Available online: http://journal.ipb.ac.id/index.php/jgizipangan ***J. Gizi Pangan, December 2023, 18(Supp.1):105-107***
Accredited based on DGHE, Republic of Indonesia No. 28/E/KPT/2019
ISSN 1978-1059 EISSN 2407-0920

Association of Central Obesity and Salty Food Consumption with Small Dense LDL-C in Middle-Aged Indonesian Adults

Yeni Rohmaeni[1*], Hardinsyah[2], Ikeu Tanziha[3]
[1]Department of Nutrition, Faculty of Health and Science, Universitas Muhammadiyah Bogor Raya, Bogor 16640, Indonesia
[2]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor 16680, Indonesia

ABSTRACT

This study aimed to investigate the association between central obesity and salty food consumption with the elevated of Small Dense Low-Density Lipoprotein-Cholesterol (sdLDL-C) among middle-aged Indonesian adults. Dietary behavior, together with the presence of obesity, leads to an increase in sdLDL-C. The study selected 8,611 subjects aged 49–64 years, from secondary data of a population-based survey conducted by the Ministry of Health of the Republic of Indonesia. The sdLDL-C concentration was determined using the Sampson equation. A significant association was observed between salty food consumption (OR=1.20; 95% CI: 1.04–1.38), general obesity (OR=2.59; 95% CI: 2.23–30), central obesity (OR=2.39; 95% CI: 2.11–2.70) and sdLDL-C. Diabetes and hypertension were positively associated with sdLDL-C, whereas Physical Activity (PA) was negatively associated with sdLDL-C. This study showed that obesity and consumption of salty food is associated with the increase of sdLDL-C, whereas PA is associated with the decrease of sdLDL-C.

Keywords: central obesity, Indonesia, middle-aged, salty food, sdLDL-C

INTRODUCTION

Oxidative stress induced by obesity (Thambiah & Lai 2021) and high salty food consumption is a possible mechanism that triggers an elevated level of sdLDL-C due to increased VLDL-C concentration (Thuesen *et al.* 2015). The sdLDL-C is more atherogenic and the homogeneous assay is usually used to measure its concentration, while the current study generated the equation to estimate sdLDL-C according to the original lipid measurement (Sampson *et al.* 2021). This study aimed to analyse the association between central obesity and salty food consumption and elevated sdLDL-C among middle-aged Indonesian adults.

METHODS

The study selected 8,611 subjects, aged 49–64 years, from secondary data of a population-based survey conducted by the Ministry of Health of the Republic of Indonesia. The data were collected by interview and direct measurement. The Sampson equation was used to define sdLDL-C, where:

$$ElbLDL\text{-}C = 1.43 \times LDL\text{-}C - (0.14 \times (\ln(TG) \times LDL\text{-}C)) - 8.99$$ and

$$sdLDL\text{-}C = LDL\text{-}C - ElbLDL\text{-}C$$

which refers to the latest LDL-C calculation equation (cLDL-C) proposed by Sampson *et al.* (2021). Body Mass Index (BMI) was categorised as normal (≤25.0), overweight (25.1 to 27.0) and obese (≥27.1), and central obesity was defined as waist circumference ≥90 cm for men and ≥80 cm for women. Blood pressure was determined according to the Global Hypertension Practice Guidelines (systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg). Diabetes Mellitus (DM) was determined by ADA classification or clinical diagnosis. The sdLDL-C was defined as low (<46.12 mg/dL) and high (≥46.12 mg/dL). Data were then analysed using SPSS version 25. Binary logistic regression was used to analyse between variables and sdLDL-C categories. Associations are illustrated by Odds Ratios (OR) and 95% CIs.

RESULTS AND DISCUSSION

Table 1 shows high level of sdLDL-C was found in subjects who were obese, female,

[*]**Corresponding Author:** tel: +6281321196684, email: yenirohmaeni@gmail.com
(Received 14-06-2023; Revised 17-07-2023; Accepted 29-07-2023; Published 30-12-2023)

Table 1. Distribution of study subjects and binary logistic regression analysis of factors associated with sdLDL-C

