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Obesity and Cholinesterase Level Related to Impaired Fasting Glucose in Indonesian Farmers

Larasati, TA[1], Fardiansyah, AI[2]
[1]Medical Faculty, University of Lampung
[2]Law Faculty, University of Lampung

ABSTRACT: Obesity is characterized by the excessive accumulation of fat caused by mutations in the leptin gene and its receptors. In Indonesia, the incidence of childhood obesity increased from 6.4% in 2007 to 9.2% in 2010. The prevalence and risk factors for childhood obesity in rural Indonesia, particularly in Teluk Pandan Subdistrict, Pesawaran District, Lampung Province, have not been extensively studied. This study aims to determine the prevalence and risk factors for childhood obesity in this rural-coastal area. A survey method was used for the prevalence study, and a case-control approach was used to identify risk factors. The study involved 94 students from elementary schools in Teluk Pandan, matched based on obesity status, gender, and age. Obesity was defined as a BMI at or above the 95th percentile of the CDC chart. Variables measured included dietary patterns, lack of physical activity, family income, parental obesity status, early introduction of complementary foods, and history of exclusive breastfeeding, analyzed using chi-square tests. The results showed that 148 out of 3190 children were overweight. Identified risk factors included excessive food consumption (p=0.0001; OR=15.622; CI95% 5.702-42.803), lack of physical activity (p=0.0001; OR=7.714; CI95% 2.868-20.751), high family income (p=0.0096; OR=2.202; CI95% 0.958-5.059), parental obesity status (p=0.0001; OR=24.5; CI95% 7.870-76.271), early introduction of complementary foods (p=0.0001; OR=4.567; CI95% 1.916-10.888), and non-exclusive breastfeeding (p=0.0005; OR=4.046; CI95% 1.605-10.201). The prevalence of childhood obesity in Teluk Pandan is 46% lower compared to urban areas in Indonesia. This study identifies several risk factors associated with childhood obesity in rural-coastal areas, including excessive food consumption, lack of physical activity, parental obesity, early introduction of complementary foods, and non-exclusive breastfeeding.

KEYWORDS: Children, Obesity, Prevalence, Rural-coastal area, Risk factors.

1.0 INTRODUCTION

Prediabetes is a metabolic disorder characterized by hyperglycemia in the form of Impaired Fasting Glucose (IFG) and / or Impaired Glucose Tolerance (IGT) as a result of defects in insulin secretion, insulin performance, or both, without meeting the diagnostic criteria for Diabetes Mellitus type 2 (T2DM) so it is called with prediabetes (ADA, 2020). Prediabetes is an early form of Diabetes mellitus type 2 (T2DM) as well as a major predictor with many risk factors, namely family history of T2DM, male gender, obesity, middle age and above, history of hypertension treatment, physical activity, low and high fiber diet. fat, hip circumference, treatment with steroids (Rahman, 2008), polycystic ovary smoking syndrome (Harati, 2009). The prevalence of prediabetes is increasing worldwide, and experts estimate that 470 million people will suffer from prediabetes by 2030. Indonesia's Basic Health Research (Riskesdas) shows the prevalence of prediabetes according to impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) has increased sharply, respectively. from 2007, 2013 and 2018 for IFG were 10.2%, 36.6%, and 26.3%, while the IGT was 29.9%, 30.8%. In 2018 in Indonesia, the proportion of prediabetes, rural communities was higher than urban areas, namely IFG 27.7% versus 25.1% and IGT 33.1% versus 28.8%, reinforced by data that the occupation group as farmers or farm laborers occupies the proportion Most prediabetes with IFG 31.6% and IGT 32.4%, compared to other occupational groups, where it is known that the majority of farmers or farm laborers live in rural areas.

