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10-year risk for atherosclerotic cardiovascular disease and coronary heart disease among Korean adults: Findings from the Korean National Health and Nutrition Examination Survey 2009–2010

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ABSTRACT

Background: This study examined the distribution of the 10-year risk for development of atherosclerotic cardiovascular disease (ASCVD) and coronary heart disease (CHD), and the proportion of participants eligible for lipid management, in the Korean population.
Methods: The risk was estimated using the Pooled Cohort Equations for non-Hispanic Whites and the Adult Treatment Panel (ATP) III equations. Eligibility for lipid-lowering treatment was assessed using the American College of Cardiology/American Heart Association Blood Cholesterol Guideline and the ATP III recommendation. Complex sampling design and area under the receiver operator characteristic curve (AUC) were used.
Results: Among 7594 ASCVD-free Korean adults, aged 40–79 years, 31.3% (men, 44.1%; women, 19%) had a 10-year risk for an ASCVD event of ≥7.5%, and 27.1% (men, 39.4%; women, 15.2%) had a 10-year risk for a CHD event of ≥10%. These proportions differed according to age groups, ranging from 6.1 to 91.9% and 8.7 to 58.7% for patients in their 40s–70s, using the ASCVD and CHD risk estimations, respectively. Overall, 78.7% of individuals remain in the same risk stratum. Those eligible for lipid management included 32.8% of the participants using the ACC/AHA Guideline and 11.9% of those using the ATP III recommendation. In discriminating ASCVD, AUCs for the ASCVD risk assessment method and the CHD risk assessment method were 0.70 and 0.64, respectively ($P < 0.001$).
Conclusions: The distribution of 10-year ASCVD and CHD risk was different according to the risk assessment methods.

1. Introduction

Risk estimation for incident cardiovascular disease (CVD) plays an important role in the guidelines for planning CVD risk factor management strategies. The equation based on the Framingham Heart Study [1], which was incorporated in the guidelines by the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (NCEP/ATP III), has been widely used to predict the risk of developing coronary heart disease (CHD) [2]. However, several concerns about this risk assessment tool have been identified, including the difficulty of its application to the non-White population, inability to estimate the risk for atherosclerotic events other than CHD, lack of sufficient evidence for risk classifications regardless of population characteristics, and lack of evidence for the categorization of diabetes mellitus into a CHD risk-equivalent level [3].

Very recently, the cardiovascular risk assessment was updated to estimate the 10-year risk of a hard atherosclerotic cardiovascular disease (ASCVD) event, defined as a nonfatal myocardial infarction or CHD death, or fatal or nonfatal stroke among people without ASCVD. This new risk prediction version, which was based on pooled cohort data from a number of longitudinal, community-based, epidemiological cohort studies [4–8], is applicable for African-American, and non-Hispanic White men and women, 40–79 years of age [3]. Although this method improves upon the limitations of the ATP III assessment tool and widens the range of applicable ethnic backgrounds, the distribution pattern of the 10-year ASCVD risk estimates in diverse populations remains unknown.

Cardiovascular disease has been a leading cause of death for the past 10 years in Koreans and explained 19.5% of all deaths of Koreans in 2012 [9]. Therefore, development of nationally applicable risk score for CHD or ASCVD for the Korean population is necessary although there are research about risk factors associated with the Framingham Risk Score and incident ASCVD [10,11] and application of the Framingham risk function for CHD in the Korean population [12]. Moreover, estimation of ASCVD and CHD risk and the proportion of the population eligible for lipid-lowering treatment in the Korean population are important

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for providing information about the distribution of these risks in an ethnic group not included in the Pooled Cohort Equations and planning CHD and ASCVD prevention strategies.

This study examined the distribution of the 10-year risk for a hard ASCVD and CHD development as proposed by the Pooled Cohort Equations [3] and ATP III equation [2], respectively, and also assessed the proportion of adults eligible for lipid management, using data from the Korean National Health and Nutrition Examination Survey (KNHANES) 2009–2010.

