



Review Article

Epidemiology of Dyslipidemia in the Asia Pacific Region

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SUMMARY

Dyslipidemia, including high levels of total cholesterol, low-density lipoprotein cholesterol, and triglyceride, and low levels of high-density lipoprotein cholesterol, is a major risk factor of atherosclerosis that leads to various cardiovascular diseases. This article compares the epidemiology of dyslipidemia among countries of the Asia Pacific region, including Australia, China, Indonesia, Japan, Korea, Malaysia, New Zealand, Singapore, Thailand, and Taiwan, based on public-accessible data from websites. Sources of lipid management guidelines of the countries are also summarized. Before comparing the data from each of the countries, the readers should pay attention to the impact of lipid testing methods, medication use, the year of data acquisition, the age range of the examinees, and the definition of dyslipidemia in each country. Apart from the mentioned factors that may affect the epidemiology data, some of the countries have unique features. For example, substantial ethnic differences existed in Indonesia and Malaysia; whereas the reports from China and Thailand exhibited significant regional variations. However, a common feature is that the levels of serum lipids change with age, and men and women may have quite different levels of serum lipids even of the same age range. Nevertheless, there is a lot of room for improvement in the awareness, treatment, and control rate of dyslipidemia. To reduce the prevalence of dyslipidemia and promote cardiovascular health, the epidemiological surveys of dyslipidemia and implementation of management guidelines according to their own national conditions are encouraged. Copyright © 2018, Taiwan Society of Geriatric Emergency & Critical Care Medicine. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The epidemiology of common diseases has changed dramatically over the last few decades. Many countries in the Asia Pacific region have evolved from the status in which the infectious diseases as the major cause of death to where non-communicable diseases now take precedence.^{1,2} Cardiovascular disease (CVD) is emerging as one of the important health issues in the Asia Pacific region and augmented by increasing rates of dyslipidemia, diabetes, obesity, and hypertension resulting from rapid urbanization, dietary changes, high smoking rates, and decreasing physical activity.^{3,4} Dyslipidemia represents a major risk factor for atherosclerosis affecting arteries of large and medium size and consequently causing ischemia in the brain, heart, or legs. There is

convincing evidence from both randomized trials⁵ and large observational studies^{6,7} that elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG) and low levels of high-density lipoprotein cholesterol (HDL-C) in the blood are associated with an increased risk of CVD. Therefore, early screening and effective lipid management may substantially reduce the burden of CVD and provide great social value.⁸

According to the World Health Organization (WHO) estimates in 2008, the prevalence of dyslipidemia (defined as blood levels of TC > 5 mmol/L [190 mg/dL]) in the Southeast Asia (30.3%) and the Western Pacific (36.7%) were much lower than that in the Europe (53.7%) and the Americas (47.7%).⁹ However, the prevalence of dyslipidemia across Asia Pacific region varies (Table 1). Therefore, it is necessary to carefully examine and compare the epidemiology of dyslipidemia between different countries. In this article, we review and report the epidemiology of dyslipidemia of Japan, Korea, China, Taiwan, Thailand, Malaysia, Indonesia, Singapore, Australia and New Zealand, based on the data available for the public from websites. The data from Taiwan will be used as an example to

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Table 1
The prevalence of dyslipidemia across countries in the Asia Pacific region.

