Irregular Menstrual Cycles as A Risk Factor of Type 2 Diabetes Mellitus in Women of Childbearing Age

by Fillah Fithra Dieny

Submission date: 06-Sep-2021 03:20PM (UTC+0700)
Submission ID: 1642362168
File name: C-37.pdf (316.5K)
Word count: 4539
Character count: 23918

Jurnal Kedokteran dan Kesehatan Indonesia

Indonesian Journal of Medicine and Health

Journal homepage: https://journal.uii.ac.id/JKKI

Irregular menstrual cycles as a risk factor of type 2 diabetes mellitus in women of childbearing age

Ayu Dea Aghestya[1], Nurmasari Widyastuti*[1], Martha Ardiaria[1], Fillah Fithra Dieny[1]

[1]Department of Nutrition Science, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia

Original Article

ARTICLE INFO

Keywords:
women of childbearing age, irregular menstrual cycles, type 2 diabetes mellitus

***Corresponding author:**
widyastutinurmasari@gmail.com

DOI: 10.20885/JKKI.Vol1Iss1.art5

History:
Received: March 29, 2020
Accepted: January 28, 2021
Online: April 30, 2021

ABSTRACT

Background: Irregular menstrual cycles are a risk factor for developing type 2 diabetes mellitus (DM) in women.

Objective: This study aimed to evaluate irregular menstrual cycles as a risk factor of type 2 DM in women of childbearing age with body fat percentage, waist-hip ratio, diet quality, and physical activity as confounding factors.

Methods: This was a case-control study. Its subjects were subjects with type 2 diabetes mellitus (n=31) and subjects without any clinical evidence of abnormal glucose regulation (n=31) who attended Puskesmas (Community Health Centre) Rowosari, Tembalang, Semarang with over 30 years of age. Based on their menstrual cycles, they were divided into two groups: women with irregular menstrual cycles, and those with regular menstrual cycles. Cochran Mantel-Haenszel test was used to control their confounding factors.

Results: There was an association between irregular menstrual cycles and type 2 DM ($p<0.05$) with a 7.2 greater risk on women of childbearing age (OR = 7.2, 95% CI=2.18-23.75). By the Cochran Mantel-Haenszel test, the association was still significant; women with over percentage of body fat and central obese with irregular menstrual cycle had 4,85 times and 4,37 times of sequentially greater risk on type 2 DM (OR = 4.85, 95% CI=0.98-23.95 vs OR = 4.37, 95% CI=0.93-20.51).

Conclusion: The irregular menstrual cycles was a risk factor of type 2 DM, especially in obese women of childbearing age.

Latar Belakang: *Gangguan siklus menstruasi merupakan faktor risiko berkembangnya diabetes mellitus (DM) tipe 2 pada wanita.*

Tujuan: *Penelitian ini bertujuan untuk menilai gangguan siklus menstruasi sebagai faktor risiko DM tipe 2 pada wanita usia subur dengan persen lemak tubuh, rasio lingkar pinggang-panggul, kualitas diet dan aktivitas fisik sebagai faktor perancu.*

Metode: *Penelitian observasi analitik dengan studi case control pada subjek dengan DM tipe 2 (n=31) dan subjek tanpa temuan klinis regulasi glukosa yang abnormal (n=31) yang terdaftar di Puskesmas Rowosari, Kecamatan Tembalang, Kota Semarang dengan usia lebih dari 30 tahun. Berdasarkan siklus menstruasinya, subjek dibagi dalam 2 kelompok: wanita dengan gangguan siklus menstruasi dan wanita dengan siklus menstruasi normal. Uji Cochran Mantel-Haenszel digunakan untuk mengontrol faktor-faktor perancu.*

Hasil: *Terdapat hubungan antara gangguan siklus menstruasi dan DM tipe 2 ($p<0.05$) dengan risiko 7.2 kali lebih besar pada wanita usia subur (OR= 7.2, 95% CI=2.18-23.75). Setelah uji Cochran Mantel- Haenszel hubungan masih signifikan, wanita dengan persen lemak tubuh berlebih dan obesitas sentral dengan gangguan siklus menstruasi memiliki 4.85 kali and 4.37 kali risiko lebih besar mengalami DM tipe 2, secara berurutan (OR=4.85, 95%, CI=0.98-23.95 vs OR= 4.37, 95% C I=0.93-20.51).*

