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Production of breast milk in pregnant women with and without Gestational Diabetes Mellitus

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Abstract
Gestational diabetes mellitus (GDM) is a health disorder associated with an increased risk of type 2 diabetes mellitus in both mother and baby. Breastfeeding is one way for mothers to reduce this risk. This study aims to determine breast milk production in GDM and non-GDM pregnant women. The research design was a prospective cohort and involved 12 pregnant women. The inclusion criteria were GDM and non-GDM pregnant women aged 28-31 weeks and willing to be respondents. The Jakarta Regional Hospital research used questionnaire instruments and breast milk production observation sheets. Chi-square statistical test analysis. The research results showed a significant relationship between the status of GDM and non-GDM pregnant women and breast milk production (P value 0.05). The maximum breast milk production of GDM pregnant women is less than non-GDM, with maximum breast milk production of 0.3cc and 0.5cc. GDM pregnant women produce lower breast milk production than non-GDM pregnant women. Breast milk production in pregnant women with GDM is slower than in pregnant women without GDM. This can be seen from the research results, which show that 58.3% of non-GDM pregnant women have expressed breast milk (on average starting at 17 weeks of gestation). Of pregnant women with GDM, only 8.3% have ever expressed breast milk (starting from the 31st week). Education on breastfeeding during pregnancy and maternal nutrition is necessary to increase maternal self-efficacy. Researchers hope to observe long-term breastfeeding expenditure from pregnancy to six months or even two years.

Keywords: gestational diabetes mellitus; GDM; pregnant women; breast milk production

1. Introduction

Gestational Diabetes Mellitus, abbreviated GDM, is one of the medical complications that often occur during pregnancy (Choudhury & Devi Rajeswari, 2021). The global GDM incidence rate ranges from 10.3% - 14% (Moody et a., 2020; Wang et al.,2022). The prevalence of GDM is highest in the Middle East and several North African countries (27,6%), followed by Southeast Asia (20.8%) (Wang et al.,2022). How about Indonesia? Studies on the prevalence of GDM show that Indonesia has relatively few or very few cases. The study using Sullivan and Mahan's criteria found that the prevalence of GDM in Indonesia ranged from 1.9 – 3.6% (Purnamasari et al.,2013).

Some studies show the presence of various complications of GDM during pregnancy and childbirth, such as an increased risk of section Caesarea (Boriboonhirunsarn & Waiyanikorn, 2016; Muche et al., 2020; Yue et al., 2022), macrosomia (Capobianco et al.,2020; Kumari et al., 2018; Yue et al.,2022), preterm labor (Greco et al., 2023; Ye et al., 2022), pregnancy-induced hypertension (Muche et al., 2020), postpartum hemorrhage (Kumari et al., 2018; Muche et al., 2020). In the long term, GDM can increase the risk of type 2 diabetes mellitus (DM type 2) (Eades et al., 2015; Noctor & Dunne, 2015), metabolic syndrome (Catov et al., 2020; Cho et al.,2016) and cardiovascular diseases (Kramer et al., 2019; S.M. Lee et al., 2022). The risk of developing type 2 DM in women with a history of GDM increases 8-10 times compared to non-GDM (Z.Li et al., 2020; Song et al., 2018; Vounzoulaki et al., 2020). The cumulative risk of developing type 2 DM at ten years postpartum ranges from 20% to 6 % (ACOG, 2018); Saucedo et al.,2020; Spaight et al., 2016). In addition, the offspring of women with

GDM have a greater risk of obesity, cardiovascular disease (CVD), type 2 diabetes (T2DM), and GDM in the future (Franzago et al.,2019; Mantzorou et al., 2023; Slupecka-Ziemilska et al., 2020). This will form a terrible vicious cycle of diabetes between generations and certainly cause a burden on health financing.

