Title
Cardiovascular Risk Factors and 10-year Risk for Coronary Heart Disease Among Korean Women

Author
Boo, Sunjoo

Publication Date
2011

Peer reviewed|Thesis/dissertation

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by

Sunjoo Boo

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

[redacted]

Acknowledgement

Completion of my doctoral study would not have been possible without the guidance, support, and help from many professors, colleges, family members, and friends. I am especially grateful and thankful to my committee members who have guided me through the qualifying examination and dissertation process.

First, my sincere thanks goes to Dr. Erika Froelicher, my advisor and dissertation chair. I do not know if I will ever be able to thank her enough for all she has done for me. Her constant support and expert knowledge in the area of cardiovascular nursing and epidemiology allowed me to complete my doctoral study in a timely manner. I especially appreciate the fact that she believed in my ability to finish this dissertation even when I was not confident. As a novice researcher, focusing only on the research questions I had planned to address and being concise were never easy. Whenever I went astray, she redirected me and helped me to get to the problems on the table. She has generously devoted her time to me whenever I needed her for scientific inquiries as well as for personal agony. Her support made a difficult time much easier. She has not only been an academic advisor for me but also another mom in the U.S. Thank you so much, Dr. Erika Froelicher.

Dr. Nancy Stotts, the chair of my qualifying examination, provided me with the insight I needed about how to organize an academic paper, which is one of the most important aspects of being a nursing researcher. I truly appreciated her guidance, encouragement, and especially sense of humor. Whenever I became nervous during the qualifying examination and dissertation defense, I looked at her, and then I felt relaxed, comfortable, and confident. I also would like to thank her for her thorough feedback on all my work.

I am grateful to Dr. Catherine Waters, one of my dissertation committee members. I had the chance to work with her during my research residency. She is introduced me to the real world of research. I truly thank her for being patient and kind in explaining the key concepts of conducting research based on her own intensive research experiences, which I could never get from a book.

I am thankful to Dr. Dianne Christopherson, also a committee member, for her gracious encouragement and support. She provided me with important clinical insights, and the importance of her help on my dissertation was immeasurable. It was an honor and privilege to have the opportunity to learn from such great faculty members. Their contributions to my professional growth were invaluable.

I would like to appreciate the Korea Centers for Disease Control and Prevention in providing the data used in my doctoral dissertation. I also would like to thank Dr. Steven Paul for his statistical consultation and guidance with data analysis. My special thanks goes to Christine Hansen for her editorial efforts. She made my dissertation clearer and easier to read.

I am also grateful for the following financial support for my doctoral study: the Graduate Dean's Health Sciences Fellowship, UCSF Nursing Alumni Association Scholarship, UCSF School of Nursing Century Club Award, UCSF Graduate Student Research Award, and the Sigma Theta Tau Alpha Eta Research Award.

Most importantly, I am thankful to my family for their constant love and support. The stresses and strains that accompanied my academic aspirations also greatly affected those closest to me. I would like to express my sincerest thanks to my husband, Changhun, and my daughter, Eunsae, for always being with me during my high points as well as low points, and for encouraging me through the long journey. I am also grateful to my parents and parents-in-law who always believed in me and prayed for my success. I could not have completed my doctoral study without the help and support of my family. I cannot thank you enough, and I would like to say I love you to each of them.

Cardiovascular Risk Factors and 10-year Risk for Coronary Heart Disease

Among Korean Women

Sunjoo Boo, RN, PhD

Abstract

Background. More women than men die of cardiovascular disease (CVD) in Korea. Of important concern to Korean women is the dramatically increasing mortality rate from coronary heart disease (CHD). Despite the significant burden of CHD in Korean women and its adverse impact on national public health, women have received little attention in cardiac research in Korea.

Purpose. The purposes of this study were to: (1) describe the prevalence of cardiovascular risk factors in Korean women, (2) estimate the 10-year risk for CHD, and (3) evaluate the proportion of women who need to be treated based on the American Heart Association (AHA) evidence-based guidelines for CVD prevention.

Methods. A cross-sectional design using the data set from the 2008 Korea National Health and Nutrition Examination Survey IV was used. The sample was 3,301 asymptomatic women aged 20 years or older. Ten-year risk for CHD was estimated with the Framingham Risk Score. Korean women were classified into three risk subgroups. The proportion of women who were in need of treatment for each subgroup was presented.

Results. About 35% of Korean women had two or more major modifiable risk factors for CHD. Among Korean women free of CVD, 97.4% had a 10-year risk for CHD of < 10%, 2.4% had a risk of 10 to 20%, and 0.2% had a risk of > 20%. About 75% of Korean women in the high risk group were in need of lipid lowering treatment, but only 10.9% of them were receiving treatment.

Conclusions. Modifiable cardiovascular risk factors were highly prevalent among asymptomatic Korean women of all ages, and the clustering of risk factors was common. Ten-year risk for developing CHD risk in Korean women was comparable to that of women in the U.S. However, the proportion of Korean women who were not at AHA guideline goals was substantial. Furthermore, there was a significant treatment gap in Korean women. The findings of this study suggest that Korean women free of CVD need to be treated more intensively. Aggressive risk reduction efforts are urgently needed to prevent CHD in Korean women.

Approved:

Erika S. Froelicher, RN, MA, MPH, PhD, FAAN
Dissertation Chairperson

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Chapter 1

Introduction

Significance of the Problem

Although cardiovascular disease (CVD) has long been considered a disease of men in Korea, women can and do get CVD. In fact, more women than men die of CVD, accounting for 1 in 4.5 deaths in women, compared to 1 in 5.8 men in 2009 (Korea National Statistics Office, 2010). Of concern is the dramatically increasing mortality rate from coronary heart disease (CHD). Over the past 25 years, mortality from CHD has increased approximately 15-fold in Korean women (Korea National Statistics Office, 2010). Furthermore, it is estimated that such epidemics will continue with the aging of the population and unhealthy changes in lifestyle and diet (Kim, Kim, Jung, Park, & Park, 2007; Lee et al., 2007; Park, Yun, Park, Kim, & Choi, 2003). There is no doubt that CHD has become a significant burden in Korean women.

CHD occurs in individuals with cardiovascular risk factors. Fortunately, most CHD in women is preventable with risk factors modification (Mosca et al., 2007; Yusuf et al., 2004). A case-control study by Yusef et al. (2004) found that nine modifiable risk factors (hypertension, diabetes, dyslipidemia, smoking, obesity, physical inactivity, unhealthy diet, alcohol intake, and psychosocial factors) accounted for 94% of first heart attacks in women. This means that 94% of first heart attacks in women could be prevented by controlling the nine modifiable risk factors. Aggressive risk reduction is crucial for preventing potentially catastrophic disease in Korean women. Health care professionals, namely physicians and nurses, must be educated and skilled in CHD risk assessment and risk reduction including behavioral interventions.

A key principle of CHD prevention is that the intensity of risk reduction should be adjusted to each individual's risk status. Accordingly, the first step in CHD prevention is to accurately assess a woman's absolute risk for future cardiac events. Current clinical guidelines for primary prevention of CHD recommend first counting the number of risk factors and then estimating the 10-year risk for CHD with risk assessment tools that take into account the multifactorial nature of CHD (National Cholesterol Education Program /Adult Treatment Panel III [NCEP/ATP III], 2001; Mosca et al., 2007). Estimation of the 10-year risk allows for classification of asymptomatic women into low, moderate, and high risk subgroups, with specific empirically validated prevention plans for each subgroup.

Recent studies have shown that women who are asymptomatic can benefit from comprehensive risk assessment and intensive risk reduction based on their risk (Cholesterol Treatment Trialists' Collaborators, 2008; Vrecer, Turk, Drinovec, & Mrhar, 2003; Ward et al., 2007). Adherence to empirically validated clinical guidelines may make it possible to achieve the highest possible levels of CHD risk reduction. Therefore, an important opportunity exists for screening for cardiovascular risk factors and for estimating the 10-year risk for CHD in Korean women in order to prevent potentially catastrophic disease. Comprehensive risk assessment for CHD not only describes the total burden of this disease but may also be useful for highlighting the potential for nursing interventions to reduce the burden of CHD.

Research Aims of the Study

The specific research aims of this study are to: (1) describe the prevalence of cardiovascular risk factors in Korean women (hypertension, smoking, dyslipidemia, obesity, central obesity, physical inactivity, diabetes, alcohol use, and depressive mood), (2) identify demographic, socioeconomic, and behavioral variables that predict heavy cardiovascular burden (defined as the presence of two or more modifiable cardiovascular risk factors), (3) estimate the 10-year risk for CHD using the Framingham Risk Score (FRS), and (4) assess the proportion of women who need to be treated based on the American Heart Association (AHA) evidence-based guidelines for CVD prevention.

In conclusion, cardiovascular risk factor assessment is an important tool that allows health professionals to provide preventive services to women at moderate to high risk of CHD morbidity or mortality. The next chapter presents a literature review of the cardiovascular risk factors in the Korean population that can be used as a basis for improving CHD risk assessment in asymptomatic Korean women. Office-based screening tools for estimating 10-year CHD risk with the Framingham Risk Score (FRS) and Reynold's Risk Score (RRS) are also described. Chapter 3 presents Bayes' theorem as a method to combine two different test results in a quantitative way to improve risk classification especially for those at intermediate risk. Chapter 4 describes the methodological issues that need to be considered specific to using existing national survey data sets. Chapter 5 describes the methods used in this cross-sectional study. Chapter 6 presents the findings of this study. Chapter 7 presents a discussion and implication for nursing practice and further research.

Chapter 2 "Coronary heart disease risk assessment in asymptomatic Korean women" is under review in the International Nursing Review. Chapter 3 "Coronary heart disease risk estimation in asymptomatic adults" is under review in the Nursing Research.

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Chapter 2

Coronary Heart Disease Risk Assessment in Asymptomatic Korean Women

Abstract

Given an epidemic rise in coronary heart disease (CHD), morbidity and mortality from CHD has become a prominent burden in Korean women. Women differ from men in their pathophysiology and symptom manifestation of CHD, thus they have a special need for risk factor screening. Despite the significant burden of CHD in Korean women and the special need for risk factor screening, their risk for CHD is underappreciated, and Korean women are underscreened. This review provides an overview of CHD in women and the cardiovascular risk factors in the Korean population that can be used as a basis for improving CHD risk assessment in asymptomatic Korean women. Office-based screening tools for estimating 10-year CHD risk with the Framingham Risk Score (FRS) and Reynold's Risk Score (RRS) are also described.

Introduction

Cardiovascular disease (CVD) is the major cause of death in Korean women. More women than men in Korea die of CVD. CVD was responsible for 1 in 4.5 deaths in women, compared to 1 in 5.8 in men in 2009 (Korea National Statistics Office, 2010). Approximately 30,000 deaths in women are attributable to CVD annually. Of concern to Korean women is the epidemic rise in coronary heart disease (CHD). Over the past 25 years, mortality from CHD increased nearly 15-fold among Korean women (Korea National Statistics Office, 2010). Furthermore, it is estimated that this rapidly increasing trend will continue, given the aging of the population and unhealthy lifestyle and dietary changes (H. M. Kim, Kim, Jung, Park, & Park, 2007; S. Y. Lee et al., 2007; H. S. Park, Yun, Park, Kim, & Choi, 2003). Notably, CHD has become a significant burden in Korean women.

Fortunately, scientific studies in the United States (U.S.) have found that CHD in women is largely preventable with risk reduction (Mosca et al., 2007; Yusuf et al., 2004). Therefore, it is crucial to assess CHD risk as accurately as possible. This will lead to a more precise selection of appropriate prevention strategies. The risk assessment approach in asymptomatic individuals consists of first determining the number of risk factors and then calculating 10- year risk for CHD with office-based screening tools (Adult Treatment Panel III [ATP III], 2001; Mosca et al., 2007). Therefore, to improve CHD risk assessment in asymptomatic Korean women, this review paper focuses on CHD in women and cardiovascular risk factors in the Korean population. Age, gender, hypertension, diabetes, dyslipidemia, obesity, and hwa-byung (Korean culture-bound “anger-disease”) will be described. In addition, office-based screening tools to estimate

10-year CHD risk, the Framingham Risk Score (FRS) and the Reynold's Risk Score (RRS), will be described.

Coronary Heart Disease in Women

Women's Special Needs for Cardiovascular Risk Factor Screening-Pathophysiology

CHD is relatively difficult to evaluate in women partially because of their atypical symptoms (K. H. Lee et al., 2008). However, once clinical CHD has developed, women have a worse prognosis than men (Bellasi, Raggi, Bairey Merz, & Shaw, 2007; K. H. Lee, et al., 2008), and more women die from a first heart attack (K. H. Lee, et al., 2008). This gender difference in symptom manifestation and prognosis may be understood by appreciating the cardiac pathophysiology that is unique to women (Quyyumi, 2006; Shaw, Bugiardini, & Bairey Merz, 2009)

The Women's Ischemia Syndrome Evaluation (WISE) study (Reis et al., 2001) found that in women, cholesterol plaques spread thinly throughout the artery wall, rather than forming major blockages. In this condition, called coronary microvascular syndrome, plaques accumulated in the very small cardiac arteries limit blood flow to the heart. It can cause chest pain similar to that experienced by people with blocked arteries, but the plaque is often not visible with diagnostic coronary angiography (Reis, et al., 2001). As a result, women's risk goes unrecognized and unmanaged. These women remain at high risk for a heart attack. In the WISE study, nearly half of women had microvascular flow dysfunction (Reis, et al., 2001), and many of them experienced adverse cardiovascular events within a few years (Pepine et al., 2004). Such women might benefit from active risk reduction. Risk factor screening and aggressive risk factor modification therapy in women are therefore essential.

An Underappreciated Risk in Korean Women

In spite of the significant burden of CHD and the special need for risk factor screening, Korean women are underscreened and their risk is underappreciated. CHD has been considered mostly a disease of men in Korea. The majority of studies concerning CHD in Korea have focused exclusively on men and very little is known about women. This is, in part, due to the lower prevalence of CHD in women in their younger years. The onset of CHD in women is generally about 10 to 15 years later than in men (Bellasi, et al., 2007; K. H. Lee, et al., 2008). Because serious co-morbidities are more common with age (K. H. Lee, et al., 2008), women might be underdiagnosed, undertreated, and neglected in cardiac research and health care. In addition, due to the patriarchal family structure, Korean women think their health is of low priority and do not want to bother others with their health problems (Im, Park, Lee, & Yun, 2004). They may not accurately perceive their CHD risk so that primary prevention may be delayed. However, in order to prevent potentially catastrophic disease, early detection of CHD risks is important. Gaps between women's perceived risk of CHD and their actual risk must be addressed to optimize Korean women's cardiovascular health. Prevention of CHD in Korean women is as critical as it is for men.

Factors Contributing to Coronary Heart Disease

Age and Gender

CHD risk increases with age in both men and women, but the onset of the disease in women is approximately 10 to 15 years later than in men (Bellasi, et al., 2007; K. H. Lee, et al., 2008). Women have a relatively low incidence of CHD before menopause, but the incidence of CHD steeply rises after menopause (Bairey Merz et al., 2003; Shaw et al., 2006; Shaw, et al., 2009). Younger Korean women experience less than half of the CHD mortality observed in men, yet, in the postmenopausal period, mortality rates increase markedly and reach that of men. In their eighth decade of life, almost twice as many women as men die from heart disease (Korea National Statistics Office, 2010). Estrogen deficiency after menopause makes traditional risk factors such as hypertension, obesity, and dyslipidemia more prevalent or more severe, resulting in a clustering of risk factors that eventually increases CHD mortality (Bairey Merz, et al., 2003; Shaw, et al., 2006).

Menopause is seemingly a non-modifiable risk factor, but an interesting study by Kok et al. (2006) showed that the age of menopause may possibly be adjustable. It may be influenced by other risk factors for CHD. The researchers showed that high blood pressure (BP), excess body weight, and high cholesterol levels were associated with an earlier onset of menopause. Each 1% higher 10-year CHD risk advanced the age of menopause by 1.8 years (95% CI: -2.72, -0.92) (Kok, et al., 2006). This result is not mutually exclusive with the current view that estrogen deficiency increases CHD risk after menopause. Rather, the results may offer a complementary explanation of the association between earlier menopausal transition and CHD risk. The WISE study also showed a strong independent association between CHD risk factors and hypoestrogenemia among premenopausal women (Bairey Merz, et al., 2003).

Indeed, ageing and menopausal transition increase CHD risk. However, estrogen replacement therapy is not recommended for counteracting the increased risk attributable to menopause for those without existing CHD (Mosca, et al., 2007). The best possible way to reduce the risk may be to increase the frequency of risk factor screening and instituting preventive measures during and after menopause to accurately assess a woman's risk in a timely fashion. Korean women should be aware that their risk for CHD sharply increases after menopause. They should be counseled to emphasize therapeutic lifestyle changes.

Hypertension

Hypertension is a significant risk factor in Koreans because the contribution of the population-attributable risk of hypertension to total CVD is 34%, the highest among traditional cardiovascular risk factors (Suh, 2001). This means that 34% of all cardiovascular events could be prevented just by controlling high BP. The effect of elevated BP in the Asian population is at least as strong as it is in Western populations. Each 10 mm Hg decrease in usual systolic BP, when systolic BP is between 110 to 170 mm Hg, decreases CHD risk by 32% in Asian women. This association was similar in men and women and was much stronger in people less than 60 years of age (Lawes et al., 2003).

Hypertension is highly prevalent in Korea, even though in recent years a decrease in this trend has been noted. Among Korean women aged 30 or older, 26.7% were hypertensive or on antihypertensive medication in 2005 (Korean Centers for Disease Control and Prevention [KCDC], 2005). The prevalence is just below that in the U.S. (see Table 2-1). However, the low rates of awareness, treatment, and control of hypertension are of great concern. Forty three percent of all hypertensive Korean women aged 30 or greater are unaware of their illness. More than half are not being treated; 73% do not have their BP controlled below 140/80 mm Hg. Awareness and treatment rates are lowest in women aged 30-39, whereas control rate is highest in this age group. On the other hand, most hypertensive women aged 60 years or older perceive themselves as being hypertensive, but often fail to control their BP (KCDC, 2005). Different approaches to managing high BP by age group need to be considered. Timely and adequate BP control is crucial for reducing the devastating effects of hypertension on cardiovascular health. The Joint National Committee 7 recommends that BP be maintained below 140/90 mm Hg in all hypertensive patients. It should be less than 130/80 mm Hg in diabetics or other individuals with high cardiovascular risk (Chobanian et al., 2003).

Dyslipidemia

Dyslipidemia plays a central role in the development of CHD (Jee, Appel, Suh, Whelton, & Kim, 1998; Suh, 2001; Suh et al., 2001). The strong association between serum total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) with the incidence of CHD is well known. At age 50 years, the lifetime risk of CHD in women with a serum TC level less than 180 mg/dL is 9.1% versus those with a TC level equal to or greater than 240 mg/dL which is 30.0% (Lloyd-Jones et al., 2006).

Compared to Western countries, TC and LDL-C levels in Koreans are generally low, but the levels have been increasing with the increase in dietary total fat intake. In 1980, dietary fat accounted for only 9% of energy intake in Korea but by 2007, the proportion increased to 18.4% (KCDC, 2008). Such a rapid increase in fat intake may pose greater risks for CHD in Koreans because the population has maintained low levels of dietary fat intake for a long time (Suh, et al., 2001). Suh et al (2001) found that even a moderate increase in fat intake (about 22% of total energy intake), which could be regarded as safe for Western populations, was associated with increased risk of CHD. Although the data came from a sample of men, the current American Heart Association (AHA) recommendation of no more than 30% of the total calorie intake from fat (Krauss et al., 2000) may not be appropriate for Korean women. Korean women may need more stringent fat intake recommendations to reduce the risk of CHD. Despite the relatively low prevalence of hyperlipidemia and low fat intake in Korean women, careful attention to their TC and LDL-C levels may be needed.

Although current clinical guidelines mainly focus on LDL-C, triglycerides and high-density lipoprotein cholesterol (HDL-C) are significant CHD risk factors. Hypertriglyceridemia and low levels of HDL-C increase CHD risk independent of TC or LDL-C levels; they pose a greater risk for CHD in women than in men (Abbott, Wilson, Kannel, & Castelli, 1988; Gordon et al., 1989; Hokanson & Austin, 1996). The relative risk for triglycerides is 1.14 (95% CI: 1.05, 1.28) for men and 1.37 (95% CI: 1.13, 1.66) for women, after adjustment for HDL-C and other risk factors for CHD (Hokanson & Austin, 1996). An increase of 1 mg/dL of HDL-C is associated with a 3% reduction in risk for women, but only a 2% reduction for men (Gordon, et al., 1989). Women with low HDL-C levels (< 46 mg/dL) had a six to seven times greater rate of coronary events compared to those with high HDL-C levels (> 63 mg/dL), controlling for other risk factors (Abbott, et al., 1988). Reduced HDL-C remains highly prevalent in those taking statins and even in those who have achieved aggressive LDL-C goals (Alsheikh-Ali et al., 2007). For women at high risk, treatment beyond lowering LDL-C and increasing HDL-C may therefore be of importance.

Hypertriglyceridemia and reduced HDL-C are highly prevalent in Korean women. Sixty-four percent of adult women 20 years or greater have HDL-C levels <50 mg/dL and 20.3% have triglyceride levels ≥ 150 mg/dL (KCDC, 2005). These levels of HDL-C and triglycerides are factors included in the metabolic syndrome (Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004) that confers an approximately two-fold increase in risk for developing CHD (Smith, 2007). Korean women's unbalanced dietary habits are partially responsible for reduced HDL-C and elevated triglyceride levels (M. H. Kim, Lee, Park, & Kim, 2007; W. Y. Kim, Kim, Choi, & Huh, 2008). Middle aged Korean women obtain about 70% of their daily energy intake from carbohydrates, mainly from white rice (KCDC, 2005). High carbohydrate diets lead to dyslipidemia (Liu et al., 2000), and must be viewed with concern in terms of cardiovascular health. More tailored diets are needed for Korean women.