Kesimpulan: *Gangguan siklus menstruasi merupakan faktor risiko DM tipe 2, terutama pada wanita usia subur yang obesitas.*

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by fasting and postprandial hyperglycaemia, atherosclerosis, and microangiopathic vascular disease.[1] Diabetes mellitus is a hyperglycaemia disease due to cell insensitivity to insulin. Insulin levels may decrease slightly or be within the normal range.[2] Based on the International Diabetes Federation (IDF) in 2012, it was reported that 300 million people of the world population have diabetes, and about 60 million of them are women of reproductive age (15-49 years).[3] Diabetes mellitus (DM) is classified into two types: type 1 diabetes and type 2 diabetes. In 2013, IDF reported that the incidence of DM in the world was 382 million people with 85-95% of the prevalence of type 2 DM. According to Basic Health Research (Riskesdas), the prevalence of DM in Indonesia in 2007 increased from 1.1% to 2.1% in 2013.[4]

This disease, the DM, often goes undetected before diagnosis, so early morbidity and mortality occur in this undetectable case. DM diagnostic tests are performed on those who show symptoms/signs with one of the risks of DM i.e. a patient with age ≥45 years and younger age accompanied by risk factors such as physical inactivity, a history of DM family, a history of childbirth with birth weight baby >4000 grams, a history of gestational diabetes, hypertension, HDL cholesterol ≤35 mg/dL and/or triglycerides ≥250 mg/dL, other clinical conditions associated with insulin resistance, a history of impaired glucose tolerance, and a history of cardiovascular disease.[5] Previous studies had found a strong relationship between irregular menstrual cycles and the incidence of DM in women. The risk of type 2 DM (T2DM) increases 3-fold in women with irregular menstrual cycles. Blood glucose disorders in women with menstrual cycle disorders occur at 30-40 years of age.[6]

There is an alteration in glucose tolerance during the menstrual cycles. Respondents who experience shorter menstrual cycles will cause an increase in blood glucose levels, and this is influenced by endogenous oestrogen secretion.[7] Irregular menstrual cycles may be associated with T2DM.[8] The relationship between DM and menstrual cycle disorders is caused by hormonal similarities that regulate mechanisms of T2DM and menstrual cycle disorders. There are two hormones that have an antagonistic effect on blood glucose levels, oestrogen hormone receptors on pancreatic β cells that cause insulin to release as insulin is the most important hormone in glucose homeostasis in blood and progesterone which has anti-insulin properties so that it can make cells less sensitive to insulin and causes insulin resistance in the body.[7] In this study, the authors evaluate whether menstrual cycle disorders can be a risk factor for type 2 DM in women of childbearing age so that the menstrual cycle can be functioned as early detection of type 2 DM in women.

METHODS

Design and subjects

This study was conducted in the work area of *Puskesmas* (Community Health Centre) Rowosari, Tembalang District. This study was included in analytic observation research with a case-control study by dividing the samples of the study into two groups: the case and the control groups. The case group was a group of women of childbearing age with type 2 diabetes mellitus (T2DM) while the control group was a group of women of childbearing age without T2DM. A minimum sample size of 28 participants was obtained, and they were later added to a 10% possibility of dropping out to 31 participants of each in the case and the control groups.

This study was approved by The Ethical Committee of Medical Research of Faculty of Medicine, Universitas Diponegoro (No. 613/EC/FK-UNDIP/XI/2018). Subject selection was conducted by using a purposive sampling

method. Inclusion criteria for the case group were T2DM patients of Rowosari Health Centre at Tembalang District, who had T2DM for at least 3 months, were women of childbearing age of 30-50 years, had never had another type of diabetes mellitus, had not suffered from and/or had a history of vascular diseases (hypertension, stroke, coronary heart disease, cholesterol). The inclusion criteria of the control group were patients of Rowosari Community Health Center patients at Tembalang District, who had not suffered T2DM or other types of DM, were women of childbearing age 30-50 years old, had not suffered from and/or had a history of vascular diseases (hypertension, stroke, coronary heart disease, cholesterol). The exclusion criteria applied in this study were participants who resigned or died while data collection were performed. Data collection was conducted by visiting from a house to a house.