Breastfeeding plays an important role in decreasing the long-term impact of GDM. Some research results show that breastfeeding is an effective way to reduce the risk of T2DM, obesity, and metabolic diseases in mothers with GDM and their children (Jirakittidul et al., 2019; Muche et al., 2020; Qian et al., 2022). The longer the breastfeeding duration, the more the risk of T2DM decreases. Even this risk reduction reached 25% - 47% (Gunderson et al., 2018). However, the results of previous studies found the fact that compared to non-GDM women, women with GDM had lower intensity and duration of breastfeeding (Bærug et al., 2018; Chamberlain et al., 2017; Haile et al., 2016; Nguyen et al., 2019). Women with GDM will end breastfeeding earlier than those with non-GDM (Bærug et al., 2018). The rate of exclusive breastfeeding for mothers with GDM is relatively low, ranging from 28.8%-33.95% (Jirakittidul et al., 2019; Qian et al., 2023). According to (Doughty & Taylor, 2021), biological barriers in the form of cesarean delivery and late lactogenesis II, are the causes of lack breastfeeding duration in mothers with GDM.

Research on GDM in Indonesia, especially on the breast milk of GDM mothers, is rarely conducted. The studies on breast milk in GDM are carried out after childbirth. Lactogenesis is a process of milk formation that begins and occurs in early pregnancy. Lactogenesis I occurs at the age of 16 weeks of pregnancy when colostrum begins to be produced by lactocyte cells under neuroendocrine control (Supinganto et al., 2021). Research on breast milk production in pregnant women with GDM and non-GDM needs to be carried out. This is important to anticipate anything that is not expected of mothers with GDM after childbirth. In this way, they can breastfeed their babies properly in sufficient breastfeeding. This study aims to determine how breast milk production in GDM and non-GDM pregnant women.

2. Research Method

This research is an analytical study with a prospective cohort approach. The comparative research design is non-experimental. This research was conducted at the Jakarta Regional General Hospital in March 2023. The population of this study was pregnant women with GDM and non-GDM at Regional General Hospital, Jakarta. The calculation of the sample formula is a hypothesis test of the difference between two proportions. The samples were obtained from 12 GDM pregnant women and 12 non-GDM pregnant women. The inclusion criteria are pregnant women with GDM and non-GDM pregnant women with a gestational age of 28 – 31 weeks.

Breast milk production becomes the dependent variable, and GDM and non-GDM pregnant women become independent variables. The instruments used in this research are questionnaires containing demographic data and observation sheets containing data such as time and amount of breast milk production. Before collecting data, the researcher explained the research, its procedure, and others related to the research to the respondents. The respondent then signed the informed consent sheet.

Breast milk in this study was obtained by manual squeezing. In this process, respondent used their hands to stimulate the mammary glands and directed the milk flow into a small container (mini cryotube). Milk produced by pregnant women with GDM and non-GDM was then measured in volume using an insulin syringe. Data analysis used a chi-square statistical test. This research has undergone an ethical test at Tanjung Karang Health Polytechnic with ethics number 223/KEPK-TJK/III/2023.

3. Results and Discussion

3.1.Results

This research involved 24 respondents. They are GDM pregnant women and non-GDM pregnant women, with the average age and gestational ages not much different. The average age of the respondents in this research is approximately 30 years, with a gestational age of 30 weeks, as shown in Table 1.

Table 1. Characteristics of respondents (n = 24)

No	Variable	N	Mean	Median	SD	Min	Max
1.	Age						
	• GDM	• 12	29.92	29.00	3.39	24	35
	• Non-GDM	• 12	30.25	31.50	6.29	22	42
2.	Gestational age						
	• GDM	12	29.92	30.00	1.24	28	31
	• Non-GDM	12	30.33	30.50	0.88	28	31
3	Parity						
	• GDM	12	0.92	1.00	0.90	0	2
	• Non-GDM	12	1.08	0.50	1.31	0	4

Source: (Data Primer, 2023)

Table 2. The relationship of breast milk production to GDM status

		Breast Milk Production				
Status of GDM	N	Yes	%	No	%	P value
Undiagnosed GDM	12	7	58.3	5	41.7	0.027
Diagnosed GDM	12	1	8.3	11	91.7	
Total	24	8	33.3	16	66.7	

Source: (Data Primer, 2023)

Based on Table 2, it was found that of all respondents in the research, only 33.3% of them had expressed their milk. Non-GDM pregnant women who have breastfed amounted to seven respondents, or 58.3%, while in the group of pregnant women with GDM, one respondent, or 8.3%, had expressed breast milk. The results of the data analysis showed a significant relationship between the status of GDM and non-GDM pregnant women with breast milk production (p-value < 0.05).