Diabetes

Development of CHD in individuals with diabetes is so frequent that current clinical evidence-based guidelines classify diabetes as a CHD equivalent condition, requiring the most aggressive risk reduction efforts (ATPIII, 2001; Mosca et al., 2007). Furthermore, diabetes contributes more to CHD in women than in men. Compared to men with diabetes, women with diabetes have a three-fold increase in CHD mortality (Barrett-Connor, Cohn, Wingard, & Edelstein, 1991; Kanaya, Grady, & Barrett-Connor, 2002). At 50 years of age, the lifetime risk of CHD through 75 years of age is 57.3% for women with diabetes, but is only 16.3% for women without diabetes (Lloyd-Jones, et al., 2006).

Based on national statistics, the age-adjusted prevalence of diabetes in Korean women is 7.7% (KCDC, 2005). But this may underestimate the true prevalence of diabetes because the frequency was estimated based on fasting glucose levels only, rather than the combination of fasting blood sugar and a glucose tolerance test. Thus, women with postprandial glucose elevations, but who have normal fasting blood sugars, may not be identified as having diabetes. Diabetes prevalence increases with age and, among women greater than 60 years old, one in five has diabetes (KCDC, 2005). Despite the effect of diabetes on CHD in women, more than 30% of Korean women with diabetes are not aware of being diabetic. Of those women with diabetes, only 37% are able to keep their HbAlc levels below 7% (KCDC, 2005). Those with diabetes are more likely to have hypercholesterolemia, hypertriglyceridemia, and low levels of HDL-C compared to those without diabetes (KCDC, 2005). This clustering of risk factors increases risk for CHD. Improvement in diabetes management and CHD risk factor screening is urgently needed to optimize cardiovascular health among Korean women.

Smoking

Unequivocal evidence exists demonstrating that cigarette smoking is a major independent risk factor for CHD. The risk of CHD increases with the number of cigarettes smoked per day as well as years of smoking. In the Nurses' Health Study that included more than 120,000 healthy nurses, women nurses who smoked even as few as one to four cigarettes per day doubled their risk for developing CHD. Those who smoked more than 25 cigarettes per day increased the risk almost six times, as compared with women who never smoked (Willett et al., 1987). In women younger than 50 years of age, smoking was the leading cause of CHD accounting for as much as two-thirds of the incidence of MI (Rosenberg et al., 1985). These detrimental effects of smoking on CHD are similar in both Asian and Western populations (Woodward et al., 2005).

The prevalence of smoking in Korean women is relatively low compared to Korean men or to women in other countries. Approximately 50% of men and 8% of women aged 20 years or older were current smokers in 2008 (KCDC, 2008). These frequencies are based on self-report and may not reflect the true prevalence of women smoking, given the strong social taboo against smoking by women in Korea. Although the proportion of women who smoke is much lower than that for men, smoking among younger women has been on the rise, and women 20 to 30 years of age showed the highest smoking prevalence (KCDC, 2008). This is of importance, given the greater smoking-related impact on cardiovascular health of young women (Woodward, et al., 2005).

In addition, the high prevalence of smoking in men means that the chance of being exposed to high levels of secondhand smoke is also high. Regular exposure to secondhand smoke increases the risk of CHD nearly as much as active smoking (Barnoya & Glantz, 2005). More than 30% of non-smokers have reported that they have been exposed to secondhand smoke at home or at work (KCDC, 2008). Quitting smoking as soon as possible is imperative for the cardiovascular health of all smokers as well as for those around them. Smoking cessation may be the most modifiable and avoidable risk factor for CHD. It yields not only immediate but long-term benefits for prevention of CHD. The benefits are greater for people who quit smoking at earlier ages, but cessation is beneficial at all ages (Satcher, Thompson, & Koplan, 2002) .

One interesting finding is the prevalence of smoking in the U.S. was lowest among Asian men (Schoenborn & Adams, 2010), even though their smoking prevalence in their native countries is much higher. This difference in smoking prevalence cannot be explained entirely by selection bias. Rather, comprehensive, strong, and enforced smoke-free policies may promote smoking cessation. It appears that there is an urgent need for smoke-free policies in Korea in order to expedite a smoke-free society.

Obesity and Abdominal Obesity

Obesity is associated with CHD, and CHD mortality increases with BMI in women (Manson et al., 1995). Abdominal obesity has also been found to be a contributor to CHD, frequently leading to insulin resistance and metabolic syndrome (Eckel, Grundy, & Zimmet, 2005). Waist circumference (WC) reflects abdominal fat and has been suggested as an index of abdominal obesity (Alberti, Zimmet, & Shaw, 2005; Eckel, et al., 2005). A reduction in WC even with no change in BMI may reduce the risk of CHD significantly (World Health Organization [WHO], 2000). Therefore, the BMI combined with WC can provide a more accurate estimate of the risk for developing obesity-associated diseases such as diabetes or CHD.

Asians, compared to Caucasians of the same sex, age, and BMI, have a higher percentage of body fat and more centralized fat distribution so that their risk of obesity-associated diseases is high even at a lower BMI and smaller WC (WHO, 2004). The Asian-Pacific region of WHO proposed revised BMI cut-points for Asians: overweight as BMI ≥23 kg/m2 and obesity as BMI ≥ 25 kg/m2 for both men and women (WHO, 2000). The International Diabetes Federation also stresses the use of ethnic-specific cut-points for WC based on the relationship of WC either to the other metabolic syndrome components or to long term outcomes such as CHD (Alberti, et al., 2005). The Korean Society for the Study of Obesity suggested WC cut-points for abdominal obesity of ≥ 90 cm for men and WC of ≥ 85 cm for women, based on data from a nationally representative sample of Koreans (S. Y. Lee, et al., 2007). Regrettably, no prospective studies are available to assure the validity of these WC cut-points for risk prediction of CHD. However, one cross-sectional study found that the Korean Society for the Study of

Obesity criteria were strongly associated with CHD or stroke in Korean women (H. M. Kim, et al., 2007).

Twenty-eight percent of Korean women meet the criteria for obesity, with 23.4% of women characterized as having abdominal obesity (KCDC, 2005). Increased BMI and WC are associated with a higher risk of having CHD risk factors (H. S. Park, et al., 2003). Korean women with BMIs of 23 kg/m2 and 27 kg/m2 have respectively a three-fold and a seven-fold increased risk for having three or more CHD risk factors compared to those with a BMI of < 21 kg/m2. Women with a WC ≥ 85 cm and a WC ≥ 90 cm respectively have approximately a four and six fold higher risk of having three or more CHD risk factors compared to those with a WC < 70 cm (H. S. Park, et al., 2003). Of those with abdominal obesity, one in four do not perceive themselves as having central obesity (KCDC, 2005). This gap should be closed through optimized cardiovascular health. Koreans need to be informed about the Korean specific cut-points for obesity and abdominal obesity.

Physical Inactivity

Physical inactivity confers 1.5 to 2.4 increased CHD risks, which is comparable with that observed for high BP, dyslipidemia, and cigarette smoking (Pate et al., 1995). Engaging in at least 30 minutes of moderate activity on most, preferably all, days of the week can enhance CHD prevention (Myers, 2003), reducing CHD risk by 30% (Manson et al., 1999). However, fewer than 15% of Korean women reach this recommended level of activity (KCDC, 2008). Physical inactivity is an important risk factor to evaluate because it is the most prevalent, modifiable risk factor, and it is a central aspect of lifestyle modification.

Hwa-byung

The hwa-byung, literally "fire-disease" or "anger-disease," is a Korean culture-related disease (Min & Suh, 2010; Y. J. Park, Kim, Schwartz-Barcott, & Kim, 2002). It manifests complex physical symptoms such as a heavy feeling in the chest, depressive mood, a sense of misery, and sleeplessness in response to the long-term suppression of anger and projection of anger into the body (Min & Suh, 2010). More than 4% of the general Korean population has hwa-byung. It is most prevalent in middle-aged, married women of lower socioeconomic status (Min, Namkoong, & Lee, 1990). The high prevalence in this group may be attributable to strictly demarcated gender roles stemming from patriarchal and Confucian norms. Traditionally, Korean women are responsible for caretaking and household chores that men rarely share, whereas men place greater emphasis on their work and self-achievement. Women are raised to obey and yield to men, and endurance has been considered to be an important virtue women must have (Im, et al., 2004; Y. J. Park, et al., 2002). Women, particularly economically disadvantaged women, in Korean culture often have low status in the family and social structure (M. H. Kim & Kim, 2007; Y. J. Park, et al., 2002), therefore, they experience more stressful and less favorable living conditions. However, they are not allowed to express their negative emotions outwardly and are forced to suppress their raw emotions. Over time, the suppressed negative emotions are expressed in symptoms called hwa-byung (Min, et al., 1990; Y. J. Park, et al., 2002). Hwa-byung is strongly related to major depression in Korean women so it is considered to be a patterned way that Korean women experience depression (Min & Suh, 2010). Although no studies yet exist directly explaining hwa-byung and the risk of developing CHD, recent meta-analysis has shown that depressive symptom predict CHD (RR ~1.6). Korean women commonly experience symptoms associated with depression, but it remains largely undiagnosed. Given that strong association between hwa-byung and major depression, identifying women who may require further assessment and treatment with simple screening tests for depression may be an efficient way to reduce the huge burden of CHD.

Approaches to Risk Assessment and Stratification in Women

CHD occurs in individuals with cardiac risk factors. Even a single major risk factor increases lifetime risk for CHD and shortens survival (Lloyd-Jones, et al., 2006). Women with more than one risk factor have substantially higher lifetime risks (50.2% versus 8.2%) and markedly shorter median survival (> 8 years), compared to women with no risk factors (Lloyd-Jones et al., 2006). Furthermore, even slight elevations in three or more risk factors noticeably increase the risk of CHD (Smith, 2007). This indicates that the clustering of risk factors is multiplicative rather than just additive. Comprehensive and accurate risk assessment is needed in order to intervene on multiple risk factors simultaneously and to prevent potentially catastrophic disease. As a first step in risk estimation, office-based risk assessments are essential and cost-effective for selecting women for further intervention or additional testing (Grundy, et al., 2004; Mosca, et al., 2007). Two risk assessment tools will be discussed: the FRS, endorsed by the AHA and ATP III, and the more recent RRS which was specifically developed to enhance risk assessment in women. The comparison between the FRS and the RRS is provided in Table 2-2.

Framingham Risk Score (FRS)

The FRS is the most commonly used and most extensively validated quantitative assessment tool for assessing CHD risk in the U.S. (Wilson et al., 1998). It is a mathematical model predicting the probability of developing CHD in the next 10 years. It estimates CHD risk using seven variables: age, gender, total cholesterol, HDL-C, smoking status, SBP and whether the patient is taking medication to treat high blood pressure. The free web-based FRS calculator is available at http://hp2010.nhlbihin.net/atpiii/calculator.asp?usertype=prof. The FRS is useful and helpful for categorizing asymptomatic adults into low (<10%), intermediate (10-20%), and high risk subgroups (>20%), with specific prevention plans for each subgroup that have been developed and empirically validated. Even though some studies have suggested that the FRS underestimates CHD risk in women (Michos et al., 2006; Sibley, Blumenthal, Bariey Merz, & Mosca, 2006), the clinical importance of the FRS is underscored by the fact that the AHA and ATP III both suggest using the FRS as an initial step to assess risk of CHD.

Reynolds Risk Score (RRS)

The RRS is a more recent tool developed to improve predictive ability especially in women (Ridker, Buring, Rifai, & Cook, 2007). It was derived from 24,558 healthy women in the Women's Health Study to predict new incidents of CVD including MI, ischemic stroke, coronary revascularization and CVD deaths in the next 10 years. In addition to the same six risk factors as in the FRS, the RRS added high-sensitivity C-reactive protein (hsCRP) and family history of CVD before age 60 to the model. In trials, the RRS predicted women at high and low risk for CHD as well as the FRS. Of importance, for those in the intermediate risk range, the RRS performed better than the FRS, resulting in risk reclassification of 40-50% of women classified to be at intermediate risk with the FRS into higher- or lower- risk categories (Ridker, et al., 2007). The free RRS calculator can be found at http://www.reynoldsriskscore.org/.

Summary

Given an epidemic rise in CHD, morbidity and mortality from CHD has become a prominent burden in Korean women. In spite of this, their risk has been underappreciated so that primary prevention is often neglected or delayed. Health care providers should understand the significance of the problem of CHD in Korean women. Early and consistent screening for CHD risk factors and initiation of risk factor modifications are imperative, given the high prevalence of cardiovascular risk factors in Korean women.

Risk assessment tools help to assess multiple risk factors simultaneously rather than focusing on any single risk factor. The FRS is clinically helpful and useful for identifying people at high risk and for guiding preventive care. However, those classified at intermediate risk with the FRS may benefit from verification of their risk with the RRS for more accurate assessment of Korean women’s risk of CHD.

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Table 2- 1

Comparison of CHD Risk Factors in Women in Korea and U.S.

Risk Factors	Korea (%)	U.S (%)[c #]
Hypertension	21.3 [a #]	33.6
Smoking	7.4 [b #]	18.1
Diabetes	7.7 [a ##]	8.8
TC ≥ 240mg/dL	6.1 [a #]	17.1
HDL< 40mg/dL	24.5 [a #]	9.1
Obesity	28.0 [a #] †	33.2 ‡
Physical Inactivity§	85.4 [b #]	71.1

a; Korean Centers for Disease Control and Prevention (2005). The Third Korea National Health and Nutrition Examination Survey (KNHANES III)
b: Korean Centers for Disease Control and Prevention (2008). The Fourth Korea National Health and Nutrition Examination Survey (KNHANES IV)
c; American Heart Association Statistics Committee and Stroke Statistics Subcommittee (2008). Heart Disease and Stroke Statistics—2008 Update. *Circulation*, 117, e25-e146
CHD; coronary heart disease; TC, total cholesterol; HDL, high-density lipoprotein cholesterol; §, proportion not engaged in regular physical activity; [#], age 20+; [##], age 30+;† BMI ≥ 25 kg/m^2; [‡]BMI ≥ 30 kg/m^2

Table 2- 2

Comparison between the FRS and the RRS

Risk Score	FRS	RRS
Population of Interest	Individuals free of diabetes and CHD; 20-79 years of age	Individuals free of diabetes and CVD; 45-80 years of age
Predictors	Age Total cholesterol HDL-C SBP Treatment for hypertension Smoking	Age Total cholesterol HDL-C SBP Smoking HsCRP Parental history of heart disease before age 60
End Point	Hard coronary heart disease: myocardial infarction or coronary death	CVD death, myocardial infarction, stroke and revascularization

*FRS, Framingham risk score; RRS, Reynolds risk score; CHD, coronary heart disease; CVD, cardiovascular disease; HDL-C, high-density lipoprotein cholesterol; hsCRP, high-sensitivity C-reactive protein.

Chapter 3

Coronary Heart Disease Risk Estimation in Asymptomatic Adults

Abstract

Accurate estimation of coronary heart disease (CHD) risk is requisite for effective primary prevention of the disease. The Framingham Risk Score (FRS) is the most commonly used method for estimating 10-year risk for CHD. Further noninvasive tests of atherosclerosis are widely available and may be added to enhance risk estimation. However, the ability to explicitly combine different test results in a quantitative way is limited, and a substantial gap remains in identification of those at high risk. This paper presents Bayes' theorem as a method to combine two different test results in a quantitative way, leading to better estimation of CHD risk. Information and examples of how to estimate 10-year risk of developing CHD with the FRS and how to combine two different test results in a quantitative way with Bayes' theorem are described. Applying Bayes' theorem in clinical settings will help to better estimate CHD risk, leading to optimal risk classification and ultimately intervention plans.

Key words: *CHD risk estimation, Bayes' theorem, Framingham Risk Score*

CHD Risk Estimation in Asymptomatic Adults

More than half of those who suddenly die of coronary heart disease (CHD) have no prior symptoms of the disease (Lloyd-Jones et al., 2009). Therefore, aggressive primary prevention for asymptomatic patients is crucial. Effective primary prevention requires an accurate assessment of CHD risk and identification of those at high risk for future cardiac events, leading to more precise selection of appropriate interventions (Adult Treatment Panel III [ATP III], 2001; Grundy et al., 2004). As a first step in predicting CHD risk in asymptomatic adults, simple office-based risk assessments are essential and cost-effective for selecting those needing further intervention or additional testing. Further noninvasive measures of atherosclerosis may be added to enhance risk prediction, when uncertainty in the risk status with the office-based risk assessments exists (ATP III, 2001; Greenland, Smith Jr, & Grundy, 2001; Grundy et al., 2004; Wilson et al., 1998). Despite these risk assessment approaches, our ability to explicitly combine different test results in a quantitative way is limited, and a substantial gap remains in detection of individuals who would benefit from aggressive risk reduction.

Let's suppose a 57-year-old asymptomatic non-smoker man comes to you asking about his risk for CHD. He has a blood pressure (BP) of 125/80 mmHg on medication, total cholesterol (TC) of 235 mg/dL, low-density lipoprotein cholesterol (LDL-C) of 170 mg/dL, and high-density lipoprotein cholesterol (HDL-C) of 32 mg/dL. How likely he is to have a heart attack in the next 10 years? How would you manage him to maximize the benefits of risk reduction? What if he has an additional test result with a coronary artery calcium (CAC) score of 200? Does the CAC score change his risk of CHD? Some might use vague terms such as “highly likely,” “unlikely,” or “cannot rule out” to describe his probability of getting CHD, but an explicit quantitative way of answering the question would be better for managing patients if it was available. Therefore, this paper focuses on methods quantifying CHD risks to better identify high risk asymptomatic individuals, leading to more optimal use of CHD risk-reducing interventions. The purpose of this paper is to present information and examples of how to estimate 10-year risk of developing CHD with the Framingham Risk Score (FRS) and how to update the estimate as other test results are added with Bayes' theorem of conditional probability.

Framingham Risk Score (FRS)

As an initial step in estimating CHD risk in asymptomatic individuals, office-based risk assessment tools are essential and useful. One approach endorsed by American Heart Association and the National Cholesterol Education Program, ATP III is calculating 10-year risk of CHD with the FRS (ATP III, 2001; Mosca et al, 2007; Wilson et al., 1998). It is a mathematical model predicting the probability of developing CHD in the next 10 years using seven items: age, gender, TC, HDL-C, smoking status, systolic BP, and treatment for high BP. The FRS is helpful for categorizing asymptomatic adults into low (<10%), intermediate (10-20%), and high (>20%) risk subgroups, with specific prevention plans for each subgroup that have been developed and empirically validated (Greenland et al., 2001). Patients in the low-risk group can be reassured and followed with reinforcement of lifestyle changes. Intermediate-risk patients may require further risk stratification, whereas high-risk patients are candidates for aggressive intervention including lipid-lowering agents (Grundy et al., 2004) .

The FRS can be calculated using the downloadable spreadsheet calculator (http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm), a free web-based calculator (http://hp2010.nhlbihin.net/atpiii/calculator.asp?usertype=prof), or the Framingham point score chart (ATP III, 2001). The web-based or spreadsheet calculators utilize continuous variables, and thus specific values can be directly entered rather than a range. However, the point-counting system is designed to be accurate for clinical purposes, as clinical practice does not always allow the use of electronic calculators, and some professionals and patients may not choose to use them (ATP III, 2001).

The first step in estimating CHD risk with the Framingham point score chart is to calculate the points for each risk factor. TC and HDL-C should be measured at least two times then using the average value. Smoking means any cigarette smoking in the past month. For systolic BP points, the average systolic BP of two measurements at assessment is used regardless of treatment for high BP. However, if the person is currently taking antihypertensive medication, an extra point is added. After calculating each point, the total is the sum of each of the points. The 10-year risk for CHD is estimated from total points, and an individual can be categorized according to absolute 10-year risk (ATP III, 2001). For example, the above 57-year old nonsmoker man has a TC of 235 mg/dL, HDL-C of 32 mg/dL, and systolic BP of 125 mm Hg on medication. This man would score 8 points for his age, 3 points for his TC, 0 point for his smoking, 2 points for his HDL-C, and 2 points for systolic BP, scoring a total of 14 points. Fourteen points would give him a 10-year CHD risk of 16%, meaning 16 out of 100 with this level of risk probably have a heart attack in the next 10 years. Based on the FRS, his risk falls into the intermediate range. Although he does not fall into the high-risk category requiring intensive intervention, his cholesterol levels are not ideal. The intermediate group represents the greatest challenge for treatment decisions, and this group accounts for about 40% of men in their fifties in the U.S (Grundy et al., 2004). If further noninvasive test results were added to better define his risk, he may be reasonably reassigned to other risk categories, leading to more appropriate intervention. If he has additional test results, we can update his risk for CHD by applying the Bayes' theorem.

Bayes' Theorem

Bayes' theorem is a mathematical formula of conditional probability, which helps quantify the uncertainty about a hypothesis. Even though risk assessment tests are performed to reduce uncertainty of the patient's true state, unfortunately there are no perfect tests in clinical practice. When uncertainty remains, test results can serve as a basis to elevate or lower the probability of the disease. Based on Bayes' theorem, the posttest probability of disease is calculated with the pretest probability of disease, the sensitivity, and the specificity of the test (Ford, Giles, & Mokdad, 2004). The following formula shows how Bayes' theorem adjusts probabilities given a new test result.

$$P(Posttest) = \frac{P(pretest) \times sensitivity}{P(pretest) \times sensitivity + (1 - P(pretest)) \times (1 - sensitivity)}$$

The pretest probability is degrees of confidence before the test is performed. If there is no relevant information before the test, the prevalence of the disease in the population being tested is usually considered as the pretest risk. Sensitivity is the probability of a positive test result among the diseased (true positive); a test that is positive in 9 out of 10 patients with disease has a sensitivity of 0.9. Specificity is a probability of a negative test result among the non-diseased (true negative); a test that is negative in 8 out of 10 without disease results in a specificity of 0.8. Posttest probability means the probability of disease after accounting for the positive test result and pretest probability. Calculated posttest probability can be used as a pretest probability when another test is added.

