

Weight Gain During Pregnancy Based on Pre-Pregnancy Body Mass Index with Duration of Labor

Siska Nawang Ayunda Maqfiro*, Triany Laila Pelu

Poltekkes Kemenkes Ternate, Ternate City, North Maluku Province, Indonesia

ARTICLE INFORMATION

Received: 7, October, 2023

Revised: 29, May, 2024

Accepted: 30, May, 2024

KEYWORD

Weight Gain During Pregnancy; Body Mass Index; Duration of labor

CORRESPONDING AUTHOR

Siska Nawang Ayunda Maqfiro
Ternate city, North Maluku Province, Indonesia
siskanawang505@gmail.com
+6282244444738

DOI

<https://doi.org/10.36456/embrio.v16i1.8141>

© 2024 The Author(s)

ABSTRACT

Chronic Energy Deficiency and being overweight in pregnancy is a severe problem because it could cause many risks in labor. This study aimed to determine the association between weight gain during pregnancy based on Body Mass Index before pregnancy with the duration of labor. The type of research was analytical observational with a cross-sectional approach. Thirty respondents used the quota sampling technique. The Spearman-rank test showed a significant value of 0,039, so there was a significant relationship between weight gain during pregnancy and the duration of the first stage of labor in the latent phase. The significant value was 0,016, indicating a relationship between weight gain during pregnancy and the duration of the first stage of labor in the active phase. However, a significant value of more than 0,05 in the variable duration of the second, third, and fourth stages of labor. So, it was necessary to monitor weight gain and provide counseling on the impact of excessive weight gain during labor. In addition, women with excessive weight gain should be given more time during the first stage because the duration in the second until the fourth stage of labor would generally run so that it could reduce unnecessary interventions.

Introduction

Based on data from the Family Health Program registered with the Ministry of Health in 2020, Indonesia's maternal mortality rate was 4.627, 4.221 more than in 2019. In 2020, the causes of maternal death were bleeding in as many as 1.330 cases, high blood pressure during pregnancy in as many as 1.110 cases, and circulatory disorders in as many as 230 cases (Indonesia Ministry of Health, 2021a). To improve women's health status and reduce MMR-IMR, to sharpen the strategy and in line with 2020-2024, the Ministry of Health is transforming the health system including maternal and infant health services with six-pillar approach, one of which is the pillar of the health primary care transformation that aims to create healthy mothers-to-be through community-based health efforts such as; 1) preparing women to be eligible for pregnancy; 2) detection of pregnancy complications as early as possible in health services; 3) delivery in Health Facilities and 4) services for babies who are born (Indonesia Ministry of Health, 2021b).

The five 'P's' are clinically relevant to the prosperous duration of labor described as power (strength of contractions/pushing), passage (shape of the mother's pelvis), passenger (size of the fetus), and position (fetus against the pelvis). In contrast, the '5th P,' the 'psyche,' reflects the mother's

psychological state (Gimovsky et al., 2024). By understanding how these components impact labor, women would effectively participate in their birthing involvement and optimize the conditions for a positive result (Graybill, 2023).

Chronic Energy Deficiency during pregnancy is a severe problem, but so is being overweight. There is a myth that pregnant women need to eat twice as much as usual to meet the needs of both mother and fetus. Pregnant women who overeat can experience excessive weight gain but unbalanced nutritional fulfillment. Being overweight is a global pandemic condition whose prevalence continues to increase. This condition is also commonly found in women of childbearing age. Overweight and obese in pregnancy is one of the high-risk obstetric conditions.

Maternal obesity has been reported to be a risk factor for various antenatal, intranatal, postnatal, and neonatal complications such as postpartum complications, induction of labor, macrosomia, shoulder dystocia, prolonged labor, increased blood loss, and cesarean section (Salman et al., 2022). Pregnant women who had weight gain during pregnancy more than usual would be 5,458 times the opportunity of postpartum hemorrhage (Maqfiro & Abd Mutalib, 2022). In 2020-2021, the occurrence of the COVID-19 pandemic triggered an increase in obesity in women entering pregnancy. High-calorie intake from sugary drinks and snacks, which is not balanced with physical activity, causes an increase in excess weight during pregnancy.

One study showed that obesity did not affect the duration of the active phase (Polónia et al., 2020). At the same time, several other studies described long labor duration as being associated with increased BMI (Carlhäll et al., 2013). However, these studies did not analyze seconds separately from each stage of labor, so this study will observe the duration from stages I-IV to be more specific.

It is imperative to consider the effect of maternal Body Mass Index on the progress and duration of labor to facilitate decision-making on potential obstetric interventions. Prolonged active labor more than 12 hours) was associated with severe postpartum hemorrhage (Nyfløt et al., 2017). Prolonged labor is common, especially in women who have just had their first child. New mothers whose first labor is difficult and prolonged say that the experience can affect them forever. Knowing the factors that influence the length of labor can increase vigilance and, at the same time, handle it properly so that the delivery can go well and as expected, both by the mother and her helper.