Lipid component	Cut-off value to define "abnormal" levels	Country	Prevalence (Year of survey)	Reference
TC	≥6.22 mmol/L or 240 mg/dL	Taiwan	11.2% (male 11.3%, female 11.1%) (2007)	[12]
		Japan	16.2% (male 11.0%, female 19.9%) (2015)	[17]
		Korea	Male 12.6%, female 14.9% (2010–2012)	[18]
		China	12.2% (2008)	[20]
		Malaysia	44.9% (2006–2012)	[26]
		Singapore	17.4% (2010)	[28]
		Indonesia	9.0%–25% (2011)	[27]
		Australia	32.8% (2011–2012)	[29]
		Philippines	46.9% (2013)	[22]
		Indonesia/WHO	35.8% (male 33.1%, female 38.2%) (2008)	[9]
LDL-C	≥5.5 mmol/L or 210 mg/dL ≥200 mg/dL ≥5 mmol/L or 190 mg/dL ≥4.14 mmol/L or 160 mg/dL	Taiwan	7.8% (male 8.6%, female 7.2%) (2007)	[12]
		Japan	11.1% (male 9.0%, female 12.5%) (2015)	[17]
		Korea	15% (male 14.3%, female 15.8%) (2010) ^a	^a
		China	17.9% (2008)	[20]
		Singapore	15.2% (22% in Malays, 14.1% in Chinese and 15.1% in Indians) (2010)	[28]
		Indonesia	14%–34% (2011)	[27]
		Australia	NA	[29]
		Philippines	47.2% (2013)	[22]
		Thailand	29.6% (2009)	[23,24]
			According to ATP III classification; high LDL-C are defined as follows: LDL-C ≥100 mg/dL if having prior CHD or CHD equivalent or having 10-year CHD risk >20%; LDL-C ≥130 mg/dL if having ≥2 risk factors (RF) and/or 10-year CHD risk 10%–20%; and LDL-C ≥160 mg/dL if having 0–1 RF.	
HDL-C	<1.03 mmol/L or 40 mg/dL for men; <1.30 mmol/L 50 mg/dL for women <1.03 mmol/L or 40 mg/dL	Japan	12.7% (male 12.0%, female 13.2%) (2015)	[17]
		Thailand	47.1% (2009)	[24]
		Australia	NA	[29]
		Taiwan	10.1% (male 15.7%, female 5.3%) (2007)	[12]
		Korea	NA	[18]
		China	12.0% (2008)	[20]
		Philippines	71.3% (2013)	[22]
		Indonesia	23%–66% (2011)	[27]
		Taiwan	15.3% (male 19.5%, female 11.6%) (2007)	[12]
		Japan	18.0% (male 25.1%, female 13.0%) (2015)	[17]
TG	<0.91 mmol/L or 35 mg/dL ≥2.26 mmol/L or 200 mg/dL ≥2.0 mmol/L or 175 mg/dL ≥150 mg/dL	Korea	NA	[18]
		China	15.1% (2008)	[20]
		Thailand	38.6% (2009)	[24]
		Australia	13.9% (male 19.0%, female 9.0%)	[29]
		Philippines	38.6% (2013)	[22]
		Taiwan	15.3% (male 19.5%, female 11.6%) (2007)	[12]
		Japan	18.0% (male 25.1%, female 13.0%) (2015)	[17]
		Korea	NA	[18]
		China	15.1% (2008)	[20]
		Thailand	38.6% (2009)	[24]

Abbreviation: ATP III=The Third Adult Treatment Panel; CHD = coronary heart disease; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; NA = not available; TC = total cholesterol; TG = triglyceride.

^a The data were cited from "Prevalence and Management of Dyslipidemia in Korea: Korea National Health and Nutrition Examination Survey during 1998–2010" (Diabetes Metab J 2013; 37:433–449).

explain the general aspect of dyslipidemia followed by the relevant data from each of the countries at the sequence from north east to south west.

Before examining and comparing the data across different countries, some issues should be clarified: (1) Is the composition of dyslipidemia identical in reports from each of the countries? Generally, "dyslipidemia" indicates that at least one component of serum lipids is abnormal (i.e. high TC, high LDL-C, low HDL-C, and high TG). However, not all studies have investigated and reported the four components. (2) Is the method of measurement the same? For example, the level of blood LDL-C can be directly measured, or obtained using Friedewald formula. The level of LDL-C from the same blood sample may yield different results by the two methods.^{10,11} (3) The prescription rate of lipid-lowering drugs differs. (4) The cut-off value of serum lipids to define dyslipidemia is not identical between the countries. (5) The year of investigation, and the distribution of age in the surveys were different between studies (Table 1).

2. Taiwan

According to the TW3H (i.e. hypertension, hyperglycemia, and hyperlipidemia in Taiwan) survey in 2002, among the people aged

<50 years the blood levels of TC, LDL-C and TG increased with age, and were higher in men than that in women. This gender gap became reduced with age. After 50 years of age, the blood levels of TC, LDL-C, and TG in women were gradually higher than those in men. Additionally, the blood level of HDL-C was higher in women than that in men among all age groups.¹² This trend in age and gender was generally seen in the Asia Pacific countries.

The follow-up report of TW3H in 2007 showed that the situation of dyslipidemia was similar to that in 2002. The prevalence of high TC (TC = 240 mg/dL), high LDL-C (LDL-C ≥160 mg/dL), low HDL-C (HDL-C <40 mg/dL), and high TG (TG = 200 mg/dL) were 11.2% (11.3% for men, 11.1% for women), 7.8% (8.6% for men, 7.2% for women), 10.1% (15.7% for men, 5.3% for women), and 15.3% (19.5% for men, 11.6% for women), respectively.

The control rate of dyslipidemia in high-risk patients remained to be improved. In T-SPARCLE (Taiwanese Secondary Prevention for patients with Atherosclerotic disease) study, only 54% of patients with stable coronary artery disease (CAD) and cerebrovascular disease achieved the level of LDL-C <100 mg/dL.¹³ The prescription rate of lipid-lowering drugs was also inadequate in high-risk patients, with only 60% of patients with acute coronary syndromes (ACS) and 38% of patients with ischemic stroke using lipid-lowering drugs.^{14,15} Recently, the 2017 Taiwan lipid guidelines for high-risk

patients was issued and demonstrated the therapeutic goals of LDL-C in different risk categories.¹⁶ The major purpose of this guideline is to improve clinical outcomes of high-risk patients through increasing the prescription rate of lipid-lowering drugs and control rate of dyslipidemia. The sources of lipid guidelines of the investigated countries in this review are summarized in Table 2 for readers' reference.