Table 3. The First Time Breast Milk Comes Out and the Total Milk Production of GDM and Non-GDM Pregnant Women

Variable	Mean	Median	SD	Min	Max	N
GDM						
• Breast Milk Production (week)	2,58	0	8,94	0	31	1
• Breast Milk Production (cc)	0	0	0	0,0	0,3	1
Non-GDM						
• Breast Milk Production (week)	17	24	15	0	34	7
• Breast Milk Production (cc)	0,19	0,16	0,19	0,0	0,5	7

Source: (Data Primer, 2023)

Generally, non-GDM pregnant women said that breast milk came out for the first time at 17 weeks gestation, while pregnant women with GDM at 31 weeks gestation. The maximum amount of breast milk production in pregnant women with GDM and non-GDM is 0.3cc and 0,5cc, respectively. Data related to the time of first release of breast milk and the amount of milk production of GDM and non-GDM pregnant women are easily seen in Table 3.

3.2.Discussion

GDM and non-GDM pregnant women involved in this study were, on average, approximately 30 years old. Some research results expose that the risk of GDM increases with age (Leng et al., 2015; G. Li et al., 2020; Y. Li et al., 2020). Leng et al. (2015) found that the age of ≥30 increased the risk of GDM by 2.3 times. This is due to reduced insulin sensitivity and pancreatic β cell function in elderly women, which increase the risk of abnormal glucose and lipid metabolism during pregnancy (Juan & Yang, 2020).

The study found a significant relationship between GDM status in pregnant women and breast milk production (p-value <0,05). Maximum milk production in pregnant women with GDM is less than non-GDM. The maximum amount of breast milk production in pregnant women with GDM is 0.3cc, while non-GDM is 0.5cc. It is also found that pregnant women with GDM have slower milk expenditure than non-GDM pregnant women. It is evidenced in this study that 58,3% of non-GDM pregnant women have expressed breast milk (on average starting at 17 weeks gestation), and 8.3% of GDM pregnant women have breastfed (starting at 31 weeks of age). Normal breast development during pregnancy affects milk production. According to Pillay & Davis (2022), at 16 weeks gestation, breast milk begins to be excreted even in small amounts. Lactation begins with conception and pregnancy, which induces changes in the mammary glands, such as ductal proliferation and aveolar development. The first phase of lactation is referred to as secretory differentiation. During this phase, the breast develops the capacity to synthesize dairy products characterized by lactocyte maturation. This phase requires progesterone, prolactin, and placental lactogen. The second phase is called secretory activation, triggered by the birth of the placenta and beginning about the first 60 hours after birth (range 24-72 hours). This phase is characterized by abundant milk discharge, and colostrum is available to babies during the first 60 hours (Pham et al., 2020).

Most studies show that insulin metabolism is responsible for breast secretion and is important in the mammary glands' transition from proliferation to differentiation. Regulation of genes associated with the proliferation of mammary epithelial cells (MEC) is enhanced by insulin, and conversely, the regulation of genes associated with MEC differentiation is enhanced by insulin (Suwaydi et al., 2022; Watt et al., 2021). In diabetic patients, low insulin sensitivity is associated with secretion differentiation, leading to delayed secretion activation and decreased milk production. The risk of decreased milk supply in women with GDM increases up to 2.6 times compared to those with normal blood sugar (Nommsen-Rivers, 2016).