Based on this background, the researcher is interested in studying the relationship between weight gain during pregnancy based on Body Mass Index (BMI) before pregnancy and the duration of the first until the fourth stage of labor.

Method

The researcher conducted a correlational analytic study to examine the relationship between weight gain throughout pregnancy, as measured by Body Mass Index (BMI) before pregnancy, and the duration of labor during stages I-IV. The researcher used a cross-sectional methodology, wherein data is gathered simultaneously. Data collection was conducted after acquiring authorization from the research location. The population consists of women who undergo labor in the Independent Midwifery

Practice in Ternate City. Thirty samples were obtained using the quota sampling technique. The inclusion criteria for respondents were primigravid women who were over 37 weeks pregnant, had a head position pregnancy, and had no contraindications for vaginal delivery. The exclusion criteria for respondents included women who had prenatally identified congenital abnormalities and contraindications for vaginal delivery. The sequence of implementation consists of the following stages: a) Researchers solicit potential respondents, indicating their willingness to participate as respondents, and b) Elucidate the goals and objectives of the research. The researcher requested that the mother peruse the explanation prior to approval. c) Once the mother assented, the researcher requested that she sign an informed consent form.

The data utilized in this study is source data. The data about weight growth during pregnancy is derived from the pre-pregnancy Body Mass Index (BMI) and the duration of labor in stages I-IV. The data were collected during the trial. The data collection tool consisted of an observation sheet that recorded data on the maternal weight gain, while the partograph was used to measure the duration of labor. Observation sheets and partographs were utilized to obtain the data. Subsequently, the data were gathered, processed, and examined. Once the researcher has gathered the results on the data collection form, they organize them in a tabular format. The study aimed to investigate the relationship between the dependent variable and one or more independent variables. All variables involved in the analysis were categorical in nature, and Spearman's rank correlation was used to evaluate the data. The Health Research Ethics Committee of the Tanjungkarang Health Polytechnic has granted an ethical exemption for this research, as shown by the approval number 047/KEPK-TJK/I/2023.

Results

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	n	Percentage	
Education	Senior High School	21	70,0%
	Higher Education	9	30,0%
Occupation	Housewife	6	20,0%
	Private employee	14	46,7%
	Government employee	10	33,3%
Age	Lower risk (20-35 years)	26	86,7%
	Higher risk (<20 years and >35 years)	4	13,3%
Antenatal Care	Complete (\geq six times)	30	100%
Type of Pregnancy	Single pregnancy	30	100%
Gestational Age	Post-term	4	13,3%
	Aterm	26	86,7%
Weight Gain During Pregnancy	More than normal-Lower than normal	18	60,0%
	Normal	13	40,0%
Duration of the first stage of labor in the latent phase	Abnormal	9	30,0%
	Normal	21	70,0%
Duration of the first stage of labor in the active phase	Abnormal	10	33,3%
	Normal	20	66,7%
Duration of the second stage of labor	Abnormal	2	6,7%
	Normal	28	93,3%
Duration of the third stage of labor	Abnormal	2	6,7%
	Normal	28	93,3%
Duration of the fourth stage of labor	Abnormal	3	10,0%
	Normal	27	90,0
Total	30	100	

According to Table 1 above, it can be seen that the majority of respondents (70%) were senior high school graduates, the majority of respondents (46.7%) were private employees, almost all (86.7%) in the lower-risk labor, all respondents (100%) had complete antenatal care, all respondents (100%) have single baby, almost all (86.7%) aterm in gestational age, the majority of respondents (60%) weighted pregnancy more than normal-lower than normal, the majority of respondents (70%) had a normal duration of the first stage of labor in the latent phase, most of the respondents (66.7%) had normal duration of the first stage of labor in active phase, almost all respondents (93, 3%) had normal duration of the second stage of labor, almost all respondents (93.3%) had normal duration of the third stage of labor. Almost all respondents (90%) had a normal duration of the fourth stage of labor.

Table 2. Weight Gain During Pregnancy and Duration of the First Stage of Labor in the Latent Phase

Weight gain during pregnancy	Duration of the first stage of labor in the latent phase				Total	
	Abnormal		Normal		f	%
	f	%	f	%		
More than normal-Lower than normal	7	38,9	11	61,1	18	100
Normal	2	16,7	10	83,3	12	100
Total	9	30,0	21	70,0	30	100

Sig. = 0,039

$\alpha = 0,05$

The table shows that among respondents with weight gain during pregnancy more than normal-lower than normal, seven respondents (38,9%) had an abnormal duration of the first stage of labor in the latent phase and 11 respondents (61,1%) in the normal category. Respondents who had weight gain during pregnancy were normal: 2 respondents (16,7%) had an abnormal duration of the first stage of labor in the latent phase, and 10 respondents (83,3%) were in the normal category. The Spearman-Rank correlation test showed that the Significant value = 0,039 (Sig <0,05) indicates a significant relationship between weight gain during pregnancy and the duration of the first stage of labor in the latent phase.

