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Relationship Between Body Mass Index, Blood Sugar, Cholesterol, and Uric Acid Levels in Infertile Women

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ABSTRACT

Background: Fertility issues are very important for married couples. Not all married couples have children easily due to infertility. This study aims to determine the relationship between body mass index, blood sugar, cholesterol, and uric acid levels in infertile women. Method: This type of research is quantitative analytical with a cross-sectional approach. This research was conducted at Royal Prima Medan Hospital in March-April 2024. The study population was women aged 21-40 years and accompanied by an obese body mass index >30, blood sugar, cholesterol, and uric acid levels. The sample size was 30 people using purposive sampling. Data analysis was done univariate, bivariate with chi-square, and multivariate with multiple logistic regression. Results: Based on the results of the study, it can be stated that there is a significant relationship between blood sugar levels (p=0.030) and cholesterol (p=0.000) with body mass index, while uric acid was not found to have a significant relationship with body mass index (p=0.103) in infertile women at Royal Prima Hospital. There is no relationship between body mass index and infertility (p=0.103) in women at Royal Prima Hospital.

Conclusion: Thus, this study concludes that women who have uncontrolled blood sugar levels and abnormal cholesterol can cause infertility. It is recommended that married couples who have not had children should consult a doctor to find out solutions that can be done to overcome infertility problems, as well as maintain a body mass index in the normal category, a healthy lifestyle, and routine health control to prevent an increase in blood sugar, cholesterol and uric acid levels.

Keyword: *Infertility, body mass index, blood sugar level, cholesterol, uric acid.*

1. INTRODUCTION

Fertility issues are of great importance to couples struggling to have offspring. The global incidence of infertility in women of childbearing age is 6%, and the incidence of infertility is about 50% of all cases in developing countries. [1]. According to the National Survey of Family Growth (NSFG), the proportion of infertile women continued to increase from 1982 to 1995, from 8.4% to 10.2%. [2]. In Asia, the infertility rate reaches 25% [1]. In Cambodia, it is 30.8%, in Kazakhstan 10%, and in Turkmenistan 43.7%. [3].

According to research by the Indonesian Hospital Association (PERSI) in Jakarta, of infertility cases, 36% occur in men and 64% in women. [4]. The number of infertility cases in North Sumatra reaches 15-17% per year. Most cases of primary infertility affect women [5].

Infertility is a condition where a man and woman cannot have a child despite having sex two or three times a week for a year and not using contraceptives. [6]. Infertility is divided into primary and secondary infertility. [7].

Factors causing infertility include obesity and elevated blood sugar levels. According to WHO, the incidence of obesity increased from 1980 to 2014. A total of 1.9 billion adults over 18 years old are obese, representing more than 600 million people. The highest obesity incidence rate is 61% in the Americas and the lowest is Southeast Asia at 22%. Nationally, Indonesia has an obesity prevalence of 15.4%. [8].

The incidence of obesity is higher in women. According to the 2013 Riskesdas data, the prevalence of obesity in young adults increased from 9.3% to 16.7%. [9]. According to the regencies/cities of North Sumatra province, the prevalence of obesity among adolescents aged 16 years and above in Deli Serdang Regency reached 36.20%. [10]. In Medan city, the prevalence of obesity has increased since 2016 from 9.2% to 18.8%. [11].

BMI (Body Mass Index) is a parameter defined by WHO as the ratio between body weight and the square of height. The IMT criteria values are: thin (<18.5 kg/m2), normal (18.5 - 22.9 kg/m2), *overweight* (>23.0 - 24.9 kg/m2), obesity I (25.0 - 29.9 kg/m2), obesity II (30.0 -39.9 kg/m2), obesity III (>40.00 kg/m2). [12].