Data Collection

In this study the subject's self-data were collected through questionnaires, levels of physical activity, quality of diet, anthropometry, and menstrual cycle histories. Data on the levels of physical activity were obtained by the International Physical Activity Questionnaire (IPAQ), and then the Metabolic Equivalent (MET) values were calculated. Physical activity was categorized as low if ≤600 MET minutes/week, moderate if ≥600-1500 MET minutes/week, and high if ≥1500 MET minutes/week.[9] The quality of the diet was measured by assessing food consumption by using the Semiquantitative Food Frequency Questionnaire (SFFQ) form, and then the diet quality scores were calculated by using the International Diet Quality Index (DQI-I) form. The quality of the diet consisted of four main components: variety (0-20 points), adequacy (0-40 points), moderation (0-30 points), and overall balance (0-10 points), so the total number of points was 100 points. The higher the points obtained, the better the results. The quality of the diet was considered poor if it had a total score <60, and it was categorized as adequate if it had a total score ≥60.[10] Menstrual cycle history data were obtained by filling in a menstrual cycle table by the subject. Menstrual cycle disorders were defined as menstrual disorders experienced during the last 3 months, and they were characterized by a long distance between the first day of the menstrual cycle and the first day of the next menstrual cycle of less than 21 days or more than 35 days. The anthropometric data were waist circumference, hip circumference, and body fat percentage. Measurement of waist circumference and hip circumference used a measuring tape with accuracy of 0.1 cm while the measurement of body fat percentage used the Bioelectrical Impedance Analyzer (BIA) expressed in a percent (%). Respondents included in the control group still had to undergo blood sampling for random blood glucose checking at the Rowosari Community Health Centre as supporting data.

Statistical analysis

The obtained data were analysed statistically by using a statistical software. Bivariate analysis was performed by using a chi-square test. Multivariate analysis was conducted to determine relationships between independent and dependent variables that were controlled with confounding variables. The stratification analysis was the Cochran Mantel-Haenszel test.

RESULTS

Group characteristics

Table 1 showed that the age in the T2DM group was slightly older than the non-DM group, meaning not statistically significant (p=0.204). Body fat percentage and waist-hip circumference ratio in the T2DM group and the non-DM group had a statistically significant difference (p<0.001). Physical activity in women of childbearing age with T2DM was lower than the non-DM group, meaning that there were no statistically significant differences in the two groups (p=0.159). Diet quality in the T2DM group was lower than in the non-DM group, meaning that there was a statistically significant difference (p =0.004).

Table 1. Characteristics among the groups based on age, body fat percentage, waist-hip circumference ratio, physical activity and diet quality

Variables	T2DM	Non-DM	p
Age (years)	45.42 ± 3.07	44.42 ± 3.50	0.204[a]
Body fat percentage (%)	30.84 ± 2.69	27.45 ± 2.44	<0.001[a]*
Waist-hip circumference ratio	0.93 ± 0.07	0.87 ± 0.05	<0.001[a]*
Physical activity (MET-minutes/week)	545.94 ± 84.93	566.77 ± 73.34	0.159[a]
Diet quality (point)	57.74 ± 8.56	60.90 ± 8.44	0.004[a]*

The data above shows the mean ± SD, *significantly different (p <0.05), [a]Mann Whitney

Relationships between Menstrual Cycle Disorders and Confounding Variables with T2DM in Women of Childbearing Age

The percentage of menstrual cycle disorders in Table 2 was higher in the T2DM group (68.4%) than in the non-DM group (31.6%), and the percentage of women who had a normal menstrual cycle in the T2DM group (20.8%) was lower than in the non-DM group (79.2%), meaning that both groups had a statistically significant difference (p <0.05).

Table 2. Relationships between menstrual cycle disorders and confounding variables

Confounding variables	T2DM	Non-DM	Total	P
Menstrual cycle				
Menstrual cycle disorders	68.4%	31.6%	100%	0.001*
Normal	20.8%	79.2%	100%	

Note: *significantly different (p <0.05)

Subjects who had menstrual cycle disorders had a 7.2 times greater risk of having T2DM compared with subjects who did not have menstrual cycle disorders as seen in Table 3. Variables that had a significant relationship (p<0.05) with T2DM were menstrual cycle (p=0.001), body fat percentage (p =0.001), waist-hip circumference ratio (p = 0.001), and diet quality (p =0.002). However, physical activity (p=0.103) did not have a significant relationship to T2DM. Judging from the odds ratio (OR), body fat percentage (OR =7.200, 95% CI =2.033- 25.496), waist-hip circumference ratio (OR=6.234, 95% CI =2.038 - 19.0769), and diet quality (OR =5.769, 95% CI =1.843 - 18.064) were risk factors that cause T2DM (OR >1).