Table 3. Weight Gain During Pregnancy and Duration of the First Stage of Labor in the Active Phase

Weight gain during pregnancy	Duration of the first stage of labor in the active phase				Total	
	Abnormal		Normal		f	%
	f	%	f	%		
More than normal-Lower than normal	8	44,4	10	55,6	18	100
Normal	2	16,7	10	83,3	12	100
Total	10	33,3	20	66,7	30	100

Sig. = 0,016

$\alpha = 0,05$

The table above shows that respondents who had weight gain during pregnancy were more than normal-lower than normal: 8 respondents (44,4%) had an abnormal duration of the first stage of labor in the active phase, and ten respondents (55,6%) in the normal category. Respondents who had weight gain during pregnancy were normal: 2 respondents (16,7%) had an abnormal duration of the first stage of labor in the active phase, and ten respondents (83,3%) were in the normal category. The Spearman-Rank correlation test showed that the Significant value = 0,016 (Sig <0,05) indicates a significant relationship between weight gain during pregnancy and the duration of the first stage of labor in the active phase.

Table 4. Weight Gain During Pregnancy and Duration of the Second Stage of Labor

Weight gain during pregnancy	Duration of the second stage of labor				Total	
	Abnormal		Normal		f	%
	f	%	f	%		
More than normal-lower than normal	2	11,1	16	88,9	18	100
Normal	0	0	12	100	12	100
Total	2	6,7	28	93,3	30	100

Sig. = 0,170

 $\alpha = 0,05$

The table above shows that respondents who had weight gain during pregnancy were more than normal-lower than normal: 2 respondents (11,1%) had an abnormal duration of the second stage of labor, and 16 respondents (88,9%) were in the normal category. All of the respondents (12 respondents) who had weight gain during pregnancy in the normal category had a normal duration of the second stage of labor. The Spearman-Rank correlation test showed that the Significant value = 0,170 (Sig>0.05) showed no significant relationship between weight gain during pregnancy and the duration of the second stage of labor.

Table 5. Weight Gain During Pregnancy and Duration of the Third Stage of Labor

Weight gain during pregnancy	Duration of the third stage of labor				Total	
	Abnormal		Normal		f	%
	f	%	f	%		
More than normal-lower than normal	0	0	18	100	18	100
Normal	2	16,7	10	83,3	12	100
Total	2	6,7	28	93,3	30	100

Sig. = 0,275

 $\alpha = 0,05$

All of the respondents (15 respondents) who had weight gain during pregnancy more than normal-lower than normal, had a normal duration of the third stage of labor. Respondents who had weight gain during pregnancy in the normal category: 2 respondents (16,7%) had an abnormal duration of the third stage of labor, and 10 respondents (83,3%) were in the normal category. Spearman-Rank correlation test showed that the significant value is 0,275 (Sig>0,05), so there is no significant relationship between weight gain during pregnancy and the duration of the third stage of labor.

Table 6. Weight Gain During Pregnancy and Duration of the Fourth Stage of Labor

Weight gain during pregnancy	Duration of the fourth stage of labor				Total	
	Abnormal		Normal		f	%
	f	%	f	%		
More than normal-lower than normal	3	16,7	15	83,3	18	100
Normal	0	0	12	100	12	100
Total	3	10	27	90	30	100

Sig. = 0,084

 $\alpha = 0,05$

The table above shows that respondents who had weight gain during pregnancy were more than normal-lower than normal: 3 respondents (16,7%) had abnormal duration of the fourth stage of labor, and 15 respondents (83,3%) were in the normal category. All of the respondents (12 respondents) who had weight gain during pregnancy in the normal category had a normal duration of the fourth stage of labor. Spearman-Rank correlation test showed that the significant value is 0,084 (Sig>0,05), so there is no significant relationship between weight gain during pregnancy and the duration of the fourth stage of labor.

Discussion

Height weight measurement is among the ten minimum integrated antenatal care standards (Indonesia Ministry of Health, 2020). Based on the results of measuring weight and height, the Body Mass Index can be determined by the formula of weight in kilograms divided by height in meters (kg/m^2). However, this formula can only be applied to ages 18 to 70, with normal spinal structure, not pregnant or breastfeeding, and not even bodybuilding or sports athletes (Irianto, 2017). Thus, the Body Mass Index of pregnant women is determined based on the weight before pregnancy as a benchmark to determine the range of weight gain during pregnancy. During pregnancy check-up services, weight gain must be monitored according to the weight gain chart in the mother and child health handbook adapted from the Institute of Medicine (IOM), United States (Indonesia Ministry of Health, 2023). Thus, each pregnant woman cannot be equated with the target weight gain because it refers to the pre-pregnancy BMI value, including the category of underweight, normal, overweight, or obesity.

