DOI: https://doi.org/10.53350/pjmhs221651347

ORIGINAL ARTICLE

Relationship Between Genistein Intake and Body Mass Index (BMI) with Serum Prolactin Levels in Breastfeeding Women in the Area of Benowo and Kenjeran Public Health Centers

BAMBANG RAHARDJO[1], WIDYA KUSUMA WARDANI[2], NI PUTU YUNITA SRI LESTARI[2], TATIT NURSETA[3], LINDARATNAWATI[4]
[1]Fetomaternal Division, Department of Obstetrics and Gynecology, Faculty of Medicine, Brawijaya University,Malang, East Java, Indonesia
[2]Departement of Midwifery, Master Program of Midwifery, Faculty of Medicine, Brawijaya University, Malang,East Java, Indonesia
[3]Oncology Division, Department of Obstetrics and Gynecology, Faculty of Medicine, Brawijaya University,Malang, East Java, Indonesia
[4]Bachelor of Midwifery Division, Faculty of Medicine, Brawijaya University, Malang, East Java, Indonesia
Corresponding author: Bambang Rahardjo, Email: bar_obg.fk@ub.ac.id

ABSTRACT
Mother's milk is considered the optimal substance for newborns because it provides complete nutrition, improves infant health, and increases immunity and low incidence of gastrointestinal disease. The development of the alveolar-lobular glands in the breast for the initiation of breastfeeding is the role of the prolactin hormone. Genistein is a type of isoflavonoid whose content is abundant in soybeans, and their processed products (tempeh and tofu) play a role in the synthesis of serum prolactin. Body Mass Index (BMI) indicates maternal nutritional status, which can also affect serum prolactin. This study will discuss the relationship between genistein intake and BMI on serum prolactin levels of nursing mothers. This research uses analytical observational research on 110 breastfeeding mothers in the Benowo and Kenjeran Health Center Work Areas, Surabaya. The results of Spearman's correlation test showed that there was a significant relationship between genistein intake on maternal serum prolactin levels (p=0.001) and BMI on maternal serum prolactin levels (p=0.036) (Pearson's test). The estrogenic properties of genistein are very similar to endogenous estrogens, which are thought to increase the formation of maternal serum prolactin levels and its activity which stimulated ductal elongation in mammary gland development. The increase in BMI levels in the body is go with an increase in serum prolactin levels due to the lack of availability of dopamine two receptor (D2R) sites in the body of nursing mothers.
Keywords: Genistein intake Body Mass Index, Serum Prolactin Levels Exclusive breastfeeding Nutrition of breastfeeding mothers

INTRODUCTION
Infant health and immune development related to breastfeeding can reduce the incidence of gastrointestinal disease and mortality compared to formula feeding. Breast milk is assessed as the maximum substance for newborns because it provides complete nutrition for infants [1]. Based on data from exclusive breastfeeding coverage in Indonesia in 2020, infants aged less than six months who received exclusive breastfeeding were around 67.74%, and where the achievement of this percentage indicator had met the 2020 target of 40% [2]. The high coverage of breastfeeding proves that more and more people are aware of the benefitsfor both mother and baby. Breast milk, the only source of the best food for newborns, is proven to contain appropriate nutrients and nutrients to support infant growth and development [3].

Based on data from the East Java Provincial Health Office, it is known that the count of infants receiving exclusive breastfeeding in East Java in 2020 is 61.0%. Surabaya, which has become one of the second most prominent cities in East Java, has an exclusive breastfeeding rate of 74.5% [4]. Although this rate is relatively high, data show there are still cases of stunting of 7040 children under five [5]. The facts show that as many as 20.58% of infants in the Benowo Public Health Center area and 21.77% of the infants in the Kenjeran Public Health Center area were stunted due to the failure of exclusive breastfeeding. This figure is relatively high compared to the average stunting baby in the city of Surabaya, which is only 8.54% [6]. The relationship between stunting and breastfeeding is explained in a study in Mexico that states exclusive breastfeeding is a protective factor in the occurrence of stunting in children aged <5 years [7]. Breastfeeding can protect infants with gastrointestinal diseases that can allow stunting to occur, so it is hoped that mothers can breastfeed their babies for at least six months (exclusively) [8]. This statement is relevant to other research, which also states that formula-fed babies can be 2.4 times more likely to be stunted than babies who are exclusively breastfed [9].

