The Relationship

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THE RELATIONSHIP OF DISLIPIDEMIA AND PRE-DIABETES MELLITUS IN INDONESIA

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Abstract: Diabetes mellitus has now become one of the major health problems in the world and even in Indonesia, the prevalence of diabetes has reached 11.8%. One of the causes of the increase in type 2 diabetes mellitus is due to the high prevalence of pre-diabetes which is 44%, and then 5-10% will develop into diabetes. On the other hand, the incidence of hypercholesterolemia is also high, reaching 35.9% in the year 2018. This study aims to find out the relationship between dyslipidemia with pre-diabetes and diabetes. Data obtained from Indonesia's basic health research year 2013, as many as 20,213 subjects aged between 15-65 years old. The results show that prevalence of pre-diabetes = 44.97%, type 2 diabetes mellitus = 12.18%. Percentage of dyslipidemia = 33.89% (hypercholesterolemia), LDL at risk = 77.61% and HDL at risk = 39.63%. The most influential factor for pre-diabetes and type 2 diabetes mellitus is age (>45years), RR= 1.82 (95% CI =1.71-1.92) and RR= 3.48 (95% CI = 3.17-3.81), respectively. There is a relationship between gender, age, dyslipidemia (total cholesterol, HDL and LDL) with pre-diabetes and type 2 diabetes mellitus. Conclusion: Dyslipidemia must be one of the serious concerns in efforts to reduce pre-diabetes and diabetes.

Keywords: Pre-diabetes, type 2 diabetes, dyslipidemia.

Introduction

Prevalence of diabetes mellitus (DM) shows a rising trend lately especially at age >15 years old. Based on the 2013 National basic health research, the prevalence of type 2 diabetes was 11.8% at the age of 15-65 years. [1] Based on the same data in year 2007, the numbers of impaired glucose tolerance (IGT) aged >15 years was 10.2%. The prevalence of DM is 6.4% (female) and 4.9% (male). The proportion of IGT at age 15-24 reaches 5.3%. The prevalence increases sharply at the age of 35-54 years. The determinant factors for IGT and diabetes are age, smoking, obesity, central obesity and hypertension. [2] (2) The other research conducted by Pramono, the prevalence of DM was 5.6% in the population aged >15 years in 2007, and the prevalence of undiagnosed diabetes 4.1% of the total diagnosed DM, and the prevalence of *impaired glucose tolerance (IGT)* reaches 10.0%. [3]

The term of dyslipidemia is a disorder of lipoprotein metabolism, including lipoprotein excess and, deficiency. It may be manifested by total cholesterol, low density lipoprotein (LDL), and triglyceride concentration elevation and decreased high density lipoprotein (HDL) concentration. [4,5]

Pre-diabetes problems

Pre-diabetes is defined as a condition where the results of blood sugar tests during fasting (*fasting plasma glucose*) are 100-125 mg/dL or blood glucose values 2 hours postprandial 140-199 mg / dL. Meanwhile

according to the value of A1C level = 5.7% - 6.4% as pre-diabetes. In pre-diabetes, the value of glucose levels is quite high, but can't be categorized as diabetics. If risk factors continue to persist in a person with pre-diabetes, then he or she will suffer from diabetes in the future.

About 5-10% of people with pre-diabetes will develop diabetes, and vice versa can also return to normal. An increase in the prevalence of pre-diabetes is increasing worldwide and it is estimated that around 470 million people will suffer from pre-diabetes by 2030. [6] The prevalence of pre-diabetes is 7.3% and diabetes is 12.1%, the risk of pre-diabetes is associated with obesity/overweight, hypercholesterolemia, hypertension. [7].