Bayes' theorem can take different forms, and it is easier to apply in clinical settings when expressed in terms of odds and the likelihood ratio. If the pretest probability of disease is expressed as its odds, the posttest odds equals pretest odds times the likelihood ratio. The odds can then be converted to probabilities with these formulas (Beers, 2006; Diamond & Forrester, 1979; Spiegelhalter, Abrams, & Myles, 2004; Spiegelhalter, Myles, Jones, & Abrams, 1999).

$$Posttest\ odds = pretest\ odds \times LR$$

$$where,\ odds = \frac{probability}{1 - probability} \qquad probability = \frac{odds}{1 + odds}$$

Likelihood ratios represent how much a test result will increase or decrease the odds of having a disease. There exist two types of likelihood ratios. The likelihood ratio for positive results (LR+) is the ratio of the probability of a positive test result occurring among diseased (sensitivity) to the probability of a positive test result occurring among non-diseased (1-specificity). It tells how much the odds of disease increases with a positive test result. The likelihood ratio for a negative test (LR-) is the ratio of the probability of a negative test result occurring among diseased (1-sensitivity) to the probability of a negative test result occurring among non-diseased (specificity). It expresses how much the odds of disease decreases when a test is negative.

Consider the case of the hypothetical man. The CAC score has 58% sensitivity and 64% specificity in predicting future myocardial infarction or CHD death in asymptomatic adults (cut point: CAC score >100) (Greenland, LaBree, Azen, Doherty, & Detrano, 2004). The LR+ from the sensitivity and specificity is 1.61(0.58/1-0.64) and the LR- is 0.65 (1-0.58/0.64). His pretest probability of getting CHD, the FRS, is 0.16, which is converted to pretest odds of 0.19 (0.16/1-0.16). Suppose he has the positive result of a

CAC score >100. Multiplying pretest odds by LR+ yields the posttest odds of 0.31, corresponding to a posttest probability of 24%. Even though he was not a candidate for aggressive risk reduction therapy with the FRS, much higher posttest risk increases the benefit of it. He may be able to justifiably proceed more aggressively to reduce his risk factors. In contrast, what if his CAC score was found to be zero? The test result is negative, and the posttest odds is the pretest odds times LR-. The calculation turns out to be 0.12, which corresponds to a posttest probability of 10%. A negative test result lowers his risk estimate, and we may not want to intervene with costly medications at this time but counsel him emphasizing therapeutic lifestyle changes. Like the examples, when the benefits of aggressive risk reduction treatments are not obvious, integrating test results with Bayes' theorem helps to better define the risk for CHD and to justify the optimal intervention plan. Although this example used a CAC score, other alternative tests or risk markers such as C-reactive protein can also be applied the same way.

Furthermore, based on Bayes' theorem, the predictive accuracy of any test depends not only on the sensitivity and specificity of the test but also on the prevalence of the disease in the population being tested (Beers, 2006). This notion can be applied in the clinical settings to determine the probability that a positive result is in fact a true or false positive (Diamond & Forrester, 1979; Spiegelhalter et al., 2004). Suppose that the FRS generates the following results: If a patient is at high risk for CHD, the FRS predicts a positive result of 90% (sensitivity); for patients at low coronary risk, the FRS predicts a positive result of 10% (1-specificity). One might think that only 10% of positive results are false, but that is quite wrong based on the prevalence of disease in the population. Suppose that 2% of the population has CHD (prior probability). We can use Bayes' theorem to calculate the probability that the patient actually is at high risk given a positive FRS result. Posttest probability of having CHD given a positive test result is:

$$Posttest\ probability = \frac{0.90 \times 0.02}{0.90 \times 0.02 + 0.10 \times 0.98} = 0.16$$

In this case, the probability of being at high risk given a positive FRS result is only 16% and 84% (1 – 0.16) of patients who test positive are not actually at high risk of CHD. Thus a positive result of the FRS has low predictive accuracy in this population with low prior probability of disease because of the large number of false positives. In contrast, in a population with a 30% prevalence of CHD, a positive result indicates a considerable likelihood of disease, suggesting substantial predictive accuracy of the FRS.

$$Posttest\ probability = \frac{0.90 \times 0.30}{0.90 \times 0.30 + 0.10 \times 0.70} = 0.79$$

A positive test result, therefore, may have different meanings depending on the prior probability. This is because the FRS was developed based on middle-aged Caucasians, its predictive accuracy for other ethnic groups might be different where prior probability is different. Bayes' theorem provides a valid reason for why the validity test of the FRS should be advanced before applying it to other ethnicities. It appears useful to obtain the probability of disease given a positive test result based on the prevalence of the disease in the population being tested, because even a test with good sensitivity and specificity will yield poor positive predictive accuracy when used in a population with low disease prevalence.

Summary

Primary prevention to reduce cardiovascular risk is effective and relatively safe when tailored to each individual's risk status. Therefore, accurate risk estimation and identification of those at increased risk is the cornerstone of prevention of CHD. As the first estimation of risk for CHD, calculating the FRS is clinically helpful in selecting those at high or low risk. However, intermediate-risk patients may need further risk stratification with additional noninvasive tests. When two or more risk assessment tests are performed, Bayes’ theorem provides a method by which to combine two different test results in a quantitative way. It demonstrates how and to what extent additional test results or risk factors can either increase or decrease the probability of developing CHD. Applying Bayes’ theorem in clinical settings will help to better define CHD risk, leading to optimal intervention plans. In addition, the accuracy of any test, based on Bayes’ theorem, depends on the prevalence of the disease in the population being tested.

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Chapter 4

Secondary Analysis of National Survey Data Sets

Introduction

Advances in digital technology have made it possible to have easy access to large data sets and to analyze them with personal computers. In response, secondary data analysis has become commonly recognized as a legitimate form of scientific inquiry in nursing research (Kneipp & Yarandi, 2002). Simply defined, secondary data analysis is the method of using any existing data sets (Clarke & Cossette, 2000). Particularly, at a time of limited funding for non-experimental studies, secondary data analysis can be an alternative mean to be able to conduct studies with less cost. It is an expedient and cost-efficient way of producing knowledge, especially when it involves a nationally representative database. Large national surveys on behaviors, health or health care commonly contain multiple variables important to nursing research and practice (Bibb & Sandra, 2007; Bierman & Bubolz, 2003; Kneipp & Yarandi, 2002). Analysis of these representative data not only provides reliable national estimates but also offers the opportunity to test or generate nursing theories based on a large representative sample.

While the benefits of reanalysis of national survey data sets are considerable, several limitations need to be considered. Because researchers using existing survey data sets were not involved in the study or sampling design, data collection, or the data entry process, it is important to fully understand the accuracy of the data sets before delving into the database. Without a full understanding of the limitations or complexities of the analysis of large national survey data sets, the process will be challenging and the results may be unreliable. Researchers planning to analyze national survey data sets must recognize unique issues pertinent to survey data quality at the beginning so that the potential for introducing threats to reliability and validity can be addressed and their impact on the results considered.

Previously, several articles have covered a wide range of topics in terms of general theoretical (Clarke & Cossette, 2000), methodological (Castle, 2003; Clarke & Cossette, 2000; Doolan & Froelicher, 2009; Magee, Lee, Giuliano, & Munro, 2006; Pollack, 1999), and practical (Clarke & Cossette, 2000) considerations and statistical issues concerned with analyzing an existing data set (Kneipp & Yarandi, 2002). This paper will describe the methodological issues that need to be considered specific to using existing national survey data sets.

Making Good Use of Existing Survey Data

Secondary data analysis can be carried out rather quickly because there is ready access to data sets. Where good data sets are available, researchers can save time and money by making use of them to answer their own new research questions. Currently, many large survey databases sponsored by the national government are easily accessible to researchers. These survey data sets provide the benefits of nationally representative samples, which often are difficult to obtain directly. When national survey data sets contain many health-related variables, they are capable of being reanalyzed to answer a wide variety of nursing research questions, cost-effectively yielding reliable estimates of public health (Bibb & Sandra, 2007; Bierman & Bubolz, 2003). Analysis of national survey data sets can be carried out to describe phenomena, to test nursing theories, to generate knowledge for nursing practice, or to understand the present, the past or trends over time.

Secondary data analysis requires the researchers to begin with a sound conceptualization of the research question to be studied including a conceptual or theoretical framework (Magee et al., 2006). The framework serves to delineate the inclusion of variables and to define how the variables are conceptualized. Formulating the research question and theoretical framework allows researchers to narrow the range of the possible data sets (Magee et al., 2006).

Once the researcher has defined the research questions, he or she needs to identify the most appropriate data set available. Working with an existing data set requires the researcher to work within that data set. Therefore, it is necessary to achieve the most appropriate fit between the research question proposed and the data sets available (Castle, 2003; Doolan & Froelicher, 2009; Magee et al., 2006). Identifying and obtaining a proper data source may require substantial time and effort, but increases the probability that the research will yield valuable results. Before evaluating data sets, the researcher should specify the population and variables of interest as well as the ideal definition and measures of the variables (Magee et al., 2006). The researchers, when selecting from existing data sets, should only consider high quality data sets with a sufficient level of accuracy and detail for the proposed research.

Data sets identified may require refinement or modifications for the research questions or scope of the study (Doolan & Froelicher, 2009). The process of secondary data analysis is often an iterative process, rather than a linear one. The process includes research question development, identification of potential data sets and modification or refinement of the research question depending on the data available in order to balance feasibility and limitations (Doolan & Froelicher, 2009).

In designing a secondary analysis of national surveys and in choosing the most appropriate data source for answering the research question, researchers face a number of potential problems. Some are inherent in studies using existing data sets, but some are related to the use of surveys. Issues about survey sampling, data collection and nonresponse and missing data in terms of methodological validity and reliability will be discussed.

Sampling Considerations

Sampling Design

When designing a study using a national survey data set, the kind of sampling design used in the survey to collect the data is very important because specific sampling design can affect the accuracy of the statistical analysis results and generalizability of the results. In national surveys, a simple random sampling method is rarely used. Not only is it extraordinarily expensive, but it is cumbersome and tedious. Instead, stratified random or multistage sampling methods are commonly used as an efficient strategy to provide a nationally representative sample (Kneipp & Yarandi, 2002). Sampling terminology and a brief definition of probability sampling methods are provided in Table 4-1 and Table 4-2. The multistage sampling strategy combines probability sampling approaches in various ways, usually clustering, stratification, or oversampling (Trochim, 2006). It may begin by selecting representative geographic units (clustering). Strata within selected geographic units are then identified for a random sample. When any sampling method other than simple random sampling is used, e.g., multistage sampling method, data from each sample need to be multiplied by the appropriate weight to obtain unbiased estimates (Bierman & Bubolz, 2003; Kneipp & Yarandi, 2002).

There are two categories of weights, sample weights and variance estimation weights (Kneipp & Yarandi, 2002). Sample weights reflect the probability of being sampled based on sample size or design as well as adjustments for nonresponse (Kneipp & Yarandi, 2002). A simple example is if 100 individuals in a sample were drawn from a population of 10,000, the sample weight would be 100 because each individual in the sample represents 100 (sample weight = 1/fraction = 10,000/100) identical responses in the population. On the other hand, variance estimation weights are needed to adjust the variances caused by design (Kneipp & Yarandi, 2002). When multistage cluster sampling was used individuals within the same geographic area might have more characteristics in common with each other than individuals selected at random from the population thus affecting the variance of the survey.

Ignoring sampling design in the analysis results in underestimating standard errors and narrowing confidence intervals, thus frequently leading to results that seem to be statistically significant when, in fact, they are not (Type I error, Table 4-3). To adjust for survey weights, specific survey software such as Stata, SAS, SUDAAN, or WesVar are needed (Kneipp & Yarandi, 2002). Regular statistical software not designed for survey data was created with the assumption that data were collected using simple random sampling (Bierman & Bubolz, 2003; Kneipp & Yarandi, 2002). Kneipp and Yarandi (2002) showed excellent examples of underestimating standard errors by not accounting for weights with SPSS leading to incorrect conclusions. Researchers analyzing national survey data sets need to understand sampling design and weights to obtain unbiased population estimates.

Sampling Frame

Many available national survey data sets provide the benefits of nationally representative large samples. This makes the analytic results from the data sets more generalizable and safer from threats to external validity than results from small studies using convenience samples. However, before making inferences from the research results from survey data, researchers need to consider the sampling frame used and the population represented in the survey. A sampling frame is the list of the population from which the sample is chosen or the way to access the population to choose the sample (Trochim, 2006). How the sampling frame is defined implies what the population represents, thus giving some idea about the subgroups that may have been excluded. For example, in a telephone survey selecting names from a telephone directory, the directory is the sampling frame. In this case, persons who have no telephone or who are not at home during the day are likely to be excluded or underrepresented. But it is possible that persons without telephones are more likely to be poor and persons not at home during the day are more likely to be employed. Such a difference between the sampling frame and the population can cause bias. Researchers using a preexisting national survey data set need to be aware that while it is a nationally representative survey, some subgroups who may differ from the population may be excluded according to the sampling frame used and this need to be included in the discussion.

Sample Size and Effect Size

In the case of secondary analysis, the sample size is predetermined. A large sample size is one major advantage of using national survey data sets. However, a researcher using a preexisting large data set needs to know that an extremely large sample often ends up with statistically significant results with very small differences (Type I error) (Magee et al., 2006). Statistical significance is different from the clinical significance of a difference. It is important to discuss explicitly whether the findings are not only statistically significant but also clinically significant.

In addition, if a researcher is interested in a subgroup of specific age or race, the sample size may not be adequate. Therefore, as in any study, the researcher needs to make sure that the sample size in the data set provides sufficient power to investigate the new research questions. This involves a power calculation in which the following four parameters are involved: alpha level (α), power (1-β), sample size, and effect size (Saba, Pocklington, & Miller, 1998). These four parameters are so related to each other that if any three of them are fixed, the fourth can be determined. The alpha level (α), the probability of mistakenly rejecting the null hypothesis when it is true (Type I error), is commonly set at 0.05. Power, the probability of correctly rejecting the null hypothesis when it is false, is 1-beta (β). The beta value (β) is the probability of failing to reject the null hypothesis when it is false (Type II error). Conventionally, a beta (β) of 0.20 is selected, producing 80% power. Researchers using preexisting data sets need to confirm whether the given sample has sufficient power to detect a statistical difference. Insufficient sample size causes a lack of power and increases the risk of a Type II error.

Data Measurement Considerations

Evaluation of Measurement of Data Set

The major threats to the reliability and validity of data sets used in secondary analysis arise from the precision and accuracy of the methods of data collection used in the primary data collection process (Clarke & Cossette, 2000; Magee et al., 2006; Pollack, 1999). The quality of the data collected determines the quality of research results. Researchers reanalyzing existing data may use the data set for answering different research questions other than those for which the original data collection was intended.

Thus, specific variables of interest may not have been assessed or may have been measured with undesirable measurement tools. Or important variables may have been defined or categorized in a way different from what the researcher would prefer. For example, race may have been defined with only two categories of white/others or age may have been collected as a categorical variable rather than as a continuous variable. For these reasons, researchers, when making use of secondary data, need to judge whether or not there is a good fit between the research questions proposed and the data set. With secondary analysis, a good fit between the research questions and the data set is mandatory to minimize errors and increase validity (Castle, 2003; Doolan & Froelicher, 2009; Magee et al., 2006). The data set should be evaluated carefully to confirm that it includes the important variables of interest and that the data are operationalized and coded in an appropriate manner allowing for the desired analysis. This can be made possible by thoroughly reviewing the purpose and the summary reports, the codebooks, the manual of operations, and previously published papers related to the data set. Most national survey data sets provide extensive documentation on the method and data reliability at their websites, allowing secondary analysts easy access to the valuable information.

Measurement Error

Measurement error is the extent to which the responses differ from the truth (Bierman & Bubolz, 2003). Large national surveys are probably designed to minimize error but it is not feasible to remove all possible sources of error. Furthermore, measurement errors made in the original survey are often invisible and it can be difficult to determine where the error came from. Therefore, a researcher using existing data sets needs to pay attention to the details of the survey methodology and understand how this may influence results.

Factors related to the survey methods, the respondents, and the instruments or measurements can introduce measurement error (Bierman & Bubolz, 2003). Differences in the survey method administrated may affect the responses of respondents. Data collected by interview is often more complete than data from self-administered questionnaires. With a personal interview, the interviewer works directly with the respondent making it more useful than a mail survey for probing questions to elicit better answers, especially when asking about feelings or opinions. But interviewers can also be a potential source of error by the way the interviewer administers the survey and records results so they must be well trained. On the other hand, mail surveys are easy to administer but response rates are often low. It may not be known who actually responded to the questionnaire.

Survey respondents can sometimes provide inaccurate information for several reasons (Bierman & Bubolz, 2003; Trochim, 2006). For example, in reporting behaviors such as drug use or sexual behaviors, they are likely to respond in more socially desirable ways. This may be more problematic with interviews than with questionnaires. Recall bias can be a threat when reporting events that happened in the past.

The use of a reliable and valid instrument to collect data is an important consideration that can minimize measurement error. Not only the reliability of the instrument provided by the instrument's author but also that provided by original research and by the current sample should be evaluated carefully (Magee et al., 2006). Wording or ordering of questions in the instrument and timing of data collection can also influence responses (Bierman & Bubolz, 2003). Even though national surveys probably adopt properly designed questionnaires and rigorous procedures for interviewing to minimize error, researchers using existing data need to be aware of the potential sources of error and must consider how potential error could bias the research results. It is helpful to maintain open communication channels with the individuals involved in the collection of the original data in order to obtain information about the accuracy of the data.

Nonresponse and Missing Data

Both nonresponse and missing data reduce the sample size and can bias results. The response rate in a survey is the percentage of people who complete the survey from the selected sample. A low response rate may result in low accuracy (Bierman & Bubolz, 2003; Pollack, 1999). Selection bias can be a problem especially when the subjects differ between those who responded and those who did not. In the case of secondary analysis, the response rate may not simply be how many persons complete the original survey (Bierman & Bubolz, 2003). For example, if an original survey had a response rate of 80% and if 90% of the responses had sufficient data to permit inclusion in the secondary analysis, the response rate of the secondary analysis is the product of both numbers, 72% (0.8×0.9). Nonresponses may be adjusted with a technique that weight sample using specific survey software (Kneipp & Yarandi, 2002).

Missing data can be an important concern in secondary data analysis. Large surveys usually contain many variables in the questionnaire and this burden on the respondent to complete the questionnaire appears to increase the risk of missing data. Excessive missing data may be a sign of poor data quality; if that is the case, choice to use the data set may be inappropriate (Doolan & Froelicher, 2009; Pollack, 1999). Before deciding how to handle missing data, the researcher needs to determine the nature of the missing data. There are several reasons why the data may be missing. It can be considered missing completely at random (MCAR) if the missing variables are related neither to the value of the variable nor to the value of the other variables (Allison, 2001; Polit, 2010). This is the most desirable case, providing unbiased results, but it is almost never the case. When missing data are not MCAR, they may be categorized as missing at random (MAR). When a variable has missing data that are MAR, it means that the missing data are not related to the value of the variable that has the missing values but to other variables (Allison, 2001; Polit, 2010). For example, data could not be MCAR, if women might be less inclined to report their weight, thus missing on weight would be related to gender. It is possible to test this relationship by dividing the sample into those who did report their weight and those who did not and then testing for a difference by gender. But if among women, the probability of reporting weight is equal regardless of their weight, the missing variable is random and the data would be considered MAR, though not MCAR. The third type is missing not at random (MNAR), in which the missing variables are related to the value of the variable and, often, to other variables as well (Allison, 2001; Polit, 2010). For example, if obese women had a tendency to refuse to report their weight, data would be considered as MNAR. Distinguishing MAR from MNAR is sometimes difficult and requires prior knowledge about the variable (Allison, 2001).

Nonrandom missing data may be a threat to validity because it means that some respondents have chosen not to answer one or more questions or items for some unknown reason (Munro, 2004; Pollack, 1999). It is not possible to predict from other cases what the missing data would have been. Missing data increases the chance of a Type 2 error and affects the generalizability of the study findings (Munro, 2004). If some data are missing at random, they are somewhat inconsequential because the outcome of interest is independent of the missing data.

The most commonly used ways to handle missing data are: (1) to delete the respondent for whom there is any missing value for any variable (listwise deletion), (2) to delete the respondent only when the variable with missing data is involved in an analysis (pairwise deletion), or (3) substitute some value for the missing data (Munro, 2004; Polit, 2010). The researcher who is using an existing data set needs to examine patterns of missing data in order to assess potential biases and include in the analytic plan strategies to deal with the missing data properly.

Summary

Secondary data analysis is a legitimate way to enhance knowledge development in nursing. Its advantages are less time and less cost than undertaking a prospective study. Readily available national survey data sets are valuable sources for nursing research that can produce generalizable results in a versatile way.

While the potential for secondary analysis of national surveys is tremendous, successful investigations require a methodological consideration of the intrinsic limitations of secondary survey analysis. A sound conceptualization of the research question and a good fit between the research question and the data set are prerequisites to yielding valuable insights. Potential sources of error associated with sampling, data measurement, and nonresponse or missing data in survey data sets should be considered when evaluating the appropriateness of the data set. Even though it is impossible to eliminate all of the potential sources of errors, researchers must be aware of their possible influence on the results of the analyses to maximize opportunities for eliciting accurate and useful insights.

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Table 4- 1

Sampling Terminology

Term	Definition
Population	The whole unit from which the sample is drawn.
Target Population	Population of interest; the population from which a sample is drawn and to which inference from the study is generalized
Sampling Frame	The list of the population from which the sample is drawn.
Sample	The group of people selected for a study
Sampling Fraction	The ratio of sample size to population size (sampling fraction (f) = n/N, where N = the number of cases in the sampling, n = the number of cases in the sample)

*Adapted from Trochim, W. (2001). *The Research Methods Knowledge Base* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.

Table 4-2

Definitions of Probability Sampling

Term	Definition
Simple random sample	Each person has an equal chance of being selected out of the entire population; the chance of a person being selected is independent of whether other persons are selected; randomly selected sample from population.
Systematic sampling	Select sample according to a systematic, simple rule such as all persons born on certain dates.
Stratified random sampling	Divide population into groups different from each other (strata) based on some important characteristic, often by demographic variables such as sex, race, age; sample randomly from each group; oversampling small group improves intergroup comparisons; could be expensive to obtain stratification information before sampling.
Random cluster sampling	Divide population into comparable groups (clusters), usually geographic or organization groups (e.g., school); sample randomly some of the clusters; measure all units within sampled clusters; can be cheaper than simple random sample but higher sampling error if the clusters are different from each other.
Multistage sampling	Combine sampling methods in a variety of useful ways; e.g., construct the clusters in the first stage, then set up stratified sampling process within the clusters

*Adapted from Trochim, W. (2001). *The Research Methods Knowledge Base* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.