One of the most important carbohydrates and the main source for body cells and muscles is glucose, which is influenced by glucagon and insulin. [13]. Diabetes is diagnosed when fasting blood glucose is >126 mg/dl and during >200 mg/dl. Normal blood sugar levels are between 70 to 110 Generally, blood sugar levels below 120 to 140 mg/dl 2 hours after eating or drinking sugar liquids or other carbohydrates [14]. Blood sugar values for low risk (BMI < 30) and obesity (BMI ≥ 30) [15].

Cholesterol is the main sterol produced by the liver and is required by the body as a major component of plasma membranes and lipoproteins, as well as a precursor to steroid compounds. [16]. The body needs cholesterol to make cell walls, hormones, vitamins, and energy. Cholesterol is divided into triglycerides, LDL, and HDL. [17].

WHO data, the largest increase in total cholesterol in Europe (54%), followed by the United States (48%), while the lowest cholesterol in the African and Southeast Asian regions is 22.6% and 29%, respectively. [18]. Women are more at risk of high cholesterol with 54.3% and men only 48%. The percentage of patients with high cholesterol according to age is patients aged more than 60 years (58%), 35-59 years (52.9%), and 39 15-34 years (39.4%). [19]. North Sumatra reached 7.25% of the total population, an increase of 6.96% in 2016. [20].

One part of nucleic acids, purines, found in the nuclei of body cells can increase in blood levels between 0.5 and 0.75 g/ml. This leads to the buildup of crystals in the joints. Within normal limits, uric acid is beneficial as an antioxidant, aiding cell regeneration and rejuvenation. [21]. For men, normal uric acid levels range from 3.5-7 mg/dl and women 2.6-6 mg/dl. [22].

Gout disease is increasing in adults in the United States by 8.3 million (4%). In 2016, China had 25.3% hyperuricemia and 0.36% gout in adults. According to previous studies, the prevalence of gout disease was 41.4% and increased by 0.5% per year. [23] Currently, many cases of *gout* in Indonesia are diagnosed by health professionals. The incidence rate in women reaches 12.1% and men is 10.3%. [24]. In 2017, the prevalence of gout was 11.9% in North Sumatra. In Medan, the prevalence of gout diagnosed by health professionals was 5.1%. [25].

According to Hiferi (2013), women with a body mass index (BMI) of more than 29% tend to experience infertility disorders or take a longer time to get pregnant. Women with a BMI of less than 19% are also likely to experience menstrual disorders, which inhibit growth changes. According to Pebrian (2016), both deficiency and excess of a woman's nutritional status will have an impact on reducing the function of Follicle Stimulating Hormone (FSH), which is responsible for the process of egg maturation and ovulation. As a result, because there is excess fat in the female reproductive organs, the disrupted production of FSH and LH will lead to reproductive fertility problems. (26).

Various factors related to the disease can affect the decline in female fertility. To date, the final mechanism responsible for female reproductive dysfunction is not fully known. However, it is known that chronic hyperglycemia plays an important role. For women, an imbalance of estradiol, testosterone, and progesterone can lead to menstrual cycle disorders, infertility, polycystic ovary syndrome, etc. This study shows that insulin resistance, hyperinsulinemia, and obesity are associated with high testosterone levels. Another hormone that affects blood sugar levels is cortisol, which is normally produced by the adrenal glands every day to help the body cope with stress, when stress increases the adrenal glands produce more cortisol, which increases blood sugar levels so that the body has enough energy. Insulin resistance and hyperglycemia are caused by long-term high cortisol levels. Women with PCOS have high cortisol levels. (27).

Cholesterol is very important for both male and female fertility. In men, high cholesterol can cause fewer sperm, poorer quality, or sperm with abnormal morphology. Whereas in women high cholesterol can cause hormonal imbalances that can make fertilization and pregnancy more difficult. Excess cholesterol prevents the egg from escaping metaphase II arrest and becoming active too early. As a result, this disrupts the normal synchronization between fertilization and completion of meiosis, leading to infertility. High cholesterol can also interfere with estrogen and progesterone hormones and can also cause a buildup in blood vessel flow. While important for reproduction, cholesterol also affects the brain's second messenger system, a system responsible for antidepressant and mood-stabilizing biological functions. In addition to its association with various health disorders, such as diabetes, depression, metabolic syndrome, cardiovascular and cerebrovascular diseases, and other disorders, the NHHR provides insights into the composition of various lipoproteins (28).