Hypercholesterolemia as a cause of type 2 diabetes mellitus

High levels of cholesterol are a risk factor for type 2 diabetes mellitus, hypercholesterolemia is defined as a situation in which the levels of serum triglycerides> 150 mg / dl (1.7 mmol/l), serum *high-density* lipoprotein cholesterol (HDL-c) < 40 mg / dl (1.03 mmol/l) in men and <50 mg/dL (1.29 mmol/l) in women or a history of dyslipidemia treatment. [4,8] Increased of total cholesterol levels will increase the risk of heart disease and stroke. Globally, one-third of the incidence of ischemia in heart disease results from high cholesterol. An overall increase in blood cholesterol estimated to cause 2.6 million deaths (4.5% of the total) and 29.7 million disability every year (*disability-adjusted life years = DALYs*, or 2% of the total *DALYs* . By lowering serum cholesterol at 10% a man at the age of 40 can reduce 50% of heart disease in 5 years, whereas a 70-year-old man will result in a 20% reduction in the incidence of heart disease in 5. In Ireland, a 30% reduction in heart disease deaths is contributed by a decline in average 4.6 % of total cholesterol. In Finland, a decrease of 50% of deaths caused by ischemic heart disease due to the cholesterol reduction population. [9]

In 2008 the figure prevalent s world, total cholesterol at age adults (≥ 5.0 mmol/l) was 39% (37% male and 40% female). The highest prevalence of total cholesterol increase in Europe (54% for men and women), followed by the American region (48%). The regions of Africa and Southeast Asia are around (22.6% for Africa and 29.0% for Southeast Asia) (WHO, 2014). In America, the proportion of high LDL cholesterol (> 130 mg/dL) reaches 31.7% where the proportion of men and women is almost the same. In 1999 to 2000 a high proportion of LDL ranged from 12.9% - 18.3%. [10]

According to Li's research in Taiwan in 2011 there were 5.2 % averaging 184 +/- 33.01 (men) and 5.0% averaging 179 +/- 33.17 (women) who had total cholesterol> 240 mg/dL. Meanwhile, the proportion of HDL cholesterol <40 mg/dL at 16.8 % average 49.72 +/- 11.16 (males) and 3.4% mean 61.29 +/- 13.34 (women). Triglycerides high levels of> 200 mg / dL at 13.3 % average of 130.57 +/- 103.71 (males) and 3.8% mean 86.01 +/- 58.12 (women). [11] A preliminary study conducted by Djap on 216 peoples in Kepa

Duri Village, West Jakarta, 2014 found the prevalence of hypercholesterolemia when (>200mg/dL) was 35,37 %.

High insulin levels in the blood in circumstances where the occurrence of resistance to insulin will increase cholesterol levels in the blood, especially LDL (*low-density lipoprotein*) levels. High LDL levels will tend to form plaque in arteries and reduce levels of HDL (*high-density lipoprotein*). Hypercholesterolemia is a predictor of diabetes mellitus because in these conditions will occur resistance to insulin.

As a result of insulin resistance, the use of glucose by insulin-sensitive tissues will decrease, while the levels of *hepatic glucose output* increases. As blood glucose levels increase, there will be an accumulation of lipids in skeletal muscle fibers, which disrupt oxidative phosphorylation and decrease mitochondrial ATP production. As a result, many free fatty acids come out of the adipocytes resulting in an increase in lipid synthesis (VLDL and triglycerides) in hepatocytes. Lipid storage (steatosis) in the liver can lead to non-alcoholic fatty liver and liver function abnormalities, such circumstances cause dyslipidemia in type 2 diabetes mellitus, which is an increase of triglycerides, LDL, and decreased HDL. [12]

Ectopic fat induces insulin resistance is an excess of intracellular energy in the form of diacylglycerol (DAG), which causes activation of protein kinase C (PKCθ) in muscles and PKCε in the liver and subsequent inhibition of insulin signals in this tissue. Thus it can be explained that insulin resistance is associated with obesity, aging, lipodystrophy, pre-diabetes, and type 2 diabetes. Logically, insulin resistance in muscles and liver induced by DAG and nPKCs may be an autonomous cell mechanism to turn off energy storage in liver and muscle cells when excessive intracellular fat and adipose tissue storage routes. [13]

The distribution of body fat is an additional factor that alleviates insulin resistance. Total body fat mass, accumulation of visceral adipose tissue / abdominal area and liver add to insulin resistance. This is related to inflammatory changes in the adipose depot with cytokine release. Intraperitoneal (visceral) adipose tissue may be very damaging because it flows directly to the liver through the portal vein, causing a high concentration of FFA (*free fatty acids*) in the liver. Furthermore, visceral adipocytes appear to be more responsive to lipolytic stimulation to catecholamines and lack of suppression of lipolysis by insulin. This can increase in the flow of *FFA* into the muscles and liver, increasing in intramyocellular and hepatic triglyceride levels and insulin resistance. [14,15]. Adiponectin content is inversely related to inflammatory markers and CRP (C-reactive protein) levels. [16]. Epidemiological studies also obtain inversely proportional results between *CRP* levels and the incidence of type 2 diabetes mellitus. [17]

Research purposes:

To find a picture of the incidence of pre-diabetes, type 2 diabetes, characteristics of dyslipidemia also the relationship between pre-diabetes, type 2 diabetes mellitus, and dyslipidemia.

