ORIGINAL ARTICLE

pISSN: 1907-3062 / eISSN: 2407-2230

Psychological distress and dyslipidemia in adult women: a 6-years follow up study in Bogor City, Indonesia

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ABSTRACT

BACKGROUND

Dyslipidemia is of global occurrence, with a prevalence 30% or higher in several countries, including Indonesia. One risk factor of dyslipidemia is physical or mental stress, that is more frequent in women. This study aimed at investigating the association between psychological distress and dyslipidemia in adult women.

METHODS

This observational longitudinal study involved 1850 women aged 25 years and older at baseline. Dyslipidemia was determined from the ratio of low-density lipoprotein to high-density lipoprotein. Psychological distress was determined using the 20-item self-reporting questionnaire. Data analysis was by Cox regression for calculating the hazard ratio of the incidence of dyslipidemia as predicted by the psychological distress.

RESULTS

Among the 1474 participants without dyslipidemia at baseline, 545 (36.9%) developed dyslipidemia during 6 years of monitoring, while 93 (6.3%) had a history of psychological stress. There was a significant association between psychological distress and dyslipidemia (HR = 3.08; 95% CI: 2.33- 4.07). Cox regression revealed that the association was still found to be significant after a further adjustment for the variables of age, BMI, menopause, smoking status, physical activity, and carbohydrate and fat intakes (HR=2.8; 95% CI: 2.10 - 3.77).

CONCLUSIONS

Dyslipidemia incidence was high among adult women in Bogor. Women with psychological distress had higher incidence rates of dyslipidemia than women without psychological stress. Psychological distress in women was statistically significantly associated with incidence rate of dyslipidemia. This finding highlights the importance of the need for a dyslipidemia- reduction program in women through prevention and control of psychological distress.

Keywords: Psychological distress, LDL/HDL ratio, dyslipidemia, longitudinal study, adult women

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Date of first submission, May 25, 2022
Date of final revised submission, October 24, 2022
Date of acceptance, October 28, 2022

Cite this article as: Tuminah S, Ronoatmodjo S, Driyah S, Kristanti D, Tjandrarini DH. Psychological distress and dyslipidemia in adult women: a 6-year follow-up study in Bogor City, Indonesia. Univ Med 2022;41:236-43. doi: 10.18051/UnivMed.2022.v41.236-245.

DOI: http://dx.doi.org/10.18051/UnivMed.2022.v41.236-245

INTRODUCTION

Dyslipidemia comprises one or more of the following abnormal lipid concentrations, namely high total cholesterol, high low-density lipoprotein (LDL), low high-density lipoprotein (HDL) or high triglycerides.[1,2] The occurrence and development of dyslipidemia frequently involves a continuous long-term process. Various risk factors, including changes in social and economic status, changes in life style, such as westernization of the diet, insufficient physical activity and long-term sedentary behavior, are believed to be contributing to the increased prevalence of dyslipidemia.[3,4]

The prevalence of dyslipidemia varies between countries, because of differing LDL cutoffs. The prevalence of dyslipidemia in Thailand is 66.5%, using as reference the Third Adult Treatment Panels (ATP III) high LDL cutoff of 100 mg/dL and above.[2] The prevalence of dyslipidemia in Africa (LDL cutoff = 130 mg/dL and above) is 25.5% and in Iran 83%.[5,6] The prevalence of dyslipidemia in Indonesia (LDL cutoff = 160 mg/dL or more) at ages 25 years and above is around 36% (33.1% in men and 38.2% in women).[2]

In addition to being affected by nutrition, body weight, physical activity, treatment, and genetic factors, the blood lipid concentration may also be influenced by mental or physical stress.[7] Stress is the condition of physical and psychic stress as a result of individual and environmental demands, such as to cause anxiety, which is a general and early sign of physical and psychological abnormality.[8] The are 2 types of stress, namely eustress and distress. Eustress is a positive response that brings pleasure and health, whereas distress is a negative response of the body that has a deleterious impact on health.[9] Psychological distress (psychological stress) is one of the main causes of disability in the global disease burden. The morbidity resulting from psychological distress has reportedly a negative impact on the broader socio-economic health outcomes. The prevalence of psychological distress is especially reported to be higher in low-middle income countries (LMICs) and is significantly higher in women (as compared to men) and in those with comorbidities.[10,11]