Table 4- 3

Types of Statistical Error

Decision (Result in the study sample)	True state of null hypothesis in population	
	Null hypothesis is True	Null hypothesis is False
Reject null hypothesis	Type I error (α)	Correct (Power)
Fail to reject null hypothesis	Correct	Type II error (β)

Chapter 5

Methodology

Methodology

This chapter describes the study design, sample, measures of study variables, and the plan for data management and analysis.

Study Design and Research Aims

This study used a cross-sectional design with a secondary data set from the 2008 Korea National Health and Nutrition Examination Survey IV (KNHANES IV) from the Korea Centers for Disease Control and Prevention (KCDC). The research aims of this study are to: (1) describe the prevalence of cardiovascular risk factors in Korean women (hypertension, smoking, dyslipidemia, obesity, central obesity, physical inactivity, diabetes, alcohol use, and depressive mood), (2) identify demographic, socioeconomic, and behavioral variables that predict heavy cardiovascular burden (defined as the presence of two or more modifiable cardiovascular risk factors), (3) estimate the 10-year risk for CHD using the Framingham Risk Score (FRS), and (4) assess the proportion of women who need to be treated based on the American Heart Association (AHA) evidence-based guidelines for CVD prevention (ATP III, 2001; Mosca et al., 2007; Pearson et al., 2002).

Secondary data analysis is a legitimate way of enhancing knowledge development in nursing requiring less time and less cost than undertaking a prospective study. Large national survey data sets such as the KNHANES provide the benefit of a large representative sample, which often is difficult to obtain directly. This makes the analytic results from this study more generalizable. It also makes it possible to reliably define risk for CHD at the national level. A brief introduction to the KNHANES IV and an overview of the survey methods of the original study will be presented first, followed with a description of the methods that was used for the present study.

The Original Data Source

The KNHANES, an ongoing program of the KCDC, is a series of independent, nationally representative surveys that have been conducted periodically since 1998 (http://knhanes.cdc.go.kr/). The survey was designed to assess the health and nutritional status of Koreans using interviews, self-administered questionnaires, and physical examinations at fairly regular intervals. The current study used the data set from the 2008 KNHANES IV because not only it is the latest data set available but also, each individual within the selected households in the 2008 survey was interviewed separately rather than by obtaining a proxy interview with the household reference person. In addition, a mobile center which traveled to locations throughout the country was introduced as a new feature in 2008 to facilitate participation in the program so the response rate was high in 2008.

The KNHANES IV interview included questions about demographics, socioeconomic status, medical history, comorbid conditions, and dietary habits. Information on health behaviors such as smoking, alcohol consumption, and physical activity was collected via self-administered questionnaires. The health examination portion consisted of medical, dental, and physiological measurements including blood pressure (BP), height, weight, and waist circumference as well as laboratory tests administered by highly trained medical personnel.

The sample for the KNHANES IV was obtained through a stratified, multistage probability sampling design based on the 2005 Census data intended to represent civilian, non-institutionalized Koreans at least 1 year old. The sampling frame consisted of households, so households were randomly sampled, but each individual within the household was interviewed separately. Selected households received a letter from the KCDC director introducing the survey. They were approached by trained interviewers to schedule a day to obtain written consent and to schedule personal interviews and physical examinations. On the scheduled day, upon obtaining informed written consent, health interviews and physical measurements were performed in a specially designed mobile center or in public health centers equipped with highly trained personnel and high-tech fully calibrated and standardized medical equipment. This process took an average of 60 to100 minutes to complete and participants were encouraged to ask for assistance if needed. To encourage participation, compensation (snacks and KRW 10,000 - corresponding to USD 8.30) and a copy of the medical findings report were given to each participant. Of a total of 12,528 subjects approached from January 2008 to December 2008, 9,744 subjects (4,370 men and 5,374 women) completed the survey so that the overall response rate for the original study was 77.8%.

Sample for the Present Study

Sample for research aim 1, 2, and 3. The sample was limited to women who: (1) completed both health interviews and physical examinations, (2) did not have established CVD, and (3) were older than 20 years, because the AHA recommends that CHD risk assessment in women should begin at age 20 years. To define established CVD in this study, self-reported heart attack, angina pectoris, or stroke were used. Women who were pregnant or lactating were excluded because pregnancy or lactation may affect cardiovascular risk factors such as body mass index (BMI), BP or blood sugar. To determine if a woman was pregnant or lactating, self-reported pregnancy or breast feeding were used.

Figure 5-1 shows the sample size and reasons for exclusion from analyses in the present study. Of the total of 5,374 women participants in the original KNHANES IV survey, 4,100 women were older than 20 years. Among them, 90.9% (*n* = 3,726) completed the survey; 3.2% (*n* = 131) had a diagnosis of established CVD; 0.9% (*n* = 33) were pregnant; 2.1% (*n* = 74) were breast-feeding. After excluding those with established CVD, pregnancy, and breastfeeding, 3,562 women aged 20 to 93 years were eligible for the analysis for Research Aim1, 2, and 4. Among these women, 3.0% (*n* = 108) women did not fast for at least 8 hours prior to the blood tests; 0.1% (*n* = 2) women did not answer the question about number of fasting hours. Because glucose and lipid levels for those who fasted less than 8 hours are unreliable, mean substitutions for glucose and lipid levels for those 110 women were considered. However, substituting means for glucose and lipid levels for those women did not change the final results significantly. Also, those 110 women did not differ in demographics and other cardiovascular risk factors from those who fasted more than 8 hours so they were excluded from the analysis for this study. About 0.7% (*n* = 26) women had one or more items missing about times of physical activities, making it impossible to estimate their MET-minutes/week (MET; 1 MET is approximately 3.5~4.0 ml of oxygen uptake per kg per minute). Those with missing data for specific physical activities did not differ from those without missing data in terms of demographics and cardiovascular risk factors, so the 26 women with missing data were excluded from the analysis. In the original study, the lipid profile did not include LDL-C directly, so in the present study LDL-C was estimated by the Friedewald equation (LDL = TC – HDL - TG/5). The equation is unreliable and invalid when triglycerides are over 400 mg/dL (Friedewald, Levy, & Fredrickson, 1972). About 1.4%

(n = 51) women had triglyceride levels ≥ 400 mg/dL, and therefore these women were excluded, yielding a final sample of a 3,301 women for the analysis for Research Aim 1, 2, and 4.

Sample for research aim 3. Of the women who were included in the study for Research Aim 1and 3, the analyses for Research Aims 3 were limited to a subgroup of women who were age 20 through 79 years, and did not have diabetes. Diabetes is considered to be a CHD equivalent for risk classification purposes, requiring the most aggressive risk reduction efforts, so diabetes is not incorporated into the FRS (Wilson et al., 1998). In addition, the FRS was devised for people age 20 to 79 years. Thus, for Research Aims 3, only women aged 20 to 79 years free of diabetes were included. Of the 3,375 women included in the analysis for Research Aim 1, 2, and 4, women older than 79 years (2.7%, n = 89) and women with diabetes (8.3%, n = 273) were excluded for a final sample of 2,939 asymptomatic women.

Measurements

Demographic characteristics. Table 5-1 summarizes how the variables were measured in the KNHANES IV study, and how they were classified in the present study. Demographics such as marital status, education level, work status, monthly household income, perceived general health condition, menopausal status, and menopausal age were reviewed, and these data were included in this study to describe the sample characteristics.

In particular, there is no official poverty line in Korea so the concept of poverty income ratios (PIR) was used to define poverty level for this study. The PIR represents the ratio of family income adjusted by family size to the poverty threshold, which is based on the Minimum Cost of Living set by the Ministry of Health and Welfare (KRW 1,400,000 for a household of four people; approximately USD 1,250 per month). Ratios below 1 indicate that the income for the respective family is below the poverty threshold, and were defined as being below the government poverty level in this study. A ratio of 1 or greater is above the poverty level.

Cardiovascular risk factors. Age was presented in years in the original data set. Participants were considered current smokers if they reported that they were currently smoking. Physical activity was self-reported with the Korean version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) (Appendix). Subjects were asked to recall the frequency, duration, and intensity of physical activity engaged in for at least 10 minutes in the past 7 days. Data collected with the IPAQ were scored in MET-minutes/week in the present study (www.ipaq.ki.se). One MET is the rate of energy expenditure while at rest (Ainsworth et al., 2000). Numerous governmental and professional organizations suggest that engaging in at least 30 minutes of moderate activity on most, preferably all days of the week can benefit CHD prevention (Myers, 2003; US Department of Health and Human Services, 2009). This amount of physical activity is approximately 600MET-minutes/week (www.ipaq.ki.se). Women with less than 600 MET-minutes/week were considered sedentary in this study. The IPAQ, when developed, showed acceptable reliability (Spearman's rho = 0.67) and criterion validity (compared to the accelerometer) for 20 diverse countries, comparable to most other self-report physical activity questionnaires (Craig et al., 2003). The reliability and validity of the Korean version of IPAQ showed similar results (Oh, Yang, Kim, & Kang, 2007).

Women with depressive mood in this study were identified with the answer “yes” to the following question; “During the last year, have you ever felt so sad, hopeless, or depressed almost every day for two weeks or more in a row?” Alcohol use was measured by the question “How often do you drink alcoholic beverages 5 or more drinks at one sitting?” Response choices were (1) never, (2) less than once a month, (3) about once a month, (4) once a week, and (5) almost every day. Responses with once a week and almost every day were coded as “alcohol use” in this study.

Height was measured in centimeters in the upright position and weight was measured in kilograms on a calibrated scale with the subject wearing light clothing and no shoes. With these two anthropometric measures, BMI was calculated from the formula of weight in kilograms divided by height in meters squared (kg/m^2). Overweight and obesity were defined as $23 \leq$ BMI< 25 kg/m^2 and BMI ≥ 25 kg/m^2, respectively, on the basis of the Asian-Pacific region of the World Health Organization (WHO, 2000). Waist circumference was measured in centimeters midway between the bottom of the rib cage and the iliac crest while participants were standing. The International Diabetes Federation stresses the use of ethnic-specific cut-points for waist circumference (Alberti, Zimmet, & Shaw, 2005). Thus, in this study, the cut-point of ≥ 85 cm was used to define abdominal obesity as suggested by the Korean Society for the Study of Obesity (Lee et al., 2007).

Blood pressures were obtained three times in the NHANES IV and the average of the second and third systolic BP and diastolic BP readings were used in the analyses for the current study as recommended by the Joint National Committee 7 (Chobanian et al., 2003). Participants were also asked whether they were currently taking antihypertensive medications. Hypertension was defined as a systolic or diastolic BP $\geq$ 140/90 mm Hg or taking antihypertensive medications (Chobanian et al., 2003).

Blood samples were collected after at least 8 hours of fasting and blood glucose and lipid levels were analyzed in a national laboratory. In this study, diabetes was defined as a self-reported previous history of diabetes or use of glucose lowering medications or a fasting blood glucose ≥ 126 mg/dl (American Diabetes Association, 2010). In the original study, LDL-C particles were not measured directly so in the present study it was estimated using the Friedewald equation. A LDL-C level ≥ 130 mg/dl, triglyceride level ≥ 150 mg/dl, and total cholesterol ≥ 200 mg/dl are considered elevated (Mosca et al., 2007), and were classified as risk factors for CHD in this study. A high density lipoprotein cholesterol (HDL-C) level < 50 mg/dl in women is considered low (Mosca et al., 2007) and was defined as a risk factor for CHD. In this study, "*heavy cardiovascular burden*" was defined as the presence of two or more modifiable cardiovascular risk factors included in the Framingham Risk Score (FRS) and diabetes.

10-year risk for CHD. Given that there is no specific risk assessment tool for Korean women, the well known and widely used FRS was used to estimate Korean women's 10-year risk for CHD in this study. It estimates a women's risk of having a first heart attack in the next 10 years using seven variables: age, sex, TC, HDL-C, smoking status, systolic BP and whether the subject is taking medication to control hypertension. Both the AHA and the National Cholesterol Education Program Adult Treatment Panel III (NCEP/ATP III) have adopted the FRS to guide appropriate prevention strategies. In this study, the FRS was calculated using the downloadable spreadsheet calculator (http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm). Table 5-2 and Table 5-3 show the equation to calculate the FRS and an example, respectively.

Data Management and Statistical Analysis

The SPSS 18.0 was used for data management of the variables involved in the present study. All study variables were screened for missing data, outliers, and suspected errors. Statistical analyses were carried out to answer each research question.

Descriptive statistics were used to determine the prevalence of cardiovascular risk factors (hypertension, smoking, dyslipidemia, obesity, central obesity, physical inactivity, diabetes, alcohol use, and depressive mood). To identify women with "heavy cardiovascular burden," the number of modifiable risk factors included in the FRS (smoking, hypertension, HDL-C<50 mg/dL, LDL-C ≥130 mg/dL) plus diabetes was calculated. Then, the number was dichotomized with a cut-point of 2 to define heavy cardiovascular burden in this study. Logistic regression was used to identify potential demographic, socioeconomic, and behavioral predictors of heavy cardiovascular burden (menopause, education attainment, poverty, marital status, sedentary lifestyle, alcohol use, and depressive mood). Bivariate analyses, chi-square tests and correlations, were conducted to examine the relationship between the dependent variable (heavy cardiovascular burden) and the above listed potential independent variables. Independent variables were examined for multicollinearity. Significant variables in the bivariate analyses were entered into the multivariate logistic regression. Independent variables for the logistic regression were dichotomized or dummy coded. Table 5-4 shows the coding categories for all variables that were entered in logistic regression analysis.

For research aim 4, women were re-classified into three risk subgroups according to the AHA guidelines (Figure 5-2) in order to determine the intensity of risk reduction for each subgroup. The risk categories were based on the number of risk factors and a 10-

year risk estimated with the FRS. Descriptive statistics were used to present the proportion of women who were not at goal levels and thus in needs of treatment for each subgroup.

Ethical Aspects

The original survey was reviewed and approved by the KCDC Institutional Review Board in Korea. The present study uses only de-identified existing data with no subject contact. Permission to conduct the present study was approved by the UCSF Committee on Human Research as an Expedited Review (IRB #: 10-03209). SPSS data set and the data directory were directly downloaded from the KCDC website, and downloaded electronic data were protected with a password.

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Table 5- 1

How Variables Were Measured in the KNHANES IV and How They Were Used in the Present Study

Variables	How it was measured in the KNHANES IV Dataset	How it was used in the present study (Coding method)
Gender	• Men/women	• Women were included
Age	• Measured in years	• Women older than 20 were included. • Described age as a continuous and a categorical variable.
Menopausal status	• Six response choices were: (1) period not yet started, (2) having periods, (3) menopause, (4) pregnant, (5) breast feeding, or (6) hysterectomy. If menopausal, asked the age of menopause in years.	• Pregnant and breast-feeding women were excluded from the present study. • Described other categories and presented mean age of menopause.
Marital status	• Two questions related with marital status. • First asked either (1) married or (2) never married. • If answered as married for the first question, then asked to select among (1) married, living together, (2) married but not living together, (3) widowed, or (4) divorced.	• Collapsed (2) married but not living together and (4) divorced from the second question, and created a new variable. • Coding in the present study 0: married (living together) 1: never married, 2: divorced or separated 3: widowed, 4: did not answer
Educational attainment	• Four response choices were: (1) less than elementary level, (2) middle school graduate, (3) high school graduate, or (4) college graduate or more.	• Described sample characteristics with same categories
Work status	•Yes/No	• Described sample characteristics with same categories

Variables	How it was measured in the KNHANES IV Dataset	How it was used in the present study (Coding method)
Household income	•Asked to report household income in last year including income from all sources such as salaries, retirement benefits, help from relatives and so forth.	• Described sample characteristics as a continuous and/ or categorical variable (below poverty vs. above poverty level[§])
General health condition	• Five response choices were: (1) excellent, (2) good, (3) about the average, (4) fair, and (5) poor	• Described sample characteristics with same categories
Comorbid conditions	•Asked whether they have ever had a diagnosis of heart attack, angina pectoris, stroke or diabetes.	• Used to defined established CVD (self-reported heart attack, angina pectoris or stroke) and diabetes
Medications	•Asked to report whether they are taking a prescription medication to control high blood pressure, high blood sugar or high cholesterol.	• Hypertension: systolic or diastolic BP $\geq$ 140/90 mm Hg or taking antihypertensive medications [a] (0: no hypertension/ 1: hypertension) • Diabetes: a self-reported previous history of diabetes or a fasting blood glucose $\geq$ 126 mg/dl or use of glucose lowering medications [b]. (0: no diabetes/1: diabetes)
Physical Activity	•Self-reported with the Korean version of the IPAQ. Asked to recall the frequency, duration, and intensity of physical activity engaged in for at least 10 minutes in the past 7 days.	• Sedentary life style: less than 600 MET-minutes/week [c] (0: active / 1: sedentary women)
Depressive mood	• Asked if felt so sad, hopeless, or depressed almost every day for two weeks or more in a row during the last year (Yes/No).	• 0 : no/ 1: yes
Alcohol use	• Asked how often drink alcoholic beverage 5 or more drinks at one sitting. Response choices were (1) never, (2) less than once a month, (3) about once a month, (4) once a week, and (5) almost every day.	• Collapsed (1) ~ (3) and (4) ~ (5), and creased a new variable “Alcohol use.” • 0 : no/ 1: yes (more than once a week)

Variables	How it was measured in the KNHANES IV Dataset	How it was used in the present study (Coding method)
Smoking	•Self-reported current smoking status (Yes/No)	• 0: non-smoker/ 1: current smoker
Physical examination	•Measured height, weight, WC, three BPs •Blood samples drawn for blood glucose and a full lipid panel	•Calculate BMI = kg/m^2 •Overweight or obesity: BMI ≥ 23 kg/m^2 [d] (0: no obesity/ 1: obesity) •Abdominal obesity: WC ≥ 85 cm [e] (0: no abdominal obesity/ 1: abdominal obesity) •Diabetes: a self-reported previous history of diabetes or a fasting blood glucose ≥ 126 mg/dl or use of glucose lowering medications [b]. (0: no diabetes/1: diabetes) •Dyslipidemia [f] LDL-C level ≥ 130 mg/dl (0: LDL-C< 130/ 1: ≥ 130) TG level ≥ 150 mg/dl (0: TG < 150/ 1: ≥ 150) TC ≥ 200 mg/dl (0: TC< 200/ 1: ≥ 200) HDL-C level < 50 mg/dl (0: HDL ≥ 50/ 1:< 50)

CHD: coronary heart disease; IPAQ: International Physical Activity Questionnaire; MET: metabolic equivalent; WC: waist circumference, BP: blood pressure; LDL-C: low-density lipoprotein cholesterol; TG: triglyceride; TC: total cholesterol; HDL-C: high-density lipoprotein cholesterol

§ Poverty status was defined as a poverty-income ratio of less than 1.

*Criteria: (a) Joint National Committee 7, 2003; (b) American Diabetes Association, 2010; (c) International Physical Activity Questionnaires, 2003; (d) World Health Organization Asian-Pacific region, 2000; (e) Korean Society for the Study of Obesity, 2007; (f) American Heart Association, 2007

Table 5- 2

Framingham Risk Score Equation

Outcome: Hard CHD					
MEN			WOMEN		
Independent Variable	Cox Parameter Coefficient	Means	Independent Variable	Cox Parameter Coefficient	Means
Ln(AGE)	52.009610	3.8926095	Ln(AGE)	31.764001	3.9213204
Ln(TOTAL)	20.014077	5.3441475	Ln(TOTAL)	22.465206	5.3628984
Ln(HDL CHOL)	-0.905964	3.7731132	Ln(HDL CHOL)	-1.187731	4.0146369
Ln(SBP)	1.305784	4.8618212	Ln(SBP)	2.552905	4.8376494
TRT for HTN (SBP > 120)	0.241549	0.1180474	TRT for HTN (SBP > 120)	0.420251	0.1428020
CURRENT SMOKER	12.096316	0.3356020	CURRENT SMOKER	13.075430	0.3236202
Ln(AGE)*Ln(TOTAL)	-4.605038	20.8111562	Ln(AGE)*Ln(TOTAL)	-5.060998	21.0557746
Ln(AGE)*SMOKER†	-2.843670	1.2890301	Ln(AGE)*SMOKER‡	-2.996945	1.2519882
Ln(AGE)*Ln(AGE)	-2.933230	15.2144965			
Average 10 Year Survival =	0.940200		Average 10 Year Survival =	0.987670	

† If Age > 70 then use Ln(70)*SMOKER ‡ If Age > 78 then use Ln(78)*SMOKER

$$\text{Probability} = 1 - S(t)^{\exp(\Sigma\beta X - \Sigma\beta\overline{X})}$$

Source: http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm

Table 5- 3

Framingham Risk Score Example

Consider a male, age 41, with total cholesterol 180, HDL 55, systolic blood pressure 128, not on treatment for hypertension, and a non-smoker. His 10-year risk is computed as follows:	
Step 1	$\Sigma\beta x =$ 52.009610*ln(41) +20.014077*ln(180) –0.905964*ln(55) + 1.305784*ln(128) +0.241549(0) +12.096316(0) – 4.605038*ln(41)*ln(180) -2.843670*ln(41)*(0) – 2.933230*$(\ln(41)^2)$ = 170.5223
Step 2	$\Sigma\beta\bar{X}$ =52.009610*3.8926095 +20.014077*5.3441475 –0.905964*3.7731132 + 1.305784*4.8618212 +0.241549*0.1180474 +12.096316*0.3356020 – 4.605038*20.8111562 -2.843670*1.2890301 – 2.933230*15.2144965 = 172.3002
Step 3	$\exp(\Sigma\beta x - \Sigma\beta\bar{X}) = \exp(170.5223 – 172.3002) = 0.16899$
Step 4	S(10) = 0.9402
Step 5	$\text{Probability} = 1 - S(t)^{\exp(\Sigma\beta X - \Sigma\beta\bar{X})}$ $= 1 - 0.9402^{0.16899}$ = 1-0.98963 = 0.0104.
Step 6	10-year risk for CHD = 0.0104 × 100 = **1.04%**