Research in Guatemala by Frojo et al. in 2014 showed that the poor nutritional status of breastfeeding mothers contributed to stunting in infants. The high stunting rate is also caused by poor maternal BMI nutritional factors in meeting breastfeeding needs. Body Mass Index (BMI) indicates the nutritional status of breastfeeding mothers [10]. The mother's less milk production generally influences as much as 32% of exclusive breastfeeding failures. The condition is caused by an imbalance of hormonal and psychological factors in the mother. Lack of the hormone prolactin is one of the causes of lack of milk production [11]. The process of releasing breast milk by prolactin hormone. The anterior pituitary gland on lactotroph cells will produce this hormone [12]. Alveolar-lobular glands of the breast are affected by prolactin in the initiation of milk secretion, which is located on the cell surface of the breast alveoli. The PRL gene encodes prolactin on human chromosome 6 [13]. Plasma prolactin levels are significant for the process of lactogenesis in humans. In the breast gland, lipoprotein lipase activity is increased by prolactin, which functions in expanding breast milk [14].

Prolactin release is inhibited by Prolactin Inhibiting Factor (PIF) and stimulated by Prolactin Releasing Factor (PRF). PIF is closely related to dopamine. prolactin release controls the release of serotonin or catecholamines-serotonin. Thyrotropin-releasing hormone (TRH) has been shown to stimulate prolactin release. Nipple stimulation during the first four days will be proportional to the amount of prolactin produced. Milk synthesis occurs in the first four days under stimulated conditions or not. At this time, prolactin levels were the same for breastfeeding mothers or not [14]. The pathway in controlling inhibition of prolactin secretion is through endocrine neurons that produce prolactin-inhibiting factors such as somatostatin and dopamine, aminobutyric acid (GABA), or prolactin-secreting factors such as TRH, oxytocin, and neurotensin [14]. Lactotroph glands are affected by PIF and PRF released from paracrine or autocrine regulation (lactotroph cells themselves) [14] PRL secretion is maintained at a basal level as a result of dopamine (DA) inhibitory activity. Various physiological stimuli, including stress, trigger the temporary release of this input inhibition. This condition shows that stress can affect milk production [15]. Other factors that can affect serum prolactin are physiological stimulation of the breast, sleep, stress, sexual intercourse, use of drugs (domperidone and metoclopramide), estrogen, and hypoglycemia [14].

Genistein is a type of phytoestrogen whose content is found in soybeans and their derivatives, including soy products, edamame, and tempeh [16]. Genistein has a potential phytoestrogenic effect similar to endogenous estrogen [17].

According to this mechanism, genistein can influence the release of prolactin with a concomitant effect on the expression of the prolactin gene in the pituitary gland through its estrogenic mechanism. Research by Gorksi et al. stated that the serum prolactin mRNA content in genistein-infused ewes increased significantly (p<0.05) [18]. Prolactin secretion is also influenced by body mass index (BMI) [19]. Body Mass Index (BMI) is one indicator of achieving a balance of nutrients in the body. This condition illustrates that body weight is appropriate for height. Nutritional status can be assessed from anthropometric measurements (weight and height). this can be measured using the body mass index (BMI) method. Body mass index is the standard weight ratio toheight and is often used as an indicator of general health [20]. The method of measuring BMI is dividing body weight (in kg) by height squared (in meters). WHO criteria (2022) for nutritional status were divided into Underweight with BMI under 18.5 kg/m2, normal with BMI 18.5-24.9 kg/m2, pre-obese with BMI 25.0-29.9 kg/m2, and Obesity with BMI above 30 kg/m2 (WHO, 2022). The nutritional status of breastfeeding mothers can be represented through BMI. BMI is one factor that plays a role in prolactin synthesis [19]. Another study showed that obesity might be associated with high serum prolactin levels in the body [19].

Based on the description above, it can be concluded that genistein intake and Body Mass Index (BMI) contribute to increasing serum prolactin levels of nursing mothers [21][10]. A previous study provides information that the increase in BMI is in line with the increase in serum prolactin levels, but in this study, there were no respondents with obese BMI rates [22], so researchers were interested in conducting further research. Inline with that, research related to the relationship of genistein with serum prolactin shows that giving cerebrospinal infusion of genistein in experimental animals (sheep) [21]. However, there are no specific studies that mention the effect of oral intake of genistein in humans. Therefore, researchers are interested in researching the relationship between maternal nutritional status (BMI) and genistein intake in nursing mothers to serum prolactin levels of breastfeeding mothers in the areas of Benowo and Kenjeran health centers.