Variable	Distribution high sdLDL-C		High sdLDL-C	
	% (95% CI)	*p*	OR (95% CI)	*p*
Gender				
Men	25.8 (24.0–27.8)	<0.001	1.00	<0.001
Women	30.3 (28.5–32.1)		1.25 (1.10–1.41)	
Region				
Rural 23.5 (22.0–25.1)	33.2 (31.0–35.5)	<0.001	1.00	<0.001
Urban 33.2 (31.0–35.5)	23.5 (22.0–25.1)		1.62 (1.41–1.85)	
Education				
Primary School	26.0 (24.6–27.5)		1.00	
Secondary School	39.5 (35.2–44.0)	<0.001	1.86 (1.53–2.26)	<0.001
College or above	46.2 (39.6–52.9)		2.44 (1.85–3.22)	
Occupation				
Farmer/fisher/laborer	21.1 (19.5–22.9)		1.00	
Employee	36.2 (31.0–41.7)		2.12 (1.64–2.73)	
Self-employed	35.8 (31.9–39.8)	<0.001	2.08 (1.71–2.54)	<0.001
Others	26.6 (20.7–33.4)		1.35 (0.96–1.90)	
Unemployed	33.1 (30.9–35.4)		1.85 (1.61–2.12)	
Economic status				
Very poor	21.2 (18.7–23.8)		1.00	
Poor	20.3 (18.0–22.7)		0.95 (0.77–1.17)	0.900
Middle-class	26.8 (24.4–29.4)	<0.001	1.36 (1.12–1.66)	<0.001
Rich	33.6 (30.5–36.9)		1.89 (1.53–2.33)	<0.001
Very rich	39.4 (35.9–42.9)		2.42 (1.96–2.99)	<0.001
Physical activity				
Less	33.4 (29.0-38.1)		1.00	
Moderate	34.0 (31.0-37.2)	<0.001	1.03 (0.82-1.29)	0.959
High	26.0 (24.6-27.5)		0.70 (0.56-0.87)	<0.001
Consumption of salty food				
<1 time/day	25.8 (23.7–28.0)	<0.015	1.00	0.015
≥1 time/day	29.4 (27.7–31.2)		1.20 (1.04–1.38)	
General obesity				
Normal weight	22.6 (21.1–24.1)		1.00	
Overweight	39.3 (35.4–43.3)	<0.001	2.22 (1.86–2.65)	<0.001
Obese	43.1 (40.0–46.3)		2.60 (2.23–3.03)	
Central Obesity				
Normal weight	21.8 (20.3–23.3)	<0.001	1.00	<0.001
Obese	40.0 (37.7–42.3)		2.39 (2.11–2.70)	
Diabetes Mellitus				
No	25.7 (24.3–27.2)	<0.001	1.00	<0.001
Yes	40.4 (36.8–44.1)		1.96 (1.66–2.31)	
Hypertension				
No	24.0 (22.3–25.7)	<0.001	1.00	<0.001
Yes	33.8 (31.7–36.0)		1.62 (1.43–1.84)	

*Data are presented as 95% CI

All data were weighted to represent the total population of middle-aged Indonesian adults based on the 2013 population-based survey

Abdominal obesity is defined as WC≥90 cm for men and WC≥90 for women, using WHO classification for Asians

OR: Odds Ratio; CI: Confidence Interval: sdLDL-C: Small Dense Low-Density Lipoprotein-Cholesterol; WC: Waist Circumference

educated, employed and belonged to the "very rich" group, had DM and hypertension and lived in urban area. High sdLDLC was also found in subjects who were less physically active and consumed salty foods (≥1 times/day). The study showed that general and central obesity increased the risk of sdLDL-C by 2.60 and 2.39 times, respectively. High intake of salty foods, DM and hypertension increased sdLDL-C by 20, 96 and 62%, respectively. In contrast, physical activity reduced it by 30%.

The data showed that general and central obesity was highly prevalent in subjects with high sdLDL-C levels. The findings are similar to those of a previous study in China (Fan *et al.* 2019). The possible mechanism of obesity being associated with high sdLDL-C is stimulated by the insulin resistance present in diabetic dyslipidaemia (Thambiah & Lai 2021), which induces endothelial dysfunction that increases oxidative stress. This phenomenon is often found in obese subjects (Fan *et al.* 2019; Thambiah & Lai 2021). Therefore, the subjects with DM and hypertension had higher sdLDL-C levels than those without. The study also showed that consumption of salty foods is closely related to sdLDL-C.

CONCLUSION

The results showed that sdLDL-C levels were positively associated with central and general obesity, salty food consumption, DM and hypertension, while negatively associated with physical activity. This findings suggested greater awareness for sdLDL-C through controlled body weight, balanced diet and physical activity.

ACKNOWLEDGEMENT

We would like to thank the Ministry of Health for the provision of the data for this study.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflicts of interest to declare.

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