Source: **http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm**

Table 5- 4

Coding of Variables for Logistic Regression

<table>
<tr><th>Variables</th><th colspan="2">How it was coded for logistic regression</th></tr>
<tr><td colspan="3">Dependent Variable</td></tr>
<tr><td>Heavy cardiovascular burden</td><td colspan="2">1 = yes (the presence of ≥ 2 modifiable risk factors)
0 = no</td></tr>
<tr><td colspan="3">Independent Variables</td></tr>
<tr><td>Menopause</td><td colspan="2">1= menopause (menopause or hysterectomy)
0 = else</td></tr>
<tr><td>Poverty</td><td colspan="2">1 = less than poverty
0 = above poverty</td></tr>
<tr><td>Education</td><td colspan="2">1 = high school or less
0 = college or above</td></tr>
<tr><td>Marital status</td><td>Dummy coded
(reference group:
married & living together)</td><td>(1) Living alone
1 = living alone
0 = else

(2) Never married
1 = never married
0 = else</td></tr>
<tr><td>Work status</td><td colspan="2">1 = no
0 = yes</td></tr>
<tr><td>Sedentary life style</td><td colspan="2">1 = < 600 MET-minutes/week
0 = ≥ 600 MET-minutes/week</td></tr>
<tr><td>Depressive mood</td><td colspan="2">1 = yes
0 = no</td></tr>
<tr><td>Alcohol use</td><td colspan="2">1 = yes
0 = no</td></tr>
</table>

Figure 5-1

Reasons for Exclusion from Analyses in the Present Study

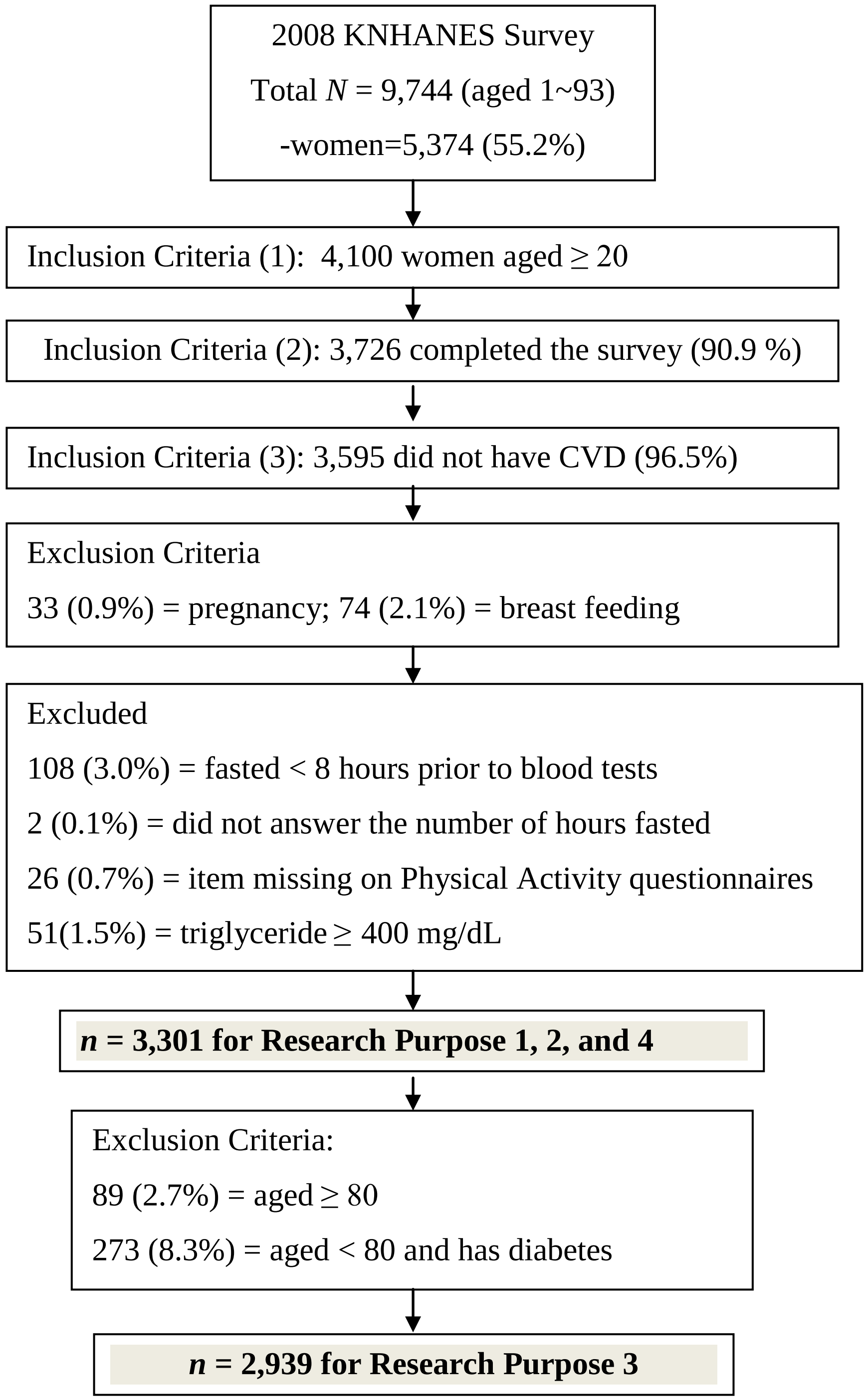
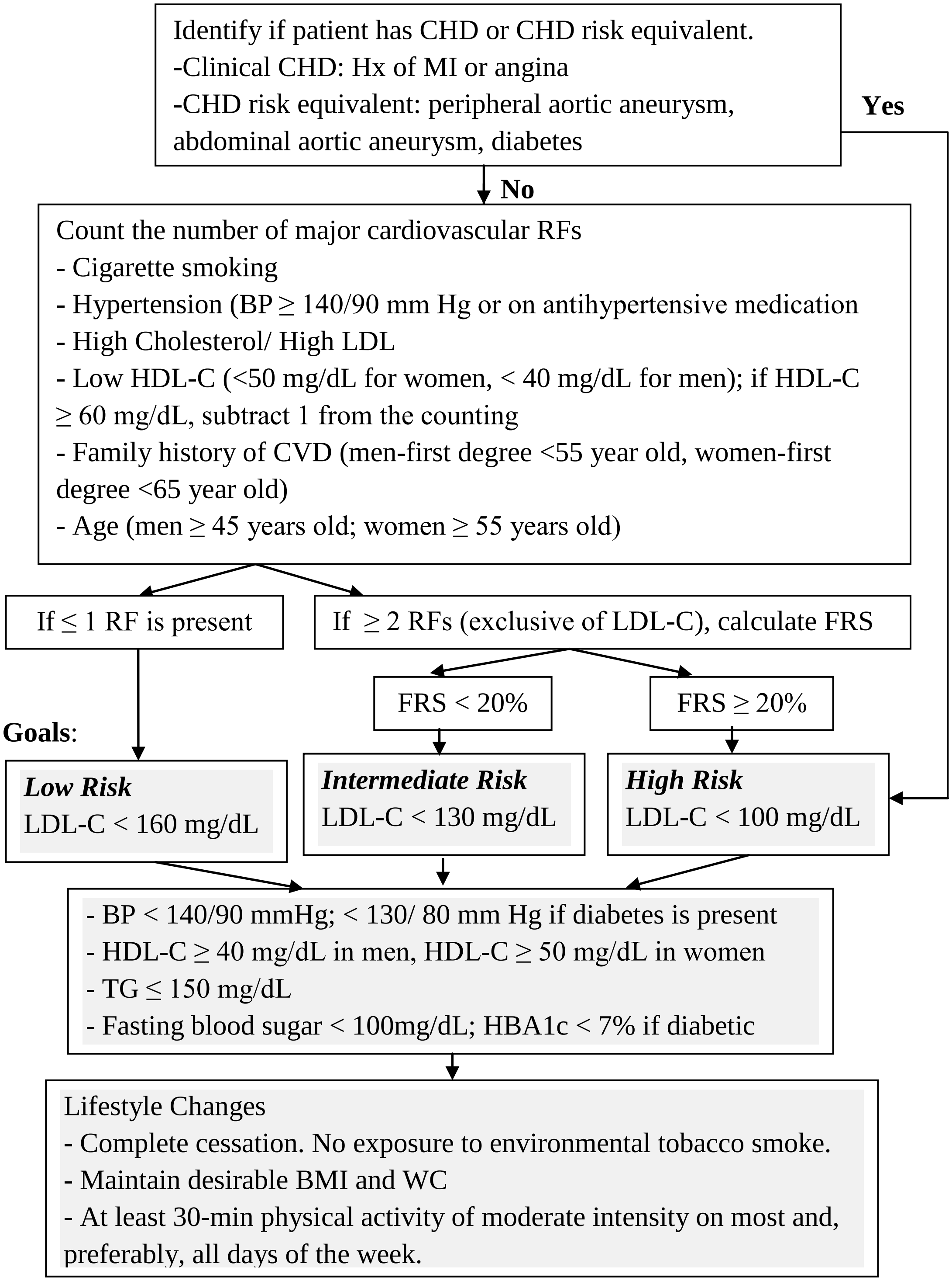


Figure 5-2

AHA guidelines: Cardiovascular Risk Assessment and Prevention Guidelines



Developed based on: Pearson, TA et al. (2002). AHA guidelines for primary prevention of cardiovascular disease and stroke: Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular disease. *Circulation, 106*(3), 388-391

Chapter 6

Results

Results

This chapter presents the results of this cross-sectional study. The demographic characteristics of the sample will be described first, then the findings of the study organized by research question.

The Demographic Characteristics of Korean Women

Table 6-1 shows the demographic characteristics of Korean women (*n* = 3,301). The mean (± SD) age was 49 (± 16) years ranging from 20 to 93. About 68% of the women were married or living with a partner; 20.5% of women were divorced, separated, or widowed. Korean women had low educational attainment with 77.9% having a high school education or less. Less than half of the women (48.6%) were employed and 50.5% had a monthly household income of less than KRW 2,000,000 (USD 1,789.58). The mean monthly household income was 2,713,749 (*n* = 3,208; SD = 5,210,704; median = 2,000,000), and 25 % of women would be considered low incomes below the poverty level as defined by poverty income ratios (PIR). Most women (71%) indicated that their general health was about average or above, 24.6% fair health, and 4.2% poor health.

About half of the women had regular periods, 5% had a history of hysterectomy, and 37 % were post-menopausal. The average menopausal age was 49 years (*n* = 1,132, SD=5), and 14.6 % used female hormones to control post menopausal symptoms.

Table 6- 1

Demographic Characteristics of Korean Women (n=3,301)

Demographics	Mean ± SD / % (*n*)	
Age	49 ± 16	
20-29	12.3	(405)
30-39	20.8	(687)
40-49	20.5	(677)
50-59	17.2	(569)
60-69	15.9	(526)
70-79	10.5	(348)
≥ 80	2.7	(89)
Marital status		
Married	67.5	(2229)
Never married	11.5	(378)
Divorced or separated	4.3	(143)
Widowed	16.2	(535)
Did not answer	0.5	(16)
Education		
Less than elementary level	34.7	(1146)
Middle school graduate	10.3	(339)
High school graduate	33.0	(1088)
College graduate or more	22.1	(728)
Work Status		
Yes	48.6	(1603)
No	51.3	(1693)
Did not answer	0.2	(5)
Monthly household income		
≤ KRW 1,000,000 (USD 894.79)	29.5	(974)
KRW 1,000,001 ~ 2,000,000 (USD 1,789.58)	21.1	(695)
KRW 2,000,001 ~ 3,500,000 (USD 3,131.77)	23.1	(762)
> KRW 3,500,000	23.5	(777)
Did not answer	2.8	(93)
Below Poverty Level (n=3,208) †	25.0	(826)
General Health Condition		
Excellent	3.7	(123)
Good	34.7	(1147)
About the average	32.6	(1077)
Fair	24.6	(812)
Poor	4.2	(140)
Did not answer	0.1	(2)

Demographics	Mean ± SD / % (*n*)	
Menopausal Status		
Having Periods	48.7	(1609)
Menopause	37.0	(1223)
Hysterectomy	5.1	(169)
Did not answer	9.1	(300)
Menopausal Age (*n* = 1,132)	48.91 ± 4.66	
Use of Female Hormones (*n* = 1,392)	14.6	(203)

n = total sample; *SD* = standard deviation; KRW = Korean Won; USD = United States dollar (1 USD = 1,117.58 KRW)
† Poverty status was defined as a poverty-income ratio of less than 1.

Research Aim 1: Describe the Prevalence of Cardiovascular Risk Factors in Korean Women

Cardiovascular risk factors in Korean Women. The cardiovascular risk factors in Korean women are presented in Table 6-2 and Table 6-3. Age ≥ 55 years was considered as a risk factor for CVD by NECP/ATP III and AHA guidelines. About one in three of study sample was older than 55 years. In this study, one in four women (25%) had an elevated systolic or diastolic BP ≥ 140/90 mm Hg, or was taking antihypertensive medications to control blood pressure. About 34% of Korean women 20 years or older had total cholesterol levels ≥ 200 mg/dL, and 29.2% had LDL-C levels ≥ 130 mg/dL. More than a half (53.2%) of women did not reach the recommended HDL-C levels of greater than 50 mg/dL, and 21.3% had triglyceride levels of greater than 50 mg/dl. The prevalence of diabetes was 8.7% based on fasting blood glucose levels of greater than 126 mg/dl. One in two women were categorized as being overweight/obese, having a BMI of greater than 23 kg/m^2; 28.6% of women exceeded the Korean Society for the Study of Obesity criteria for abdominal obesity of WC ≥85 cm. About 6% of women were current smokers. The percentage of women who drank at least once a week and had five or more drinks at one sitting was 7.8%. About 30% of Korean women were categorized as sedentary. In addition, 19.4% of women answered that they felt sad, hopeless or depressed almost every day for two weeks or more in a row during last year.

Table 6- 2

Proportion of Cardiovascular Risk Factors in Korean Women (n= 3,301)

Cardiovascular Risk Factors	% (*n*)	
Age (≥ 55 years)§	36.6	(1209)
Hypertension§	24.8	(818)
Self-reported hypertension	18.5	(610)
Taking antihypertensive medication§	17.5	(577)
Lipid Values		
TC ≥ 200 mg/dL§	33.8	(1115)
HDL-C (≤ 50 mg/dl)§	53.2	(1756)
Triglyceride ≥ 150 mg/dL	21.3	(702)
LDL-C ≥ 130 mg/dL	29.2	(963)
Self-reported dyslipidemia	6.8	(226)
Taking lipid lowering medication	3.4	(113)
BMI ≥ 23 kg/m²	50.5	(1666)
WC (women ≥ 85 cm)	28.6	(943)
Diabetes	8.7	(288)
Self-reported diabetes	6.2	(204)
Taking insulin or antidiabetic drug	5.4	(177)
Behavioral Factors		
Current smoker§	6.2	(205)
Alcohol use	7.8	(256)
Physical inactivity	33.1	(1092)
Depressive mood	19.4	(639)

Hypertension = BP ≥ 140/90 mm Hg or on antihypertensive medication; Diabetes = fasting blood glucose ≥ 126 mg/dl or taking glucose lowering medications; Alcohol use = at least once a week and 5 or more drinks at one sitting ; Physical inactivity = MET-minutes/week < 600 (Metabolic equivalent [MET]; 1 MET = 3.5 ml of oxygen uptake per kg per minute)

§Risk factors included in the Framingham Risk Score

Table 6- 3

Means (± SD) of Cardiovascular Risk Factors in Korean Women (n=3,301)

Cardiovascular Risk Factors	Mean ± SD/ % (*n*)
Blood Pressure	
SBP (mmHg)	113.89 ± 17.78
DBP (mmHg)	72.78 ± 10.55
Lipid Values	
TC (mg/dL)	188.31 ± 35.75
HDL-C (mg/dL)	50.11 ± 10.80
Triglycerides (mg/dL)	111.24 ± 65.27
LDL-C (mg/dL)†	115.95 ± 31.73
BMI (kg/m²)	23.35 ± 3.40
WC (cm)	79.30 ± 9.86
Fasting blood glucose (mg/dL)	96.90 ± 22.94

n = total sample; *SD* = standard deviation; SBP = systolic blood pressure; DBP = diastolic blood pressure; TC = total cholesterol; HDL-C = high density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; BMI = body mass index; WC = waist circumference

†Calculated result of LDL-C = TC-(HDL-C+TG/5)

The mean values and the distribution of each risk factor by age group are presented separately in Table 6-4 and Table 6-5. This information is graphically depicted in Figure 6-1. The prevalence of hypertension increased steeply with age. In women aged 20-29 years, hypertension was present in 1.2% of the population, whereas the rate was more than 60% in women aged 70 or more. The prevalence of smoking was highest in women aged 20-29 years (12.1%). The rate decreased with age until 50 years and lowest in women aged 50-59 years (3.7%) but after age 60, the rate increased again with age. The prevalence of hypercholesterolemia increased especially after age 50, and it was most prevalent in women aged 60-69 years. A low HDL-C level was very common in Korean women. Even in the younger age group (aged 20-29 years), 33.8% had low HDL-C levels. BMI and WC increased with age until age 60. Obesity and abdominal obesity were most prevalent in women in the 60-69 years age category (68.1% and 49.0%, respectively). Diabetes increased at a steady rate until age 70. The prevalence of diabetes was 13.4 times higher in women aged 70-79 years than in women aged 20-29. Korean women older than 80 years were the most sedentary (44.9%); whereas women aged 50-59 years were the most active (17.6%). Drinking of alcoholic beverage was most prevalent in women aged 20-29 years (17.8%), and decreased with advancing age. The prevalence of depressive mood increased especially after age 50, and in women aged 60-69 years the rate was 1.7 times higher than in women aged 30-39 years.

Table 6- 4
Proportion of Cardiovascular Risk Factors in Korean Women by Age Group (n= 3,301)

Risk Factors	Age group (years), %							
	20-29	30-39	40-49	50-59	60-69	70-79	≥ 80	Total
Hypertension	1.2	3.8	13.7	29.5	49.8	59.5	64.0	24.8
Current smoking	12.1	7.0	4.7	3.7	4.4	6.6	10.1	6.2
LDL-C ≥ 130 mg/dL	10.1	15.6	22.0	42.4	41.6	49.1	39.3	29.2
HDL-C < 50 mg/dL	33.8	47.0	52.1	53.3	66.7	67.0	62.9	53.2
TG ≥ 150 mg/dL	6.9	11.4	18.9	22.3	34.0	37.4	36.0	21.3
TC ≥ 200 mg/dL	12.8	19.2	26.6	48	47.9	54.0	42.7	33.8
BMI ≥ 23 kg/m²	28.1	35.1	51.6	62.7	68.1	62.1	34.8	50.5
WC ≥ 85 cm	9.9	15.4	21.9	36.4	49.0	45.7	28.1	28.6
Diabetes	1.5	1.7	4.7	10.2	18.1	20.1	16.9	8.7
Physical inactivity	29.1	30.1	26.1	22.7	30.2	38.2	50.6	29.3
Alcohol use	17.8	10.5	10.9	4.0	1.9	1.1	1.1	7.8
Depressive mood	16.3	14.8	15.8	22.3	25.7	25.3	15.7	19.4

TC = total cholesterol; HDL-C = high density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; BMI = body mass index; WC = waist circumference.
Hypertension = BP ≥ 140/90 mm Hg or on antihypertensive medication; Diabetes = fasting blood glucose ≥ 126 mg/dl or taking glucose lowering medications; Physical inactivity = MET-minutes/week < 500; Alcohol use = at least once a week and 5 or more drinks at one sitting ; depressive mood = sad, hopeless or depressed almost every day for two weeks or more in a row during last year

Table 6- 5

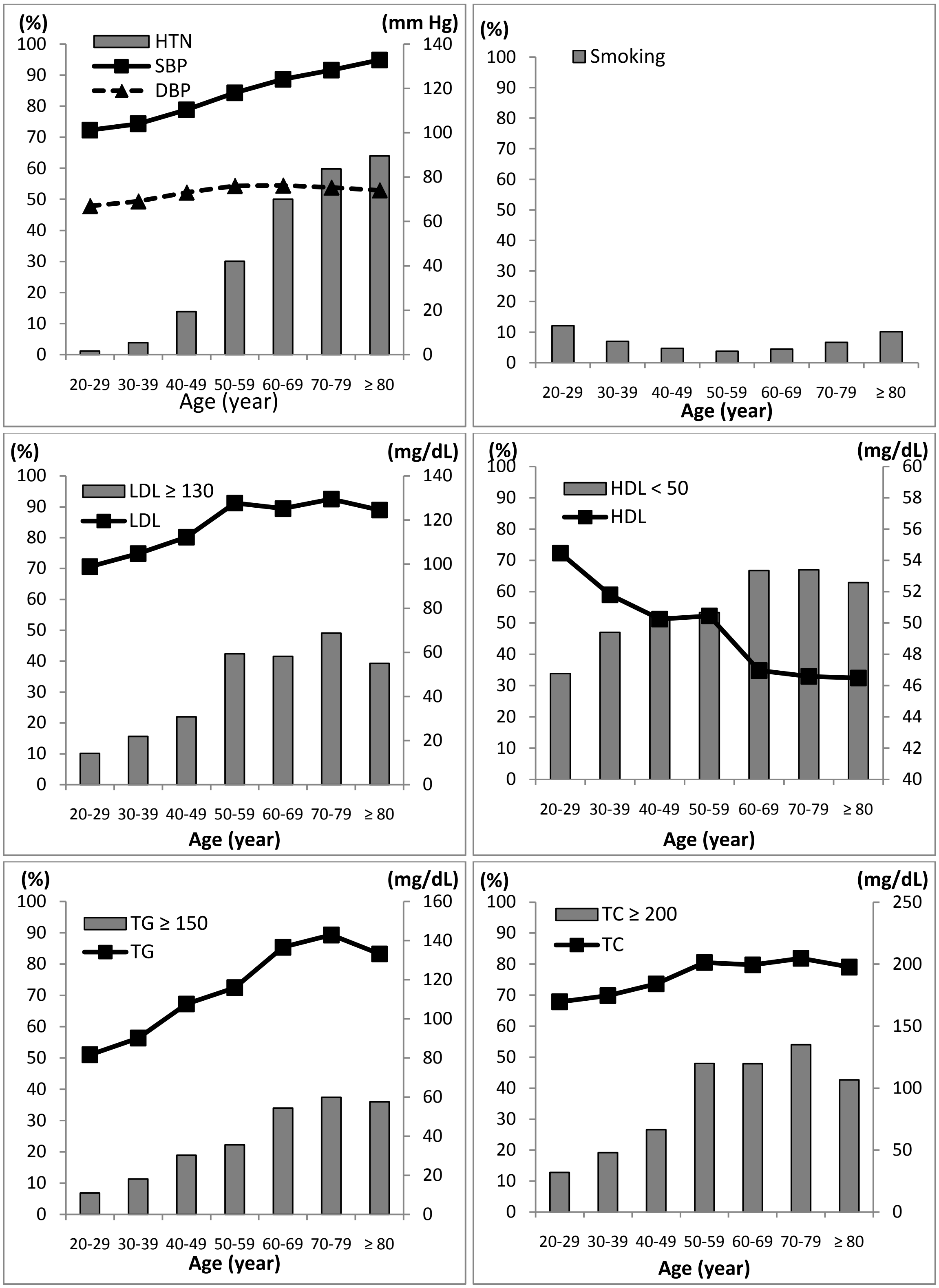
Means (± SD) of Cardiovascular Risk Factors in Korean Women by Age Group (n=3,301)