2. Methods

2.1. Study participants

A representative sample of civilian, non-institutionalized Korean population participated in the KNHANES between 2009 and 2010, which used a multistage, stratified, systemic sampling and rolling survey sampling design of household units. The sampling frame was based on the 2009 resident registration data and 2008 apartment market value data for Korea. A total of 10,533 (82.8% of 12,722 individuals) individuals in 2009 and 8473 (77.5% of 10,938 individuals) individuals in 2010 participated in the Health Behavior Survey, the Health Examination Survey, or the Nutrition Survey [13,14]. The current study included 7594 Korean adults (3307 men, 4287 women), aged 40–79 years, who were free of nonfatal ASCVD, and who provided the data required for estimating a 10-year risk for ASCVD and CHD and 8006 Korean adults, aged 40–79 years, who included individuals with history of stroke or CHD (angina and myocardial ischemia) for estimating eligible groups for lipid-lowering treatment and comparison of two risk assessment methods for stroke or CHD. All participants signed a form that signified their informed consent.

2.2. Estimation of 10-year risk for ASCVD/CHD and individuals eligible for lipid-lowering treatment

Blood pressure (BP) measurements were performed three times with a standard manual sphygmomanometer with the participants seated. The average of the second and third systolic and diastolic BP readings was used for the analyses. Antecubital venous blood samples were taken from each subject after a 12-h, overnight fast. The levels of high density lipoprotein cholesterol (HDL-C), triglycerides (TG), total cholesterol, and fasting glucose were measured using an automatic analyzer (Automatic Analyzer 7600, Hitachi, Tokyo, Japan). The level of low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation [15] or was directly measured in the blood when the TG level was >5.65 mmol/L.

Self-reported questionnaires were used to assess the medical history (diagnosis and treatment) regarding hypertension, diabetes mellitus, angina pectoris, myocardial ischemia, and stroke, as well as to assess smoking status (current smoker vs. non-current smoker). An individual was defined as having diabetes mellitus if (s)he had a high fasting blood glucose level (≥6.99 mmol/L), had been diagnosed with diabetes mellitus by a physician, or was currently being treated for diabetes mellitus [13,14].

The 10-year risk of developing ASCVD was calculated by the Pooled Cohort Equations for non-Hispanic Whites, which included age, total cholesterol level, HDL-C, systolic BP (using different coefficients, depending on whether or not the individual was treated for hypertension), current smoking status, and the presence/absence of diabetes mellitus for each sex. The 10-year risk was defined as the risk of developing the first ASCVD event (a nonfatal myocardial infarction or CHD death, or fatal or nonfatal stroke) within a 10-year period, among people free of ASCVD at the beginning of the period [3]. The 10-year risk for a hard CHD (coronary death or nonfatal myocardial infarction) was calculated using the ATP III 10-year risk assessment equations, which included age, sex, BP (and whether or not the individual was treated for hypertension), HDL-C, LDL-C, diabetes mellitus, and current smoking status [2].

Individuals eligible for lipid-lowering treatment were determined using the American College of Cardiology/American Heart Association (ACC/AHA) Blood Cholesterol Guideline [16] or the ATP III guideline [2]. According to the ACC/AHA Blood Cholesterol Guideline, four treatment recommended groups (those with CHD or stroke, those without CHD and stroke who had LDL-C ≥ 4.92 mmol/L, those without CHD and stroke who were 40 to 75 years of age, and had diabetes and LDL-C 1.81–<4.92 mmol/L, and those without CHD, stroke, and diabetes who were 40 to 75 years of age, and had LDL-C 1.81–<4.92 mmol/L and an estimated ASCVD risk of ≥7.5%) were categorized. In addition, based on the ATP III recommendation, four treatment-recommended groups (those with a CHD risk > 20%, CHD or diabetes who had LDL-C ≥ 3.37 mmol/L, those without CHD and diabetes who had ≥2 cardiovascular risk, a 10–20% CHD risk, and LDL-C ≥ 3.37 mmol/L, those without CHD and diabetes who had ≥2 cardiovascular risk, a CHD risk < 10%, and LDL-C ≥ 4.14 mmol/L, and those without CHD and diabetes who had 0 to 1 cardiovascular risk, and LDL-C ≥ 4.92 mmol/L) were generated. For the cardiovascular risk, cigarette smoking, hypertension, low HDL-C < 1.04 mmol/L, and age (men ≥ 45 years of age; women ≥ 55 years of age) were taken into account [2].