Method

The study design was cross-sectional using the basic health research database in 2013 (Riskesdas). The study population was aged 15-65 years, after cleaning the data, a total of 26,213 subjects could be analyzed. The diagnostic criteria are based according to the *ADA (American Diabetes Association)* where pre-diabetes: fasting blood sugar = 100-125 g/dL or blood sugar 2 hours postprandial = 140-199 g / dL and diabetes: fasting blood sugar ≥126g/dL or blood sugar 2 hours postprandial ≥200g/dL. [18] The dyslipidemia criteria are based according to the *American Association of Clinical Endocrinologists and the American College of Endocrinology*. [19]

Research result:

Table 1. Frequency of Diabetes based by fas**ting and 2 hours post prandial blood glucose**

Diabetes Status	**n**	**%**
Normal	11,233	42.85
Pre DM	11,787	44.97
DM	3,193	**12.18**
Total	26,213	100.00

Table 2. Distribution of frequency based by sex, age, total cholesterol, triglyceride, LDL, and HDL

Variable		**N**	**%**
Gender	Male	10,349	39.5
	Female	15644	60.5
Age	> 45 years old	9,957	37.98
	<= 45 years	16,256	62.02
Total cholesterol	> = 200 mg/dL	8,883	33.89
	<200 mg/dL	17,330	66.11
Triglyceride Levels	Risk (> = 150mg/dL)	5,409	20.63
	No risk (<150mg/dL)	20,804	79.37
LDL levels	Risk> = 100 mg/dL	20,343	**77.61**
	No risk <100 mg/dL	5870	22.39
HDL content *	Risky	10,389	39.63
	No risk	15,824	60.37

* HDL levels are at risk: - Men <40 mg/dl (1.03 mmol/L)
- Women <50 mg/dL (1.29 mmol/L)

The table above shows that the proportion of LDL lipid profiles at risk (≥100mg/dL) is very high, reaching 77.61 %, this is due to the projection of high total cholesterol levels (≥200mg/dL)= 33.89%, where generally the increase in total cholesterol is followed by high levels of LDL. The proportion of HDL at risk is also quite high (men <40mg/dL and women <50mg/dL) which reaches =39.63%. The majority of Indonesian people just have a mild physical activity (60.8 %) in which could potentially as a risk factor for obesity and then becoming pre-diabetes and diabetes incidence.

Table 3. Subject characteristics and bivariate analysis of the relationship between diabetes mellitus, pre-diabetes and normal with independent variables

Variable	Diabetes Mellitus		Pre-diabetes		Normal
Gender	N (%)	PR (95% CI)	N (%)	PR (95% CI)	Reff (%)
- woman	2,100 (13.23)	1.27 (1.19-1.36)	7,181 (45.27)	1.05 (1.02-1.08)	6,583 (41.5)
- man	1,093 (10.56)		4,606 (44.51)		4,650 (44.93)
Age					
- > 45 years	1,914 (19.23)	**2.85** (2.68-3.03)	4,986 (50.07	**1.37** (1.33-1.40)	3,057 (30.70)
- <= 45 years	1,279 (7.87)		6,801 (41.84)		8,176 (50.29)
Total cholesterol					
- > = 200 mg / dL	1,617 (18.20)	2.18 (2.05-2.31)	4,265 (48.01)	1.23 (1.21 -1.26)	3,001 (33.79
- <200 mg / dL	1,576 (9.09)		7,522 (43.40)		8,232 (47.51)
Triglyceride					
- > = 150 mg / dl	623 (25.72)	**2.47** (2.31-2.64)	1,133 (46.78)	**1.25** (1.21-1.30)	666 (27.50)
- <150 mg / dl	2,570 (10.80)		10,654 (44.78)		10,567 (44.42)
LDL					
- > = 100 mg / dL	2,738 (13.46)	1.91 (1.74-2.09)	9,391 (46.16)	1.21 (1.17-1.25)	8,214 (40.38)
- <100 mg / dL	455 (7.75)		2,396 (40.82)		3,019 (51.43)
HDL					
- Risky (low)	1,626 (15.65)	1.63 (1.53-1.73)	4,779 (46.01)	1.11 (1.08-1.14)	3,983 (38.34)
- No risk (high)	1,567 (9.90)		7,008 (44.28)		7,250 (45.82)