Extremely high uric acid levels are a sign of a chronic metabolic condition known as hyperuricemia (HUA). Gout occurs due to the buildup of uric acid crystals in the joints, which can cause pain and inflammation. One of the risks of increasing uric acid is eating foods that are high in purines. Hyperuricemia with uric acid deposition in the female reproductive system can cause female sexual dysfunction. High uric acid levels may be associated with polycystic ovary syndrome (PCOS), endometriosis, or unfavorable pregnancy outcomes. This is because uric acid has potential mechanisms such as oxidative stress, increased inflammation, endothelial damage, and thrombosis. The number of hyperuricemia cases is increasing due to unhealthy living habits and diet in modern society. At the same time, unhealthy lifestyle and unhealthy dietary factors will increase the likelihood of women becoming infertile (29)

2. METHODS

- This type of research is a quantitative study that is analytic in nature with a *cross sectional* approach.
- **Location and time**

This research was conducted at Royal Prima Hospital Medan in March-April 2024.

Population and research sample

The population in this study were infertility women aged 21-40 years and accompanied by an obese body mass index> 30, blood sugar, cholesterol, and uric acid levels . The sampling technique was purposive sampling according to the inclusion and exclusion criteria with a sample size of 30 people.

Data analysis

- Data were analyzed univariately, bivariately, and multivariately using the Chi-Square statistical test, and BInary Logistic Regression.

3. RESULTS

Frequency Distribution of Respondent Characteristics

According to Table 1, the majority of respondents were 21-30 years old (80%), and 31-40 years old (20%). In terms of occupation, the results of this study showed that most respondents worked as self-employed (40%), employees (16.7%), and civil servants (3.3%), while respondents who did not work (housewives) (40%).

Table 1 also shows that the majority of husbands were aged 21-30 years (66.7%), while only 33.3% of husbands were aged 31-40 years. In terms of occupation, most of the husbands were self-employed (50%), followed by employees (16.7%), civil servants and military/police (10%), as well as farmers, state-owned enterprises, prosecutors and drivers (3.3%).

Table 1. Frequency Distribution of Characteristics (N=30)

Characteristics	n	%
Age		
21-30 years old	24	80,0
31-40 years old	6	20,0
Jobs		
self-employed	12	40,0
IRT	12	40,0
employee	5	16,7
PNS	1	3,3
Age of husband		
21-30 years old	20	66,7
31-40 years old	10	33,3
Husband's occupation		
self-employed	15	50,0
farmers	1	3,3
PNS	3	10,0
TNI/POLRI	3	10,0
employee	5	16,7

SOE	1	3,3
prosecutor	1	3,3
driver	1	3,3

Frequency Distribution of Body Mass Index, Blood Sugar Level, Cholesterol, Uric Acid, and Infertility

Table 2 shows that respondents who are not obese (66.7%), while respondents who are obese (33.3%). Respondents who have controlled blood sugar levels (90%), while respondents with uncontrolled blood sugar levels (10%).

The results of the study in Table 2 show that respondents with normal cholesterol (73.3%), while respondents with abnormal cholesterol (26.7%). Respondents who have normal uric acid (93.3%), while respondents with abnormal uric acid (6.7%). Respondents with primary infertility (93.3%), while respondents with secondary infertility (6.7%).