2.3. Statistical analyses

A complex sampling design was applied to report estimates that would be representative of the Korean population, using sampling weights for each year, and calculated weighted percentages and standard errors for selected 10-year risk strata for ASCVD (<7.5%, 7.5 to <10.0%, 10.0 to <20.0%, and ≥20.0%) and CHD (<10.0%, 10.0 to <20.0%, and ≥20.0%) among the overall participants, and by sex, and after grouping the individuals by age (40–49 years, 50–59 years, 60–69 years, and 70–79 years). Two risk assessment methods were compared using cross-tabulation for the risk strata among the overall subjects and after grouping by sex. Descriptive analyses were conducted for the distribution of categories of those eligible for lipid-lowering treatment for the total population and for both sexes. Area under the receiver operating characteristic curve (AUC), which plots the sensitivity against its false positive rate against all possible values, was used to compare two risk assessment methods for discriminating individuals had stroke or CHD [17]. The IBM SPSS statistics, version 19.0.0 (IBM, Armonk, NY, USA) and MedCalc software, version 12.0.0 (MedCalc, Ostend, Belgium) were used for analyses.

3. Results

Table 1 presents the distribution of the components included in the 10-year ASCVD and CHD risk estimation. The average 10-year risk for ASCVD and CHD was almost double for men as compared with women. Among Korean adults without ASCVD, 40–79 years old, 31.3% and 27.1% had a 10-year risk of a hard ASCVD event of ≥7.5% and a CHD event of ≥10%, respectively. Irrespective of the risk estimation method, the proportions of individuals included in these risk categories were greater among men than among women (44.1% vs. 19%, using the ASCVD risk estimation; 39.4% vs. 15.2%, using the CHD risk estimation), and rose with increasing age. However, compared to the proportion with a risk of ≥10% using the CHD risk estimation, those identified using the ASCVD risk estimation tended to be older at a risk of ≥10%: 2.8% vs. 8.7% for individuals in their 40s, and 94.6% vs. 58.7% for individuals in their 70s, using the ASCVD and CHD risk estimations, respectively (Table 2). Table 3 displays a cross-tabulation of the risk strata (<7.5% and 7.5 to <10% strata of ASCVD risk estimation were combined) using the 10-year risk for CHD and the 10-year risk for ASCVD in the same individuals. Overall, 78.7% of individuals (men, 73.4%; women, 84.0%) remained in the same risk stratum regardless of the approach; 7.9% (men, 8.9%; women, 7.0%) of individuals classified using the CHD risk assessment were up-classified by the ASCVD risk assessment, and 13.0% (men, 17.7%; women, 8.9%) were down-classified. As shown in Table 4, the distribution of Korean adults eligible for lipid-lowering treatment using the ACC/AHA Blood Cholesterol Guideline differed from that generated by the ATP III guideline. Using the ACC/AHA Blood Cholesterol Guideline and the ATP III recommendations, 32.8% and 11.9% of the individuals were classified into the recommended treatment groups, respectively. The two classification schemes also differed in the proportion of men and women who qualified for lipid

Table 1
Distribution of variables included in the 10-year risk estimates for ASCVD and CHD in the ASCVD-free, non-pregnant Korean population aged 40 to 79 (KNHANES 2009–2010).