3. Japan

In the report of 2015 National Health and Nutrition Survey in Japan for adults aged ≥ 20 years, the prevalence of high TC (≥ 240 mg/dL), high LDL-C (≥ 160 mg/dL), low HDL-C (male < 40 mg/dL, female < 50 mg/dL), and high TG (≥ 200 mg/dL) in men vs. women were 11.0% vs. 19.9%, 9.0% vs. 12.5%, 12.0% vs. 13.2%, and 25.1% vs. 13.0%, respectively.¹⁷ The trend of blood levels of TC and LDL-C associated with age and gender was similar to those of Taiwan, whereas men had a higher blood level of TG than women irrespective of age.¹⁷

4. Korea

For Korean adults older than 30 years, the prevalence of hypercholesterolemia (TC ≥ 240 mg/dL) during the period of 2010–2012 was 12.6% in males and 14.9% in females, which increased by 5.4% in males and by 6.5% in females since 2005. The prevalence rate was highest in males in their 50s and females in their 60s (16.9% and 32.2%, respectively). The awareness rate of hypercholesterolemia (defined as percentage of patients with a diagnosis of hypercholesterolemia among the total patients with hypercholesterolemia) was 45.2% in males and 49.1% in females, whereas the treatment rate (percentage of hypercholesterolemia patients who were taking cholesterol-lowering drugs for > 20 days/month) was 35.8% in males and 38.4% in females, both of which increased by approximately 20% compared to those in 2005. Generally, the control rate of hypercholesterolemia (percentage of hypercholesterolemia-treated patients with TC < 200 mg/dL among the total patients with hypercholesterolemia) was about 30%.¹⁸

5. China

The prevalence of dyslipidemia in Chinese cities has increased dramatically over the past decade.¹⁹ In a survey of 5,761 Beijing residents aged 18–79 years, the abnormal lipid profile was defined as TC ≥ 240 mg/dL, LDL-C ≥ 160 mg/dL, HDL-C < 40 mg/dL and TG ≥ 200 mg/dL. Dyslipidemia was defined as any abnormality of the four lipid components.²⁰ This survey

reported that the prevalence of high TC, high LDL-C, low HDL-C, and high TG were 12.2%, 17.9%, 12.0%, and 15.1%, respectively.²⁰ Regarding high TC, the prevalence in men who lived in urban areas was higher than those lived in rural areas, whereas the relation was inverted in women.²⁰ The awareness rate (percentage of participants with a diagnosis of dyslipidemia among the total participants with dyslipidemia), treatment rate (percentage of dyslipidemic participants who had received treatment in the past 2 weeks), and control rate (percentage of total dyslipidemic participants with treatment and reached normal lipid profiles) in men were 20.7%, 46.7%, and 29.6%, respectively. In women, the awareness rate, treatment rate, and control rate were 23.6%, 45.6%, and 45.4%, respectively.²⁰ A meta-analysis with a total of 387,825 persons showed that the prevalence of dyslipidemia (the definition was identical to that of Beijing survey) in China adults aged ≥ 30 years was higher in east region than that in other regions. The risk factors of dyslipidemia were male, old age, family history of dyslipidemia, smoking, obesity, hypertension and diabetes.^{20,21}

6. Philippines

According to the National Nutrition and Health Survey (NNHeS) in 2013, a Philippine's nationwide survey conducted by the Food and Nutrition Research Institute of the Department of Science and Technology, the prevalence of borderline (200–239 mg/dL) to high TC (≥ 240 mg/dL), borderline (130–159 mg/dL) to high LDL-C (≥ 160 mg/dL), low HDL-C (< 40 mg/dL), and elevated TG (≥ 150 mg/dL) in adults aged ≥ 20 years were 46.9%, 47.2%, 71.3% and 38.6%, respectively.²² Overall, 72% of adults in this survey had at least one abnormal lipid component.²²

7. Thailand

The definition of dyslipidemia in the Thailand's National Health Examination Survey (NHES) conducted in 2009 was based on the Third Adult Treatment Panels (ATP III).²³ This means that people with different cardiovascular risk levels have different cut-off blood LDL-C levels. Under this definition, the prevalence of high LDL-C was 29.6%.²⁴ Additionally, the prevalence of low HDL-C (male < 40 mg/dL, female < 50 mg/dL) and high TG (≥ 150 mg/dL) in adults aged ≥ 20 years were 47.1% and 38.6%, respectively.²⁴ People who lived in Bangkok and central region of Thailand had a significant higher level of LDL-C but a lower level of HDL-C than those who lived in other regions.²⁴ Overall, 66.5% of Thais had some forms of dyslipidemia.²⁴

Table 2
The lipid guidelines of countries in the Asia Pacific region.

