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Correlation between intakes of carbohydrates, protein, and fat with random blood sugar levels in menopausal women

Original article

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Abstract: **Objective:** Carbohydrates, proteins, and fats are energy sources needed by the body for performing daily activities and generating primary energy substances. In women who have undergone menopause, the function of thyroid hormone in their body begins to decline and thus affects the ability of the body to produce energy. The purpose of this study was to determine the correlation between the intakes of carbohydrates, proteins, and fats and random blood sugar levels in menopausal women.
Methods: This study was a correlational analytical research with a cross-sectional design, which was conducted in 72 menopausal women recruited by the purposive sampling technique. In this study, a 24-hour food recall form was used, and randomized blood sugar levels were measured using a glucometer. The analysis of the data was performed using a Pearson product moment and multiple linear regression.
Results: Carbohydrates and fats together affected random blood sugar levels with an F-value of 25.810 and a p-value of 0.000. Meanwhile, adjusted R^2 showed the value of 0.411, indicating that the difference in the intake of carbohydrates and fats together affected random blood sugar levels by 41.1%.
Conclusions: Intake of carbohydrates and fats affected random blood sugar levels, whereas the rest were influenced by other factors, and protein intake was unrelated to random blood sugar levels in menopausal women.

Keywords: carbohydrate intake • fats • menopausal women • protein • random blood sugar levels

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1. Introduction

Diabetes mellitus (DM) is a major health problem in the world. WHO estimated that more than 346 million people worldwide suffer from DM.[1] In women, DM is a leading cause of death due to non-communicable diseases.[2] Obesity, high-calorie diet, and lack of physical activity and exercises are some contributing factors to DM.

Women, especially in the postmenopausal period, have decreased thyroid and leptin hormones, which results in decreased basal metabolic rate and fat metabolism, causing a tendency to obesity.[3]

People with obesity often have decreased functions of insulin, which causes the disruption of blood sugar metabolism, resulting in increased blood sugar levels. Blood sugar levels are elevated in untreated DM. An

How to cite this article: Suniyadewi NW, Pinatih GNI. Correlation between intakes of carbohydrates, protein, and fat with random blood sugar levels in menopausal women. *Front Nurs*. 2019; 1: xx-xx.

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elevated random blood sugar level of ≥200 mg/dl, along with the symptoms of polyuria, polydipsia, polyphagia, and unexplained weight loss are diagnostic criteria for DM.[1] Therefore, the level of random blood sugar is one of the earliest indicators to detect the possibility of DM. However, for further detection, two or more blood sugar tests, either fasting blood sugar or blood sugar before or 2 hours after a meal with abnormal value, are still required. Based on a preliminary study conducted in menopausal women, it was shown that 58% of these women had random blood sugar levels of ≥ 200 mg/dl. It was also indicated that these women had an average carbohydrate and fat intake, which exceeded their daily needs. This study aimed to determine the correlation between the intakes of carbohydrates, proteins, and fats and random blood sugar levels in menopausal women.

2. Materials and methods

This study used an analytical cross-sectional design and was conducted in the work area of Public Health Centers III in North Denpasar, Bali. A total of 72 menopausal women were included in this study. The inclusion criteria are as follows: willing to be a respondent, do not have DM, hypothyroidism or hyperthyroidism, menopause not caused by tumors, cancer, estrogen hormone therapy, and has no history of hysterectomy. They were recruited by the consecutive sampling technique. To measure the intakes of carbohydrates, proteins, and fats, a form of 24-hour food recall for household use was used.[4] The data were retrospectively collected. The respondents were requested to write on the 24-hour recall form on Monday to assess the food intake on Sunday, on Wednesday for Tuesday's intake, and on Saturday for Friday's intake. The intakes were converted into grams by using the Nutrisurvey program, 2007 version. Weitgasser et al.[5] reported that random glucose levels could be measured in milligrams per deciliter (mg/dl) by using an Essay Touch glucometer with a sensitivity of 70% and a specificity of 90%. A capillary blood sugar examination was randomly done once without considering the mealtimes.

In this study, the data were analyzed using a bivariate analysis of Pearson product moment and a multivariate analysis of multiple regression tests. This study was approved by the Research Ethics Committee of the Faculty of Medicine, Udayana University and Sanglah Denpasar Hospital of number 204/UN.14.2/Litbang/2015 dated on February 18, 2015.

3. Results

All respondents (n=72) participated in this study well. The majority were 60–74 years (88.90%) and worked as a housewife (86.10%).

In Table 1, it can be seen that the average intake of carbohydrates, proteins, and fats of the 72 respondents in 3 days is lower than the average daily nutritional intake of women aged 65–80 years. Based on the average level of blood sugar, the respondents are included in the category of uncertain DM.