RESEARCH METHOD

This research is quantitative research with an analytical observational research design. This research wascarried out from December 2021 to February 2022 in the city of Surabaya, namely in the Benowo Health Centerand Kenjeran District working area.

The research method used purposive sampling in accord with the inclusion and exclusion criteria. Inclusion criteria: Infants breastfeed exclusively and do not suffer from certain diseases that can interfere with suction power (tongue-tie and cleft lip), healthy mothers: no mastitis, breast abscess and are willing to participatein all interventions carried out. Exclusion criteria: Mother taking drugs that can affect breast milk production (metoclopramide and domperidone), and the mother is not in place/loss to follow-up. The sample size calculationin the study was based on the population of mothers who were exclusively breastfeeding in 2 sub-districts of Surabaya, namely Benowo and Kenjeran sub-districts. Calculating the sample using the Slovin formula found theresults of a sample of 100 people with an additional 10% dropout calculation so that the total sample needed was 110 people. The instrument used to measure genistein intake is a questionnaire of Semi-Quantitative Food Frequency (SQFFQ) for three days in 24 hours and divided by the average intake in 3 days, after which genistein intake was converted using the USDA Database for the Isoflavone Content of Selected Foods. Measurement of BMI uses a weight scale (in kilograms) and a height ruler (in meters). Meanwhile, the measurement of serum prolactin levels was carried out by taking 5 ml of maternal blood samples from the cubital vein placed in a bloodtube and analyzed using the Ellectrochemiluminescent Assay (ECLIA) test type Cobas E 411. The measurement of serum prolactin levels was carried out in collaboration with the Prodia Surabaya Clinic laboratory.

Data collection is done by direct interviews with respondents who collected data to measure maternal BMI, followed by interviews with genistein intake for three consecutive days. On the fourth day, the researcher took a blood sample from the respondent and then submitted it to the Prodia Surabaya clinical laboratory to measure serum prolactin levels. All data is recorded according to the required instrument. All procedures have received ethical approval from the Faculty of Medicine, Brawijaya University, and direct permission from the Surabaya City Health Office

The analysis data was executed using Spearman's Rho correlation to dictate whether genistein intake affected serum prolactin levels of nursing mothers and Pearson's test to determine whether genistein intake affected serum prolactin levels. The test was carried out using SPSS for windows version 21 software

RESULTS

According to the inclusion and exclusion criteria, the study results stated that there were 110 breastfeeding mothers in the public health center Benowo and Kenjeran areas. Result data is presented with respondent characteristics and correlation test on genistein intake and BMI and its relationship to serum prolactin levels.

Characteristics of Respondents: Characteristics of Respondents are illustrated in the table below:

Table 1:

Characteristics ofSample	Amount (people)	Percentage (%)
Age		
<15th	1	9,0%
15-49th	99	99,1%
>50th	None	-
Educational level		
Elementary School	21	19,1%
Middle School	18	16,4%
High School	47	42,7%
Diploma	6	5,5%
Bachelor	18	16,4%
Parity		

Table 2:

PrimiparousMultiparous	36 74	32,7% 67,3%
Profession Housewife Working Mom	79 31	71,8% 28,2%
Total	110	100%

The results found that the age of respondents in the range of 15-49 years was 99 people (99%), and only one (9%) mother was 15 years old. The average age of the respondents was at 28.78 years. The educationalstatus of the respondents was dominated by high school graduates where as many as 47 mothers (42.7%) of the total 110 respondents, the remaining 21 people (19.1%) had elementary school education, 18 people (16.4%) had junior high school education, six people (5,5%) have Diploma education and 18 people (16.4%) have S1 education. Parity data showed that as many as 74 mothers (67.3%) were multiparous, and 36 (32.7%) were primiparous. Employment data shows that as many as 79 people (71.8%) are housewives and the remaining 31(28.2%) are working mothers.

The following is data from the respondent's Body Mass Index (BMI) and its relationship with serum prolactin levels of nursing mothers :

Table 2 Percentage of body mass index of respondents who are breastfeeding mothers in the health centers of Benowo and Kenjeran. (Note:**. The correlation is significant at the 0.005 level (2-tailed)).