In addition to hormonal regulation, several factors affect milk production, including nutrition, infant attachment, breast care, frequency of breastfeeding, husband and family support, and psychological condition of the mother (Golan & Assaraf, 2020; Widiarta & Megaputri, 2022). The results of the systematic review and meta-analysis show that women with GDM are at risk for maternal psychological distress, such as anxiety, stress, and depression during pregnancy and postpartum (Azami et al., 2019; K. W. Lee et al., 2020; Wilson et al., 2020). Compared to non-GDM women, during pregnancy and postpartum, women with GDM have a 2-4 times higher risk of developing depression (Delanerolle et al., 2021).

Maternal psychological pressure and GDM are two interconnected sides. The hypothalamus-pituitary and chronic adrenals are hyperactive due to psychological distress (anxiety and depression),

which causes insulin resistance and cortisol production to increase (Robinson et al., 2018). This leads to an increased risk of GDM in the mother. On the other hand, the risk of maternal psychological distress during pregnancy and postpartum increases due to the diagnosis of GDM (Azami et al., 2019). Nagel et al. (2022) state that psychological pressure on mothers inhibits the production and secretion of breast milk through 3 potential mechanisms, including psychological pressure decreases insulin sensitivity and secretion causes dysregulation of the HPA axis and causes disturbances in the anterior pituitary in oxytocin release. Studies have shown that the duration of breastfeeding in GDM mothers is shorter than in non-GDM mothers (Melov et al., 2022; Nguyen et al., 2019). The decrease in milk production is the cause of shorter breastfeeding duration in GDM mothers (Pang et al., 2021).

Breastfeeding can reduce the risk of T2DM, obesity, and metabolic diseases in mothers with GDM and their children (Jirakittidul et al., 2019; Much et al., 2014; Qian et al., 2022). According to Tendoménech et al. (2020), the long-term benefits of breast milk consumption in children with maternal GDM are a reduced risk of type 1 diabetes and inflammatory bowel disease and overweight in adulthood. Bjerregaard et al. (2019) found that breastfeeding for>4 months reduced the risk of T2DM by 51%. Considering how great the benefits of breastfeeding are for mothers with GDM and their children, some efforts are needed to increase the self-efficacy, intensity, and duration of breastfeeding in GDM mothers. Efforts that can be made include providing education about breastfeeding and its benefits, increasing social support for mothers, minimizing barriers to breastfeeding initiation, increasing hospitalization, and education about breast care.

Breast care during pregnancy has a positive and important relationship with milk production (Nur et al., 2021). It can improve blood circulation, prevent milk duct clogging, and help produce healthy breast milk. In addition, maintaining breast hygiene, flexing, and keeping the nipples can make it easier for babies to breastfeed and prevent inflammation (Nur et al., 2021). Research by Avellar et al. (2022) clearly shows the differences in milk production in mothers with GDM and normal pregnant women in the form of changes in immune characteristics observed in the blood of GDM pregnant women that affect breast milk composition. Breast milk colostrum of GDM mothers indicated a decrease in antibody levels and a reduced phagocytic capacity of monocytes.

It must be admitted that this research faced various limitations. One of them is the number of respondents. The research needed 16 non-GDM pregnant women and 16 samples of pregnant women with GDM. The fact there were only 12 non-GDM pregnant and 12 pregnant women in GDM.

4. Conclusion

The result of this research showed a significant relationship between the status of GDM and non-GDM pregnant women on breast milk production (P value < 0.05). Pregnant women with GDM have less milk production compared to non-GDM pregnant women. Giving education about breastfeeding and its benefits and breast care, besides increasing social support for mothers, can minimize the obstacles or problems of breastfeeding initiation and increase hospitalization. It can also be an effort to increase self-efficacy, intensity, and duration of breastfeeding in mothers with GDM. Observation of breast milk expenditure in pregnant women with and without GDM in this study was carried out within one month. It is admitted that the length of research is still lacking. It is reasonable that further researchers can observe long-term breast milk expenditure in pregnancy from six months to two years with more samples.

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