Based on the characteristics of the respondents, it is known that 70% are in Senior High School, 46,7% are private employees, 86,7% are at lower risk for childbirth, all respondents 100% had complete antenatal care, all respondents 100% had single baby, 86,7% were aterm in gestational age so that from these characteristics indicate that the mother is in a safe condition for delivery. However, 60% weighted pregnancy, which was more than normal-lower than normal. Obesity rates are increasing worldwide, and this trend also affects women of childbearing age. Maternal obesity is the leading cause of maternal death in developed countries and is associated with gestational diabetes, fetal abnormalities, preeclampsia, and macrosomia compared to women of normal weight (Mother & Child Installation, 2023; Hung & Hsieh, 2016). Women who were underweight before pregnancy are at risk for placental abruption, small gestational age, and low birth weight (Tsai et al., 2015).

According to this study, those who gained extra weight had a longer duration of the initial stage of labor in the latent phase. Specifically, seven respondents (46.7%) in the excess weight category experienced an abnormal duration, while eight respondents (53.3%) in the normal weight category had a normal duration. Participants who had a higher than usual body weight encountered an atypical length of the initial stage of childbirth in a dormant phase. Specifically, two participants (16.7%) experienced this abnormality, whereas the remaining 10 participants (83.3%) had a normal duration. Participants who experienced below-average weight gain throughout pregnancy exhibited a typical duration of the initial stage of labor in the latent period. According to the Spearman-Rank correlation test, the Sig value of 0.039 (Sig <0.05) indicates a statistically significant link between weight growth throughout pregnancy and the duration of the first stage of labor in the latent phase.

According to a study conducted by Mohamed Samy et al. at Bab El Shearia Hospital, around 50% of nulliparous women who are fat had a significantly prolonged first stage of labor. Conversely, the second stage of labor may be independent of the mother's BMI. The duration of the second stage of labor in women who have not given birth previously may be relatively short or may result in a cesarean section, depending on their body mass index (BMI) prior to pregnancy (Samy et al., 2015). Caroline Shenouda and her colleagues conducted a study at Victoria Hospital in London, Ontario, revealing that

the labor rate may decrease when the maternal BMI increases. According to Shenouda et al. (2020), obese primiparous women take an extra 1.62 to 2.67 hours to reach 10 cm dilatation compared to women of normal weight. Likewise, Shayna M. According to Norman's research, women with a Body Mass Index (BMI) of 30 or above experienced a longer duration and slower progression of the initial stage of labor during the latent phase (Norman et al., 2012).

Most published studies examining the impact of obesity on the advancement of labor focus on comparing the initial and subsequent stages of labor. The findings of this study are consistent with those of other authors, indicating that overweight pregnant women had a longer average duration of the initial stage of labor, particularly in terms of the latent phase (Hilliard et al., 2012; Bogaerts et al., 2013). Pregnant women who are overweight have an increased frequency of labor induction and a higher likelihood of unsuccessful induction of labor, as indicated by several research findings. The findings indicate that overweight pregnant women experience a reduced rate of cervical dilatation during childbirth (Carlhäll et al., 2013).

A study at Centro Hospitalar São João, Porto, Portugal, showed that the active phase was not significantly affected by obesity (Polónia Valente et al., 2020). In another prospective study in Southern Sweden conducted by Sara Carlhäll et al., it was found that the duration of the active phase increased with increasing BMI in nulliparous women. However, after reaching the opening of the second stage of labor, obese women would give birth faster, so the possibility of prolonged labor was only during the first stage (Carlhäll et al., 2013). A retrospective observational cohort study of 1885 women at Nordsjællands Hospital, University of Copenhagen, Denmark, stated that excess weight had no significant effect on the total duration of the first stage of labor in the active phase. However, there was an increase in the occurrence of sectio caesarea. The absence of this effect may be due to sectio caesarea delivery in obese women being carried out earlier, thus shortening the duration of the first stage of labor in the active phase (Ellekjaer et al., 2017).

In this study, individuals who had gained weight during pregnancy were found to have a higher-than-average weight gain, while others had a lower-than-average weight gain. Out of the total respondents, eight individuals (44.4%) experienced an abnormal duration of the first stage of labor in the active phase, while ten individuals (55.6%) fell into the typical category. Out of the respondents who had weight increases throughout pregnancy, two individuals (16.7%) had an abnormal duration of the first stage of labor in the active phase. Ten individuals (83.3%) fell into the normal category. The Spearman's rank correlation test revealed a significant link between weight growth during pregnancy and the duration of the first stage of labor in the active phase, as indicated by a significant value of 0.016 (Sig < 0.05).

Obese women experience elevated cholesterol levels, leading to alterations in intracellular calcium and potential impacts on myometrial contractions. There is a hypothesis that leptin levels, a peptide generated by fat cells, may rise and hinder uterine contractions, leading to more prolonged first-stage labor (Wray & Arrowsmith, 2021). According to the findings of Annick Bogaerts et al., obesity is a significant risk factor for extended labor, particularly when the cervix has not yet dilated to 6 cm

(Bogaerts et al., 2013). Obese and overweight women who are induced into active labor have an equivalent likelihood of experiencing spontaneous vaginal birth as women with a normal weight (Carlhäll et al., 2020).