	Men (n = 3307, weighted n = 8,981,617)	Women (n = 4287, weighted n = 9,358,210)
ASCVD risk (%)	9.6 (0.22)	4.8 (0.16)
CHD risk (%)	10.9 (0.19)	5.1 (0.11)
Age (yr)	53.0 (0.24)	54.0 (0.22)
Systolic blood pressure (mm Hg)	125.4 (0.38)	121.9 (0.38)
Diastolic blood pressure (mm Hg)	83.0 (0.29)	77.6 (0.21)
Glucose (mmol/L)	5.72 (0.03)	5.44 (0.02)
Total cholesterol (mmol/L)	4.97 (0.02)	5.05 (0.02)
HDL cholesterol (mmol/L)	1.28 (0.01)	1.40 (0.01)
LDL cholesterol (mmol/L)	2.79 (0.02)	3.02 (0.02)
Current smoker, %	43.4 (1.1)	4.7 (0.5)
Presence of diabetes mellitus, %	13.4 (0.7)	10.4 (0.6)
Treatment of hypertension, %	20.2 (0.9)	21.8 (0.9)

ASCVD, atherosclerotic cardiovascular disease; CHD, coronary heart disease; KNHANES, Korean National Health and Nutrition Examination Survey.
Values are the mean or % (SE) using complex sampling design analyses.

Table 2
Distribution of 10-year risk for ASCVD and CHD in the ASCVD-free, non-pregnant Korean population aged 40 to 79 (KNHANES 2009–2010).

	10-year risk for ASCVD (%)					10-year risk for CHD (%)			
	Weighted n	<7.5	7.5–<10.0	10.0–<20.0	≥20.0	Weighted n	<10.0	10.0–<20.0	≥20.0
Total	18,339,828	68.7 (0.8)	7.6 (0.4)	14.9 (0.5)	8.8 (0.4)	17,611,446	72.9 (0.7)	19.7 (0.6)	7.4 (0.4)
Sex									
Men	8,981,617	55.9 (1.2)	10.4 (0.7)	21.4 (0.8)	12.3 (0.7)	8,693,290	60.6 (1.1)	26.2 (0.9)	13.2 (0.7)
Women	9,358,210	81.0 (0.8)	4.8 (0.4)	8.7 (0.5)	5.4 (0.4)	8,918,156	84.8 (0.7)	13.4 (0.7)	1.8 (0.2)
Age (yrs)									
40–49	7,647,934	93.9 (0.6)	3.3 (0.5)	2.7 (0.4)	0.1 (0.1)	7,503,829	91.3 (0.7)	6.9 (0.6)	1.8 (0.3)
50–59	5,797,819	74.8 (1.1)	10.3 (0.7)	12.5 (0.9)	2.4 (0.4)	5,694,541	69.5 (1.2)	23.4 (1.1)	7.1 (0.7)
60–69	3,298,841	32.5 (1.1)	14.2 (0.9)	37.6 (1.2)	15.7 (1.0)	3,250,436	47.5 (1.3)	36.4 (1.3)	16.1 (1.1)
70–79	1,595,232	0.9 (0.3)	4.5 (0.9)	35.2 (1.7)	59.4 (1.7)	1,162,639	41.3 (2.2)	37.6 (2.1)	21.1 (1.6)

ASCVD, atherosclerotic cardiovascular disease; CHD, coronary heart disease; KNHANES, Korean National Health and Nutrition Examination Survey.
Values are the % (SE) using complex sampling design analyses.

management (42.0% vs. 13.6% for men; 23.9% vs. 10.3% for women), although both indicated that more men than women qualified. In the ROC curve analysis for discriminating stroke and CHD, there was a significant difference in the AUC for the ASCVD risk assessment method and the AUC for the CHD risk assessment method ($P < 0.001$). In discriminating stroke or CHD ($n = 433$), the AUC for the ASCVD risk assessment method was significantly different from that for the CHD risk assessment method (0.702 vs. 0.64, $P < 0.001$) for the cutoff value 8% vs. 4%, respectively (Table 5).