Relationships of Menstrual Cycle Disorders with T2DM after Controlling for Confounding Variables

Table 4 showed that the group with excessive body fat percentage who experienced menstrual cycle disorders experienced T2DM (72.2%) more compared to the group that had excess body fat percentage with normal menstrual cycle who experienced T2DM (16.7%). Statistically using the chi-square fisher's exact test, a significant difference was obtained between the two groups (p =0.016). There was no significant difference between the two groups (p =1.000). Based on Table 4, it could be seen that body fat percentage was a confounding factor that had no interaction with menstrual cycle disorders. Then after

Table 3. Body fat percentage, waist-hip circumference ratio, physical activity and quality of the diet in the T2DM and non-DM groups

Confounding variables	p	OR	95% CI
Menstrual cycle			
Menstrual cycle disorders	0.001[b*]	7.2	2.18-23.75
Normal			
Body fat percentage			
High	0.001[b*]	7.2	2.03–25.49
Optimal			
Waist-hip circumference ratio			
Central obesity	0.001[b*]	6.2	2.03–19.06
Non-central obesity			
Physical activity			
Low	0.103[b]		
Moderate-high			
Diet quality			
Low	0.002[b*]	5.7	1.84–18.06
High			

Note: *significantly different (p <0.05), [b] Chi-square

Table 4. Stratification analysis using the Cochran Mantel-Haenszel test

	Subject total (n)	Subjects with T2DM, n (%)	p	OR
High body fat percentage (n=42)				4.85 (0.98-23.95)[d]
Normal menstrual cycles	6	1 (16.7)	0.016[c*]	
Menstrual cycle disorders	36	26 (72.2)		
Optimal body fat percentage (n=20)				
Normal menstrual cycles	18	4(22.2)	1.000[c]	
Menstrual cycle disorders	2	0 (0.0)		
Central obesity (n=35)				4.37 (0.93-20.51)[d]
Normal menstrual cycles	3	0 (0.0)	0.025[c*]	
Menstrual cycle disorders	32	24 (68.6)		
Non-central obesity (n=27)				
Normal menstrual cycles	6	2 (33.3)	0.633[c]	
Menstrual cycle disorders	21	5 (23.8)		
Low diet quality (n= 38)				5.23 (2.48-27.31)[e]
Normal menstrual cycles	6	2 (33.3)	0.154[c]	
Menstrual cycle disorders	32	23 (71.9)		
High diet quality (n=24)				
Normal menstrual cycles	18	3 (16.7)	0.139[c]	
Menstrual cycle disorders	6	3 (50.0)		

Note: *significantly different (p <0.05), [c] Chi-square fisher's exact test; [d] adjusted OR; [e] Crude OR

controlling for body fat percentage variable, the risk of T2DM in the group of women who had excess body fat percentage with menstrual cycle disorders was 4.37 times greater than women with normal body fat composition (OR=4.37, 95% CI=0.93-20.51).

The percentage of groups of women with central obesity who experienced menstrual cycle disorders experiencing T2DM (68.6%) was very different compared to the group without central obesity with normal menstrual cycles who experienced T2DM (0.0%). Statistically with the chi-square fisher's exact test, a significant difference was obtained from the two groups (p =0.025). In the non-central obesity group with normal menstrual cycles, the incidence of DM (33.3%) was not too different from the non-central obesity group, but it had menstrual cycle disorders (23.8%). It also statistically proven that there were no significant differences between the two groups (p =0.633). It could also be seen that central obesity was a confounding factor that had no interaction with menstrual cycle disorders and after controlling for obesity variables. The risk of T2DM in the group of women with central obesity who had menstrual cycle disorders was 4.85 times greater than women who had optimal body fat percentage (OR= 4.85, 95% CI=0.98-23.95).