Because it is associated with different population characteristics and conditions, the prevalence of psychological distress varies widely, being 35.5% in Iraq, 16.0% in Mexico,[11] 37.6% in Brazil,[12] and 23.0% in Eritrea.[13] Psychological distress is associated with poor physical health and is predictive of the occurrence of chronic physical conditions.[14] The Indonesian national prevalence of psychological distress is 9.8% according to the Basic Health Research (Riskesdas) data for 2018. Psychological distress tends to increase with increasing age, its proportion being 8.5 - 15.8%. The prevalence of psychological distress is higher in women (12.1%) than in men (7.6%).[15] The proportion of psychological distress in the cohort study of risk factors of non-communicable disease (*studi kohor faktor risiko penyakit tidak menular* - FRPTM) in Bogor City in 2019 was 28.6%. The proportion of HDL concentration of less than 50 mg/dL in women (or less than 40 mg/dL in men) is around 36 - 42%.[16] The proportion of subjects with high LDL concentration (100 mg/dL and above) at baseline and in monitoring years 2, 4 and 6, was found to be higher than 80%.[17]

Multivariate analysis of the study of Chen et al.[18] found a significant association between psychological distress and dyslipidemia, with a hazard ratio (HR) of 1.14 (95% CI: 1.04-1.25). On the other hand, the results of the study of Zhang et al.[19] showed that the group with mental health disorders had a significant relationship for awareness of dyslipidemia, with odds ratio (OR) =1.81, but not for treatment of dyslipidemia (OR=1.29) and for controlled dyslipidemia (OR=0.93). However, evidence showed that not all people with psychiatric disorders display metabolic impairments due to age and gender, these latter being the most significant factors influencing the relationship between metabolism and mental disorder. For instance, metabolic conditions (abdominal obesity, high triglyceride and glucose levels) are associated with an increased

risk of a future depressive episode in middle-aged adults.[20] The present study aimed at investigating the association between psychological distress and dyslipidemia in adult women.

METHODS

Design of the study

This observational longitudinal study was conducted using data from 5 villages *(kelurahan)* of Bogor Tengah District, Bogor City, West Java Province from 2011/2012 until 2017/2018. The study was preceded by recruitment of candidate respondents and a baseline study comprising health screening that was conducted in 3 recruitment stages, namely stages 1 (2011), 2 (2012) and 3 (2015), to maintain the minimum sample size. For 6 years, 3 annual routine monitoring studies were performed.[16] New cases of dyslipidemia that occurred in the monitoring period were recorded as the incidence of dyslipidemia.

Research subjects

The study subjects were female respondents of the cohort study of risk factors of non-communicable Disease (FRPTM) aged 25 years and above (in the baseline study). The reason for selecting female respondents was that dyslipidemia as well as psychological distress is more frequently found in women.[2,15] The inclusion criteria were: Respondents who did not have dyslipidemia at baseline and had been monitored for 6 years. The exclusion criterion was incomplete results of blood lipid examination.

From a total of 5258 respondents of the FRPTM cohort study aged 25 years and above, the data of 3482 female respondents were collected. Of the latter, 1850 persons who did not have dyslipidemia at baseline were selected, from whom subsequently were collected 1642 respondents who had been monitored up to year 6, i.e. recruited in stages 1 and 2. The data of 168 persons, who had incomplete blood lipid results, were not included in the analysis, such that the number of respondents who met the criteria for analysis was 1474 (Figure 1).