Since the Green Revolution was launched in the 1960s, rice production has increased by 40% from the initial period of the rice intensification program. The Indonesian government has issued Government Regulation Number 7 of 1973 concerning pesticides in response to their use which has increased from year to year, with the number recorded up to October 2012 totaling 2987 formulations. Pesticides are substances or compounds used to control organisms that are detrimental to plants (pests, diseases, weeds) and therefore

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detrimental to farmers, animals and plants. (Setyanto, 2014). Initially the use of pesticides was used in rice farming, then it was also widely used in various types of plantations, such as fruits and vegetables. Although it began to be used in 1960, Indonesia only achieved food self-sufficiency in 1984. The long and extensive use of pesticides has damaged the environment, as well as impacted the health of farmers. Organophosphates, both acute and chronic exposure, have also been shown to cause diabetes through various mechanisms (Laksmi *et al*, 2019), as well as distance from agricultural land which can cause chronic pesticide poisoning, leading to insulin resistance. Diabetes risk is increased in applicators over 100 lifetime days. Previous studies on pesticide spraying couples on farms have shown an association with gestational diabetes and pesticide use during pregnancy (Montgomery, 1996). The high level of prediabetes in farmers and rural communities (Riskesdas, 2018) raises suspicions regarding exposure to organophosphates which are widely used by Indonesian farmers. However, there is no study in Indonesia that examines this, whether exposure to organophosphates plays a role in increasing prediabetes in rural areas in Indonesia. It is important to know this so that the government can determine the right prevention policy. So far diabetes prevention has been focused on healthy lifestyle campaigns, and has not implemented specific prevention of prediabetes and diabetes in agricultural populations with organophosphate exposure. With this background, this study aims to determine the factors associated with prediabetes at the individual farmer level, including: hypertension, age, body mass index, central obesity, waist-hip ratio, and cholinesterase levels. characterized by hyperglycemia in the form of Impaired Fasting Glucose (IFG) and / or Impaired Glucose Tolerance (IGT) as a result of defects in insulin secretion, insulin performance, or both, without meeting the diagnostic criteria for Diabetes Mellitus type 2 (T2DM) so it is called prediabetes (ADA, 2020).

2.0 RESEARCH METHODS

2.1Study Design and Population

This was a observational - cross sectional study, with purposive sampling. Participants were 70 couples of vegetable farmers or 125 men and women in a rural area, Gisting village, Tanggamus Distric, Lampung Province, Indonesia. Recruitment of subjects in this study was based on the willingness to come to the village hall where the sample was measured and not based on random. A total of 15 subjects who obtained fasting blood sugar 126 mg / dl or more were excluded from the study.

2.2 Sampling and Data Collection

The population of farmers who were the subjects of this study grew vegetables such as cabbage, green beans, eggplant, pumpkin, long beans, chilies, and cucumbers. To keep plant growth from pests, farmers spray pesticides 2-3 times a week. Their houses are surrounded by plantation areas, so that their gardens can be located between the dwellings up to 1-2 km from their houses.

2.3 Measurement

The anthropometric measurement is done in person, BMI is measured using a standard measuring scale, by the public health officers. BMI was calculated as the ratio of body weight in kilograms divided by square of the height in meters. Waist circumference was obtained by measuring waist circumference at the end of several consecutive natural breaths, at a level parallel to the floor, midpoint between the top of the iliac crest and the lower margin of the last palpable rib in the mid axillary line. (WHO, 2008). Pregnant women and people with ascites were not included. Systolic and diastolic BP were recorded after two measurement made 15 minutes apart. BP was measured by community nurses using sphygmomanoeter. IFG measurement was conducted only on those who had fasted overnight for 8 hours before the test. The IFG level and Cholinesterase was checked by kinetic photometric test.

2.4 Definitions

IFG has been defined as an IFG result of ≥100 mg% and <126 mg% (ADA, 2020). BMI has been defined as <23 as normal; ≥23 as overweight-increased risk and ≥27.5 as obesity - high risk (WHO, 2004). Central obesity has been considered as abnormal for females with a WC >80 cm and for males with a WC >90 cm (IDF, 2006). Hypertension has been defined as either systolic blood pressure ≥140 mmHg; high normal 120-139 mmHg; normal 120 mmHg or diastolic pressure ≥90 mmHg (JNC 7, 2004). Age has been categorized into less than 40 years and 40 years and above. Low levels of cholinesterase have been defined as <4355 for females and <5355 for males. Although the normal range of cholinesterase for females is 3930-10800 u/l and for males is 4620-11500 u/l (Banday, 2015), previous studies on acute OP poisoning showed that hyperglycemia (Random Blood Sugar >200 mg/dl) occurred with an average pseudocholinesterase level of 4355.35 with an SD of 1520.86, whereas normoglycemia had an average cholinesterase level of 5355 without gender differentiation (Ravi BN, 2018).