Frequency Distribution of Body Mass Index, Blood Sugar Level, Cholesterol, Uric Acid, and Infertility (N=30)

Variables	**n**	**%**
Body mass index		
not obese	20	66,7
obesity	10	33,3
Blood Sugar Levels		
Controlled	27	90,0
Uncontrolled	3	10,0
Cholesterol		
normal	22	73,3
abnormal	8	26,7
Uric acid		
normal	28	93,3
abnormal	2	6,7
Infertility		
Primary	28	93,3
secondary	2	6,7

Relationship between Body Mass Index and Blood Sugar Levels in Infertile Women at Royal Prima Hospital Medan

Table 3 shows that all respondents with uncontrolled blood sugar levels were obese (100%), while respondents with controlled blood sugar levels were obese (25.9%), and not obese (74.1%). *Chi Square* statistical test results obtained p=0.030 (p<0.05) means that there is a significant relationship between blood sugar levels and body mass index in women with infertility at Royal Prima Medan Hospital.

Table 3 Relationship between Blood Sugar Level and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Blood sugar levels	IMT			*p value*
	Not obese	Obesity	Total	

	f	%	f	%	f	%	
Controlled	20	74,1	7	25,9	27	100,0	0,030*
Uncontrolled	0	0	3	100,0	3	100,0	

*Significant

Relationship between Cholesterol and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Table 4 shows that all respondents with abnormal cholesterol were obese (100%), while respondents with normal cholesterol were obese (9.1%) and not obese (90.9%). *Chi Square* statistical test results obtained p=0.000 (p<0.05) means that there is a significant relationship between body mass index and cholesterol in women with infertility at Royal Prima Medan Hospital.

Table 4 Relationship between Cholesterol and Body Mass Index in Women with infertility at Royal Prima Medan Hospital

Cholesterol	IMT						*p value*
	Not obese		Obesity		Total		
	f	%	f	%	f	%	
Normal	20	90,9	2	9,1	22	100,0	0,000*
Not normal	0	0	8	100,0	8	100,0	

*Significant

Relationship between Uric Acid and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Table 5 shows that all respondents with abnormal uric acid were obese (100%), while respondents with normal uric acid were obese (28.6%) and not obese (71.4%). *Chi Square* statistical test results obtained p=0.103 (p>0.05) means that there is no significant relationship between uric acid and body mass index in women with infertility at Royal Prima Medan Hospital.

Table 5 Relationship between Uric Acid and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Uric acid	IMT						*p value*
	Not obese		Obesity		Total		
	f	%	f	%	f	%	
Normal	20	71,4	8	28,6	28	100,0	0,103
Not normal	0	0	2	100,0	2	100,0	

Relationship between Body Mass Index and Infertility in Women at Royal Prima Medan Hospital

Table 6 shows that as many as 8 people (80%) of obese respondents experienced primary infertility, and 2 other people (20%) with secondary infertility. All non-obese respondents experienced primary infertility (100%). *Chi Square* test results obtained p=0.024 (p<0.05) means that there is a significant relationship between body mass index and infertility in women at Royal Prima Medan Hospital.

Table 6 Relationship between Body Mass Index and Infertility in Women at Royal Prima Medan Hospital

IMT	Infertility						*p value*
	Primary		Secondary		Total		
	f	%	f	%	f	%	
Not obese	20	100,0	0	0	20	100,0	0,103
Obesity	8	80,0	2	20,0	10	100,0	

Multivariate

Based on Table 7, the multivariate analysis results show that blood sugar and cholesterol levels have a p>0.05 value, so it can be stated that these two variables are the dominant variables that equally affect body mass index in women with infertility at Royal Prima Medan Hospital.