Definition of dyslipidemia

Dyslipidemia as outcome was determined by the LDL to HDL ratio, because this ratio is a substitute marker for a decrease in lipids.[21] The result of the blood examination is categorized as dyslipidemia if the LDL/HDL ratio is high (2.5 and above) because according to the study of Chen et al.[22] this is the optimal cutoff value in women. The LDL and HDL concentrations were obtained from the results of blood lipid examination in the FRPTM cohort study that are conducted once in 2 years.

Definition of history of psychological distress

The data on exposure to psychological distress were obtained from the results of mental health screening using the 20-item self-reporting questionnaire (SRQ-20). Subjects are categorized as having "psychological distress" if they answer "yes" to at least 6 of the 20 SRQ-20 questions.[14] Subjects are categorized as having "history of psychological distress" if they had been detected as having psychological distress in at least 2 successive monitoring periods prior to the occurrence of the dyslipidemia.

Covariates

Several covariate that were seen as potential confounders were included in this analysis. The age variable was divided into 2 groups, namely less than 55 years and 55 years and above, with reference to the study results of Sudikno et al.,[23] where LDL cholesterol concentration increases 3-fold in the age group of 55 years and above. The values of the menopause variable were obtained from the interview results based on the subjects' admissions and were grouped into 2 categories, namely "yes" or "no". Smoking status was estimated using the Brinkman index (BI), which is calculated by multiplying the duration of smoking (in years) by the number of cigarettes smoked.[24] Smoking status was categorized into 3 groups, namely non-smoker (0), light smoker (1—199), and heavy smoker (200 and above).[25] The physical activity variable is a composite of the type and duration of activity (days per week

and minutes per day) including the type of sport. Vigorous activity as well as vigorous sport has an 8-fold weight, moderate activity or sport has a 4-fold weight, while low activity has a 2-fold weight. Subjects were categorized as having insufficient physical activity if they had a total activity of less than 600 metabolic equivalent for task (MET) per week.[26] Fat and carbohydrate intakes were determined based on the General Guideline for Balanced Nutrition (*Pedoman Umum Gizi Seimbang*, PUGS). Fat intake was grouped into less than 25% and 25% and above of total energy requirement. Carbohydrate intake was grouped into less than 60% and 60% and above of total energy requirement.[27] The nutritional data were obtained through interviews using the food frequency questionnaire (FFQ) and food recall. Body mass index (BMI) was obtained from weight in kg divided by height in m^2, referring to BMI standards for Asians. BMI was divided into 2 categories, namely obesity (BMI 25 kg/m^2 and above) and no obesity (BMI less than 25 kg/m^2).[28,29] Subjects were categorized as having obesity if in at least 2 of 3 monitoring periods (per year) in 6 years they had a BMI of 25 kg/m^2 and above.

Statistical analyses

Sample characteristics were compared between subjects with and without the onset of dyslipidemia at baseline, using the chi-square test for categorical variables. Multivariable analysis was performed with the Cox regression test to obtain the hazard ratio (HR) which is the ratio of the incidence dyslipidemia of the group with a history of psychological distress during monitoring to that of the group without such a history in the same period. The results are declared to be statistically significant if the p value is less than 0.05.