The study results in Table 3 show that most respondents have a body mass index in the normal category. As many as 59 people (53.6%) and 34 people (30.9%) in the pre-obesity category, and 13 people (11.8%) in the obesity category. Furthermore, respondents who have a body mass index category underweight amounted to 4 people (3.6%). Meanwhile, the following are the results of genistein intake and serum prolactin levels in respondents showed that respondents with underweight nutritional BMI had an average serum prolactin level of

Table 3: Description of Characteristic respondents in the research

Categories	BMI level (Kg/m^2)	Amount(People)	Percentage(%)	ProlactinSerum Average (ng/mL)	Correlationcoefficient	Value
Underweight	<18,5	4	3,6%	71,30	.202	0,036
Normal	18,5-24,9	59	53,6%	118.11		
Pre-Obese	25,0-29,9	34	30,9%	126,65		
Obese	>30,0	13	11,8%	203,87		
Total		110	100%			

71.36 ng/mL. At the same time, respondents with an average BMI had a mean serum prolactin level of 118.11 ng/mL, then respondents with a BMI with Pre-Obesity status had serum prolactin levels of 126.65 ng/mL. Respondents with obesity nutritional status have a serum prolactin level of 203.87 ng/mL. The results of the correlation analysis test using Spearman on BMI and maternal serum prolactin variables showed a significant correlation coefficient of .202. This positive value indicates a continuous relationship between the two variables,and if there is an increase in BMI, there will be an increased level of prolactin serum in breastfeeding mothers (p = 0.036). Based on these data, it can be concluded that there is an increase in the mean serum prolactin level and BMI levels. The highest intake of genistein levels in the respondents was 324.6 mg, and the lowest was 2.09 mg. The average genistein intake of respondents was 87.78 mg.

The following are the results of the Pearson correlation test to determine the relationship between genistein intake and prolactin levels in nursing mothers:

Table 4:

Variable	Correlation test	Correlationcoefficient	p-value
Genistein Intake	Pearson	.317**	0,001

Table 3. Pearson correlation test results mean intake of genistein and serum prolactin levels. (Note:**. The significant correlation at the 0.01 level (2-tailed)).

The correlation test in table 3 results showed a significant correlation/relationship connecting the intake of genistein and serum prolactin with the level of closeness of the relationship (correlation coefficient), which wasquite significant, namely .317. A positive value indicates a continuous relationship between the two variables, and it is indicated that if there is an increase in genistein intake, there will be an increase in serum prolactin levels so that the first hypothesis is proven, there is a relationship between genistein intake and serum prolactinlevels in nursing mothers (p = 0.001).

DISCUSSION

Genistein intake was measured for three consecutive days using multiple 24-hour recall interviews with therespondents. This method is the primary method that is accurate in describing the intake of nutritional status by considering good reproducibility, easy application, and relatively affordable cost [23]. After that, the data from genistein will be converted using the USDA Database of the Isoflavone Content of Selected Foods for the average genistein intake. This condition is similar to another study that used the USDA Database for the Isoflavone Content of Selected Foods to measure the adequate daily intake of isoflavones in humans [24].

Measurement of the results of genistein intake in respondents showed that the average intake of genistein in nursing mothers was 87.78 mg/day. That condition corresponds with the theory that the safe intake of genistein ranges from <400 mg/Kg orally in rats but the toxicological dose for humans is still not determined clearly [25]. Genistein is one type of isoflavonoid with a higher average content than other types, namely daidzein and glycitein [26]. The representation of genistein intake patterns was also obtained from the average intake of isoflavone. The theory states that the intake of isoflavones in Asian countries is higher than in European countries because, in Asia, there are more soy-based preparations such as tempeh, tofu, soy milk, and other preparations [24]. The results of the measurement of serum prolactin levels were the highest at 315.4 ng/mL andthe lowest at 21.1 ng/mL. The variation in results that experienced significant differences could be influenced by several factors, namely exercise and a high-protein diet between breastfeeding mothers [27][28].

The results of the Pearson correlation test on the intake of genistein and serum prolactin showed a p- value = of 0.001, and there is a significant relationship connecting genistein intake and serum prolactin in breastfeeding mothers (p<0.005). Previous research states that genistein is an isoflavonoid that has phytoesterogenic properties. The estrogen properties present in genistein are very similar to endogenous estrogens, where genistein has a 20x higher affinity for estrogen receptors beta (ER) than alpha receptors (ER- α). Estrogen receptor beta (ER) is the receptor shared by most natural estrogens. The specialty possessed by genistein is related to the increasing number of estrogen receptor beta (ER), the more prolactin formed throughthe mechanism of prolactin formation through classical and non-classical pathways [29].