The percentage of women who had low-quality diets with menstrual cycle disorders who experienced T2DM (71.9%) was greater than the group of women without menstrual cycle disorders who experienced T2DM (33.3%). However, statistically with the test Chi-Square Fisher's Exact Test, there were insignificant differences between the two groups (p =0.154). The group with a high-quality diet with normal menstrual cycles had the incidence of DM (16.7%) as it was not too different to the group that had menstrual cycle disorders (50.0%). Statistically it also proven that there were no significant differences between the two groups (p =0.139). It could also be seen that diet quality was not a confounding factor in menstrual cycle disorders associated with DM (OR = 5.23, 95% CI =2.48-27.31).

DISCUSSION

The grouping of subjects in this study was determined by using a medical record diagnosed by a doctor, and in the non-DM group random blood glucose test of the subjects were performed as supporting data. A significance of supporting data in the group of women without DM is to minimize if the respondents do not know that they have DM. The incidence of menstrual cycle disorders is defined as menstrual disorders experienced during the past 3 months. A previous study found that those who had menstrual cycle disorders had an increased risk of DM and pre-DM compared to women who had normal menstrual cycles.[8]

Menstrual cycle disorders and type 2 DM have the same risk factors such as obesity and hyperinsulinemia, so they were used as confounding variables in this study.[11,12] In this study, physical activity did not have a significant relationship with the incidence of type 2 DM in women of childbearing age because the two groups of subjects did not have significant differences in the mean results of the IPAQ score, and other possibilities that could occur due to the physical daily activities (such as walking, hoeing, washing, gardening, sweeping, mopping, washing dishes) were not included in the physical activity. This is in accordance with a study conducted at RSUD (Regional Public Hospital) of Cilegon in 2013 stating that physical activity had no significant relationship with fasting blood glucose levels in type 2 DM patients.[13]

In this study, women of childbearing age with menstrual cycle disorders had greater risk of developing type 2 diabetes, and this was strengthened after controlling for confounding factors in the form of body fat percentage and waist-hip circumference ratio. Body fat percentage and waist-hip circumference ratio were confounding factors that had no interaction on the relationship of menstrual cycle disorders and type 2 DM. Diet quality was not a confounding factor in this study. Based on a previous study, there was no significant relationship between diet and nutritional status with menstrual cycle disorders (p >0.05).[14] Another study found that

diet quality did not have a significant relationship with HbA1c levels in patients with T2DM with socio-demographic control variables and family support.[15]

A study conducted in South Korea in 2011 stated that women with menstrual cycles or more than 40 days were associated with type 2 DM was significantly greater in obese women than in those who were not obese, after controlled by using age, BMI, systolic blood pressure, triglycerides, and high-density lipoprotein with the frequency of type 2 DM. A prospective research in 2016 showed that women with menstrual cycle disorders were 2.01 times more likely to develop T2DM than women who had normal menstrual cycles. This significant increase in the risk was still seen when controlled with BMI, fasting blood glucose, family history of diabetes, and parity with an increased risk of 1.73 times.[8]

Women with excess fat levels are 4-5 times more frequent to experience ovarian dysfunction. In obese women there are excess androgen and excess oestrogen, especially estrone. Hormonal conditions in obese women experienced increased suprarenal androgen production, increased 17-ketosteroid and 17-hydroxysteroid expenditure, increased plasma testosterone levels, increased plasma androstenedione levels, estrone/estradiol ratio 2.5, and low sex hormone-binding globulin (SHBG) levels.[16] High abdominal fat accumulation or central obesity trigger adipose tissue to produce hormones in suboptimal amounts, high insulin secretion, high levels of testosterone, free androstenedione, low levels of progesterone in women, high cortisol production, and low levels of growth hormone. High levels of free testosterone stimulate the production of androgens in ovarian tissue normally disrupting ovulation and causing menstrual cycle disorders.[17]

Metabolic disorders are found in women with menstrual cycle disorders due to insulin resistance. Insulin resistance is found in 50-90% of women with menstrual cycle disorders even though their prevalence in the general population is only 10-20%. The cause of insulin resistance in menstrual cycle disorders involves more than one mechanism.