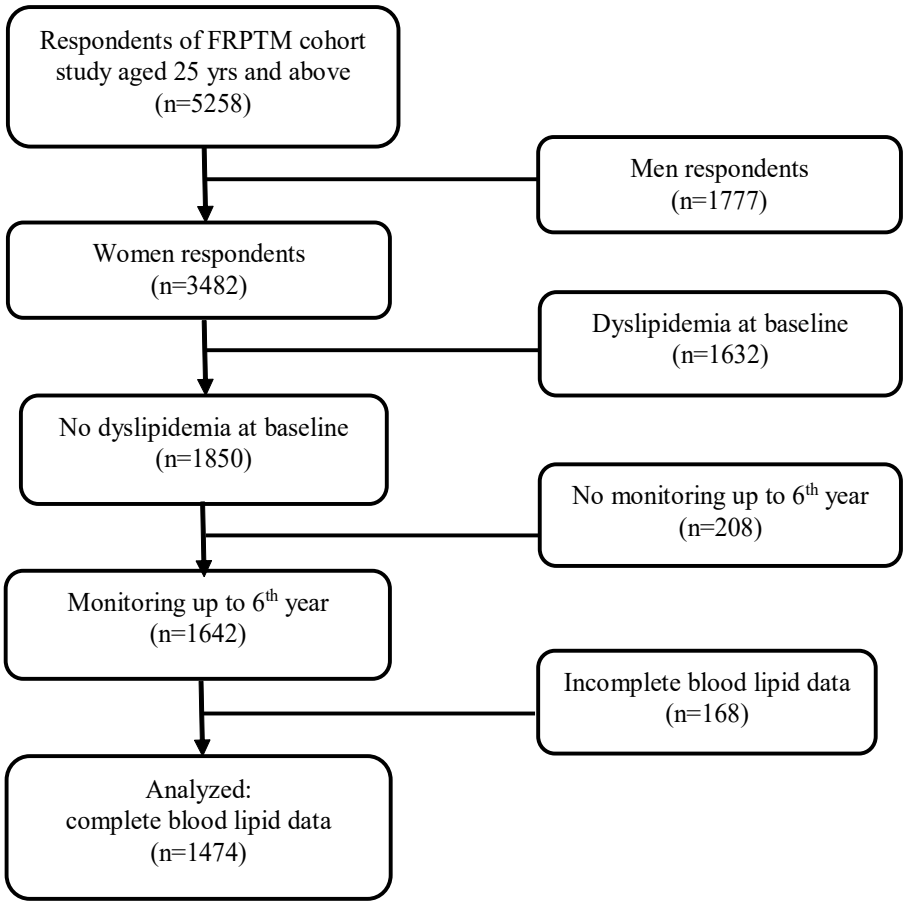

Figure 1. Flow of selection of analyzed sample (n=1474)

Ethical clearance

The FRPTM cohort study obtains ethical clearance for each year of conduct, from the National Commission of Health Research Ethics (*Komisi Nasional Etik Penelitian Kesehatan*, KNEPK) of the Health Research and Development Agency, Ministry of Health, the current license being No. LB.02.01/2/KE.076/ 2018 dated March 1, 2018.

RESULTS

Among the 1474 women without dyslipidemia at baseline, 93 (6.3%) had a history of psychological stress, but the majority (1381 or 93.7%) did not. In the 6-year monitoring period, 57 (61.3%) of the 93 women and 488 (35.3%) of the 1381 women developed dyslipidemia, resulting in a cumulative incidence of dyslipidemia (number of new cases) of 545 (36.9%).

The Chi-square test results showed that the proportion of dyslipidemia incidence was significantly higher in the group with psychological stress, age less than 55 years, and BMI 25 kg/m^2 ($p<0.05$) (Table 1).

The results of bivariable analysis showed a higher risk of dyslipidemia incidence in subjects with psychological distress than in subjects without psychological distress (HR=3.08; 95% CI: 2.33-4.07) (Table 2). After controlling for the covariate variables of age, BMI, menopausal status, smoking status, physical activity, carbohydrate intake, and lipid intake, the risk of dyslipidemia incidence was higher in the group with psychological distress (HR= 2.8; 95% CI: 2.10 – 3.77 (Table 3).