4. Discussion

In this representative sample of ASCVD-free Korean adults, aged 40–79 years, the distribution of the 10-year risk for a hard ASCVD event differed from that generated by the 10-year risk for a hard CHD event in several respects. First, the distribution of proportions into specific risk categories differed by age when using the two estimation methods. Despite the observation that similar proportions of the total participants had a 10-year risk for a hard ASCVD event of ≥7.5% and CHD event of ≥10% (31.3% and 27.1%, respectively), the increase in these proportions, with advancing age, was steeper for the ASCVD risk than that for the CHD risk. In addition, the individuals classified into the high 10-year ASCVD risk group were different from those in the high 10-year CHD risk group. For example, as shown in Table 3, when the threshold for a high risk group was defined as ≥7.5%, using the 10-year ASCVD risk estimation or ≥10% using the 10-year CHD risk estimation, 75.3% of those in the high risk group, using the 10-year CHD risk estimation (27.1%), were also included in the high risk group using the 10-year ASCVD risk estimation (20.4%). Likewise, 68.7% of those in the high risk group, using the 10-year ASCVD risk estimation (29.7%), qualified for the high risk group using the 10-year CHD risk estimation (20.4%). These differences between the two estimation methods resulted in different estimations of individuals who may be eligible for lipid management. In other words, the population who were candidates for lipid-lowering treatment based on the ACC/AHA Blood Cholesterol Guideline was 2.8 times larger than that identified by the ATP III recommendation.

The distribution of Koreans in the 10-year ASCVD risk and eligible for lipid-lowering treatment using the ACC/AHA Blood Cholesterol Guideline [16] appears to be very similar to that for the US population [3]. For example, the proportion of Koreans in the high risk group, based on the 10-year ASCVD risk estimation (i.e., ≥7.5%), approximates that in the US population (overall, 31.3% vs. 32.8%; men, 44.1% vs. 44.3%; women, 19.1% vs. 22.5%, respectively). The distribution according to age groups in the Korean population was also comparable to that in the US population: age 40–49 years, 6.1% vs. 6.7%; 50–59 years, 25.2% vs. 23.5%; 60–69 years, 67.5% vs. 61.7%; and 70–79 years, 91.9% vs. 99.0%, respectively. Despite the different 10-year risk strata classification, the agreement between the Korean strata and those for the US population is very similar (overall, 69.5% vs. 68.7% in overall; men, 63.1% vs. 63.2%; women, 75.8% vs. 73.8%, respectively). Moreover, the proportion of the Korean population eligible for lipid-lowering treatment, using the ACC/AHA Blood Cholesterol Guideline, was also quite similar to that for the US population (32.8% vs. 32.4%, respectively). However, these proportions are lower in the Korean population than in the US population (11.9% vs. 32.3%, respectively) when the ATP III recommendation was used. Therefore, selection of more appropriate risk assessment method would be important based on these big differences in CHD or CVD risk distribution according to two risk assessment methods. In the analysis to compare the discriminating ability for individuals with stroke or CHD, the AUC for ASCVD risk assessment method was different from that for the CHD risk assessment method. Although

Table 3
Cross tabulation of distribution of 10-year risk for CHD and 10-year risk for ASCVD in the ASCVD-free, non-pregnant Korean population aged 40 to 79 (KNHANES 2009–2010, n = 7207, weighted n = 18,325,792).