PR = prevalence ratio

Table 4. Multinomial logistic regression analysis, pre-diabetes and type 2 diabetes mellitus compared to the healthy group

	RRR	Std. Err	z	p> (z)	95% Conf. the interval	
Pre-diabetes						
HDL	0 .99 5	0 .001	-4.31	0.000	0.992	0 .997
LDL	1.003	0 .000	7.70	0.000	1.003	1.004
Triglyceride	1.002	0 .000	9.36	0.000	1.002	1.003
Gender	0.849	0 .25	-5.53	0.000	0.802	0.900
Age (> 45 yrs)	**1.815**	0.054	19.96	0.000	1.71 2	1.924
Cons	0.651	0.054	-5.20	0.000	0.55 4	0.765
Diabetes						
HDL	0.98 2	0.002	-9.08	0.000	0 .97 8	0.985
LDL	1.008	0.001	12.79	0.000	1.00 7	1.009
Triglyceride	1.005	0 .000	17.33	0.000	1.00 6	1.006
Gender	0 .56 5	0 .027	-11.92	0.000	0. 514	0.620
Age (> 45 yrs)	**3.47 6**	0 .161	26.86	0.000	3.17 4	3.80 7
Cons	0.90	0 .012	-17.94	0.000	0 .069	0.117

Discussion;

By using of the classification criteria IFG, and IGT, pre-diabetes was detected in 44.97% and diabetes 12.28% for age 15-65 years of participants, which this numbers is higher than 10.2% (pre-diabetes) and 6.4% in year 2007. [2] Pre-diabetes diagnosis by Oral glucose tolerance test (OGTT) is not convenient for some people because need more time and difficult to drink 75 gram glucose water at once. But this method is still suitable for diabetes screening. After we adjusted by performing logistics regression analysis to find out the predictors of pre-diabetes and diabetes, there are all of dyslipidemia

showed associated with the risk of pre-diabetes and diabetes. This findings are relevance to many studies that pre-diabetes is associated with dyslipidemia. [20–23] Thus, the presence of dyslipidemia was associated with the progression of developing form pre-diabetes to full type 2 diabetes.

Dyslipidemia is statistically significant as a risk factor for pre-diabetes. Triglyceride PR= **1.25** (95% CI=1.21-1.30); HDL 1.11 (1.08-1.14), LDL 1.21 (1.17-1.25),

Our result showed that dyslipidemia predominant of hypercholesterolemia, consisted of LDL levels> 100 mg/dL = 77.61 %, peoples at risky levels (39.63%), and total cholesterol (>200mg/dL) = 33.89%, meanwhile the high level of triglyceride (>150 mg/dL) = 20.63%. These numbers are quite alarming, because hypercholesterolemia has been proven as a major risk factor for cardiovascular disease and type 2 diabetes mellitus. [23–26] When viewed from the age distribution of study subjects which included the majority of ages> = 45 years was 62.02 %. Then this condition may be influenced by socioeconomic factors in which there are changes in unhealthy lifestyles, especially the consumption of foods high in cholesterol, low physical activity. [27,28]

The high level of dyslipidemia occurred to the full diabetes condition, but a quite lower for pre-diabetes and normal person. [23]

Dyslipidemia, especially high LDL levels are risk factors for insulin resistance, resulting in hyperglycemia. In the early stages of becoming pre-diabetes, if LDL levels continue to be high then it will become type 2 diabetes later in life. High cholesterol levels are also caused by obesity, especially waist size that exceeds 80 cm (female) and 90 cm (male), where high levels of visceral fat cause an increase in free fatty acids which results in insulin resistance. [29,30]

In multivariate analysis, it appears that age (> 45 years) as the biggest factor causing pre-diabetes (PR = 1.815; 95CI = 1.712-1.924) and diabetes (PR = 3.476; 95% CI = 3.174 – 3.807)