Table 1. Comparison of characteristics of adult women with and without dyslipidemia during 6 years of monitoring (n=1474)

Risk factor	Dyslipidemia		p value
	Yes (n=545)	No (n=929)	
	n (%)	n (%)	
Psychological distress			<0.001
Absent	488 (35.3)	893 (64.7)	
Present	57 (61.3)	36 (38.7)	
Age (years)			0.030
Less than 55	412 (38.7)	652 (61.3)	
55 and above	133 (32.4)	277 (67.6)	
BMI (kg/m^2)			0.040
Less than 25	233 (34.2)	449 (65.8)	
25 and above	312 (39.4)	480 (60.6)	
Menopause			0.060
No	340 (39.0)	531 (61.0)	
Yes	205 (34.0)	398 (66.0)	
Smoking status			0.080
Non smoker	454 (35.6)	822 (64.4)	
Light smoker	72 (44.4)	90 (55.6)	
Heavy smoker	11 (40.7)	16 (59.3)	
Physical activity			0.05
Sufficient	356 (35.3)	653 (64.7)	
Poor	189 (40.6)	276 (59.4)	
Carbohydrate intake (% of total energy)			0.180
Less than 60	376 (35.8)	673 (64.2)	
60 and above	169 (39.8)	256 (60.2)	
Fat intake (% of total energy)			0.620
Less than 25	91 (35.4)	166 (64.6)	
25 and above	454 (37.3)	763 (62.7)	

Note: BMI = body mass index

Table 2. Cox regression model of factors associated with the incidence of dyslipidemia in adult women

Risk factor	Crude Hazard Ratio (CHR)	95% CI	p value
Psychological distress			
Absent	1 (Ref)		
Present	3.08	2.33—4.07	<0.001
Age (years)			
Less than 55	1 (Ref)		
55 and above	0.79	0.65—0.96	0.020
BMI (kg/m^2)			
Less than 25	1 (Ref)		
25 and above	1.10	0.93—1.30	0.250
Menopause			
No	1 (Ref)		
Yes	0.83	0.70—0.99	0.040
Smoking status			
Non smoker	1 (Ref)		
Light smoker	1.39	1.09—1.79	0.010
Heavy smoker	1.14	0.63—2.08	0.660
Physical activity			
Sufficient	1 (Ref)		
Poor	1.37	1.15—1.64	<0.001
Carbohydrate intake (% of total energy)			
Less than 60	1 (Ref)		
60 and above	1.21	1.01—1.46	0.030
Fat intake (% of total energy)			
Less than 25	1 (Ref)		
25 and above	0.98	0.78—1.35	0.900

Note: BMI = body mass index

DISCUSSION

In this study it was found that the cumulative incidence of dyslipidemia that occurred in the monitoring period of 6 years was 36.9%. This is relatively low as compared with the study of Chen et al.[18] who found a cumulative incidence of dyslipidemia of 60.5% in a period of 2.6 years. This is because the definition of dyslipidemia in Chen et al. [18] study was at least one abnormal lipid level, whereas in our study dyslipidemia was determined by the combination of a high LDL and a low HDL, resulting in a smaller value.

The results of multivariable analysis showed a statistically significant association between psychological distress and incidence of dyslipidemia, after controlling for covariate variables, namely age, BMI, menopause, smoking status, physical activity, and carbohydrates and fat intakes. Our study results are consistent with the results of other studies that associate stress with dyslipidemia. For the risk of dyslipidemia, the study of Catalina-Romero et al.[30] had an OR=1.11 (95% CI: 1.04 - 1.19), while the study of Assadi [31] had RR=14.54 (95% CI: 3.54 - 59.65). The study of Yu et al.[32] found a correlation between psychological distress and high LDL concentration in middle-aged women. The study results of Kim et al.[33] showed a significant relationship between chronic mental problems, such as depressive mood, and serum lipid concentration in male adolescents, but not in female adolescents. Although psychological distress in the FRPTM cohort study is determined with the SRQ-20 that is used to detect mental health in general, the results are consistent with a number of studies that use different and more specific instruments, in that there is a significant

Table 3. Multivariate Cox regression analyses on the association between psychological distress and dyslipidemia in adult women