Table 7. Multivariate Analysis Results

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	kgd	22.647	18505.694	.000	1	.999	6849213749.000
	cholesterol	23.698	12776.861	.000	1	.999	19589782450.000
	Constant	-49.341	22487.972	.000	1	.998	.000

The magnitude of the effect is shown by the EXP (B) value in Table 7, infertile women are likely 6849213749,000 to have uncontrolled blood sugar levels, and 19589782450,000 with abnormal cholesterol. Hence the regression equation model:

BMI = 6849213749 (blood sugar level) + 19589782450 (cholesterol)

Multiple logistic regression equation to determine the probability of female BMI infertility:

$$P = \frac{1}{1 + exp^{-a+b1x1}}$$

$$P = \frac{1}{1 + 2{,}718^{-49{,}341 + 22{,}647x1 + 23{,}698x2}}$$

$$P = \frac{1}{1 + 2{,}718^{-2{,}996}}$$

$$P = \frac{1}{1 + 0{,}05}$$

$$P = 0{,}4778 = 47{,}78\%$$

Description:

P : body mass index in infertile women

Exp: constant which is 2.718

According to the equation above, infertile women will have uncontrolled blood sugar and abnormal cholesterol levels of 47.78%.

4. DISCUSSION

Characteristics

Infertility can be caused by the woman, the man, or both. However, most of the causes of infertility are female in origin (30). Respondents of this study amounted to 30 infertility women at Royal Prima Medan Hospital.

Age characteristics, the majority of respondents in this study were 21-30 years old (80%). The results of this study are supported by Ningsi et al., (2019) that infertility in women is dominated at the age of ≤35 years (31). The results of this study are also in line with Ayu et al., (2020) and Indarwati et al., (2017) that women aged <35 years have more infertility (26) (32). Adnyana et al., (2019) mentioned that women aged 30-34 years experience the most infertility (33). However, in contrast to Mulyani et al., (2021) that most infertile women are ≥35 years old (34).

According to Ningsi et al. (2019), peak fertility in women occurs within 18-25 years of age. (31). Age is one of the important factors affecting fertility. The older the mother, the less likely she is to become pregnant. This is related to the number of egg reserves. The female reproductive phase will have a reserve of 400 eggs in the ovary. Every month, one of the most dominant eggs will develop, mature, and be ready to be fertilized. At the age of 35, the egg reserve is depleted and changes in hormonal balance begin to occur, so a woman's chances of getting pregnant decrease. Egg quality decreases, so the chance of miscarriage increases. Around the age of 45, eggs are depleted and women no longer menstruate. The natural decline in female fertility occurs from the age of 35 due to fewer egg reserves. (35).

Most of the infertile women at Royal Prima Medan Hospital were working (60%). The results of this study are in line with Mulyani et al., (2021) that infertility women in the UPTD Puskesmas Lembak Work Area, Muara Enim Regency in 2021 are working (87.5%). (34). However, in contrast to research Yuliarfani & nina, (2022) that women of childbearing age who are infertile at the Indonesian Boy Clinic, Awal Bros Hospital, Tangerang City who work as much as (49.0%). Respondents working have a 5.124 times chance of experiencing primary infertility. (36). Likewise research Indarwati et al., (2017) that women who experience infertility are more likely not to work (30).

Infertility is more common in career women. The type of work can play a role in the onset of disease through the work environment, food, physical activity, and stress. (36). Uncomfortable work environment, inappropriate workload can cause stress and fatigue. Every woman who works with a heavy workload and an uncomfortable work environment will be brought home. [34].

According to *The Royal College of Obstetricians and Gynaecologists* (RCOG) in 2004, there are several physical and chemical substances associated with work that have an effect on fertility including heat, X-ray radiation, metals and pesticides. Occupational groups such as paramedical professions, factory workers, office workers who are daily exposed to physical, chemical, ionic and visual radiation can have an effect on female fertility. [30].

Body Mass Index Overview

Based on the results of the study, the majority of body mass index of infertility women at Royal Prima Medan Hospital is not obese (66.7%). The results of this study are in line with research Fauziah et al., (2020) that more women who are not obese have infertility (88%). [35]. Other research from Adnyana et al., (2019) found that most women with infertility had a normal body mass index (33). [33].

Body Mass Index (BMI) is one of the measurement tools used to measure the nutritional status of adults over 18 years of age in relation to underweight and overweight. Underweight men and women are at risk of infectious diseases, while overweight men and women are at risk of degenerative diseases. [37].