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3.0 RESULTS

Table 1 shows several variables that jointly affect IFG, namely hypertension, age group, body mass index, and cholinesterase levels, while central obesity, waist hip ratio were excluded. Table 2, shows significant differences in the proportion of body mass Index, Central Obesity and Cholinesterasis levels based on gender in the study population.

Table 1. Impaired Fasting Glucose and Related Factors

No.	Criteria	Blood glucose		*p-value*	*OR*	*Convidence 95%*	*Interval*
		Normal	IFG			Lower	Upper
1	Hypertension						
	Normal (< 120 mmHg)	34 (85,0%)	6 (15%)	0,009*	4,499	0,010	0,01
	High normal (120-139 mmHg)	43 (65,2%)	22 (34,8%)	**0,003****		1,656	12,226
	Hypertension (≥140mmHg)	9 (47,4%)	10 (52,6%)				
2	Age group						
	< 40	38 (77,6%)	11 (22,4%)	0,134*	4,029	0,383	1,747
	≥ 40	48 (63,2%)	28 (36,8%)	**0,047****		1,017	15,954
3	Sex						
	Male	42(66,7%)	21 (33,3%)	0,745*	-	0,383	1,747
	Female	44(71,0%)	18(29,0%)	0,09**		0,087	0,098
4	Body Mass Index						
	< 23; normal	52 (82,5%)	11 (17,5%)	0,001*	-	-	-
	≥ 23- <27,5; overweight	26 (63,4%)	15 (36,6%)				
	≥ 27,5: obesitas	8(38,1%)	13(61,9%)	**0,001****	**19,12**	5,007	73,017
5	Waist Hip Ratio						
	0-0,85 female) or 0-0,90 (male)	61 (75,3%)	20 (24,7%)	0,054*	2,318	1,061	5,065
	0,86 ≤ (female) 0,90 ≤ (male)	25 (56,8%)	19 (43,2%)				
6	Waist circumference						
	0 – 80 (female) 0- 90 (male)	79 (74,5%)	27 (25,5%)	0,003*	5,016	1,792	14,042
	81 – and above(female) 91- ke and above (male)	7 (36,8%)	12 (63,2%)				
8	Cholinesterase levels						
	0-4355 (female) / 0-5355 (male)	9 (48,4%)	25 (73,5%)	0,001*	15,28	5,902	39,551
	4355- ke and above (female)/ 5355- ke and above (male)	77 (84,6%)	14 (15,4%)	**0,001****		41,524	6039

*chi-square test

**logistic regression test; backward method (Wald)

The proportion of IFG in the survey population of 31.2% is equivalent to the prevalence of the IFG among farmers in Indonesia in 2018 of 31.6%. The ratio of gender-based IFGs showed that men were 33.3% higher than women at 29%, which is also roughly

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the same as the national data in Indonesia, where the gender ratio was 27.3% higher for men compared to 25.3% for women. (Balitbangkes, 2018).

Table 2. Risk Factor of IFG based on Sex

No	Variables	Sex		P	OR	95% CI	
		Male	Female			Lower	Upper
1	**Sistolic hypertension**						
	Norm	19 (47,5%)	21 (52,5%)	0,902*	-	-	-
	Pre-hypertension	34 (51,5%)	32 (48,5%)				
	Sistolic hyprtension	10 (52,6%)	9 (47,4%)				
2	**Body Mass Index**						
	Norm	42 (66,7%)	21 (33,3%)	0,001*	-	-	-
	Overweight	18 (43,9%)	23 (56,1%)				
	Obesity	3 (14,3%)	18 (85,7%				
3	**Central obesity**						
	No	58(54,7%)	48(45,3%)	0,042*	3,39	1,137	10,067
	Yes	5(26,3%)	14(73,7%)				
4	**Cholinesterase**						
	Norm	37(40,7%)	54(59,3%)	0,01*	0,211	0,086	0,517