The injection of intrapartum oxytocin was found to be linked to excessive weight gain, indicating a potential connection between excessive weight gain and labor dysfunction. This association may be attributed to the negative impact of increased adiposity on uterine contractions. Obese pregnant women with a significant estimated fetal weight may experience longer labor and require more muscular contractions due to the presence of extra soft tissue deposits in the pelvis. Moreover, pregnant women tend to store more fat in the core part of their bodies rather than at the periphery. This leads to soft tissue deposition in the pelvis, which narrows the birth canal's diameter and prolongs the delivery duration (Amyx et al., 2023).

The labor process involves a complex interaction between five variables, namely the 5Ps: Power (strength of uterine contractions), Passenger (condition of the fetus), Passage (structure of the mother's pelvis), Position, and Psychic (emotional well-being of the mother)(Graybill, 2023). The strength of uterine contractions is evaluated every 10 minutes to determine whether they are regular, frequent, or last more than 40 seconds. Passenger assessment involves looking at the fetus's size, position, and attitude, as well as the presence of conditions that may affect the progress of labor. Maternal pelvic structures involving bones and soft tissues also need to be noted, including the state of the bladder, rectum, masses, or vaginal canal. It is only during labor that the adequacy of the pelvis can be determined. The position of the birthing person during labor can significantly affect the delivery process. Certain positions can speed up the descent of the baby's head, optimize pelvic size, and increase comfort during the birthing process. The mother's emotional well-being should be considered when ensuring proper support and a supportive environment. This includes the mother's stress and anxiety levels and the presence of a partner who provides adequate support(Swer, 2021).

According to this survey, a higher percentage of respondents had weight increases throughout pregnancy than those who did not: 2 respondents (11.1%) had a longer than average duration of the second stage of labor, whereas 16 respondents (88.9%) had a normal duration. All 12 responders who saw weight gain within the usual range during pregnancy also had a normal duration of the second stage of labor. The Spearman's rank correlation test indicated that the p-value was 0.170 ($p > 0.05$), indicating no statistically significant association between weight growth during pregnancy and the duration of the second stage of labor.

Regardless of the weight increase throughout pregnancy based on maternal BMI, all women who reach active phase I of labor have an equal probability of experiencing spontaneous delivery during phase II. This knowledge may be relevant for patients undergoing induction who can feel disheartened if the duration between hospital admission and the onset of active labor is prolonged (Carlhäll et al., 2020). The primary objective is to ensure a smooth transition during the active period of labor. By accomplishing this, even women who are overweight will experience labor that is as effortless as women with a normal weight (Hautakangas et al., 2022). Obese women typically experience a shorter period of

exertion, resulting in a speedier second stage of labor. Pregnant women classified as obese and those classified as normal experience a similar rise in intrauterine pressure during the second stage of labor (Zelig et al., 2013). The correlation between maternal weight gain during pregnancy and the baby's birth weight is insignificant. This implies that mothers who experience excessive weight gain during pregnancy do not necessarily give birth to babies with a corresponding increase in weight. This is because the increase in maternal weight includes various components such as the contents of the uterus, abdomen, breasts, extracellular fluid, and blood volume (Wigianita et al., 2020).

Leptin also hinders collagen breakdown by matrix metalloproteinases (MMPs) and the programmed cell death of cervical cells in laboratory settings. This interference may impede the development of the uterus in fat women. Furthermore, leptin decreases the development of the uterus in overweight women by promoting the production of cervical collagen during the latter part of pregnancy. To prevent fetal membrane malfunction, membrane cell death is reduced. This helps prevent the membranes from breaking on their own in obese women. Therefore, obese women in the second stage of labor may need to have amniotomy, as suggested by Wendremaire et al. (2013) and Carlson et al. (2015).

Overweight and obese women during pregnancy experienced reduced duration of labor upon entering the second stage of labor. Regardless of the cause, pregnant women are motivated by the evidence indicating that the duration of the second stage of labor is shorter for them compared to women with average weight, and there is a reduced likelihood of requiring an emergency C-section. Hence, the findings of this study have the potential to curtail superfluous interventions for expectant women who are overweight or obese. Consequently, increased body weight during pregnancy is linked to a reduced length of labor (Østborg et al., 2022).

Nevertheless, the likelihood of sphincter ani damage diminishes as the mother's weight increases throughout pregnancy (Blomberg, 2014). During childbirth, the rates of episiotomy are notably higher in women with a normal weight. This could be attributed to the greater muscle mass resulting from increased pressure on the pelvic floor in obese women or the larger volume of fat mass they have (Hjertberg et al., 2018).