A woman's BMI also affects her reproductive organs. Female reproductive organs require nutrients to reach sexual maturity. Increased fertility can be obtained by consuming balanced nutritious foods, so that the *body mass index* is normal. People who experience under or over nutritional status will cause problems with their reproductive health. [34].

Overview of Blood Sugar Levels

Based on the results of the study, the majority of blood sugar levels in infertility women at Royal Prima Medan Hospital were controlled (90%), the results of the study were as follows Wati, (2020) The results of Wati's *research*, (2020) stated that blood glucose levels during the elderly women at *Aisyah Medical Center* (AMC) were normal. [38].

Blood glucose levels depend on hormones secreted by the adrenal glands, namely adrenaline and corticosteroids. Adrenaline will spur an increase in blood glucose demand, and corticosteroids will reduce it back. The control of blood sugar levels can be caused by several factors such as food intake and physical activity. When the body's activity is categorized as strenuous, glucose utilization by the muscles will increase. Endogenous glucose synthesis will be increased to keep blood glucose levels in balance. When normal, this homeostasis can be achieved by various mechanisms from the hormonal, nervous, and glucose regulatory systems. [38].

Cholesterol Overview

Based on the results of the study, the majority of cholesterol of infertility women at Royal Prima Medan Hospital was normal (73.3%). Dana & Maharani, (2022) showed that most female academicians had normal cholesterol levels (61%). [39]. Likewise in research Badriyah, (2021) that respondents had normal cholesterol with an average of 178.2 + 27.2 mg / Dl. [37].

Cholesterol is the main type of sterol in animal tissues and its source is only found in animal foods. In addition to being obtained from animal foods, cholesterol can also be synthesized in the body from acetyl CoA [37]. Cholesterol plays an important role in forming cell membranes, and lipoproteins, as well as a precursor to bile acids that facilitate the absorption of fats in the gastrointestinal tract, forming steroid hormones, as well as skin building materials in preventing excessive evaporation of water from the body. [37], [40].

Several factors influence the increase in cholesterol levels, namely factors that cannot be changed and factors that can be changed. Immutable factors consist of genetics, age, gender, and education, while modifiable factors are diet, smoking, alcohol consumption, physical inactivity, and obesity. [41]. Elevated blood cholesterol levels can result from abnormalities in blood lipoprotein levels which in the long run accelerate the incidence of arteriosclerosis and hypertension that manifests in various cardiovascular diseases [40].

Respondents' Uric Acid Overview

Based on the results of the study, the majority of uric acid in infertile women at Royal Prima Medan Hospital was normal (93.3%). This may be due to the dominant age of 21-30 years. The older a person is, the greater the risk of suffering from gout, aging means reduced kidney function. This results in increased uric acid levels. Medications taken with age can also increase the risk of developing gout. Uric acid levels in women only increase after menopause. [42].

Uric acid levels are compounds present in the human body. The normal ratio is 3-7.2 mg/dL for men and 2-6 mg/dL for women. Under normal conditions, uric acid is not harmful to human health. If excess or deficient, uric acid levels in blood plasma will be an indication of disease due to metabolic failure. [43].

Dietary behavior of samples with gout can be done by avoiding consumption of foods with high purine content, animal meat, seafood, highly sweetened beverages, and weight control. This disease has an impact on the daily activities of sufferers, so efforts need to be made to motivate a regular and healthy lifestyle such as exercise, adjusting diet, maintaining weight, regular health checks and routine control of uric acid levels. [44].

Overview of Infertility in Women

Based on the results of the study, the majority of infertile women at Royal Prima Medan Hospital had primary infertility (93.3%). The same thing is seen from the results of research Mulyani et al., (2021) that the number of respondents experiencing primary infertility is more, namely 82.8% [34]. Likewise in research Ayu et al., (2020) that 64.1% of women experienced primary infertility at Puri Bunda Hospital in 2017. [32].