10-year risk for CHD (%)		10-year risk for ASCVD				
		<7.5%	7.5–<10.0%	10.0–<20.0%	≥20.0%	Total
Overall	<10.0%	63.6 (0.8)	4.1 (0.3)	4.3 (0.3)	0.8 (0.1)	72.9 (0.7)
	10.0–<20.0%	6.3 (0.4)	3.1 (0.2)	7.5 (0.3)	2.8 (0.2)	19.7 (0.6)
	≥20%	0.4 (0.1)	0.5 (0.1)	3.0 (0.3)	3.5 (0.2)	7.4 (0.4)
	Total	70.3 (0.8)	7.8 (0.4)	14.9 (0.5)	7.1 (0.4)	100.0
Men	<10.0%	50.1 (1.3)	5.2 (0.5)	4.4 (0.4)	0.9 (0.2)	60.6 (1.1)
	10.0–<20.0%	6.4 (0.6)	4.6 (0.4)	11.6 (0.6)	3.6 (0.3)	26.2 (0.9)
	≥20%	0.4 (0.1)	0.8 (0.2)	5.5 (0.5)	6.5 (0.5)	13.3 (0.7)
	Total	56.9 (1.2)	10.6 (0.7)	21.5 (0.8)	11.0 (0.7)	100.0
Women	<10.0%	76.8 (0.9)	3.1 (0.3)	4.3 (0.3)	0.6 (0.1)	84.8 (0.7)
	10.0–<20.0%	6.2 (0.5)	1.6 (0.2)	3.5 (0.3)	2.1 (0.3)	13.4 (0.7)
	≥20%	0.3 (0.1)	0.2 (0.1)	0.6 (0.1)	0.6 (0.1)	1.8 (0.2)
	Total	83.3 (0.7)	5.0 (0.4)	8.4 (0.5)	3.3 (0.3)	100.0

CHD, coronary heart disease; ASCVD, atherosclerotic cardiovascular disease; KNHANES, Korean National Health and Nutrition Examination Survey.
Values are the % of total N (SE).

Table 4
Distribution of individuals who were eligible for lipid-lowering drug therapy in the non-pregnant Korean population aged 40 to 79 (KNHANES 2009–2010, n = 8006 for ACC/AHA guideline, n = 7610 for ATP III guideline).

	Total		Men		Women	
	Weighted n	% (SE)	Weighted n	% (SE)	Weighted n	% (SE)
ACC/AHA guideline	19,115,344		9,400,604		9,714,739	
CHD or stroke	818,942	4.3 (0.3)	429,758	4.6 (0.4)	389,184	4.0 (0.3)
No CHD or stoke						
LDL-C ≥ 4.92 mmol/L	266,600	1.4 (0.3)	95,859	1.0 (0.2)	170,741	1.8 (0.2)
DM & 40–75 years & LDL-C 1.81–<4.92 mmol/L	1,707,915	8.9 (0.4)	933,668	9.9 (0.6)	774,247	8.0 (0.5)
No DM & 40–75 years & LDL-C 1.81–<4.92 mmol/L & ASCVD risk ≥ 7.5%	3,469,875	18.2 (0.6)	2,485,679	26.4 (0.9)	984,196	10.1 (0.5)
Subtotal	6,263,334	32.8 (0.7)	3,944,964	42.0 (1.1)	2,318,369	23.9 (0.9)
ATP III guideline	18,381,631		9,096,640		9,284,991	
CHD/DM/CHD risk > 20% & LDL-C ≥ 3.37 mmol/L	1,063,115	5.8 (0.3)	604,739	6.6 (0.5)	458,375	4.9 (0.4)
No CHD & NO DM & CVD risk ≥ 2						
CHD risk 10–20% & LDL-C ≥ 3.37 mmol/L	824,009	4.5 (0.3)	511,856	5.6 (0.5)	312,152	3.4 (0.3)
CHD risk < 10% & LDL-C ≥ 4.14 mmol/L	173,691	0.9 (0.1)	93,768	1.0 (0.2)	79,922	0.9 (0.1)
No CHD & NO DM & CVD risk 0–1						
LDL-C ≥ 4.92 mmol/L	129,729	0.7 (0.1)	24,695	0.3 (0.1)	105,034	1.1 (0.2)
Subtotal	2,190,545	11.9 (0.5)	1,235,060	13.6 (0.7)	955,485	10.3 (0.6)

KNHANES, Korean National Health and Nutrition Examination Survey; ACC/AHA, American College of Cardiology/American Heart Association; ATP, Adult Treatment Panel; CHD, coronary heart disease; LDL-C, low density lipoprotein cholesterol; DM, diabetes mellitus; ASCVD, atherosclerotic cardiovascular disease;. CVD risk, cardiovascular risk [cigarette smoking, hypertension, high density lipoprotein cholesterol < 1.04 mmol/L, and age (men ≥ 45 years; women ≥ 55 years)].

the classification of those had CHD and stroke was not proved by hospital records, these results suggest that the two risk assessment methods would be different in the Korean population.