All 15 respondents in this study who experienced weight increase during pregnancy that deviated from the normal range, either higher or lower, had a normal duration of the third stage of labor. Of the respondents who experienced weight growth throughout pregnancy in the normal category, two respondents (16.7%) had an abnormal duration of the third stage of labor. In contrast, ten respondents (83.3%) had a normal duration. The Spearman-Rank correlation test indicated a non-significant association ($p=0.275$, $p>0.05$) between weight gain during pregnancy and the duration of the third stage of labor. The lack of a link may be attributed to the limited size of our sample. Obesity has been recognized as the primary factor contributing to postpartum hemorrhage. The risk of postpartum hemorrhage increases as the mother's weight increases (Kim et al., 2017). According to Cummings et al. (2018), the longer the duration of labor, the higher the risk of postpartum hemorrhage.

A prolonged duration of the third stage of labor, lasting more than 20 minutes, is associated with an increased risk of postpartum hemorrhage (Frolova et al., 2016).

In overweight pregnant women, the width and frequency of muscle contractions are lower than in normal pregnant women. Uterine contractions compared to a normal pregnant woman, calcium (Ca^{2+}) flow is low, and myometrial contractions are weak. It is believed to be caused by high cholesterol levels in the body, which affects the ease with which the uterus contracts. Several components of the cell signaling system play an important role in smooth muscle transport, found in cholesterol-rich cell membrane regions called lipids and caveolae. Estrogen and oxytocin receptors in the myometrium increase, and cholesterol levels determine their effectiveness (Muir et al., 2023; Carlhäll, 2018).

In this study, respondents who had weight gain during pregnancy were more than normal-lower than normal: 3 respondents (16,7%) had an abnormal duration of the fourth stage of labor, and 15 respondents (83,3%) were in the normal category. All of the respondents (12 respondents) who had weight gain during pregnancy in the normal category had a normal duration of the fourth stage of labor. Spearman-Rank correlation test showed that the significant value is 0,084 (Sig>0,05), so there is no significant relationship between weight gain during pregnancy and the duration of the fourth stage of labor. Three respondents were in the abnormal category because contractions were inadequate due to residual placenta, so additional monitoring time was added.

Expanded body weight is emphatically connected with expanded blood cholesterol levels and mindful of myometrial contractility changes. Cholesterol is an imperative component of cell films. A few primary components within the smooth direction of muscle signaling pathways are localized in cholesterol-rich locales of cell film parts, such as caveolae. In creature models, high-fat, high-cholesterol count calories diminished the expression of connexin-43 and caveolin-1 (myometrial contraction-associated proteins). However, they expanded the expression of COX-2, which may lead to destitute myometrial contractility amid corpulence. On the off chance that uterine contractility is impeded, the mother will experience excessive blood misfortune, which can, at that point, imperil the mother's life, called postpartum hemorrhage (Hajagos-Tóth et al., 2017).

The limitation of this study is that the small number of research samples does not allow to study all categories of weight gain based on Body Mass Index before pregnancy, besides that internal examination with Vagina Toucher (VT) to determine cervical opening is still a subjective measurement made by midwives from time to time.

Conclusions

There was a significant association between weight gain during pregnancy and the duration of the first stage of labor in the latent phase and active phase.

There was no significant association between weight gain during pregnancy and the duration of the second, third, and fourth stages of labor.

Acknowledgments (if any)

The author would like to thank the research team, midwives, respondents involved in this research, and the Ternate Ministry of Health Polytechnic for providing funding for the implementation of this research.