The mechanism of prolactin formation classically begins with where the lignan of genistein (estrogen) dimerizes and binds to a sequence similar to the estrogen response element in the target gene's promoter. In contrast, the non-classical mechanism is initiated by estradiol forming a dimer with genistein (estrogen) on the membrane, which then enters the signaling pathway causing the release of prolactin in lactotrophs in the membrane [30]. Tsugami et al (2022) stated that genistein induced mammary gland development with increased ductal elongation in low dose consumption (0,5 mg/kg/day) [31].

Previous research stated that cerebrospinal genistein infusion could significantly increase ewes' serumprolactin level [3]. However, unfortunately, there are no more detailed studies that describe the intake of micronutrients (genistein) specifically that can have an impact on increasing serum prolactin levels in humans. More generally, some studies mention phytoestrogen intake in general in its effect on breast milk production of nursing mothers to increased serum prolactin levels. According to another research, prolactin affects increasing the amount of breast milk production [32].

Genistein is the most common type of phytoestrogen found in soybeans and their processed products such as tempeh, tofu, soy milk, and other preparations [24]. USDA states that the genistein content in green beans is 0.08 mg/100 gr, which is greater than the content of daidzein (0.06mg/100gr) and glycitein (0.00mg/100gr) [26]. This research shows that consuming isoflavones containing high levels of genistein (e.g., green beans) can increase milk production. This statement is in line with research by Sufiani and Pramana (2022), which showed that the consumption of mung bean juice as a galactagogue (smooth milk secretion) showed promising results, where there was a diversity in the average mother's milk production before and after being given mung bean juice with an average The average of giving is above 100 grams of green beans (p = 0.000). Giving green bean juice can increase milk production, so its consumption is highly recommended for breastfeeding mothers [33]. Another study by Ritonga et al. also explained the same thing where mothers who consumed mung bean juice would get breast milk more smoothly than those who did not consume mung bean juice (p<0.005) [34].

Measurement of Body Mass Index (BMI) in mothers was carried out to determine the nutritional status of respondents. The data shows that from 110 respondents, the average BMI is 59 people (30.9%), followed by pre-obesity as many as 34 people (30.9%), obesity 13 people (11.8%), and underweight four people (3.6%). A correlation test was performed using Spearman to determine the relationship between BMI and serum prolactin. Spearman correlation test is a non-parametric measurement to assess the relationship between the two variables.

The coefficient of the Spearman test has the symbol r(rho) [35]. The result of the correlation test between bodymass index and serum prolactin of nursing mothers showed a p-value = 0.036, which means that BMI and serum prolactin levels in nursing mothers have a significant relationship (p < 0.005). Data on mean serum prolactin increased with increasing BMI levels in breastfeeding mothers. It is similarly relevant to a previous study managed by Baydili et al. showed that humans who had a body mass index >25 Kg/m2 had higher prolactin levels (p<0.005). These results suggest that the increase in prolactin levels is caused by increased levels of estrogen in the body, which will bind to estradiol and play a role in the formation of serum prolactin levels [36]. Another similar study by Indrayani et al. showed that there were significant differences in serum prolactin levels of breastfeeding mothers connecting mothers with low nutritional status (BMI under 18.5 /m2)and high (BMI above 25 Kg/m2) and the status group. moderate nutrition (BMI above 18.5-24.99 Kg/m2) and high ((BMI above 25 Kg/m2) (p<0.005) [22]. Other mechanisms that may occur in the relationship between BMI The effect on serum prolactin levels is due to the lack of availability of dopamine two receptor (D2R) binding sites in overweight humans. This D2R functions as a tonic inhibitor by dopaminergic input in highintrinsic basal secretory activity so that more prolactin will be produced in the body [37]. A similar study by Rohman et al. explains there is a significant correlation between the BMI of breastfeeding mothers and the correlations with the success of exclusive breastfeeding (p < 0.005). Breastfeeding mothers are encouraged to consume foods that have good nutritional content. With good nutrition, it is hoped that mothers can provide exclusive breastfeeding for six months. Poor nutritional intake or eating patterns during breastfeeding make the mother susceptible to illness, resulting in disruption of the lactation process and the baby not getting proper

nutrition, and a decrease in breast milk production in the mother [38].