In Table 2, it can be seen that the results of the bivariate analysis with Pearson product moment showed a strong, positive, and significant correlation between carbohydrate intake and random blood sugar levels with r = 0.647. Moreover, there was also a weak, positive, and significant correlation between fat intake and random blood sugar levels with r = 0.264. However, there was no correlation between protein intake and random blood sugar levels.

Table 3 shows that carbohydrate and fat intakes are associated with blood sugar levels in menopausal women with a p-value of 0.000 and an adjusted R^2 of 0.411. This means that 41.10% increase in blood sugar levels is affected by carbohydrate and fat intakes, whereas the rest is affected by other factors. Similarly, the t-value of each variable indicates that carbohydrate and fat intakes are associated with random blood sugar levels.

Scores	Carbohydrates (g)	Proteins (g)	Fats (g)	Random blood sugar (g/dl)
Mean	230.67	38.70	24.04	183.50
Minimum	93.00	15.70	11.72	96.00
Maximum	418.50	76.63	39.19	271.00
SD	68.27	1.12	6.10	4.30

Table 1. Average intake of carbohydrates, proteins, and fats and blood sugar levels.

Variables	Random glucose level	
	P	r
Carbohydrate intake	0.000	0.647
Protein intake	0.576	−0.670
Fat intake	0.025	0.264

Table 2. Bivariate correlation analysis between the intake of carbohydrates, proteins, and fats and random blood sugar levels.

Variables	t	P	Adjusted R^2	F	P
Carbohydrate intake	6.080	0.000	0.411	25.81	0.000
Fat intake	2.262	0.027			

Table 3. Multivariate analysis between the intake of carbohydrates, proteins, and fats and random blood sugar levels.

4. Discussion

This study shows that there is a correlation between carbohydrate and fat intakes and random blood sugar levels in menopausal women, and only protein intake is not correlated. Carbohydrate intake can increase random blood sugar levels, and according to Sudoyo,[6] it occurs because carbohydrates are converted into disaccharides that are broken down into monosaccharides, i.e., glucose, fructose, and galactose. Glucose and galactose are absorbed faster than fructose, and hence they can directly increase blood sugar levels, and along with the fat intake, they can also indirectly lead to obesity. The results of absorption of the monosaccharide, if not used by the body, circulates in the blood and are gradually stored in the liver and muscle tissues in the form of glycogen by the insulin.[7] It is because the rest of the unused carbohydrates are quickly converted to fatty acids and glycerol and are eventually stored as triglycerides in the adipose tissues. The excessive intake of carbohydrate that is not balanced with energy consumption will be stored as fat tissue that can lead to obesity.[8]

In line with carbohydrate intake, fat intake is also associated with random blood sugar levels. It is because excessive fat intake can increase the risk of obesity. In obese individuals, increased fat intake can aggravate the condition and may increase the risk of metabolic syndrome; one of which is type 2 DM. In obese individuals, there is a risk of an inflammatory response due to the accumulation of trans fats. Trans fats can quickly cause a person to gain weight. A person who has excess body weight has a greater risk of insulin resistance since the fat interferes with the body's ability to use insulin. In menopausal women, the leptin produced by the pituitary gland is decreasing. A decreased level of leptin will decrease the rate of fat metabolism and make the hypothalamus function abnormal, and this causes a state of hyperphagia. Meanwhile, the amount of insulin will increase, which causes the occurrence of hyperinsulinemia. However, in this state, the insulin cannot work well due to its resistance caused by the buildup of fat tissue that causes increased levels of glucose in the blood.[9]

According to Dedi,[10] premenstrual syndrome and postmenopause make the body fat to be easily accumulated due to hormonal process and hence women are at risk of increased blood sugar levels that lead to type 2 DM. If hyperglycemia occurs in prolonged time and exceeds 200 mg/dl and is worsened by the presence of insulin resistance due to obesity and/or menopause, there will be an increase in HbA1c, which causes someone to positively suffer from DM.[11]

Based on the results of this study, it is indicated that only protein variable is unrelated to random blood sugar levels. In a study by Indriasari,[12] which investigated the relationship between diet and blood sugar levels in outpatients with type 2 DM, the p-value of the protein intake was 0.162, indicating that there was no correlation between protein intake and blood sugar levels. It occurs because the primary function of protein is to assist the process of growth and replace damaged cells. Furthermore, protein stays longer in the stomach since it is not hydrolyzed by the gas. This condition is beneficial to prevent the occurrence of hunger and overeating to prevent from obesity. In the Atkins diet, the intake of proteins should be increased, whereas the intake of carbohydrates should be decreased.[13]

5. Conclusions

The variables that were evident to be significantly correlated with random blood sugar levels in menopausal women include carbohydrate and fat intake. On the contrary, protein intake was unrelated to the random blood sugar level.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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