Risk factor	Adjusted Hazard Ratio	95% CI	p value
Psychological distress			
Absent	1 (Ref)		
Present	2.81	2.10—3.77	<0.001
Age (years)			
Less than 55	1 (Ref)		
55 and above	0.86	0.65—1.14	0.310
BMI (kg/m^2)			
Less than 25	1 (Ref)		
25 and above	1.10	0.93—1.31	0.240
Menopause			
No	1 (Ref)		
Yes	0.92	0.72—1.18	0.540
Smoking status			
Non smoker	1 (Ref)		
Light smoker	1.29	1.00—1.67	0.040
Heavy smoker	1.02	0.56—1.71	0.930
Physical activity			
Sufficient	1 (Ref)		
Poor	1.38	1.15—1.65	<0.001
Carbohydrate intake (% of total energy)			
Less than 60	1 (Ref)		
60 and above	1.32	1.05—1.66	0.010
Fat intake (% of total energy)			
Less than 25	1 (Ref)		
25 and above	1.26	0.95—1.67	0.100

*Covariates included age, BMI, menopausal status, smoking status, physical activity, carbohydrate intake, lipid intake, and psychological distress. Significance was set at $p < 0.05$. Note: BMI = body mass index; Ref = reference category

relationship between psychological distress and the incidence of dyslipidemia.

Psychological distress may vary by type, number and duration of symptoms that are felt by the subjects, depending on the response of each individual and the way this individual overcomes the problem.[8] According to Marcondes et al.,[34] increases in blood lipids that are triggered by stress are adaptive in nature and will return to normal when the stress disappears. However, if the stress persists for a long time, the dyslipidemia that is triggered by stress will persist, have a damaging effect and contributes to the occurrence of cardiovascular diseases, such as stroke, atherosclerosis, and coronary heart disease.

The results of physiological studies show that stress from any source may affect the endocrine, hemopoietic and immune systems.[35] The stress response induces the secretion of cortisol and catecholamine hormones that influence the body metabolism including fat metabolism. There are 2 stress response pathways in the hypothalamus, namely the hypothalamic pituitary adrenal (HPA) and the sympathetic adrenal medullary (SAM) axes. Both are pathways that play a major role in regulating the balance of cortisol and catecholamine hormones. In a condition of distress, both of these pathways produce cortisol and catecholamines in non-homeostatic concentrations, that result in various types of metabolic changes, both for carbohydrates, proteins and fats.[9] Dyslipidemia that is triggered by stress involves a complex interaction between stress hormones, insulin, adipose tissue metabolism and cytokines.[34]

From the results of the evaluation on each of the covariate variables, no confounder was found. This may have been due to the presence of other confounders that were not analyzed or because previously there had been a restriction in gender, in that only data from female respondents constituted the study sample, on the grounds that 65% of the respondents in the FRPTM cohort study are women. In addition, based on the literature, both dyslipidemia and psychological distress are more frequently found in women.[2,15]

The limitation of this study is that the measurement of dyslipidemia as the outcome is done only once in 2 years. In addition, self-assessment may cause perception bias in the respondents towards the questions in the SRQ-20. Our future studies will include more specialized scales on a particular aspect of psychological distress, such as depression.

CONCLUSIONS

Dyslipidemia incidence was high among adult women in Bogor. A psychological distress in women is statistically significantly associated with the incidence of dyslipidemia. Therefore, the incidence of dyslipidemia may be reduced if the psychological distress can be prevented or controlled,

CONFLICT OF INTEREST

There was no conflict of interest.

FUNDING

None.

AUTHOR CONTRIBUTIONS

ST contributed to literature search, data analysis, and writing of the manuscript (corresponding author); SR contributed to guidance and direction in writing the manuscript (corresponding author). SD contributed to guidance on lipids; DH and DK contributed to guidance and assisting in the preparation for data analysis. All authors have read and approved the contents of the final manuscript.

ACKNOWLEDGMENTS

Our heartfelt thanks to the following mental health researchers for their guidance: Ms. Rofingatul Mubasyiroh, SKM, M.Epid; and Ms. Alifa Syamantha Putri, S.Psi; M.Psi.

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