Given that the incidence of pre-diabetes and diabetes is associated with dyslipidemia, the target of achieving cholesterol levels in the recommended treatment is as follows:

Maintain ideal body weight by doing various physical activities, reducing calorie intake so that it reaches/maintains body mass index between 18.5 - 24.9 kg/m2 and waist circumference <80 cm (women) and <90 cm (men). Maintain optimal levels of fat, lipoproteins in women, namely LDL-C <100mg/dL, HDL-C >50mg/dL, triglycerides <150mg/dL, and non-HDL-C (total cholesterol minus HDL cholesterol) <130mg/dL. The level of Hb1C is attempted at the level of <7%. [4,5,19,21]

Conclusion;

- The prevalence of dyslipidemia: LDL levels >100 mg/dL = 77.61%, Level of risky HDL = 39.63%, and total cholesterol (>200mg/dL) = 33.89%, and level of triglyceride (>150 mg/dL) = 20.63%.
- The prevalence of pre-diabetes = 44.97% and diabetes mellitus 12.18%.
- Dyslipidemia is a factor causing pre-diabetes and diabetes in Indonesia at the age of 15-65 years.
- There is a relationship between age, gender hypercholesterolemia (LDL and LDL) with pre-diabetes and type 2 diabetes mellitus.

- The most influential factor due to the occurrence of pre-diabetes and type 2 diabetes mellitus is age factors (>45years), RR= 1.82 (95% CI =1.71-1.92) and RR= 3.48 (95% CI = 3.17-3.81), respectively.

Recommendation:

1. Dyslipidemia must be one of the serious concerns in efforts to reduce pre-diabetes and diabetes.
2. Need a policy for screening lipid profile to map diabetes risk in population.
3. Strengthen the management of dyslipidemia in primary health care

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References:

1. Djap HS, Sutrisna B, Soewondo P, Djuwita R, Timotius KH, Trihono, et al. Waist to height ratio (0.5) as a predictor for prediabetes and type 2 diabetes in Indonesia. IOP Conf Ser Mater Sci Eng [Internet]. 2018;434:12311. Available from: http://dx.doi.org/10.1088/1757-899X/434/1/012311
2. Mihardja L, Delima, Manz HS, Ghani L, Soegondo S. Prevalence and determinants of diabetes mellitus and impaired glucose tolerance in Indonesia (a part of basic health research/Riskesdas). Acta Med Indones. 2009;41(4):169–74.
3. Pramono L a, Setiati S, Soewondo P, Subekti I, Adisasmita A, Kodim N, et al. Prevalence and predictors of undiagnosed diabetes mellitus in Indonesia. Acta Med Indones. 2010;42(4):216–23.
4. Rhee E, Kim HC, Kim JH, Lee EY, Kim BJ, Kim EM, et al. 2018 Guidelines for the management of dyslipidemia Cardiovascular disease in Koreans. Korean J Intern Med [Internet]. 2019;34(4):723–71. Available from: http://kjim.org/journal/view.php?doi=10.3904/kjim.2019.188
5. Fodor G. Primary prevention of CVD: treating dyslipidaemia. BMJ Clin Evid. 2010;2010.
6. Tabák AG, Herder C, Rathmann W, Brunner EJ, Kivimäki M. Prediabetes: a high-risk state for diabetes development. Lancet (London, England) [Internet]. 2012 Jun 16 [cited 2017 Jan 30];379(9833):2279–90. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3891203&tool=pmcentrez&rendertype=abstract
7. Okwechime IO, Roberson S, Odoi A. Prevalence and Predictors of Pre-Diabetes and Diabetes among Adults 18 Years or Older in Florida: A Multinomial Logistic Modeling Approach. PLoS One [Internet]. 2015 Jan [cited 2017 Feb 16];10(12):e0145781. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4699892&tool=pmcentrez&rendertype=abstract
8. Subramanian S, Chait A. Dyslipidemia in diabetes. Encycl Endocr Dis. 2018;186–98.
9. Joseph J, Svartberg J, Njølstad I, Schirmer H. Risk factors for type 2 diabetes in groups stratified according to metabolic syndrome: a 10-year follow-up of the Tromsø Study. Eur J Epidemiol [Internet]. 2011 Feb [cited 2014 Dec 8];26(2):117–24. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3043259&tool=pmcentrez&rendertype

=abstract

10. CDC 2007. High Cholesterol. 2015. p. 1–2.

11. Li WC, Chen IC, Chang YC, Loke SS, Wang SH, Hsiao KY. Waist-to-height ratio, waist circumference, and body mass index as indices of cardiometabolic risk among 36,642 Taiwanese adults. Eur J Nutr. 2013;52(1):57–65.