References

- Amyx, M., Zeitlin, J., Blondel, B., & Le Ray, C. (2023). Gestational weight gain adequacy and intrapartum oxytocin and cesarean section use: Observational population-based study in France. *Acta Obstetrica et Gynecologica Scandinavica*, 102(3), 301–312. <https://doi.org/10.1111/aogs.14496>
- Blomberg, M. (2014). Maternal body mass index and risk of obstetric anal sphincter injury. *BioMed Research International*, 2014. <https://doi.org/10.1155/2014/395803>
- Bogaerts, A., Witters, I., Van den Bergh, B. R. H., Jans, G., & Devlieger, R. (2013). Obesity in pregnancy: Altered onset and progression of labor. *Midwifery*, 29(12), 1303–1313. <https://doi.org/10.1016/j.midw.2012.12.013>
- Carlhäll, S. (2018). *Maternal Obesity, Duration of Labor and The Role of Leptin*. [PhD dissertation, Linköping University Electronic Press]. Digitala Vetenskapliga Arkivet. <https://doi.org/10.3384/diss.diva-147650>
- Carlhäll, S., Källén, K., & Blomberg, M. (2013). Maternal body mass index and duration of labor. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, 171(1), 49–53. <https://doi.org/10.1016/j.ejogrb.2013.08.021>
- Carlhäll, S., Källén, K., & Blomberg, M. (2020). The effect of maternal body mass index on duration of induced labor. *Acta Obstetrica et Gynecologica Scandinavica*, 99(5), 669–678. <https://doi.org/10.1111/aogs.13795>
- Carlson, N. S., Hernandez, T. L., & Hurt, K. J. (2015). Parturition dysfunction in obesity: Time to target the pathobiology. *Reproductive Biology and Endocrinology*, 13(1), 1–14. <https://doi.org/10.1186/s12958-015-0129-6>
- Cummings, K. F., Helmich, M. S., Ounpraseuth, S. T., Dajani, N. K., & Magann, E. F. (2018). The Third Stage of Labour in the Extremely Obese Parturient. *Journal of Obstetrics and Gynaecology Canada*, 40(9), 1148–1153. <https://doi.org/10.1016/j.jogc.2017.12.008>
- Ellekjaer, K. L., Bergholt, T., & Løkkegaard, E. (2017). Maternal obesity and its effect on labor duration in nulliparous women: A retrospective observational cohort study. *BMC Pregnancy and Childbirth*, 17(1), 1–10. <https://doi.org/10.1186/s12884-017-1413-6>
- Frolova, A. I., Stout, M. J., Tuuli, M. G., López, J. D., Macones, G. A., & Cahill, A. G. (2016). Duration of the third stage of labor and risk of postpartum hemorrhage. *Obstetrics and Gynecology*, 127(5), 951–956. <https://doi.org/10.1097/AOG.0000000000001399>
- Gimovsky, A. C., Rasiah, S. S., Vergara-Lopez, C., Has, P., Ayala, N. K., & Stroud, L. R. (2024). Psyche: The 5th “P” and its Associated Impact on the Second Stage of Labor. *Rhode Island Medical Journal* (2013), 107(1), 37–44.
- Graybill, K. (2023, August 18). What are the 5 P’s of Labor?. *The Womb Room Childbirth & Spinning Babies*. <https://www.wombroom.mom/post/5-ps-of-labor#:~:text=The%205%20P's%20of%20labor%E2%80%9494Passenger%2C%20Passageway%2C%20Powers%2C,healthy%20and%20happy%20birthing%20process.>
- Hajagos-Tóth, J., Ducza, E., Samavati, R., Vari, S. G., & Gaspar, R. (2017). Obesity in pregnancy: A novel concept on the roles of adipokines in uterine contractility. *Croatian Medical Journal*, 58(2), 96–104. <https://doi.org/10.3325/cmj.2017.58.96>
- Hautakangas, T., Uotila, J., Kontiainen, J., Huhtala, H., & Palomäki, O. (2022). Impact of obesity on uterine contractile activity during labour: A blinded analysis of a randomised controlled trial

- cohort. *BJOG: An International Journal of Obstetrics and Gynaecology*, 129(10), 1790–1797. <https://doi.org/10.1111/1471-0528.17128>
- Hilliard, A. M., Chauhan, S. P., Zhao, Y., & Rankins, N. C. (2012). Effect of obesity on length of labor in nulliparous women. *American Journal of Perinatology*, 29(2), 127–132. <https://doi.org/10.1055/s-0031-1295653>
- Hjertberg, L., Uustal, E., Pihl, S., & Blomberg, M. (2018). Maternal body mass index and anovaginal distance in active phase of term labor. *BioMed Research International*, 2018, Article ID 1532949. <https://doi.org/10.1155/2018/1532949>
- Hung, T. H., & Hsieh, T. T. ang. (2016). Pre gestational body mass index, gestational weight gain, and risks for adverse pregnancy outcomes among Taiwanese women: A retrospective cohort study. *Taiwanese Journal of Obstetrics and Gynecology*, 55(4), 575–581. <https://doi.org/10.1016/j.tjog.2016.06.016>
- Indonesia Ministry of Health. (2020). *Integrated Antenatal Care Guidelines Third Edition* (Third). Jakarta: Directorate General of Public Health.
- Indonesia Ministry of Health. (2021a). *Indonesian Health Profile in 2020* (B. Hardhana, F. Sibuea, & W. Widiyanti, Eds.). Jakarta: Kemenkes RI.
- Indonesia Ministry of Health. (2021b). Let's decrease MMR and IMR, Ministry of Health Sharpened Health Transformation System. <https://www.kemkes.go.id/article/view/21122400006/turunkan-aki-akb-kemenkes-pertajam-transformasi-sistem-kesehatan.html>
- Indonesia Ministry of Health. (2023). *Maternal and Child Health Handbook*. Jakarta.
- Irianto, D. P. (2017). *Complete nutrition guide for families and athlete* (Revisi; Yeksha, Ed.). Yogyakarta: Andi Publisher.
- Kim, T., Burn, S. C., Bangdiwala, A., Pace, S., & Rauk, P. (2017). Neonatal morbidity and maternal complication rates in women with a delivery body mass index of 60 or higher. *Obstetrics and Gynecology*, 130(5), 988–993. <https://doi.org/10.1097/AOG.0000000000002316>
- Maqfiro, S., & Abd Mutalib, R. H. (2022). Characteristics of Woman and Weight Gain During Pregnancy with Post Partum Hemorrhage at Tidore Islands Hospital. *International Journal of Health Medicine and Current Research-Ijhmcr*, 7(2), 2221–2230. <https://doi.org/10.22301/IJHMCR.2221-2230.2140>
- Mother & Child Installation. (2022, August 3). Obesity in pregnancy. *Kemkes Direktorat Jendral Pelayanan Kesehatan*. https://yankes.kemkes.go.id/view_artikel/909/obesitas-pada-kehamilan#:~:text=Obesity in pregnancy is very, preeclampsia %2C diabetes%2C and miscarriage.
- Muir, R., Khan, R., Shmygol, A., Quenby, S., & Elmes, M. (2023). The impact of maternal obesity on in vivo uterine contractile activity during parturition in the rat. *Physiological Reports*, 11(5), 1–10. <https://doi.org/10.14814/phy2.15610>
- Norman, S. M., Tuuli, M. G., Odibo, A. O., Caughey, A. B., Roehl, K. A., & Cahill, A. G. (2012). The effects of obesity on the first stage of labor. *Obstetrics and Gynecology*, 120(1), 130–135. <https://doi.org/10.1097/AOG.0b013e318259589c>
- Nyfløt, L. T., Stray-Pedersen, B., Forsén, L., & Vangen, S. (2017). Duration of labor and the risk of severe postpartum hemorrhage: A case-control study. *PLoS ONE*, 12(4), 1–10. <https://doi.org/10.1371/journal.pone.0175306>
- Østborg, T. B., Sande, R. K., Kessler, J., Tappert, C., von Brandis, P., & Eggebø, T. M. (2022). Put your weight behind it—Effect of body mass index on the active second stage of labour: A retrospective cohort study. *BJOG: An International Journal of Obstetrics and Gynaecology*, 129(13), 2166–2174. <https://doi.org/10.1111/1471-0528.17186>
- Polónia Valente, R., Santos, P., Ferraz, T., Montenegro, N., & Rodrigues, T. (2020). Effect of obesity on labor duration among nulliparous women with epidural analgesia. *Journal of Maternal-Fetal and Neonatal Medicine*, 33(13), 2195–2201. <https://doi.org/10.1080/14767058.2018.1543655>