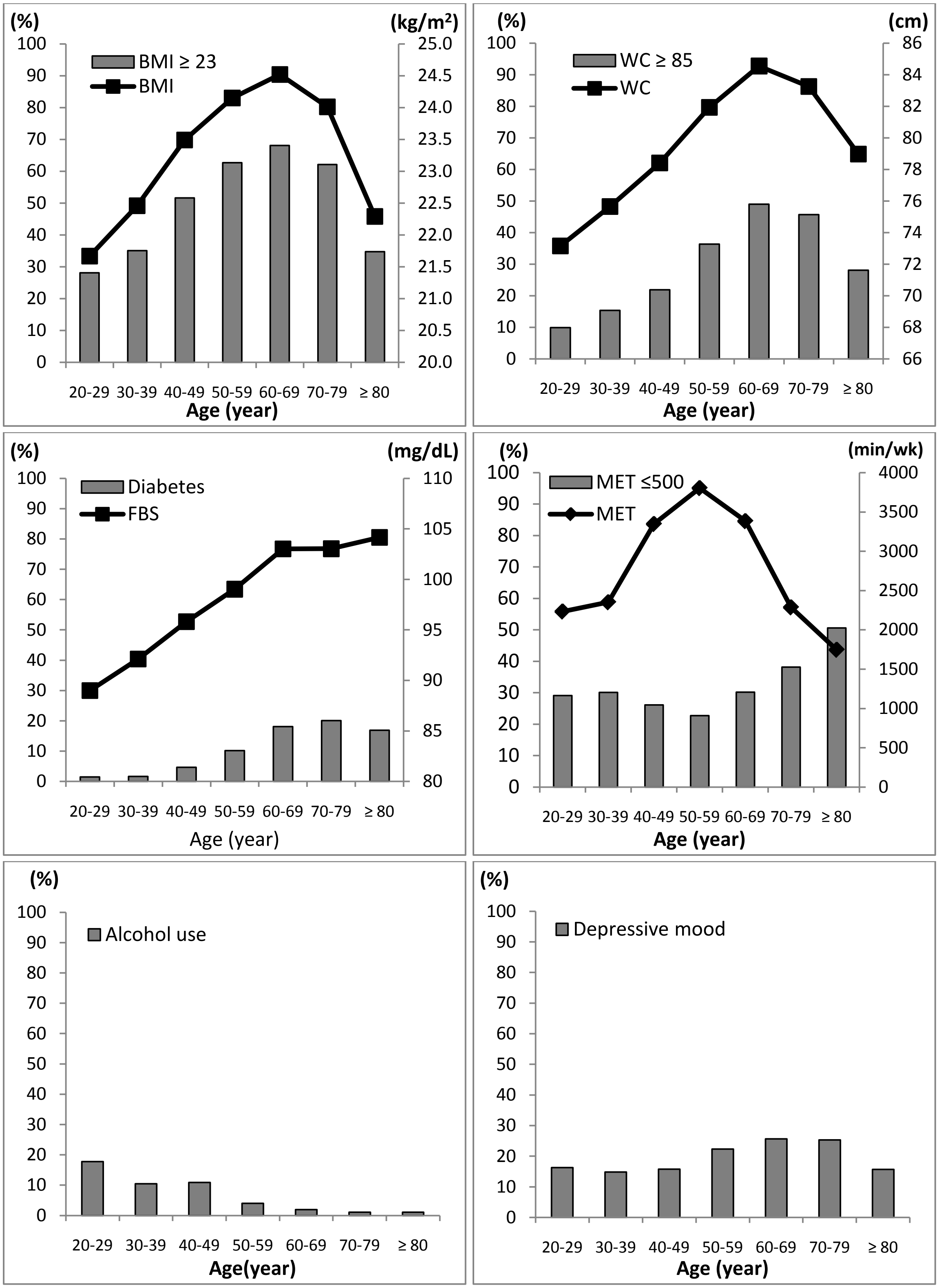
Risk factors	Age group (year)/ mean (±SD)							
	20-29	30-39	40-49	50-59	60-69	70-79	≥ 80	Total
SBP (mg Hg)	101.18 (9.28)	104.04 (11.59)	110.36 (15.08)	117.96 (16.87)	124.05 (17.08)	128.16 (18.04)	132.79 (17.76)	113.89 (17.78)
DBP (mg Hg)	66.95 (8.83)	69.10 (9.72)	73.09 (10.81)	76.04 (10.14)	76.22 (9.23)	75.34 (10.66)	74.09 (11.70)	72.78 (10.55)
LDL (mg/dL)	98.88 (24.67)	104.80 (26.33)	112.26 (28.42)	127.75 (31.37)	125.19 (32.94)	129.51 (36.39)	124.55 (25.91)	115.95 (31.73)
HDL (mg/dL)	54.46 (10.53)	51.80 (10.85)	50.25 (9.98)	50.45 (10.70)	46.96 (10.82)	46.59 (9.85)	46.48 (11.58)	50.11 (10.80)
TG (mg/dL)	81.66 (45.88)	90.19 (53.74)	107.60 (65.50)	115.89 (61.63)	136.57 (71.52)	142.84 (72.42)	133.16 (53.87)	111.24 (65.27)
TC (mg/dL)	169.67 (27.13)	174.64 (29.87)	184.03 (31.79)	201.38 (35.74)	199.47 (36.27)	204.67 (40.64)	197.66 (31.90)	188.31 (35.75)
BMI (kg/m^2)	21.67 (3.54)	22.46 (3.43)	23.49 (3.10)	24.15 (2.91)	24.52 (3.33)	24.01 (3.31)	22.29 (3.30)	23.35 (3.40)
WC (cm)	73.16 (9.51)	75.65 (8.87)	78.41 (8.40)	81.93 (8.68)	84.55 (9.37)	83.25 (10.08)	78.97 (10.59)	79.30 (9.86)
FBS (mg/dL)	88.99 (19.16)	92.12 (19.52)	95.82 (21.24)	99.03 (22.93)	103.02 (23.38)	103.03 (26.93)	104.16 (34.16)	96.90 (22.94)

SBP=systolic blood pressure; DBP=diastolic blood pressure; HDL-C = high density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; TG=triglycerides; TC = total cholesterol; BMI = body mass index; WC = waist circumference; FRS=fasting blood sugar

Figure 6-1

Proportion (Histogram) and Mean Values (Line Graph) depicting Cardiovascular Risk Factors in Korean Women by Age Group (n = 3,301)




(%)
(kg/m²)
BMI ≥ 23
BMI
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age (year)
(%)
(cm)
WC ≥ 85
WC
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age (year)
(%)
(mg/dL)
Diabetes
FBS
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age (year)
(%)
(min/wk)
MET ≤500
MET
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age (year)
(%)
Alcohol use
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age(year)
(%)
Depressive mood
20-29 30-39 40-49 50-59 60-69 70-79 ≥ 80
Age (year)

Research Aim 2: Identify Demographic, Socioeconomic, and Behavioral Variables that Predict Heavy Cardiovascular Burden

Prevalence of combination of risk factors in Korean women. Table 6-6 presents the prevalence of combinations of risk factors in Korean women by age group. This information is also graphically depicted in Figure 6-2. Counted as risk factors are diabetes and the four modifiable risk factors included in the FRS: BP ≥ 140/90 mmHg or on antihypertensive medication, HDL< 50mg/dL, LDL≥ 130 mg/dl, and current smoking. Overall, only about 25% of Korean women had no risk factors. One in three women had two or more major modifiable risk factors for CHD, and these women were defined as having heavy cardiovascular burden in this study. The prevalence of combinations of two or more risk factors increased especially after age 50, and more than 60% of women older than 60 years had two or more major modifiable cardiovascular risk factors. Even for women in their 20s, approximately 1 in 2 had one or more risk factors for CHD.

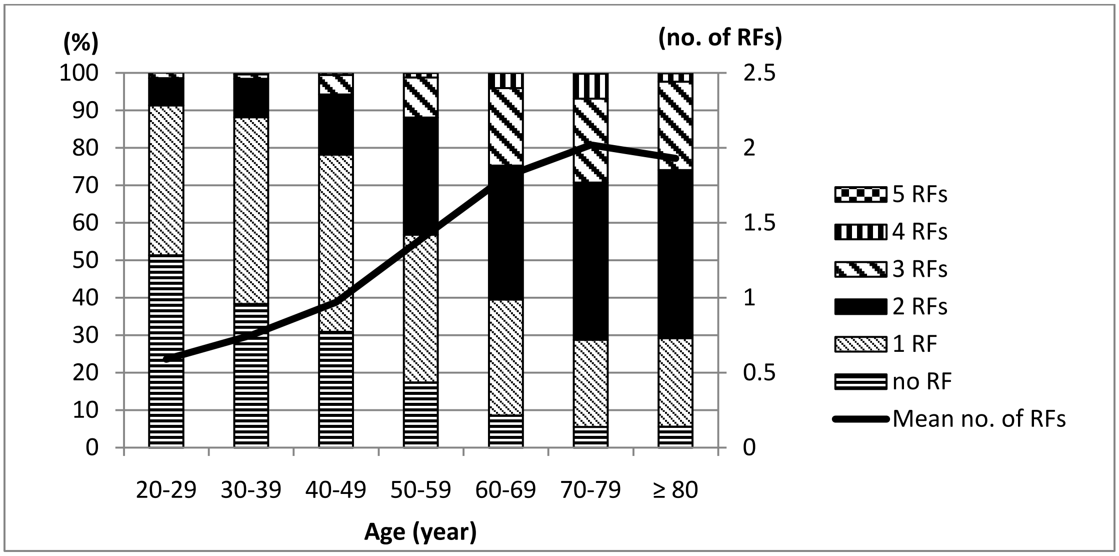
Table 6- 6

Combination of Cardiovascular Risk Factors in Korean Women by age group (n=3,301)

Age (year)	Numbers of risk factors, % (n)											
	0		1		2		3		4		5	
20-29	51.4	(208)	40.0	(162)	7.2	(29)	1.5	(6)	0.0	(0)	0.0	(0)
30-39	38.4	(264)	49.8	(342)	10.3	(71)	1.2	(8)	0.3	(2)	0.0	(0)
40-49	30.9	(209)	47.3	(320)	16.1	(109)	5.2	(35)	0.6	(4)	0.0	(0)
50-59	17.4	(99)	39.4	(224)	31.3	(178)	10.7	(61)	1.2	(7)	0.0	(0)
60-69	8.6	(45)	31.0	(163)	35.7	(188)	20.7	(109)	4.0	(21)	0.0	(0)
70-79	5.5	(19)	23.3	(81)	42.0	(146)	22.4	(78)	6.6	(23)	0.3	(1)
≥ 80	5.6	(5)	23.6	(21)	44.9	(40)	23.6	(21)	2.2	(2)	0.0	(0)
Total	25.7	(849)	39.8	(1313)	23.1	(761)	9.6	(318)	1.8	(59)	0.0	(1)

Risk factors; HDL < 50mg/dL, LDL ≥ 130 mg/dl, current smoking, hypertension (BP ≥140/90 mm Hg or on antihypertensive medication), and diabetes

Figure 6-2
Combination of Cardiovascular Risk Factors in Korean Women by Age Group (n=3,301)



RF = risk factor
Five risk factors= HDL < 50mg/dL, LDL ≥ 130 mg/dl, current smoking, hypertension (BP ≥140/90 mm Hg or on antihypertensive medication), and diabetes

Predictors of heavy cardiovascular burden. To identify demographic, socioeconomic, and behavioral variables associated with the presence of two or more cardiovascular risk factors in Korean women without CVD, a multiple logistic regression was performed using the eight independent variables: menopause (menopause or a history of hysterectomy vs. having regular periods), education (high school or less vs. college or above), poverty (less than poverty vs. above poverty), marital status (living alone vs. married / never married vs. married), work status (yes vs. no), sedentary lifestyle (yes vs. no), depressive mood (yes vs. no), and alcohol use (yes vs. no) (Table 6-7). Korean women who were past menopause (OR = 4.6, 95% CI =3.8, 5.7), less educated (OR = 1.9, 95% CI =1.4, 2.5), lived below the poverty level (OR = 1.3, 95% CI =1.1, 1.5), and lived alone (OR = 1.4, 95% CI =1.1, 1.7) compared to those who were married and living together were more likely to have two or more cardiovascular risk factors, controlling for other variables in the model. On the other hand, the odds of a Korean woman who was never married to have two or more cardiovascular risk factors was 0.6 times (95% CI=0.4, 0.9) the odds of a woman who was married and living together to have two or more cardiovascular risk factors, controlling for other variables in the model.

Table 6- 7

Multiple Logistic Regression Analysis with Eight Independent Variables that Predict Heavy Cardiovascular Burden in Korean Women (n = 2,912)

Independent variables	OR	95% CI	*p*-value
Menopause (1: menopause or hysterectomy)	4.6	3.8, 5.7	< 0.001
Education (1: high school or less)	1.9	1.4, 2.5	< 0.001
Poverty (1: less than poverty)	1.3	1.1, 1.5	0.018
Living alone (1: living alone)[§]	1.4	1.1, 1.7	0.002
Never married (1: never married) [§]	0.6	0.4, 0.9	0.010
Work status (1: no)	1.2	1.0, 1.4	0.074
Sedentary lifestyle (1: < 600 MET-minutes/week)	1.2	1.0, 1.4	0.078
Depressive mood (1: yes)	1.1	0.9, 1.3	0.650
Alcohol use (1: yes)	1.0	0.7, 1.4	0.985
Constant	0.1		0.000

Dependent variable = heavy cardiovascular burden (1= two or more modifiable cardiovascular risk factors)
Items in parentheses under "independent variables" show what attributes were coded as a 1 for the logistic regression model.
[§] dummy coded; reference group = married and living together

Research Aim 3: Estimate the 10-Year Risk for CHD Using the FRS

10-year risk for CHD using the FRS. A total of 2,939 Korean women aged 20-79 years had complete information from which to calculate their 10-year risk for CHD. Korean women who were free of CHD (self-reported myocardial infarction or angina pectoris) or a CHD risk equivalent (diabetes or stroke) had an average FRS of 1.5% (SD

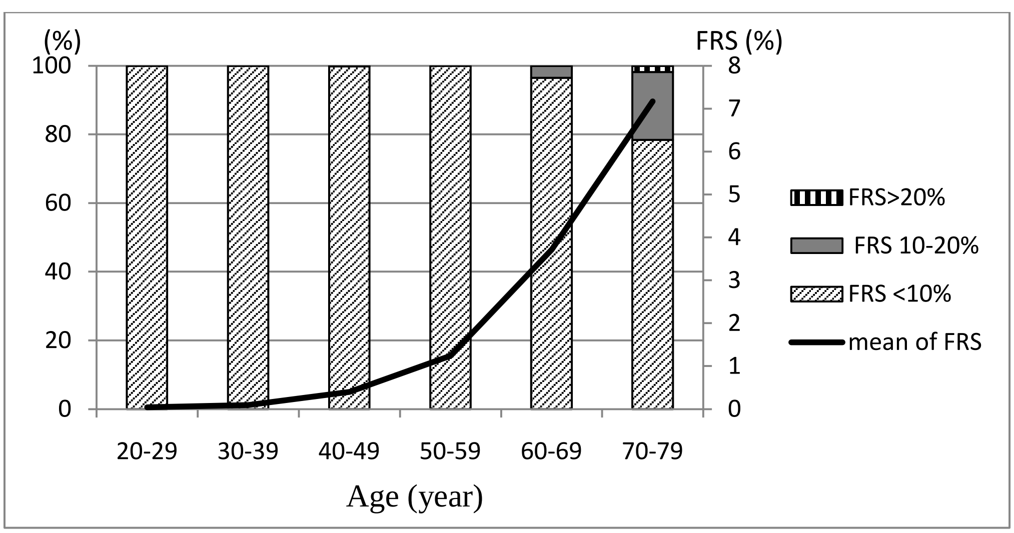
= 2.8; range = 0~27.5). With the FRS, the majority of women (97.4%) had a 10-year risk for CHD of less than 10%, 2.4% had 10 to 20% risk, and 0.2% had a risk greater than 20% (Table 6-8 and Figure 6-3). Almost women younger than 60 years had a 10-year risk of CHD less than 10%. About four percent of women aged 60-69 years, and 20% of women aged 70-79 years had risks of 10 to 20%; 2% of women aged 70-79 years had a risk of $\geq$ 20%.

Table 6- 8
Framingham Risk Score in Korean Women by Age Group (n=2,939)

Age (year)	% (*n*)					
	FRS <10%		FRS 10-20%		FRS > 20%	
20-29	100.0	(399)	0.0	(0)	0.0	(0)
30-39	100.0	(675)	0.0	(0)	0.0	(0)
40-49	98.3	(644)	0.2	(1)	0.0	(0)
50-59	100.0	(511)	0.0	(0)	0.0	(0)
60-69	96.5	(416)	3.5	(15)	0.0	(0)
70-79	78.4	(218)	19.8	(55)	1.8	(5)
Total	97.4	(2863)	2.4	(71)	0.2	(5)

FRS=Framingham Risk Score

Figure 6-3
Framingham Risk Score by Age Group (n=2,939)



Research Aim 4: Assess the Proportion of Women Who Need to Be Treated Based on the AHA Guidelines

Categorize women into three risk categories. Table 6-9 shows the distribution of Korean women into three risk categories, based on the AHA guidelines (Figure 5-2). About 65% of the women were categorized as low risk (≤ 1 RF), 26.3 % were intermediate risk (≥ 2RFs and FRS <20%), and 9.4% were high risk (≥ 2 RFs & FRS ≥ 20% or diabetes). The demographics and cardiovascular risk factors differed by risk group (Table 4-10). Women in the high risk group were older, less educated, and more of them lived alone below the poverty line. High risk women had higher percentages of comorbid diseases; about 60% were hypertensive, 20% had hypercholesterolemia and 10.9% of them were on lipid lowering treatment.

Table 6- 9

Demographic Characteristics and Cardiovascular Risk Factors in Korean Women by Three Risk Groups (n=3,301)

Demographics or Cardiovascular risk factors	Low risk (*n* = 2,123)		Moderate risk (*n* = 867)		High risk (*n* = 311)	
Age (mean ±SD)	41± 13		63 ± 12		64 ± 14	
Marital status (married), % (n)	72.4	(1536)	58.7	(509)	59.2	(184)
Education (high school or less), % (n)	68.0	(1444)	95.5	(828)	96.8	(301)
Poverty (below poverty level), % (n)	16.6	(353)	39.4	(342)	42.1	(131)
Perceived general health (good), % (n)	79.6	(1690)	58.1	(504)	49.2	(154)
Hypertension, % (n)	6.5	(137)	57.2	(496)	59.5	(185)
Hypertension treatment, % (n)	3.8	(81)	40.1	(348)	52.1	(162)
Diabetes, % (n)					92.6	(288)
Diabetes treatment, % (n)					58.8	(160)
Hypercholesterolemia Dx, % (n)	3.7	(79)	10.0	(87)	19.3	(60)
Lipid lowering treatment, % (n)	1.5	(31)	6.1	(53)	10.9	(34)

Hypertension = BP ≥ 140/90 mm Hg or on antihypertensive medication; Diabetes = fasting blood glucose ≥ 126 mg/dl or taking glucose lowering medications; Hypercholesterolemia Dx = self-reported diagnosed hypercholesterolemia

Evaluate the proportion of Korean women who are in need of treatment. The percentage and number of Korean women who did not attain AHA guidelines for CVD prevention are presented in Table 6-10. Lack of goal attainment was most prevalent in the high risk group (10-year risk of ≥ 20% or CHD equivalent conditions). Three in four women in the high risk group did not meet the primary goal of LDL-C < 100mg/dL and were in need of treatment. More than 70% of high risk women had HDL-C levels lower than the recommended levels; less than half (47.6%) of them had their blood pressure controlled, and only 17.3% had fasting blood sugar levels less than 100 mg/dL. For the moderate risk group (two or more risk factors and a 10-year risk of 10% to 20%), the recommended LDL-C goal is < 130 mg/dL, and 42% of women in this risk group were not at the LDL-C goal level. Table 6-11 presents the proportion of women who attained guideline goals by age group. Overall, only 13.8% of asymptomatic Korean women aged 20 or older met all of the guideline recommendations. About half of women aged 60 or older did not attain the LDL-C goal; less than 5% of this age group attained all recommended goals, and on average these women had three or more uncontrolled cardiovascular risk factors. The interpretation of the study findings, implications for nursing practice and research, and conclusions will be described in Chapter 7.