Infertility in women is divided into two, namely primary and secondary infertility [33], [34]. The causes of female infertility from previous studies include tubal factors as much as 60.23%, uterus as much as 30.68% and ovaries as much as 9.09%. [33]. Research Ayu et al., (2020) found that the most common cause of infertility in women at Puri Bunda Hospital in 2017 was the tubal factor, namely 12.8%. [32].

Relationship between Blood Sugar Level and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Based on the results of the study, it can be stated that there is a significant relationship between blood sugar levels and body mass index in women with infertility at Royal Prima Medan Hospital ($p=0.030$; $p<0.05$). The results of this study are in accordance with Harahap et al., (2020) that there is a significant relationship between BMI and KGD [45].

Soliah et al., (2023) mentioned that blood glucose levels are influenced by several factors, including excessive consumption of food that exceeds the necessary caloric needs [46]. Someone who is *overweight* or even obese has higher sugar levels than non-obese. The collection of fat in people with more nutritional status will increase insulin resistance, so that blood sugar levels increase due to the decreased ability of the hormone insulin (47). [47].

High blood sugar levels accompanied by a higher BMI may indicate that a person has a metabolic disease disorder. If the body weight is still normal, blood circulation in the body becomes more efficient, fluid management is smoother, and the risk of developing diseases such as diabetes mellitus, heart problems, and some types of cancer can be minimized. [48].

However, the results of this study are different from research Lisnawati et al. (2023) which states that body mass index is not associated with blood sugar levels. [48]. Similarly, the results of research from Wati, (2020) found that there was no relationship between BMI and blood sugar levels during the female elderly gymnastics group at *Aisyah Medical Center* (AMC). [38].

Relationship between Cholesterol and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Based on the results of the study, it can be stated that there is a significant relationship between cholesterol and body mass

index in women with infertility at Royal Prima Medan Hospital (p=0.000; p<0.05). All respondents with abnormal cholesterol were obese (100%), while only 2 respondents (9.1%) had normal cholesterol and 20 others (90.9%) were not obese.

The results of this study are in line with Dana & Maharani, (2022) that the IMT variable has a significant relationship to blood cholesterol levels in employees and female students. The higher a person's BMI, the higher their blood cholesterol levels. [39]. The results of this study are also in accordance with Erda et al. (2018) also states that there is a relationship between body mass index and cholesterol levels. Obese respondents have a 2.19 times greater risk of suffering from hypercholesterolemia. [49].

In contrast to research conducted by Badriyah, (2021) that BMI is not associated with total cholesterol levels [37]. Likewise in research Wahyuni & Diansabila (2021) in 2018 batch of Medical Study Program students at the Faculty of Medicine and Health, Muhammadiyah University of Jakarta, that there is no relationship between BMI and cholesterol (50). [50].

An increase in total cholesterol and LDL in the blood occurs due to high consumption of saturated fat and cholesterol sources. An increase in cholesterol can be reflected in a person's BMI. BMI is one of the benchmarks. A person with BMI in the fat and obese category reflects high levels of total cholesterol, LDL, and Triglycerides. [39]. Regular exercise can reduce cholesterol deposits in blood vessels and reduce body weight. Exercise can increase HDL cholesterol levels and reduce LDL cholesterol and triglyceride levels. [50].

Relationship between Uric Acid and Body Mass Index in Infertile Women at Royal Prima Hospital Medan

Based on the results of the study, it can be stated that there is no significant relationship between uric acid and BMI in women with infertility at Royal Prima Medan Hospital (p=0.103; p<0.05). Previous research from Kusriati & Suhita, (2022) The results were not in line with this study, which stated that there was a relationship between body mass index and blood uric acid levels in the Azziziah room of An-Nisaa Blitar General Hospital. The closeness of the relationship between body mass index (BMI) and blood uric acid levels in respondents is moderate. [43]. Research results Leokuna & Malinti, (2020) also found a significant relationship (p<0.05) between BMI and uric acid levels in adult women in East Oesapa. [51].