*chi-square test

The distribution of cholinesterase levels by sex can be seen in table 2, where men have a higher chance of

3.1 Discussion

This study on a population of farmers shows that the older age group (> 40 years) has a 4 times higher chance of developing IFG, increasing age according to many studies increases the risk of cardiovascular disease, as well as metabolic diseases, including prediabetes (Heikes, 2007) (Hilawe, 2016). (Berkowitz, 2013), Although several studies show a tendency for prediabetes in the earlier age group, namely the 25-44 year age group (Aldosari, 2018) Its known that aging induces a decrease of insulin sensitivity and alteration or insufficient compensation of beta cell functional mass in the face of increasing insulin resistance.

Systole hypertension in this population of farmers has been shown to be a risk factor for IFG with an OR 4.5 times greater than that of farmers who do not suffer from hypertension systolic. This study shows that low levels of cholinesterase together with hypertension, the age group over 40, and body mass index play a role in the occurrence of IFG in farmers. Farming community, exposed to organophosphate. As previously known, this research was conducted on vegetable farmers who sprayed pesticides 2-3 times a week, this caused them to be exposed to Ops, thereby reducing cholinesterase activity. Goswamy R et al, in their study concluded that apart from clinical indicators, low plasma cholinesterase levels were of gratest predictive value in organophosphorus poisoning. are useful in diagnosis of organophosphorus poisoning in acute. OPs can influence body glucose homeostasis by several mechanisms including physiological stress, oxidative stress, inhibition of paraoxonase, nitrosative stress, pancreatitis, inhibition of cholinesterase, stimulation of adrenal gland, and disturbance in metabolism of liver tryptophan (Rahimi, 2006). OPs compounds inhibit cholinesterase allowing accumulations. of acetylcholine at cholinergic sites resulting in continuous stimulation of cholinergic sites leading to marked increase in catecholamines which can lead to hyperglycemia. From table 2 it is known that women have a lower percentage of low cholinesterase levels. This is possible because they are not involved in the spraying process, although they are still affected indirectly through the environment.

Body mass index is better at influencing IFG in farmers than waist hip ratio and central obesity. Based on the data presented in table 2, the proportions of BMI and CO differ significantly between male and female farmers. This is because women have substantially more total adipose tissue than men, and these whole-body sex diffrences are complemented by major differences in tissue distribution (WHO, 2008). In addition to gender, race and ethnicity also influence the magnitude of the risk of prediabetes. Asian races generally have more body fat composition, so that the body fat limit of Asian races (farmers) is lower than European races.

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and in line with this, the results of this study show that the proportion of CO, BMI, and WHR of male farmers2 is smaller than that of women. Because anthropometric indicators, especially OC and WHR, take into account the amount of fat deposits in the body. Apart from differences in the proportion of body fat, it is also related to physical activity. Most of agriculture in Indonesia is in the form of small family farms, meaning that agricultural activities are managed by all family members, especially fathers and sons. Smallholder agriculture in Indonesia is often practiced without the benefit of modern tools or improved seed varieties, only 10% using motorized equipment. (FAO, 2018). To carry out the production process, prepare the land, sow and plant seeds, spray pesticides, to post-harvest activities, the share of family labor days spend on farm (0.78 person days) shows that the majority of farmers' time is working. This causes the physical activity of farmers, especially men, including vigorous-intensity activity that causes large increases in breathing or heart, such as hoeing, plowing, and lifting (WHO,2004). As a member of smallholder farming, my wife is involved only in light activities such as picking vegetables and pulling grass. This is in line with previous studies that show that women in rural areas (farmers) in Indonesia are more inactive (26%) than women (12%), and this number is among the most active compared to other countries in Asean (Nawi, 2009)

4.0 CONCLUSION

Key factors contributing to IFG among vegetable farmers include systolic hypertension, age over 40 years, BMI, and low cholinesterase levels. Further research during non-planting seasons and with larger sample sizes is recommended for better insights.

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