Table 6- 10

Prevalence of Lack of Attainment of AHA Guideline Goals in Korean Women (n = 3,301)

Goals	% (n)							
	≤ 1 RF present (n = 2123)		≥ 2 RFs & FRS < 20% (n = 867)		≥ 2 RFs & FRS ≥ 20% or diabetes (n = 311)		Total (n = 3301)	
Blood lipids								
High LDL-C [†]	6.2	(131)	42.0	(364)	74.9	(233)	22.1	(728)
HDL-C < 50 mg/dL	36.7	(779)	86.7	(752)	72.3	(225)	53.2	(1756)
TG ≥ 150 mg/dL	11.0	(234)	36.7	(318)	48.2	(150)	21.3	(702)
High BP [‡]	4.0	(84)	27.6	(239)	52.4	(163)	14.7	(486)
FBS < 100mg/dL	14.2	(302)	27.9	(242)	82.6	(257)	24.3	(801)
HbA1c < 7%[§]					53.4	(109)		
Current smoking	4.1	(87)	12.1	(105)	4.2	(13)	6.2	(205)
BMI ≥ 23 kg/m²	41.3	(876)	65.6	(569)	71.1	(221)	50.5	(1666)
WC ≥ 85 cm	17.8	(377)	45.8	(397)	54.3	(169)	28.6	(943)
MET < 600 min/week	31.4	(667)	35.5	(308)	37.6	(117)	33.1	(1092)

[†] High LDL-C = LDL-C ≥160 mg/dL if ≤ 1 risk factor present, LDL-C ≥ 130 mg/dL if ≥ 2 risk factors present and FRS <20%, LDL-C ≥100 mg/dL if ≥ 2 risk factors present and FRS ≥20%; TG = triglyceride; [‡]High BP = BP ≥ 140/90 mm Hg, if diabetes is present BP ≥130/ 80 mm Hg; FBS = Fasting Blood Sugar; BMI = body mass index; WC = waist circumstance; MET = metabolic equivalent;[§]Women with diagnosed diabetes (*n* = 204)

Table 6- 11

AHA Guideline Goals Attainment in Korean Women by Age Group (n = 3,301)

Age (year)	% (n) Meet the LDL goal		Meet 5 guidelines[a]		Meet all 9 guidelines[b]	
20-29	98.0	(397)	61.5	(249)	30.1	(122)
30-39	96.1	(660)	43.8	(301)	21.4	(147)
40-49	88.2	(597)	32.5	(220)	15.5	(105)
50-59	69.4	(395)	23.2	(132)	8.6	(49)
60-69	57.0	(300)	12.4	(65)	4.4	(23)
70-79	51.1	(178)	7.8	(27)	2.3	(8)
≥ 80	51.7	(46)	10.1	(9)	3.4	(3)
Total	77.9	(2573)	30.4	(1003)	13.8	(457)

a: Five guidelines = goals with regard to LDL-C, HDL-C, TG, BP, and blood glucose.
b: Nine guidelines= goals with regard to LDL-C, HDL-C, TG, BP, blood glucose, smoking, physical activity, BMI and WC

Chapter 7

Discussion

Discussion

This chapter interprets the study findings by the specific aims, discusses the implications for nursing practice, and recommends areas for future research. This study presents cardiovascular risk factors and 10-year risk for CHD in Korean women in a large randomly selected sample. This study is unique in that it includes comprehensive risk assessment not only traditional risk factors but also life style factors to more accurately evaluate risk for CHD in Korean women free of CVD.

This study used existing data from the 2008 KNHANES IV. The sample for this study was limited to women who completed the original survey, were free of CVD, and were older than 20 years. The average age of the Korean women in this study was 49 (± 16) years. This age is the same as the average menopausal age in this study, and about half of the women were premenopausal. Most Korean women were married, living with a partner, and had low educational attainment. Based on the 2008 Census (Korea National Statistics Office, 2010), the average monthly income in Korea was KRW 3,460,543 (Approximately USD 2,945). About 70% of Korean women had monthly incomes less than the national average income level, and 25% of women had incomes less than the Minimum Cost of Living (KRW 1,400,000 for a household of four people; approximately USD 1,250 per month). About one in two (48.6%) Korean women aged 20 or older were employed. This level of employment is far less than the men's employment rate of 71.2%, but is similar to that of women (48.5%) in the 2008 Census (Korea National Statistics Office, 2010).

The most important finding of this study is that cardiovascular risk factors are highly prevalent in Korean women who are free of CVD. Most risk factors generally became more prevalent as one gets older, increasing the risk for CHD with advancing age. But this study found that even in the younger age groups (20~39 years old), cardiovascular risk factors were already present. Unfavorable lifestyle habits such as smoking and heavy alcohol drinking were much more common in women less than 40 years old, and a high percentage of them were sedentary and overweight. Changing a habitual lifestyle is incredibly challenging for most people (Condon & McCarthy, 2006). The high prevalence of unhealthy lifestyles in young women warrants increased attention because untreated or prolonged unhealthy lifestyles convey substantial risk for CHD (Manson et al., 1999; Willett et al., 1987; Yusuf et al., 2004) and maintaining a healthy lifestyle is a core aspect of CHD risk reduction in women (Mosca et al., 2007). Facilitating an effective intervention to motivate young women to be active, maintain weight, and quit smoking may put a brake on the current epidemic rise of CHD in Korea. It should be a priority to reduce the public burden of CHD.

Although age and menopause are not modifiable, they are significant risk factors for CHD in women (Kannel, Hjortland, McNamara, & Gordon, 1976; Wilson et al., 1998). It is widely accepted that before menopause women are partly protected from CHD by estrogen. But estrogen deficiency after menopause makes existing hypertension, obesity, and dyslipidemia worse or more prevalent, eventually increasing the risk for CHD (Bairey Merz et al., 2003; L. J. Shaw et al., 2006). However, the AHA guidelines do not recommend hormone replacement therapy for counteracting the increased risk attributable to menopause in those women free of CVD (Mosca et al., 2007). One of the best possible ways to reduce the risk might be frequent and comprehensive risk factor screening during and after the menopausal transition to accurately assess a woman's risk in a timely fashion. The average age of Korean women at the time of menopause in this study was 49 (± 5) years. The prevalence and clustering of cardiovascular risk factors significantly increased after the age of 50. The average menopausal age found in this study is consistent with previous studies in Korean women (Park, Lee, & Jo, 2002; Park, Koo, Kang, & Yoon, 2001), but is a few years earlier than in European or Caucasian women, which is about 51 to 52 years (Gold et al., 2001; McKinlay, Brambilla, & Posner, 1992). The reasons for the earlier menopausal transition in Korean women than in other ethnicities remain unclear. However, Korean women may need to start risk factor screening earlier than other populations to stay heart healthy.

One of the striking findings of this study is the high prevalence of obesity and central obesity. In this study, one in two Korean women aged 20 or older were overweight or obese, and about 30% of women were centrally obese based on culture-specific cut-points for BMI and WC. Asians have a higher percentage of body fat and more centralized fat distribution, compared to Caucasians of the same gender, age, and BMI (World Health Organization [WHO], 2004). One possible explanation for this is the "thrifty genotype" hypothesis (Neel, 1962). It postulates that with food shortages, efficient storing of energy as body fat is an important survival mechanism. Thrifty genes help individuals to quickly process food and store it as fat when food is available. Koreans lived for long periods of time in inadequate nutritional state so they might have acquired the "thrifty gene." The gene might be beneficial historically. But given enough available food with the recently adopted Western life styles, the increased ability to store fat could lead to obesity-related disease even at a lower BMI and smaller waist circumstance (Neel, 1962). For this reason, the Asian-Pacific region of WHO proposed revised BMI cut-points for Asians: overweight as BMI ≥23 kg/m^2 and obesity as BMI ≥ 25 kg/m^2 for both men and women (WHO, 2000). Also, the Korean Society for the Study of Obesity suggested cut-points for abdominal obesity as WC ≥ 90 cm for men and WC ≥ 85 cm for women, based on the relationship between WC and CVD (Lee et al., 2007).

Regrettably, many studies in Korea use the cut-points for Western populations to present the prevalence of obesity and/or central obesity (Park, Park, Oh, & Yoo, 2008; Park, Oh, Cho, Choi, & Kim, 2004; Yoon et al., 2006), which may have led to an underestimation of the problem and lack of public awareness. Data analysis from this study sample showed that although there was a strong linear relationship between actual BMI and the participants' body images, the relationship between these two weakened with advancing age (results are not shown here). Furthermore, more than half of the women older than 50 years underestimated their body weight whereas younger women tended to overestimate their body weight. The underestimation of body weight by Korean women older than 50 years is a critical problem, given that two in three of them are actually overweight or obese. An accurate perception of weight is important because individuals will take actions to improve their health if they are aware of the problem (Becker & Maiman, 1975; Rosenstock, Derryberry, & Carriger, 1959). Koreans need to be informed about the Korean specific cut-points for obesity and abdominal obesity. The gap between perceived body image and actual BMI should be closed in order to optimize cardiovascular health.

In this study, 24.8% of Korean women free of CVD had a BP ≥ 140/90 mm Hg or were taking medications to lower high blood pressure. Koreans have a higher salt intake than most other populations, and it is thought that this contributes to such a high prevalence of hypertension (Kesteloot et al., 1980). Reducing the burden of hypertension in those free of CVD is extremely important because, among the traditional risk factors, hypertension contributes the most to the population-attributable risk of total CVD in Koreans. It is estimated that about 34% of all cardiovascular events in Koreans could be prevented by controlling high BP alone (Suh, 2001).

With such a well-established relationship between high BP and CVD in Koreans, important national efforts have been made over the last 10 years to improve early detection of hypertensive individuals and to keep track of their medication usage (www.nohw.go.kr). Here, there exist a good opportunity to compare the treatment rate of hypertension in this study with the previously published study. Ko, Kim, & Nam. (2006) analyzed the 2001 KNHANES data set and reported that the treatment rate of hypertension was 23.6% among hypertensive Korean women who were free of CVD. In this study, about 70% of hypertensive women answered that they were currently taking antihypertensive medications. This is a very encouraging result. However, further research evaluating control rate of hypertension is required in order to confirm whether the burden of hypertension in CVD actually decreases with improvement in treatment rates for hypertension. Furthermore, identification of subgroups susceptible to hypertension, and preventing the development of hypertension among them should be the ultimate goal, given the high impact of hypertension on CVD in Koreans.

The prevalence of current smoking in Korean women aged 20 years or older was 6.2%, which is higher than the 4.8% from 2001 KNHANES data set (Ko et al., 2006). Smoking among younger women is on the rise compared to the previous study (Ko et al., 2006), and women 20 to 30 years of age showed the highest smoking prevalence. The prevalence of smoking decreased with age, but the rate increased again in women after age 60. This pattern of smoking prevalence may be associated by marital status. Previous studies conducted in Korea as well as in Western countries have reported that people living with a partner have lower smoking rates than people living alone (Cho, Khang, Jun, & Kawachi, 2008; Chung, Lim, & Lee, 2010; Cox, Feng, Cañar, Ford, & Tercyak, 2005). But in contrast to the strong beneficial effect of marital status on men's smoking in Western countries, in Korea, this relationship was much stronger in women (Cho et al., 2008; Chung et al., 2010).

In Korean culture, the Confucian norm and patriarchy influence women's smoking behaviors (Cho et al., 2008; Chung et al., 2010). Smoking has long been considered inappropriate behavior for women in Korea (Chun, Doyal, Payne, Cho, & Kim, 2006). Living with a partner, especially in childbearing age, may constrain Korean women from smoking. In contrast, being single after a divorce or a loss of a partner could liberate women from the social constraints on smoking. Such a feeling may allow women to smoke cigarettes again. Restarting smoking even in old age apparently makes a woman vulnerable to heart disease and significantly increases mortality from all causes of death (Critchley & Capewell, 2003; U.S. Surgeon General, 1990, 2001, 2004). Smoking cessation may be the most modifiable risk factor for CHD. It yields not only immediate but long-term benefits for prevention of CHD (Satcher, Thompson, & Koplan, 2002). Quitting smoking as soon as possible and preventing relapse in advanced age appears crucial to prevent CHD in Korean women.

There is a strong association between elevated LDL-C levels and increased risk for CHD. In this study, 29.2% of Korean women had LDL-C levels greater than 130 mg/dL, and the LDL-C levels increased with advancing age. Although the prevalence of elevated LDL-C is relatively low compared to the U.S (32%; general population age ≥ 20 years) (Rosamond et al., 2008), extra attention to LDL-C levels is required, given the fact that the levels have been slightly increasing with the increases in dietary total fat intake. Furthermore, Koreans could be at increased risk for CHD even with a moderate increase in fat intake (about 22% of total energy intake), because they have maintained low levels of dietary fat intake for a long time (Suh et al., 2001). Koreans may need lower dietary fat recommendations than other populations, and culture specific LDL-C guidelines may be required to reduce the risk for CHD.

Although the main focus of CHD prevention targets LDL-C, low levels of HDL-C independently increase the risk for CHD, especially in women (Abbott, Wilson, Kannel, & Castelli, 1988; Gordon et al., 1989). Generally HDL-C levels are higher in women than in men before menopause. But after menopause, HDL-C drops, and triglycerides, LDL-C, and the risk for CHD increase (Stangl, Baumann, & Stangl, 2002). In this study, 53.2% of Korean women free of CVD had a HDL level of less than 50 mg/dL, and HDL-C levels significantly dropped after age 50. Compared to the U.S, reduced HDL-C is highly prevalent in Korean women. Previous studies found that such a high prevalence of reduced HDL-C in Korean women is related to excess carbohydrate intake and a sedentary lifestyle (Kim, Lee, Park, & Kim, 2007; Kim, Kim, Choi, & Huh, 2008; Liu et al., 2000). Interestingly, in this study, there was no linear relationship between physical activity and HDL-C levels. Further, the proportion of women who are sedentary (33.1%) was far less than previously reported with the 2001 KNHANES data set (89.1%) (Ko et al., 2006).

One explanation for this finding may be in part due to progress toward *Health Plan 2010* initiated in 2002 in Korea to improve physical activity levels (http://2010.hp.go.kr). During the last decade, important national efforts have been made to improve public awareness of the health benefits of physical activity through mass media and to provide easy access to safe and affordable physical activity opportunities. The significant decline in the prevalence of physical inactivity seen in this study may be viewed as an encouraging result indicating successful nationwide efforts.

Another possibility for the difference in physical inactivity levels between this study and the study by Ko et al. (2006) is measurement. Physical activity is a complex and multidimensional concept varying considerably both within and among individuals and populations. It is a challenge to validly measure physical activity levels with subjective questionnaires. It may also be expensive or even impossible to measure population levels of physical activity with objective measures. In the 2001 KNHANES, women were asked about the frequency and duration of regular physical activity. With this data, Ko et al. (2006) reported that 89.1% of Korean women did not participate in regular physical activity for at least 20 minutes a day for more than three days a week. In the 2008 KNHANES, the physical activity level was measured with the IPAQ (International Physical Activity Questionnaire) (Craig et al., 2003), and data collected with the IPAQ was scored as MET-minutes/week for the analysis for this study as recommended (www.ipaq.ki.se). About 33% of Korean women classified as being sedentary having less than 600 MET-minutes/week of exercise. This is about one-third of previously reported inactivity levels, even though the cut-point of 600 MET-minutes/week approximately corresponds to less than three days per week of vigorous-intensity activity of at least 20 minutes per day (www.ipaq.ki.se).

Concerns that the IPAQ systematically overestimates actual physical activity levels (Macfarlane, Lee, Ho, Chan, & Chan, 2007; Rzewnicki, Auweele, & Bourdeaudhuij, 2007) deserve further investigation. One possible reason for overestimating physical activity might be the validity problem. The validity of the IPAQ, when developed, was established based on a correlation coefficient with an accelerometer (N=781; Spearman r=0.30, 95% CI= 0.23, 0.36) (Craig et al., 2003). Although correlation coefficients indicate how close the relationship between the two variables is, it differs from agreement. It is possible that systemic differences between instruments do not affect the correlation coefficient but may substantially affect agreement. The validity test comparing the Korean version of the IPAQ against the accelerometer showed that the kappa coefficient was less than 0.4 for vigorous and walking activities (Oh, Yang, Kim, & Kang, 2007), meaning poor agreement (Landis & Koch, 1977). Repeated measures and the use of an identical, valid tool may improve the quality of physical activity monitoring. Another possibility for overestimation of physical activity levels might be a social desirability response bias. In the original survey, women were interviewed and they might have answered in a more socially desirable way.

The prevalence of diabetes in Korean women in this study was 8.7%. This proportion is higher than the 7.9%, which was previously reported in women aged 30 or older using data from the 2005 KNHANES (Choi et al., 2009). The proportion is comparable to the 8.8% reported in women aged 20 or older in the U.S. (Rosamond et al., 2008). Previous studies found that obesity is directly related to an increased risk for diabetes (Oh, Shin, Yun, Yoo, & Huh, 2004; Shin et al., 1997). Thus, the prevalence of diabetes in Korean women appears to be increasing along with the current epidemic of obesity to a level matching that of developed countries.

The risk for CHD in individuals with diabetes is similar to that of those with already established CHD. For this reason, current clinical guidelines classify diabetes as a CHD equivalent, requiring the most aggressive risk reduction efforts (ATP III, 2001). Furthermore, diabetes is more detrimental in women than in men (Barrett-Connor, Cohn, Wingard, & Edelstein, 1991; Kanaya, Grady, & Barrett-Connor, 2002). However, a recent study found that the control rate for diabetes in Korean women remains far below (36.7%) (Choi et al., 2009), than in developed countries (56.8%) (Hoerger, Segel, Gregg, & Saaddine, 2008) despite comparable prevalence. Treatment and prevention of diabetes should be an important public health goal for Korean women.

This study includes very old women (80 years or older) in the analysis to demonstrate the prevalence of cardiovascular risk factors in Korean women across the whole lifespan. Although the very old are highly susceptible to CVD, they have been excluded from most cardiac research. Very little information is available about cardiovascular risk factors, treatment, or prevention strategies in this age group. In this study, the prevalence of dyslipidemia, obesity, and diabetes decreased in women after age 80. It may be reasonable to expect that many of the women who had these risk factors earlier in life have died or have been admitted to a hospital or a nursing home. Women in this age group who are healthy enough might be able to participate and complete the national survey. However, on the other hand, low lipid levels and weight in this age group might be a marker of frailty rather than lower risk for CVD. More research about CVD in the very old is warranted because, with an increase in life expectancy, octogenarians are the fastest growing age group in Korea, and CVD is the number one killer in this age group.

According to a case-control study by Yusef et al. (2004), 94% of first heart attacks in women could be accounted for by nine modifiable risk factors (hypertension, diabetes, dyslipidemia, smoking, obesity, physical inactivity, unhealthy diet, alcohol intake, and psychosocial factors), independently of age and ethnicity. This means that 94% of first heart attacks in women could be prevented by controlling the modifiable risk factors. In this study, only 8.2% of Korean women free of CVD had no risk factors (results are not shown here). Korean women are at high risk for future cardiac events and aggressive risk reduction is crucial in this population.

Cardiovascular risk factors are associated with each other and have a multiplicative rather than just additive effect on health. Even slight elevations in three or more risk factors noticeably increase the risk of CHD (Smith, 2007). Thus, assessment of the prevalence of clustering of risk factors is crucial for identifying women at high risk for a future cardiac event. In this study, the prevalence of combinations of cardiovascular risk factors in Korean women was provided in Table 6-6 and Figure 6-2. Counted as risk factors are diabetes and the four modifiable risk factors included in the FRS (hypertension, smoking, HDL< 50mg/dL, and LDL≥ 130 mg/dl). These five risk factors have been considered to be causal to CHD because of their independent, reproducible, temporal, and dose-response relationship to the development of CHD (Wilson et al., 1998; Yusuf, Reddy, Ounpuu, & Anand, 2001). These risk factors are also important in terms of risk modification because of the availability of relatively safe and effective intervention strategies as well as compelling evidence showing reduction in CHD mortality after the interventions. Note that other risk factors such as obesity certainly increase the risk for CHD but mainly through elevating blood pressure, glucose, or lipids (Wilson et al., 1998; Yusuf, Reddy, Ounpuu, & Anand, 2001). Some are also highly related to each other (e.g., r = 0.93 between total cholesterol and LDL-C in this study population).

In Korean women without CVD, combinations of two or more risk factors markedly increased with advancing age and were observed in more than 60% of women aged 60 years or older (Figure 6-2). Another interesting note is that two or more risk factors already appeared to be clustered in young women free of CVD. It is expected that those major risk factors in young women may persist thereafter with rapid Westernization of diet and lifestyle. It is striking that the clustering of cardiovascular risk factors is common in asymptomatic Korean women across all ages.

Given the high prevalence of the clustering of cardiovascular risk factors in Korean women, this study tried to identify demographic, socioeconomic, and behavioral variables related to heavy cardiovascular burden, defined as the presence of two or more modifiable cardiovascular risk factors. Independent variables that were significantly associated on bivariate analyses were candidates' inclusion in a logistic analysis model. Age was positively highly correlated with menopause (r = 0.83), negatively correlated with education (r = -0.75), and positively correlated with marital status (r = 0.65) in the study participants, therefore age was excluded from the final model, and the final logistic regression model included eight independent variables: menopause, education, poverty, marital status, work status, sedentary lifestyle, depressive mood, and alcohol use.

Among those eight independent variables, menopause (natural or surgical menopause), education, poverty, and marital status were found to be statistically significantly independently predictive of heavy cardiovascular burden in Korean women. Menopause was the most powerful factor related to heavy cardiovascular burden controlling for other variables in the model. It increased the probability of having two or more cardiovascular risk factors by 360% (OR = 4.6, 95% CI =3.8, 5.7). Korean women should be aware that their risk for CHD sharply increases after menopause, and they should therefore be screened for cardiovascular risk factors especially during and after the menopausal transition.

In particular, women who have had their uterus removed may be at increased risk for CHD. In this study, 169 women had a history of hysterectomy, and among them, 37 women were less than 50 years old. A recent study of more than 800,000 women with and without hysterectomies over the course of three decades found that a woman who underwent a hysterectomy before age 50 had a nearly 20% higher risk of developing CVD (Ingelsson, Lundholm, Johansson, & Altman, 2011). For these women, estrogen only therapy is recommended but just for short periods.

In the present study, women below the poverty level and with low education were at risk for heavy cardiovascular burden. This is similar to results from previous studies reporting that low income and low education levels were significant predictors for the presence of multiple cardiovascular risk factors or the development of CHD (Fiscella & Tancredi, 2008; Yoon, Oh, & Park, 2006). Marital status was also a significant predictor for heavy cardiovascular burden in the final model, but it was highly correlated with age in bivariate analysis in this study population. When age was added to the final logistic model, the effect of marital status on heavy cardiovascular burden disappeared, whereas the effect of menopause, poverty, and education were attenuated but still statistically significant. The effect of marital status on heavy cardiovascular burden should be interpreted with caution based on different adjustments of covariates.