In principle, the body's uric acid level is determined by the balance of production and excretion. Uric acid production depends on diet, as well as the body's internal processes of biosynthesis, degradation, and salvage formation of uric acid. A person with excess BMI is at high risk of gout although a person with less and normal BMI can also be at risk of gout. This can occur due to an increase in uric acid in a person's body. Uric acid that accumulates in large amounts in the blood will trigger the formation of needle-shaped crystals. The crystals are usually concentrated in the joints, especially the peripheral joints (big toe or hand). The joints will become swollen, stiff, reddish, hot, and painful. [43]

Relationship between Body Mass Index and Infertility in Women at Royal Prima Medan Hospital

Based on the results of the study, it can be stated that there is a significant relationship between BMI and infertility in women at Royal Prima Medan Hospital (p=0.024; p<0.05). Obese women are more at risk of secondary infertility. This is in line with research by Yuliarfani & Nina, (2022) that there is a relationship between BMI and the incidence of infertility. Respondents who are obese have a 3.427 times chance of experiencing primary infertility compared to respondents who are not obese. [36].

Research from Mulyani et al., (2021) also supports this study that there is a relationship between BMI and primary infertility in the work area of UPTD Puskesmas Lembak Muara Enim Regency in 2021. [34]. However, in contrast to research Fauziah et al. (2020) that BMI is not significantly associated with primary infertility at Al Munawaroh Samarinda Alert Hospital for the period December 2019 - January 2020. [35].

Prawiroharjo's theory (2011) in Mulyani et al., (2021) states that the female reproductive organs require nutrients that must be considered to achieve sexual maturity and increase nutritionally balanced foods. Increased fertility can be obtained by consuming nutritionally balanced foods, neither less nor more so that the body mass index is normal. People who experience less or more nutritional status will cause problems with their reproductive health. [34].

According to Fauziah et al., (2020), overweight and obese women have a higher incidence of menstrual disorders and anovulation. Nutritional factors are also very important in supporting fertility. In theory, being overweight is not only associated with an increased risk of chronic disease but also an increased risk of reproductive problems. [34]. Weight and weight changes that exceed normal weight or are less than normal weight will affect the delay in conception. [30].

Multiariat

Based on the results of multivariate tests with *binary* logistic regression, women with infertility will be at risk of having uncontrolled blood sugar levels and abnormal cholesterol . Both variables, namely blood sugar and cholesterol levels, have the same dominant influence on body mass index in women with infertility at Royal Prima Medan Hospital by 47.78%.

This is in line with Lisnawati et al., (2023) that a person's BMI above normal can increase the risk of increasing total cholesterol, triglycerides, and blood sugar levels. [48]. Increased cholesterol and triglycerides can lead to insulin resistance

which leads to increased blood sugar levels. Metabolic abnormalities due to insulin resistance will affect metabolism in the body including changes in the process of production and disposal of plasma lipoproteins. In fat tissue, there is a decrease in the effect of insulin, so that lipogenesis is reduced and lipolysis increases, thus triggering *glucotoxicity* accompanied by *lipotoxicity*. [52].

5. CONCLUSION

1. Blood sugar, and cholesterol levels have a relationship with body mass index in infertile women, while uric acid is not associated with body mass index in infertile women at Royal Prima Medan Hospital.
2. Body mass index has an association with infertility in women at Royal Prima Medan Hospital.
3. Blood sugar and cholesterol levels were both the most dominant variables with body mass index in women at Royal Prima Medan Hospital.

Advice

1. It is appealed to the public, especially women, to be able to maintain a body mass index in the normal category, a healthy lifestyle, and routine health control in order to prevent an increase in blood sugar, cholesterol, and uric acid levels.
2. It is recommended that married couples who do not have children should consult a doctor to find out the solutions that can be done to overcome infertility problems.

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