Several limitations related to data accuracy should be taken into account. The exclusion of participants with ASCVD was based on self-reported data and the enrolled participants may have included those with ASCVD compatible conditions, such as peripheral artery disease, carotid artery disease, abdominal aortic aneurysm, and transient ischemic attack, which were not included in the questionnaire. Likewise, those with such atherosclerotic diseases were not taken into account for clinical ASCVD group who are eligible for lipid-lowering treatment. As the participants undergoing lipid-lowering treatment were not excluded, the risk estimation and the proportion of the population eligible for lipid-lowering treatment may be inaccurate and some individuals, especially those with borderline results based on the set cutoff values, may not be adequately categorized. When the distribution of 10-year ASCVD risk estimation was compared between those who self-reported lipid-lowering medication use that were excluded and those who self-reported lipid-lowering medication use that were included, those who had a risk of <7.5% were 69.5% vs. 70.3%, those who had a risk of 7.5–10% were 7.4% vs. 7.8%, those who had a risk of 10–20% were 14.7% vs. 14.9%, and those who had a risk of ≥20% were 8.4% vs. 7.1%. On the other hand, the proportion of those eligible for lipid-lowering treatment, based on the ACC/AHA Blood Cholesterol Guideline, was 30.6% in those who self-reported lipid-lowering medication use were excluded, while the proportion was 32.8% in those who self-reported lipid-lowering medication use were included. Therefore, the categorization of participants based on 10-year ASCVD risk estimation would be underestimated and the proportion of those eligible for lipid-lowering treatment would be overestimated in the participants including those undergoing lipid-lowering treatment. Finally, as the comparison for incident ASCVD or CHD were not conducted, the current study did not identify which risk assessment method would be superior for ASCVD risk estimation in Koreans.

In conclusion, the 10-year risk distribution for a hard ASCVD event using the Pooled Cohort Equations in an ASCVD-free, representative Korean population, aged 40–79 years, differed from that for developing a hard CHD event using the ATP III equation. In addition, the proportion of patients eligible for lipid management was greater when using the ACC/AHA Blood Cholesterol Guideline than that with the ATP III recommendation. Further studies to establish optimal risk assessment method for prediction of ASCVD in the follow-up study of a Korean population are necessary.

Conflict of interest

There are no conflicts of interest to be declared.

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Table 5
Comparison of sensitivity and specificity for classification of stroke and coronary heart disease between 10-year risk for CHD and 10-year risk for ASCVD in the Korean population aged 40 to 79 (KNHANES 2009–2010, n = 8006).

	Stroke (n = 199)					CHD (n = 252)				
	Cutoff value	Sensitivity (95% CI)	Specificity (95% CI)	AUC (95% CI)	P-value[a]	Cutoff value	Sensitivity (95% CI)	Specificity (95% CI)	AUC (95% CI)	P-value
10-year risk for ASCVD	6.2	79.4 (73.1, 84.8)	56.2 (55.1, 57.3)	0.72 (0.71, 0.73)	<0.001	8.8	64.7 (58.4, 70.6)	65.5 (64.4, 66.5)	0.68 (0.67, 0.69)	<0.001
10-year risk for CHD	4	85.1 (79.0, 90.1)	39.5 (38.4, 40.6)	0.67 (0.65, 0.68)		7	58.1 (51.5, 64.5)	58.4 (57.2, 59.5)	0.61 (0.60, 0.62)	

CHD, coronary heart disease; ASCVD, atherosclerotic cardiovascular disease; KNHANES, Korean National Health and Nutrition Examination Survey; AUC, area under the receiver operating characteristics (ROC) curve; values are in %.
[a] Comparison of ROC curve of two risk estimation methods.

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