A previous study in India in 2009 and C/T polymorphisms in His1058 INSR gene in patients with lean type Polycystic Ovary Syndrome (PCOS) and non-obese type. CT+TT genotype was found more in the patients with the lean type PCOS when compared to the lean type control group with a low frequency of TT genotype in both groups. All PCOS patients in the study experienced insulin resistance.[18]

Hyperandrogenism decreases with age, but insulin resistance increases with age, and it is likely caused by increased abdominal obesity (BMI, body fat percentage, waist-hip circumference ratio).[19,20] Obesity affects the menstrual cycle and has a direct impact on the incidence of T2DM. Obesity is closely related to impaired insulin sensitivity, causing the pancreatic beta-cell responds to an increase in reduced blood glucose; effects of decreased tissue sensitivity to insulin cause the body to compensate with increased plasma insulin concentration (hyperinsulinemia) as this is known as insulin resistance.[21] A study in 2010 showed that an increase in triglyceride levels, a decrease in HDL, insulin resistance and an increase in the levels of inflammatory factors in obese patients could occur.[22]

CONCLUSION

The percentage of menstrual cycle disorders was higher in the T2DM group than in the non-DM group. Variables having a significant relationship with type 2 DM were body fat percentage, waist-hip circumference ratio, and diet quality; while, physical activities did not have a significant relationship with type 2 DM. The menstrual cycle disorders could be a risk factor for type 2 DM in women of childbearing age because they had a significant relationship with a 7.2 times greater risk in women with menstrual cycle disorders.

It is hoped that this study can be used as a reference for developing further research by paying attention to hormonal factors associated with menstrual cycle disorders and type 2 DM

in women of childbearing age.

CONFLICT OF INTEREST

The author declares that there was no conflict of interest.

ACKNOWLEDGEMENT

The author thanks to all participants in this study.

REFERENCES

1. Hiyoshi T, Fujiwara M, Yao Z. Postprandial hyperglycemia and postprandial hypertriglyceridemia in type 2 diabetes. Journal of Biomedical Research. 2019;33(1):1–16.
2. Suyono S. Buku Ajar Ilmu Penyakit Dalam. III. Jakarta: Balai Penerbit FKUI; 2008.
3. International Diabetes Federation. Women and diabetes. Diabetic Medicine. 2017;13(12):1009–16.
4. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia. Riset Kesehatan Dasar 2013. 2013.
5. Mihardja L, Soetrisno U, Soegondo S. Prevalence and clinical profile of diabetes mellitus in productive aged urban Indonesians. Journal of Diabetes Investigation. 2014;5(5):507–12.
6. Kousta E, Tolis G, Franks S. Polycystic ovary syndrome. Revised diagnostic criteria and long-term health consequences. Hormones. 2005;4(3):133–47.
7. Primadina MA. The effect of menstrual cycle to blood glucose levels. Jurnal Majority. 2015;4(3):65–70.
8. Rostami Dovom M, Ramezani Tehrani F, Djalalinia S, Cheraghi L, Behboudi Gandavani S, Azizi F. Menstrual cycle irregularity and metabolic disorders: A population-based prospective study. PLOS ONE. 2016;11(12):e0168402.
9. IPAQ. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)–Short and Long Forms. Ipaq. 2005;1–15.
10. Dieny FF, Widyastuti N, Fitranti DY. Sindrom metabolik pada remaja obes: Prevalensi dan hubungannya dengan kualitas diet.Jurnal Gizi Klinik Indonesia. 2015;12(1):1.
11. Fung J, Berger A. Hyperinsulinemia and insulin resistance: Scope of the problem. Journal of Insulin Resistance. 2016;1(1).
12. Bae J, Park S, Kwon JW. Factors associated with menstrual cycle irregularity and menopause. BMC Women's Health. 2018;18(1):36.
13. Hariyanto F. Hubungan aktivitas fisik dengan kadar gula darah puasa pada pasien diabetes mellitus tipe 2 di Rumah Sakit Umum Daerah Kota Cilegon Tahun 2013. Universitas Islam Negeri Syarif Hidayatullah, 2013.
14. Ahmed MNBBA. Hubungan Pola Makan dan Status Gizi dengan Keteraturan Menstruasi pada Mahasiswa Faklutas Kedokteran Gigi Univeristas Sumatera Utara Tahun 2017. Universitas Sumatera Utara, 2017.
15. Gardiarini P, Sudargo T, Pramantara IDP. Hubungan antara kualitas diet, sosio-demografi, dan dukungan keluarga terhadap pengendalian gula darah pada penderita diabetes melitus tipe 2 di Rumah Sakit Kanujoso Djatiwibowo (RSKD) Balikpapan. Gizi Indonesia. 2017;40(2):89.
16. Seif MW, Diamond K, Nickkho-Amiry M. Obesity and menstrual disorders. Best Practice & Research Clinical Obstetrics & Gynaecology. 2015;29(4):516–27.
17. Rakhmawati A, Dieny FF. Hubungan obesitas dengan kejadian gangguan siklus menstruasi pada wanita dewasa muda. Journal of Nutrition College. 2013;2(1):214–22.
18. Mukherjee S, Shaikh N, Khavale S, Shinde G, Meherji P, Shah N, et al. Genetic variation in exon 17 of INSR is associated with insulin resistance and hyperandrogenemia among lean Indian women with polycystic ovary syndrome. European Journal of Endocrinology. 2009;160(5):855–62.
19. Martinez KE, Tucker LA, Bailey BW, LeCheminant JD. Expanded normal weight obesity and insulin resistance in US adults of the National Health and Nutrition examination survey. Journal of Diabetes Research. 2017: 9502643.
20. Hsu MI. Changes in the PCOS phenotype with age. Steroids. 2013;78(8):761–6.