In addition, the dependent variable in this study was based on the number of dichotomous risk factors. It neither reflects which combinations of risk factors, nor adequately account for the severity of risk factors. It is likely that some combinations of risk factors may convey higher risk for the development for CHD than others. Also the severity of risk factors such as cholesterol levels or duration/amount of smoking matters more in the development of CHD. These limitations should be considered in order to appropriately interpret the results of this study.

In summary, for Korean women, menopause, low education, income below poverty, and living alone increased the probability of heavy cardiovascular burden in women free of CVD. To counter this, Korean women should be counseled about their risks for CHD during and after the menopausal transition. Also, specific health education programs should be developed and resources for screening should be directed toward women of low socioeconomic status.

Given the multifactorial nature of CHD, assessing the overall effect of multiple risk factors on the development of CHD is helpful in order to prevent potentially catastrophic disease. Risk assessment tools help to assess multiple risk factors simultaneously rather than focusing on any single risk factor. Estimating 10-year risk for CHD with tools is useful for identifying asymptomatic but at high risk for a future cardiac event (ATP III, 2001; Mosca et al., 2007; Wilson et al., 1998). Given the high prevalence of cardiovascular risk factors in asymptomatic Korean women, estimating 10-

year risk for CHD can be an important step for identifying those needing further intervention or additional testing. In this study, the Framingham Risk Score (FRS) endorsed by the AHA and NCEP/ATP III was used to estimate 10-year risk for CHD in Korean women (http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm). The FRS was developed for people aged 20 to 79 years; consequently only women in this age range were included in the analysis of research aim 2.

When using the FRS, there are two important things to keep in mind for its appropriate use. First, the FRS is a prediction model, thus it only can be applied to estimate 10-year CHD risk in individuals who are free of CVD. Once clinical CVD has been established, the risk for future cardiac events is much higher than for those without CVD. Also, the 10-year risk for development of CHD in individuals with diabetes is so high that diabetes is considered to be equivalent to CHD for risk-classification purposes (ATP III, 2001; Wilson et al, 1998). Therefore, the application of the FRS to those with already established CVD or diabetes is likely to be less useful. Second, interpretation of the FRS requires an accurate definition of CHD. The end point of the FRS is "*hard CHD*," which includes only myocardial infarction (MI) and /or coronary death, and excludes angina pectoris (ATP III, 2001, Wilson et al, 1998).

In this study, Korean women who were free of CVD or diabetes had an average FRS of 1.5%. This means, on average, 1.5% of Korean women aged 20-79 years would have an MI and/or coronary death in the next 10 years. The FRS increased substantially with advancing age, especially after age 50. This finding suggests that the 10-year risk for CHD significantly increases after menopause. Korean women need to be assessed frequently for their cardiovascular risk during and after menopause to prevent potentially catastrophic disease.

Current clinical guidelines classify asymptomatic individuals into three risk categories based on the FRS: <10%, 10 to 20%, and >20%. Based on these risk categories, the most appropriate intervention can be determined. Individuals with a 10-year risk of less than 10% can be reassured and followed with reinforcement of lifestyle changes. Those between 10 and 20% may require further risk stratification or additional testing, whereas individuals with a 10-year risk of 20% or higher are candidates for aggressive intervention (ATP III, 2001). In this study, most Korean women younger than 60 years old had a 10-year risk that fell below 10%. However, about two in every one hundred women aged 70~79 years had a 10-year risk of 20% or higher. Even though they do not have established CVD, their risk for future cardiac events is as high as those with CVD. Those women would benefit from aggressive risk factor modification therapy.

Although data on the incidence of CHD are scarce, national statistics show a persistently increasing mortality rate from CHD in Korean women. It is reasonable to expect that the risk for CHD would increase over time. However, somewhat surprisingly, comparison with the previous study by Ko et al. (2006) showed that the proportion of Korean women with a FRS ≥ 10% actually decreased (Table 7-1, Column A vs. Column C = 2.6% vs. 4.0%) despite an increase in average age in this study. In addition, when compared to women in the U.S., Korean women free of CVD and diabetes had a much lower 10-year risk for CHD (Ajani & Ford, 2006) (Table 7-1, Column A vs. Column D).

The decrease in the FRS found in this study suggests that risk for MI or coronary death would be decreased in Korean women who are free of CVD or diabetes in the next 10-years. One possibility for this result is that changes in the prevalence or management of cardiovascular risk factors have affected the FRS. The results of this study (research aim 1) found increases in obesity, diabetes, and smoking rates but a decrease in hypertension. Furthermore, the treatment rate for hypertension has improved significantly. Because hypertension is an established major risk factor for CHD included in the FRS, it seems reasonable to observe a decrease in the FRS over time with improvement in the treatment rate of hypertension. It should be noted that smoking is included in the FRS, and the prevalence of smoking in Korea has been on the rise but in the youngest women (20~29 years old). Smoking in young women can substantially increase lifetime risk for CHD, but may not increase short-term 10-year risk as defined by the FRS.

Another explanation for this finding is that the sample characteristics included in the FRS calculation in this study differ from those in the studies by Ko et al. (2006) and Ajani and Ford (2006). The original study, the 2008 NHANES, did not measure LDL-C directly, so in this study LDL-C was estimated using the Friedewald equation (LDL=TC-HDL-TG/5). The equation can be unreliable and invalid when triglycerides are over 400 mg/dL. Although the FRS does not require triglycerides or LDL-C levels in its calculation, in order to provide a more accurate estimate of CHD risk in Korean women, the analysis of this study was limited to those with triglyceride levels less than 400 mg/dL. Exclusion of these extreme cases might have resulted in a healthier sample than in the other studies, shifting a great proportion of Korean women into the lower risk group. This explanation is supported by the fact that, on average, women in this study had lower triglyceride levels but higher LDL-C levels compared to those in the study by Ko et al. (2006).

In addition, women with diabetes were excluded from the FRS calculation but the definition of diabetes in this study was differed from other studies. In this study, a woman was thought to have diabetes and was excluded from the analysis if she had a diagnose of diabetes, was on treatment to lower blood glucose, or had a fasting blood sugar level greater than 126 mg/dl regardless of her awareness of the disease. In the studies by Ko et al. (2006) and Ajani and Ford (2006), diabetes was confirmed with self-report of diabetes thus some women with diabetes but not aware of the disease might have been included in the analysis, shifting the distribution of the FRS into a higher risk group.

Because diabetes is on the rise in Korean women and women with diabetes were excluded from the FRS calculation, whether the decrease in the FRS actually results in reduction in the total public burden of CHD deserves consideration. In order to assess the public burden of CHD in Korean women, it is important to look at the distribution of 10-year risk for CHD as a whole including those women with CVD or diabetes. It would be helpful to define the percentages of Korean women at three levels of 10-year risk, compared to those in the U.S. in the study by Ajani and Ford (2006). Indeed, when women with CVD or diabetes were assigned to the highest risk category, Korean women in this study were found to have a similar or even worse cardiovascular risk profile compared to women in the U.S. (Table 7-1, Column B vs. Column E). Therefore, the decrease in the FRS found in this study may be explained by the exclusion of those with diabetes and may not reflect an actual decrease in overall risk for CHD in Korean women. Rather, the increase in the prevalence of diabetes moves a high proportion of Korean women into the highest risk category, significantly increasing public burden of CHD.

The FRS has been widely used to assess risk for CHD, but there are several limitations that need to be considered when using it and interpreting the results to an individual Korean woman. Notably, there is evidence showing that the FRS underestimates women's risk of CHD (Michos et al., 2006; Sibley, Blumenthal, Bairey Merz, & Mosca, 2006). On the other hand, some studies indicated that the FRS overestimates CHD risk in Asians (Asia Pacific Cohort Studies Collaboration, 2007; Liu et al., 2004). When data are available, recalibration of the FRS should be considered to improve its accuracy based on the prevalence of CHD in Korean women.

The FRS may also be somewhat limited in that it was designed to predict hard CHD events, which include only myocardial infarction and coronary death. However, women are less likely than men to have hard CHD events as their first manifestation of ischemic heart disease; rather, angina pectoris predominates in women (Lerner & Kannel, 1986; Ridker et al., 2005). Of importance, once clinical CHD has developed, women have a worse prognosis and a higher mortality rate (Jessup & Pina, 2004; shaw et al., 2006). Therefore, a lower score on the FRS which relies on hard CHD may not be enough to confirm that a Korean woman really is at low risk of CHD.

Another limitation of the FRS is that it does not include important lifestyle factors. AHA guidelines for CHD prevention in women underscore the importance of a healthy lifestyle, including quitting smoking, having regular physical activity, weight management, and eating a heart healthy diet (Mosca et al., 2007). Unhealthy lifestyle habits, if persisting for a long period, can lead to a greater lifetime risk than just a 10-year risk for CHD. These lifestyle habits, except smoking, are not included in the FRS. However, the findings of this study support that the proportion of Korean women engaged in healthy lifestyles is very small. Furthermore, this study observed a significantly increased proportion of Korean women who were obese or centrally obese. Obesity and central obesity have now became highly prevalent in Korean women approaching one in two. A sizable body of research supports a strong association between obesity or central obesity and development of CHD. Such unfavorable changes in BMI or WC might increase the actual burden of CHD but not the FRS in Korean women.

In summary, the major CHD risk factors incorporated in the FRS are important for Korean women so that the FRS appears suitable for clinical use to assess a Korean woman's overall risk for CHD and to identify those at high risk for further cardiac event. However, a lower score on the FRS may not be sufficient to ensure that an individual Korean woman is actually at low risk. Comprehensive risk assessment not just the traditional risk factors included in the FRS but also life style factors, is important to accurately picture the risk for CHD in Korean women.

Given the high prevalence of cardiovascular risk factors in Korean women and their comparable 10-year risk for CHD as compared to women in the U.S., aggressive risk reduction is crucial for Korean women. Evidence-based clinical guidelines are available to assist in the classification of asymptomatic women into low, moderate, and high risk categories and to provide target LDL-C levels for each subgroup (ATP III, 2001). The risk assessment consists of first counting the numbers of risk factors and then calculating the 10-year risk for CHD using the Framingham Risk Score (FRS). The primary target for CHD prevention is LDL-C. The recommended LDL-C goal is < 160 mg/dL, < 130 mg/dL, and <100 mg/dL respectively for those in the low, moderate, and high risk groups (ATP III, 2001; Mosca et al, 2007). Although current guidelines identify LDL-C as the primary target for CHD prevention, the important role of BP, blood glucose, HDL-C, TG, and lifestyle factors on the development of CHD are also recognized. Recent studies have shown that all asymptomatic women can benefit from achieving the recommended goals (Cholesterol Treatment Trialists' Collaborators, 2008; Vrecer, Turk, Drinovec, & Mrhar, 2003; Ward et al., 2007). Therefore, this study evaluated the level of goal attainment recommended by the AHA in Korean women without established CVD in order to determine the proportion of Korean women who are in need of treatment.

The most important finding of this study is that the proportion of Korean women who were not at goal was substantial. Furthermore, there was a significant treatment gap in Korean women. The findings of this study suggest that Korean women free of CVD need to be treated more aggressively.

Based on the numbers of risk factors and the FRS, 9.4% (n = 311) of Korean women without established CVD were at high risk for CHD, 26.5% (n = 867) were at moderate risk, and 64.3% (n = 2123) were at low risk. It should be noted that in this study, family history was not available in the original data set, thus only four risk factors excluding family history were used in the risk factor count. Such data may underestimate the true proportion of Korean women at moderate risk, overestimate the low risk group, but not affect the high risk group.

Even though the benefits of risk reduction are well identified, Korean women showed a lack of goal attainment. Overall, 22.1% of Korean women free of CVD were not at LDL-C goal levels and were in need of LDL-C treatment. Although the benefits of risk reduction are greatest in those at high risk, unfortunately goal attainment was the worst in Korean women at high risk. Three in four women in the high risk group did not meet the primary goal of LDL-C less than 100 mg/dL; 72.3% had HDL-C levels of less than 50 mg/dL; more than half had blood pressure greater than 130/80 mm Hg; 82.6% had blood sugar 100 mg/dL or greater; 4.2% were current smokers. Overall, 79.1% of high risk women did not attain their goals for at least three out of the above five guideline goals. Only 0.3 % women attained all five goal levels. This is a serious problem because their risk for future cardiac events is as high as those with established CVD. They need to be managed as soon as possible to lower their risk for future CHD.

LDL-C, the primary target, can be managed effectively through the use of lipid-lowering medications and lifestyle changes such as quitting smoking, increasing physical activity, and healthy diet for all risk categories. However, for those at high risk, lifestyle changes alone are often insufficient to attain the LDL-C goal (ATP III, 2001). Current guidelines recommend starting lipid-lowering medications for those at high risk when asymptomatic individuals do not meet the LDL-C goal of less than 100 mg/dL (ATP III, 2001). Previous studies found that use of lipid-lowering medications is the strongest predictor for the LDL-C goal attainment (Fuke et al., 2004; Mosca et al., 2005) and is beneficial in reducing cardiovascular mortality (Brugts et al., 2009; Cannon et al., 2004; Collins, Armitage, Parish, Sleight, & Peto, 2004). However, this study found a significant treatment gap in Korean women. Even though treatment rates increased with increased cardiovascular risk, there still was substantial room for improvement in the high risk group. In this study, only 10.9% of women in the high risk group were on treatment to lower their blood lipids, and most Korean women at high risk remained untreated. This is a significant treatment gap, given that 74.9% women were actually in need of lipid lowering treatment. Korean women are exposed to high risk for CHD even though there are relatively safe and effective intervention strategies available as well as compelling evidence showing reduction in CHD mortality with lipid lowering treatment.

Furthermore, evidence from the U.S. suggests that for the high risk group, an LDL-C level of less than 100 mg/dL is not an optimal goal but a minimal goal (Fitchett, Leiter, Goodman, & Langer, 2006; Grundy et al., 2004; O'Keefe Jr, Cordain, Harris, Moe, & Vogel, 2004). Clinical trials have shown that an LDL-C level lower than 100 mg/dL with lipid lowering medications further reduces relative risk for CHD (Cannon et al., 2004; Collins et al., 2004). They showed that reducing LDL-C to 70 mg/dL would produce another 16~30% of risk reduction compared to LDL-C 100 mg/dL. For the high risk group, an LDL-C level of 100 mg/dL should be viewed as a minimal goal to be attained. For maximal benefit of LDL-C lowering, an LDL-C level of less than 70 mg/dL is recommended. In this study, when applying the cut-points of LDL-C of less than 70 mg/dL, only 3.9% of women in the high risk group attained the level. This suggests that there is substantial opportunity to improve lipid management in Korean women free of CVD. Immediate action to lower the risk for CHD is crucial in this population.

Limitations and Strengths

Self report data may be subject to response bias, especially for questions about smoking status. Because there is a strong social taboo against women smoking in Korea, participants may respond in a socially desirable way so the risk of CHD may be underestimated. The NHANES IV used a probability sampling design but the sampling frame excluded individuals residing in long term care facilities, incarcerated in prisons, or in the military. The findings from the survey can be interpreted as representative of the community-dwelling population.

The transportability of the FRS has not been tested directly for Korean women. It does not include important life style habits in its estimation. In addition, some studies have suggested that the FRS underestimates CHD risk, especially in women (Michos et al., 2006; Sibley, Blumenthal, Bairey Merz, & Mosca, 2006). On the other hand, some studies indicated that the FRS overestimates CHD risk in Asians (Asia Pacific Cohort Studies Collaboration2007; Liu et al., 2004). Validation of the FRS with a prospective cohort is warranted to better estimate and plan for resource allocation and women's health education among asymptomatic Korean women.

However, this study involves comprehensive risk assessment including not only traditional risk factors such as smoking, high BP, diabetes, and dyslipidemia, but also life style factors such as obesity, central obesity, physical inactivity, and depressive mood to more accurately evaluate Korean women's risk of CHD. The results from this study using well-established methods and procedures and a large randomly selected representative sample can be used to develop focused preventive nursing interventions for Korean women at the national level. It could be especially useful for public health planning.

Implications for practice and research

The present study shows that modifiable cardiovascular risk factors are highly prevalent, and the clustering of risk factors is common in asymptomatic Korean women across all ages. Aggressive risk reduction efforts are urgent in this population. The first step in risk reduction may be accurate perception of their risk for CHD. Korean women may lack knowledge about cardiovascular risk factors, thus they may not accurately perceive their risk for CHD. Lack of awareness of their risk may impede risk reduction efforts as well as the adoption of a healthy lifestyle. A future study regarding knowledge, awareness, and perception of CHD in Korean women is warranted to see if there is a significant gap between their actual risk and perceived risk for CHD. Efforts to raise public awareness about CHD in women and its risk factors are also essential at the national level as well as in clinical settings. Korean women should “Know their Numbers.”

The findings of this study suggest changes in prevalence of some risk factors, such as increased diabetes and obesity but decreased hypertension. Research to confirm temporal trends in risk factors are needed to inform population strategies to reduce risk for CHD and predict the future burden of the disease. In particular, the prevalence of obesity in Korean women found in this study was striking. Obesity and unhealthy lifestyle habits were highly prevalent in women even in their 20s. Lifestyle modification is a core aspect of intervention and is an integral part of long-term risk reduction. Facilitating an effective intervention to motivate Korean women to be active, maintain healthy weight, and quit smoking is urgent. Nurses in all settings are well positioned and should be active in advising women to change unhealthy lifestyles. In addition, given the already prevalent obesity and unhealthy lifestyles in younger women, the first approach should focus on prevention of obesity and adoption of healthy lifestyles in childhood. Research about cardiovascular risk factors and health behaviors in childhood may be helpful for understanding the process of development of obesity and unhealthy lifestyles.

This study shows the distribution of 10-year risk for CHD with the FRS at the national level. Given changes in the prevalence of risk factors, repeated research needs to be continued. Such information may be helpful for evaluating the public burden of CHD over time and holds promise for surveillance purposes. Of importance, a prospective study to test the predictive validity of the FRS is warranted to more accurately assess

Korean women's risk for CHD. In addition, regular use of the FRS to estimate 10-year risk for CHD in clinical settings can be a cost-effective and helpful way of identifying Korean women who would benefit from aggressive risk reduction. Providing women with their 10-year risk score as a part of an intervention may also give them a more accurate perception and awareness of their risk and motivate them to reduce their risk of CHD. Assessing women's risk with the simple office-based tool and providing information about it in clinical setting is warranted.

In particular, the findings of this study suggest that despite improvement in the treatment rates for hypertension, the total burden of CHD may be increasing with the unfavorable changes in diabetes and obesity. Targeting any single risk factor is important, but the goal of CHD prevention should be to reduce the total public burden of the disease. Comprehensive risk assessment and multifaceted interventions focusing on several risk factors simultaneously are required.

Korean women were found to be at high risk for future cardiac events, but failed to meet the goals as defined by AHA guidelines. Lack of goal attainment can be related to several factors such as co-morbid diseases, treatment status, or socioeconomics and nonadherence to treatment guidelines by physicians or lack of adherence by patients or by either. This study did not attempt to identify the variables related to the lack of goal attainment. Future research is warranted to identity predictors of lack of goal attainment in order to help Korean women effectively reduce their risk for future cardiac events.

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Table 7- 1

Distribution of 10-Year Risk for Coronary Heart Disease in Korean Women Aged 20 to 79 Years in KNHANES IV Compared to Previous KNHANES II and NHANES (1999~2002)

FRS	Korea			U.S.	
	Current study: KNHANES IV (2008)		KNHANES II (2001)	NHANES (1999~2002)	
	Column A	Column B	Column C	Column D	Column E
	n = 2,939	*n* = 3,332	*n* = 2,700	*n* = 7,336	*n* =7,886
< 10%	97.4	85.9	96.0	94.8	85.5
10-20%	2.4	2.1	3.3	4.3	3.8
> 20%	0.2	11.9	0.7	0.9	10.7

KNHANES= Korea National Health and Nutrition Examination Survey
Column A; Calculated from those without self-reported CVD (myocardial infarction, angina pectoris or stroke) or diabetes (self-reported diabetes or taking glucose lowering medications or fasting blood glucose ≥ 126 mg/dl)
Column B & E; Calculated from women aged 20~79 years including people with self-reported CVD or diabetes.
Column C & D; Calculated from those without self-reported CVD or self-reported diabetes.
Column C; Source; Ko, Kim, and Nam (2006). Assessing risk factors of coronary heart disease and its risk prediction among Korean adults: The 2001 Korea National Health and Nutrition Examination Survey. *International Journal of Cardiology, 43,* 184-190.
Column D & E; Source; Ajani and Ford (2006). Has the risk for coronary heart disease changed among U.S. Adults? *Journal of the American College of Cardiology, 48,* 1177-1182

Appendix A: Committee on Human Research Approval

UCSF
University of California
San Francisco

Human Research Protection Program
Committee on Human Research

Notice of Exempt Certification

Principal Investigator	*Co-Principal Investigator*
Erika S Froelicher	Sunjoo Boo

Study Title: Cardiovascular risk factors and 10-year risk for coronary heart disease among Korean women: Secondary data analysis
IRB #: 10-03209
Reference #: 007162
Committee of Record: San Francisco General Hospital Panel
Type of Submission: Initial Review Submission Packet

Certification Date: 10/26/2010 **Expiration Date:** 10/25/2013

This research qualifies as exempt under the following category: Exempt 4

The iMedRIS system will generate an email notification eight weeks prior to the expiration of this project's approval. However, it is your responsibility to ensure that an application for re-certification has been submitted by the required time.

Approved Documents: To obtain a list of documents that were approved with this submission, follow these steps: Go to My Studies and open the study – Click on Submissions History – Go to Completed Submissions – Locate this submission and click on the Details button to view a list of submitted documents and their outcomes.

For a list of all currently approved documents, follow these steps: Go to My Studies and open the study – Click on Informed Consent to obtain a list of approved consent documents and Other Study Documents for a list of other approved documents.

San Francisco Veterans Affairs Medical Center (SFVAMC): If the SFVAMC is engaged in this research, you must secure approval of the VA Research & Development Committee in addition to CHR approval. The CHR website has more information.

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Sunjoo Bae

__________________________________ ____06/07/2011___

Author Signature Date