12. Ozougwu O. The pathogenesis and pathophysiology of type 1 and type 2 diabetes mellitus. J Physiol Pathophysiol [Internet]. 2013 Sep 30 [cited 2014 Oct 23];4(4):46–57. Available from: http://academicjournals.org/journal/JPAP/article-abstract/974E7B515872

13. Shulman GI. Ectopic Fat in Insulin Resistance, Dyslipidemia, and Cardiometabolic Disease. Vol. 31. 2014.

14. Bergman M. Pathophysiology of prediabetes and treatment implications for the prevention of type 2 diabetes mellitus. Endocrine. 2013;43(3):504–13.

15. Kahn SE. The relative contributions of insulin resistance and beta-cell dysfunction to the pathophysiology of Type 2 diabetes. 2003;3–19.

16. Coen DA, Casper G. Inflammatory markers , adiponectin , and risk of type 2 diabetes in the Pima Indian. 2003;

17. Anthony JG, Lynne E, Jill M. Adiponectin and the Incidence of Type 2 Diabetes in Hispanics and ... 2011;

18. International Diabetes Federation. Global Guideline for Type 2 Diabetes. 2005.

19. Jellinger PS, Handelsman Y, Rosenblit PD, Bloomgarden ZT, Fonseca VA, Garber AJ, et al. American Association of Clinical Endocrinologists and American College of Endocrinology Guidelines for Management of Dyslipidemia and Prevention of Cardiovascular Disease. Endocr Pract [Internet]. 2017;23(Supplement 2):1–87. Available from: http://journals.aace.com/doi/10.4158/EP171764.APPGL

20. Al Amri T, Bahijri S, Al-Raddadi R, Ajabnoor G, Al Ahmadi J, Jambi H, et al. The association between prediabetes and dyslipidemia among attendants of primary care Health Centers in Jeddah, Saudi Arabia. Diabetes, Metab Syndr Obes Targets Ther. 2019;12:2735–43.

21. Dunn FL. Management of dyslipidemia in people with type 2 diabetes mellitus. 2010;41–51.

22. Pokharel DR, Khadka D, Sigdel M, Yadav NK, Acharya S, Kafle R, et al. Prevalence and pattern of dyslipidemia in Nepalese individuals with type 2 diabetes. BMC Res Notes. 2017;1–12.

23. Li Y, Zhao L, Yu D, Ding G. The prevalence and risk factors of dyslipidemia in different diabetic progression stages among middle-aged and elderly populations in China. PLoS One. 2018;13(10):1–12.

24. Frank B. Genetic Predisposition to Dyslipidemia and Type 2 Diabetes Risk in Two Prospective Cohorts. 2012;

25. Article T, Disorders L. Diabetic dyslipidemia or “ diabetes lipidus ”? 2011;

26. Gouni-Berthold I, Betteridge D, Krone W. Dyslipidemia and Diabetes. Type 2 Diabetes. 2007. p. 405–16.

27. Lee TC, Glynn RJ, Peña JM, Paynter NP, Conen D, Ridker PM, et al. Socioeconomic status and

incident type 2 diabetes mellitus: Data from the women's health study. PLoS One. 2011;6(12).

28. Demakakos P, Marmot M, Steptoe A. Socioeconomic position and the incidence of type 2 diabetes: The ELSA study. Eur J Epidemiol. 2012;27(5):367–78.

29. D 'adamo E, Caprio S. Type 2 Diabetes in Youth: Epidemiology and Pathophysiology. Diabetes Care. 2011;34(Supplement 2):S161–5.

30. DeFronzo R a. Insulin resistance, lipotoxicity, type 2 diabetes and atherosclerosis: The missing links. The Claude Bernard Lecture 2009. Diabetologia. 2010;53(7):1270–87.

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