21. Guyton, Hall. Insulin, Glukagon, dan Diabetes Melitus. In: Fisiologi Kedokteran. Edisi 11. Jakarta: EGC Medical Publisher,2008. p: 1010–27.
22. Hui WS, Liu Z, Ho SC. Metabolic syndrome and all-cause mortality: A meta-analysis of prospective cohort studies. European Journal of Epidemiology. 2010;25(6):375–84.

Irregular Menstrual Cycles as A Risk Factor of Type 2 Diabetes Mellitus in Women of Childbearing Age

ORIGINALITY REPORT

23%	16%	17%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.ugm.ac.id Internet Source	2%
2	Submitted to Universitas Teuku Umar Student Paper	2%
3	synapse.koreamed.org Internet Source	2%
4	garuda.ristekdikti.go.id Internet Source	1%
5	isainsmedis.id Internet Source	1%
6	Edy Siswantoro, Nasrul Hadi Purwanto, Sutomo . "Effectiveness of Alkali Water Consumption to Reduce Blood Sugar Levels in Diabetes Mellitus Type 2", Journal of Diabetes Mellitus, 2017 Publication	1%
7	Marzieh Rostami Dovom, Fahimeh Ramezani Tehrani, Shirin Djalalinia, Leila Cheraghi, Samira Behboudi Gandavani, Fereidoun Azizi.	1%

	"Menstrual Cycle Irregularity and Metabolic Disorders: A Population-Based Prospective Study", PLOS ONE, 2016 Publication	
8	tsukuba.repo.nii.ac.jp Internet Source	1 %
9	eprints.mums.ac.ir Internet Source	1 %
10	"1st Annual Conference of Midwifery", Walter de Gruyter GmbH, 2020 Publication	1 %
11	link.springer.com Internet Source	1 %
12	journals.plos.org Internet Source	<1 %
13	mainearms.com Internet Source	<1 %
14	repository.ubaya.ac.id Internet Source	<1 %
15	www.ncbi.nlm.nih.gov Internet Source	<1 %
16	ejcm.journals.ekb.eg Internet Source	<1 %
17	Karolina Łagowska, Daria Kazmierczak, Katarzyna Szymczak. "Comparison of	<1 %

anthropometrical parameters and dietary habits of young women with and without menstrual disorders", Nutrition & Dietetics, 2018
Publication

18	potravinarstvo.com Internet Source	<1 %
19	www.myfoodresearch.com Internet Source	<1 %
20	eprints.undip.ac.id Internet Source	<1 %
21	A Panaitescu. "Gestational Diabetes. Obstetrical Perspective", Acta Endocrinologica (Bucharest), 2016 Publication	<1 %
22	ajmb.umsha.ac.ir Internet Source	<1 %
23	reproductive-health-journal.biomedcentral.com Internet Source	<1 %
24	Eun-Kyung Jung, Seok-Won Kim, Sun-Myeong Ock, Kyu-In Jung, Chan-Hee Song. "Prevalence and related factors of irregular menstrual cycles in Korean women: the 5th Korean National Health and Nutrition Examination Survey (KNHANES-V, 2010–2012)", Journal of Psychosomatic Obstetrics & Gynecology, 2017	<1 %