Country	Data source
Australia	http://www.racgp.org.au/download/Documents/Guidelines/Redbook9/17048-Red-Book-9th-Edition.pdf
China	Expert Panel of Chinese Guidelines for the Treatment and Prevention of Dyslipidemia. Chinese guidelines for the treatment and prevention of dyslipidemia. <i>Chin J Cardiol.</i> 2007;35:390–410.
Japan	http://www.j-athero.org/en/publications/guideline2012.html
Korea	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4891593/pdf/kcj-46-275.pdf
Malaysia	http://www.moh.gov.my/penerbitan/CPG2017/6632.pdf
New Zealand	https://www.health.govt.nz/system/files/documents/publications/nz-primary-care-handbook-2012.pdf
Philippines	http://endo-society.org.ph/v5/wp-content/uploads/2013/06/Dyslipidemia-Clinical-Guidelines-final_01mar.pdf
Singapore	https://www.moh.gov.sg/content/dam/moh_web/HPP/Doctors/cpg_medical/current/2016/lipids/MOH%20Lipids%20CPG%20-%20Executive%20Summary.pdf
Taiwan	http://www.tas.org.tw/index.php?lang=en
Thailand	http://www.thaiheart.org/Download/2016-RCPT-Dyslipidemia-Guideline.html

8. Malaysia

Malaysia is a multi-ethnic nation with 3 major ethnic groups, including Malays (63.1%), Chinese (24.6%), and Indians (7.3%).²⁵ The Malaysian Cohort study which recruited a total 106,527 participants aged 35–70 years in 2006–2012 to investigate the rising trends of non-communicable diseases showed that the prevalence of hypercholesterolemia (TC \geq 240 mg/dL) was 44.9%.²⁶ By ethnic groups, the prevalence of hypercholesterolemia among Malays, Chinese, Indians and other races were 51.0%, 40.8%, 41.6% and 34.4%, respectively.²⁶

9. Indonesia

According to the WHO statistics, the prevalence of dyslipidemia (defined as TC \geq 160 mg/dL) in adults aged \geq 25 years in Indonesia was about 36% (33.1% for men and 38.2% for women).⁹ A study with a small population (N = 1,013) showed that the prevalence of dyslipidemia in all ethnic groups in Indonesia (defined as TC > 240 mg/dL) was between 9.0% and 25%.²⁷

10. Singapore

According to the Singapore National Health Survey, the prevalence of high TC (\geq 240 mg/dL) in adults aged 18–69 years dropped from 25.4% in 1998 to 17.4% in 2010.²⁸ Additionally, high LDL-C (\geq 160 mg/dL) decreased from 26.5% in 1998 to 15.2% in 2010.²⁸

11. Australia

In the Australian National Health Survey (NHMS, 2011–2012), 63.2% of adults aged \geq 18 years had at least one characteristic of dyslipidemia (i.e., taking cholesterol-lowering drugs, TC \geq 5.5 mmol/L [210 mg/dL], LDL-C \geq 3.5 mmol/L [135 mg/dL], HDL-C <1.0 mmol/L [40 mg/dL] in males and <1.3 mmol/L [50 mg/dL] in females, and TG \geq 2.0 mmol/L [177 mg/dL]).²⁹ The prevalence of high TC (\geq 5.5 mmol/L [210 mg/dL]) was 32.8%, in which no significant differences were seen between men and women.²⁹ The prevalence of high TG (\geq 2.0 mmol/L [177 mg/dL]) was 13.9% with a significant higher prevalence in men (19.0%) than that in women (9.0%).²⁹

12. New Zealand

According to the report of New Zealand Health Survey (NZHS) conducted in 2015–2016, the prevalence of high TC (defined as being diagnosed with high TC and currently taking cholesterol-lowering drugs) in people aged \geq 15 years was 11.5%.³⁰ The prevalence of high TC increased with age. In addition, people with a lower socioeconomic status had a higher prevalence of high TC than those with a higher socioeconomic status.³⁰

13. Conclusion

The prevalence of dyslipidemia across the Asia Pacific region varied substantially, partly attributable to ethnicities, as evidenced by the difference in ethnic groups of the same country, and partly owing to the prescription rate of lipid-lowering drugs of a wide range between countries. In addition, the prevalence of dyslipidemia may differ with age, gender, resident region, and socioeconomic status. Generally, the awareness, treatment, and control rates of dyslipidemia remained to be improved. Therefore, it is necessary for each country to conduct the epidemiological survey and implement treatment programs to reduce the prevalence of dyslipidemia and the risk of CVD.

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