CONCLUSION

Genistein intake affects the serum prolactin level of breastfeeding mothers. The higher the genistein intake, the higher the maternal serum prolactin level. BMI rates also affect the serum prolactin level of breastfeeding mothers. The higher BMI, the higher the serum prolactin levels of nursing mothers.

REFERENCES

1. Salminen, S. et al. (2020). Infant Formula Supplemented with Biotics : Current, Nutrients, 12.
2. Ministry of Health of the Republic of Indonesia (2021) 2020 Ministry of Health Performance Report, Ministry of Health of the Republic of Indonesia 2021, pp. 1–224.
3. Grote, V. et al. (2016). Breast milk composition and infant nutrient intakes during the first 12 months oflife., European Journal of Clinical Nutrition, 70(2), pp. 250–256. doi: 10.1038/ejcn.2015.162.
4. East Java Provincial Health Office., (2020). 2019 East Java Provincial Health Profile. Central JavaProvincial Health Office., pp. 1–123. Available at: www.dinkesjatengprov.go.id.
5. Widari, Restu. 2020. For Five Years, the Stunting Rate in Surabaya Continues to decrease (Online). Available at https://jatimnet.com. Accessed April 4, 2022
6. Surabaya City Health Office (2020). Surabaya City Health Profile 2019'.
7. Campos, A. P., Vilar-Compte, M. and Hawkins, S. S. (2021). Association Between Breastfeeding and Child Overweight in Mexico, Food and Nutrition Bulletin, 42(3), pp. 414–426. doi: 10.1177/03795721211014778.
8. Barir, B. (2019). The Associations between Exclusive Breastfeeding, Complementary Feeding, and the Risk of Stunting in Children Under Five Years of Age: A Path Analysis Evidence from Jombang East Java, Journal of Maternal and Child Health, 4(6), pp. 486–498. doi: 10.26911/thejmch.2019.04.06.09.
9. Umiyah, A. and Hamidiyah, A. (2020). Exclusive Breastfeeding With Stunting, STRADA Health Scientific Journal, 9(2), pp. 471–477. doi: 10.30994/sjik.v9i2.454.
10. Frojo, G. A. et al. (2014). Relationship between the nutritional status of breastfeeding Mayan mothers and their infants in Guatemala, Maternal and Child Nutrition, 10(2), pp. 245–252. doi: 10.1111/j.1740-8709.2012.00404.x.
11. Yuliana, W. (2022). The Effect of Marmet Technique as a Form of Mother Empowerment on Breast Milk Production in Post Partum Mothers, Scientific Journal of Midwifery, pp. 14–17.
12. Bernad, V., Young, J., and Binart, N. 2019. Prolactin-a pleiotropic factor in health and disease. Nature Reviews Endocrinology, 15(6), pp.356-365.
13. Mizutani and Takai. 2018. Prolactin. References in Biomedical Sciences: Elsevier
14. Lawrence, A. Ruth; Robert, M. R. (2022) Breastfeeding : A Guide for the Medical profession NinthEdition. ninth. Elsevier.
15. Martinez et al., 2022. A New Experimental Tool Toward Understanding the Regulation of Human Prolactin Secretion and Functions. Journal of Endocrinology. 163 (4).
16. Yu, L. et al. (2021). Genistein : Dual Role in Women ' s Health. Journal of Nutrients: MDPI
17. Wójcik-Gładysz, A. et al. (2005). Effects of intracerebroventricular infusion of genistein on the secretory activity of the GnRH/LH axis in ovariectomized ewes, Animal Reproduction Science, 86(3–4), pp. 221– 235. doi: 10.1016/j.anireprosci.2004.08.004.
18. Misztal, T. et al. (2007). Central estrogen-like effect of genistein on growth hormone secretion in the ewe, Acta Neurobiologiae Experimentalis, 67(4), pp. 411–419.
19. Roelfsema, F. et al. (2012) Prolactin secretion in healthy adults is determined by gender, age, and body mass index, PLoS ONE, 7(2), pp. 1–10. doi: 10.1371/journal.pone.0031305.
20. Słowik, J. et al. (2019).Nutritional Status Assessment in Children and Adolescents with Various Levels of Physical Activity in Aspect of Obesity, Obesity Facts, 12(5), pp. 554–563. doi: 10.1159/000502698.
21. Górski, K. et al. (2007). Genistein-induced pituitary prolactin gene expression and prolactin release in ovariectomized ewes following a series of intracerebroventricular infusions., Reproductive biology, 7(3), pp. 233–246.
22. Indrayani, D., Shahib, N., and Husin, F. (2018) Relationship of Nutritional Status with Serum Prolactin Levels in Breastfeeding Mothers, Journal of Maternal and Child Care, 3(1), pp. 45–50
23. Crispim, S. P., Maria, D. and Marchioni, L. (2022) .Anthropometric and dietary indicators applied in population-based surveys : a systematic review Indicadores antropométricos e dietéticos utilizados em estudos de base populacional : uma revisão Indicadores antropométricos y dietéticos utilizados en estudi, Research Society adn Development, 11, pp. 1–27.
24. Kim, Y. et al. (2022). Usual intake of dietary isoflavone and its major food sources in Koreans: Korea National Health and Nutrition Examination Survey 2016-2018 data, Nutrition Research and Practice, 16(Suppl 1), p. S134. doi: 10.4162/nrp.2022.16.s1.s134.
25. Goh, Y. X. et al. (2022). Genistein: A Review on its Anti-Inflammatory Properties, Frontiers in Pharmacology, 13(January), pp. 1–23. doi: 10.3389/fphar.2022.820969.
26. Bhagwat, S., Haytowitz, D. B. and Holden, J. M. (2011). USDA Database for the Isoflavone Content of Selected Foods', U.S. Department of Agriculture, pp. 1–156.
27. Saleem, M., Martin, H. and Coates, P. (2018). Prolactin biology and laboratory measurement: An update on physiology and current analytical issues, Clinical Biochemist Reviews, 39(1), pp. 3–16.
28. Al-Kuraishy, H. M. et al. (2022) The crucial role of the prolactin-lactogenic hormone in Covid-19, Molecular and Cellular Biochemistry, 477(5), pp. 1381–1392. doi: 10.1007/s11010-022-04381-9.
29. Thangavel, P. et al. (2019). Genistein as a potential therapeutic candidate for menopausal symptoms and other related diseases, Molecules, 24(21), pp. 1–17. doi: 10.3390/molecules24213892.
30. Zárate, S. and Seilicovich, A. (2010). Estrogen receptors and