- Salman, M. M., Mokhtar, R., Ghanem, K., Nabil, A., Wasef, F., Mahmoud, M., & El, A. (2022). Effect of body (BMI) on mode of delivery and maternal and neonatal complications in nulliparous women. *Ginekologia I Poloznictwo*, 3(64), 1–7. <https://www.ginekologiaipoloznictwo.com/articles/effect-of-body-mass-index-bmi-on-mode-of-delivery-and-maternal-and-neonatal-complications-in-nulliparous-women.pdf>
- Samy, M., Sanad, Z., Emara, M., & Mohamed Abdou, S. (2015). Effect of obesity on the length of the first and second stages of labor. *Menoufia Medical Journal*, 28(4), 858. <https://doi.org/10.4103/1110-2098.173604>
- Shenouda, C., Wijesooriya, A., Toufeili, A., Miller, M. R., Penava, D., & de Vrijer, B. (2020). Labour Progression in Obese Women: Are Women With Increased Body Mass Index Having Unnecessary Cesarean Sections? *Journal of Obstetrics and Gynaecology Canada*, 42(3), 293–300. <https://doi.org/10.1016/j.jogc.2019.04.014>
- Swier, M. M. (2021). Clinical Assessment of Labor Progress. In E. Chandrachan (Ed.), *The Continuous Textbook of Women's Medicine Series – Obstetrics Module* (Vol. 11). London: Global Women's Medicine. <https://doi.org/10.3843/GLOWM.413923>
- Tsai, Y. L., Chen, L. C., Seow, K. M., & Chong, K. M. (2015). The recommendations of the American Institute of Medicine (IOM) for normal and underweight women to reduce the risk of low birth weight. *Taiwanese Journal of Obstetrics and Gynecology*, 54(1), 1–7. <https://doi.org/10.1016/j.tjog.2014.11.007>
- Wendremaire, M., Mourtialon, P., Goirand, F., Lirussi, F., Barrichon, M., Hadi, T., ... Bardou, M. (2013). Effects of leptin on lipopolysaccharide-induced remodeling in an in vitro model of human myometrial inflammation. *Biology of Reproduction*, 88(2), 1–10. <https://doi.org/10.1095/biolreprod.112.104844>
- Wigianita, M. R., Umijati, S., & Trijanto, B. (2020). The relationship between maternal weight gain during pregnancy and newborn weight. *Darussalam Nutrition Journal*, 4(2), 57. <https://doi.org/10.21111/dnj.v4i2.3944>
- Wray, S., & Arrowsmith, S. (2021). Uterine Excitability and Ion Channels and Their Changes with Gestation and Hormonal Environment. *Annual Review of Physiology*, 83, 331–357. <https://doi.org/10.1146/annurev-physiol-032420-035509>
- Zelig, C. M., Nichols, S. F., Dolinsky, B. M., Hecht, M. W., & Napolitano, P. G. (2013). Interaction between maternal obesity and bishop score in predicting successful induction of labor in term, nulliparous patients. *American Journal of Perinatology*, 30(1), 75–80. <https://doi.org/10.1055/s-0032-1322510>