	Publication	
25	Mengfan Wei, Gaihong An, Lijun Fan, Xuewei Chen, Chao Li, Jiajun Chen, Qiang Ma, Danfeng Yang, Jing Wang. "Characteristics of Menstrual Cycle Disorder and Saliva Metabolomics of Young Women in High-temperature Environment", Research Square Platform LLC, 2021 Publication	<1 %
26	eprints.qums.ac.ir Internet Source	<1 %
27	mikm.undip.ac.id Internet Source	<1 %
28	repository.stikes-bhm.ac.id Internet Source	<1 %
29	www.sciepub.com Internet Source	<1 %
30	Hardisman, Sunesni, Silvia Mardiah. "THE RELATIONSHIP OF WOMEN's CHARACTERISTICS WITHVISUAL INSPECTION OF ACETIC ACID TEST OUTCOME IN PADANG PASIR PUBLIC HEALTH CENTRE AREA 2017", Walter de Gruyter GmbH, 2020 Publication	<1 %
31	bapendik.unsoed.ac.id Internet Source	<1 %

32	ir.ymlib.yonsei.ac.kr Internet Source	<1 %
33	ptj.uswr.ac.ir Internet Source	<1 %
34	"Poster Session Clinical", European Journal of Heart Failure, 2013. Publication	<1 %
35	Michinori Mayama, Takeshi Umazume, Hidemichi Watari, Sho Nishiguchi, Takuhiro Moromizato, Takashi Watari. "Frequency of night shift and menstrual cycle characteristics in Japanese nurses working under two or three rotating shifts", Journal of Occupational Health, 2020 Publication	<1 %
36	Xue Liang, Chao Qiang Jiang, Wei Sen Zhang, Feng Zhu, Ya Li Jin, Kar Keung Cheng, Tai Hing Lam, Lin Xu. "Glycaemia and Hand Grip Strength in Aging People: Guangzhou Biobank Cohort Study", Research Square, 2020 Publication	<1 %
37	sites.kowsarpub.com Internet Source	<1 %
38	www.ijdr.in Internet Source	<1 %
39	www.mdpi.com Internet Source	

		<1%
40	www.science.gov Internet Source	<1%
41	www.tandfonline.com Internet Source	<1%
42	Julian Mutz, Cathryn M Lewis. "Age-related changes in physiology in individuals with bipolar disorder", Cold Spring Harbor Laboratory, 2021 Publication	<1%
43	Leslie-Faith Morritt Taub, Nancy S. Redeker. "Sleep Disorders, Glucose Regulation, and Type 2 Diabetes", Biological Research For Nursing, 2008 Publication	<1%
44	Lim, Hyunjung, and Ryowon Choue. "Diet Quality and Cerebral Infarction: South Korean Aspects", Diet Quality, 2013. Publication	<1%
45	hdl.handle.net Internet Source	<1%
46	J. H. Piatt. "Treatment of Dystonia in Children", AAP Grand Rounds, 2002 Publication	<1%

47	Małgorzata Jacewicz-Święcka, Irina Kowalska. "Polycystic ovary syndrome and the risk of cardio-metabolic complications in longitudinal studies: a review of the data", Diabetes/Metabolism Research and Reviews, 2018 Publication	<1 %
48	T. Cundy. "Perinatal mortality in Type 2 diabetes mellitus", Diabetic Medicine, 1/2000 Publication	<1 %
49	&NA;, . "Abst D-FreeCommPosters :", Medicine & Science in Sports & Exercise, 2012. Publication	<1 %
50	Diet Quality, 2013. Publication	<1 %
51	Jiyun KIM, Jong-Eun LEE. "Social Support and Health-Related Quality of Life Among Elderly Individuals Living Alone in South Korea", Journal of Nursing Research, 2018 Publication	<1 %
52	Selvy Apriani, Zen Hafy, Yusuf Effendi. "Hubungan Kadar Anti Mullerian Hormon (AMH) dan Indeks Massa Tubuh (IMT) dengan Panjang Siklus Menstruasi Premenopause", Biomedical Journal of Indonesia: Jurnal Biomedik Fakultas Kedokteran Universitas Sriwijaya, 2018 Publication	<1 %

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		