signaling pathways in lactotropes and somatotropes, Neuroendocrinology, 92(4), pp. 215–223. doi: 10.1159/000321683.
31. Tsugami et al. (2020). Adverse Effects of Coumestrol and Genistein on mammary Morphogenesis and Future Milk Production Ability of Mammary Epithelial Cells. Journal of advanced Biosystem Hokkaido University, 4(4).
32. Hendriyani, F., Suryaningsih and Suharto, A. (2019). Effectiveness of oxytocin massage and breast care treatment on breast milk production, Indian Journal of Forensic Medicine and Toxicology, 13(4), pp. 1687–1691. doi: 10.5958/0973-9130.2019.00550.4.
33. Sufiani, A. and Pramana, C. (2022). Differences in Breast Milk Production by Giving Green Bean and Soybean Extracts at Lumpue Health Center, Pare-Pare City, Sebatik Journal Vol. 26 No. 1, 26(1), pp. 306–311. DOI: 10.46984/sebatik.v26i1.1520.
34. Ritonga, N. J. et al. (2019). Mung Bean Extract as an Alternative to Increase Breast Milk Production in Breastfeeding Mothers, Journal of Nursing and Physiotherapy (Jkf), 2(1), pp. 89–94. doi:10.35451/jkf.v2i1.272.
35. Yanti, C. A. and Akhri, I. J. (2021). Differences in the Pearson, Spearman and Kendall Tau Correlation Test in Analyzing the Incidence of Diarrhea, Journal of Endurance: Scientific Studies of Health Problems, 6(1), pp. 51–58. Available at: http://doi.org/10.22216/jen.v6i1.5256.
36. Baydilli, N. et al. (2020). How does body mass index affect semen parameters and reproductive hormones in infertile males?, Turkish Journal of Urology, 46(2), pp. 101–107. doi: 10.5152/tud.2020.19243.
37. Kok, P. et al. (2004). Prolactin release is enhanced in proportion to excess visceral fat in obese women, Journal of Clinical Endocrinology and Metabolism, 89(9), pp. 4445–4449. doi: 10.1210/jc.2003-032184.
38. Rohman, M. A. et al. (2020). Nutrition Status and Maternal Age Affect Exclusive Breastfeeding, pp. 1– 16.