monitoring and screening local populations in their own settings[1, 24-26] because FH can be changed according to ethnicity, culture, socioeconomics and nutrition.[2, 26-28]

In Thailand, healthcare providers also use fundal height measurement as a routine practice in antenatal care units. The guidelines are fundal height in centimeters equals GA in week ±2. However, fundal height growth curve is not frequently used as a screening tool because US is widely used among antenatal care units in Thailand. The study of FH growth curves in the past were based on their own settings.[29, 30] These might be due to varieties of subjects, GA calculation method and measurement method. In addition, most studies were conducted by university hospitals leading to some limitations when using in community and local hospitals, where pregnant women have middle to poor economic status. Their fundal height growth curve varies. Moreover, the GA that has been used to create the FH growth curve was based on GA calculated using the first day of the last menstrual period (LMP). After US became more prominent in antenatal care units, US was used to calculate GA. Apparently, reliable and accurate GA calculation used in community and local hospitals has 2 perspectives: 1) GA calculated by the first day of LMP is confirmed by US and 2) GA calculated by US when GA by LMP is unreliable. Hence, to establish a fundal height growth curve that is proper for a specific population in a specific region is necessary to monitor and screen abnormal intrauterine growth.[2, 8, 26]

Pregnant women who had the same local settings also shared other factors that affected fundus height, i.e., maternal height, weight, body mass index (BMI), parity, and sex of fetus[4, 27, 30-33] when the body structure of pregnant women (obese-thin) was the most influential factor in causing the variety of fundal height growth curve patterns. The studies showed that FH of high BMI pregnant women was 2 cm higher than the FH of pregnant women who are thin or low BMI.[27, 30] Therefore, to use a regular fundal height growth curve based on a normal population for monitoring and screening abnormal intrauterine growth in these specific population may lead to over or under investigation and/or intervention. Some studies have derived FH growth curve for each of these populations.[27, 30] In Thailand, one study separated FH growth curves following pre-pregnant BMI and divided BMI in 3 groups: less than 20, 20-24, and more than 24 kg/m^2 and calculated GA using only US.[30] These practicums were not used as routine antenatal care in community and local hospitals where they divided BMI following the

World Health Organization (WHO) criteria: less than 18.5, 18.5-24.9, 25.0-29.9, and more than or equal to 30.0 kg/m^2.[34] Therefore, there should be FH growth curves for each of the BMI categories to use in antenatal care units to be able to use properly and increase effectiveness of screening for any population that differs from a normal population.

Lastly, the study aimed to find proper guidelines to screen and detect abnormal intrauterine growth of fetus especially SGA or IUGR, which may lead to LBW infant. Related studies have reported that ability to detect SGA or IUGR will increase when examiners plot FH in centimeters on FH growth curve in every antenatal care visit[8] because fundal height changes dynamically depending on intrauterine cavity passenger, i.e., the fetus, placenta and amniotic fluid and other factors when fetal size is the most important factor influencing the change of fundal height.[7, 35] Therefore, plotting serial of fundal height measurement results on standard FH growth curve simulates monitoring fetal growth compared with normal baseline for the whole pregnancy period and indicates the approximate intrauterine growth of the fetus.[4, 17]

A majority of studies normally focus on finding normal values of FH for each gestational week, FH growth curve for a population in a specific region.[2, 27, 28, 30] However, still no study has focused on describing the change of FH growth curve patterns to be able to use as guidelines to detect and screen abnormal fetal growth. Thus, to study characteristics of FH growth curve patterns for pregnant women with term LBW compared with standard FH growth curve could possibly be used as proper screening for term LBW. This is because term LBW infants are still an important problem for maternal and child health care system in developing countries including Thailand. In 2010, the prevalence of term LBW infants in 138 countries with middle to low income were 8.8% (10.6 out of 120.5 million of total births) and majority of these infants were in Asia.[36] Thailand shows a prevalence of LBW infants at 16.0%, preterm LBW, 7.0%, and term LBW, 9.0%.[37] Most term LBW infants comprise the term SGA fetus, which may affect the mother and fetus for the whole period of pregnancy until postpartum including perinatal morbidity and mortality such as perinatal asphyxia, meconium aspiration syndrome, hypothermia, hypoglycemia and polycythemia.[38, 39] Moreover, these will increase risk for long term morbidity including poor mental and psychomotor development, coronary heart disease, type 2 diabetes,[39, 40] hypertension and stroke in adulthood.[41] Therefore, when healthcare providers can detect and screen pregnant women, who are prone to have term LBW early during the antenatal period so they will be able to plan and provide care effectively to prevent these long term effects.

Scope of the thesis

Research questions in this thesis were carried out from the routine antenatal care practice of two provincial hospitals and two regional hospitals in upper northern Thailand under the supervision of the Thai Ministry Public Health with similar guidelines for antenatal care practice.

1. Fundal height growth curve for Thai women

This study demonstrated that each population should have its own fundal height growth curve and demographically specific fundal height growth curve to use in screening abnormal intrauterine growth such as fundal height, which is influenced by ethnicity, socioeconomics and nutritional status.

2. Fundal height growth curve for underweight and overweight and obese pregnant women in Thai populations

This study demonstrated that FH growth curves of the underweight and overweight and obese pregnant women differed from those of normal weight. In monitoring or screening for abnormal intrauterine growth in thin or obese women, FH growth curves specifically developed for such women should be applied to reduce the over- or under-investigation and/or -intervention as a consequence of the inappropriate application of the FH growth curve for normal weight women.

3. Fundal height growth curve patterns of pregnant women with term LBW infants

This study demonstrated that the patterns of fundal height growth curves observed among pregnant women with term LBW infants may be used to recognize women who were likely to deliver term LBW infants from early pregnancy to the day of admission for labor. Such screening may detect future term LBW infants at 80%. Thus, it might be used as guidelines or a simple tool to monitor and screen for term LBW infants, from early pregnancy. Detected cases may be intervened to reduce complications that may arise from term LBW infants.

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