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Clinical Approach and Management Strategies of Medical Ailments in Women

Oorja—The Power of Her



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CONTENTS

Section 1: Cardiology
Shibba Takkar Chhabra, Gurbhej Singh

1. Role of Women in Development of Cardiology in India 3
   IB Vijayalakshmi
2. Cardiovascular Risk Assessment and Primary Prevention Strategies in Women 13
   Jyotsana, Naveen Kumar, Lalitha Nimani
3. IHD in Women: Epidemiology, Presentation, Diagnosis and Management Strategies 31
   Shibba Takkar Chhabra, Jyoti Jindal, Pooja Tandon
4. Women with Heart Failure: Etiopathogenesis, Clinical Presentation, Diagnostic, and Management Strategies 38
   Neelam Dahiya, Lipi Uppal, Krishna Prasad, Basant
5. Coronary Intervention in Women: How is it Different? 49
   Hetan C Shah, Rajesh Matta
6. Structural Heart Disease in Women: Age-based Presentation, Medical, and Interventional Strategies 56
   Tripti Deb, Shashank S Telang, Sandeep Kaur, Rajiv Gupta
7. A to Z of Rheumatic Heart Disease in Women 63
   Arati Dave Lalchandani
8. Congenital Heart Disease: Pertinent Issues in the Fair Sex 69
   Anita Saxena, Nidhi Bhim Sain
9. Pregnancy and The Heart 78
   Asha Moorthy, Jain T Kallarakkal
10. Sudden Cardiac Arrest in Women with Migraine 82
    Poonam Malhotra

Section 2: Endocrinology
Gagan Priya

1. Diabetes, Women, and Pregnancy 89
   Belinda George, Ankia Coetzee

2. Thyroid Dysfunction in Women 100
Vaishali Deshmukh, Dina Shreshtha

3. Polycystic Ovary Syndrome: A Multifaceted Endocrinopathy 114
Savita Jain, Sarah Nadeem, Gagan Priya

4. Contraception and Women's Health 126
Arundhati Dasgupta, Faria Afsana

5. Health Issues during Menopausal Transition 135
Tejal Lathia, Than Than Aye

Section 3: Rheumatology
Mohanjeet Kaur, Vikas Gupta

1. Pertinent Rheumatological Issues in Women 147
Benzeeta Pinto, Ramya Janardana

2. Risk of Cardiovascular Events in the Presence of Autoimmune Diseases 155
Nupoor Acharya, Debasish Mishra

Section 4: Neurology
Monika Singla, Aastha Takkar Kapila

1. Epilepsy in Women 163
Anuja Patil, Sita Jayalakshmi

2. Specific Issues of Stroke in Women 173
Sucharita Ray, MV Padma Srivastava

3. Movement Disorders: Gender Issues and Management Strategies 180
Roopa Rajan, Asha Kishore

4. Headache Disorders: Are They Different in Women? 187
Monika Singla, Sulena, Aastha Takkar Kapila

5. Neuroimmunology: Special Considerations in Women 195
Aastha Takkar Kapila, Anu Gupta, Julie Sachdeva, Monika Singla

Section 5: Gastroenterology
Vandana Midha

1. Gender Divide: Common Gastrointestinal Disorders in Women 213
Shobna Bhatia, Sridhar Sundaram

2. Gut Microbiome and Obesity: Ladies Corner 220
Usha Dutta, Shubra Mishra

3. Gastrointestinal and Liver Disorders in Pregnancy 230
Vandana Midha, Harmeet Kaur

4. Hepatobiliary Disorders in Females 238
Shivani Mehta, Neha Berry, Praneet Wander

5. Does Gender Matter in Liver Transplantation? 244
Mayank Jain, Chandan Kumar Kedarisetty, Tamarai Selvan, Senthil Kumar, Jayanthi Venkataraman

Section 6: Oncology
Shibba Takkar Chhabra, Mohanjeet Kaur

1. Breast and Gynecological Cancers: An Overview 253
Jaya Gosh, Davinder Paul

2. Pertinent Hemato-oncological Issues in Women 264
Shruti Kakkar

Section 7: Nephrology
Simran Kaur, Suman Sethi

1. Hypertensive Disorders in Pregnancy 273
Suman Sethi, Nitin Sethi

2. Lupus Nephritis: What's New? 282
Simran Kaur, Vikas Makkar

3. Acute Kidney Injury in Pregnancy 291
Jasmine Das

4. Challenges of Urinary Tract Infections in Females 298
Harmeet Riyait

5. Challenges of Renal Transplant in Females 306
Suceena Alexander, Elenjickal Elias John, Santosh Varughese

Section 8: Pulmonology
Shibba Takkar Chhabra, Akashdeep Singh

1. Pulmonology: Salient Issues in Women 313
Battu Chaithanya, Jayasri Helen Gali

Section 9: Infectious Diseases
Mohanjeet Kaur

1. HIV in Women 327
Harbir Kaur Rao, Rajinder Singh Gupta, Rahul Purbey

2. Approach to Fever in a Pregnant Women 334
Savita Kapila, Ena Sharma, Jeji Pukhraj

3. Vaccination in Adolescent Girls and Women 343
Mary John

4. Tuberculosis in Women: Unaddressed Issues 350
Mohanjeet Kaur, Rupinder Kaur, Jyoti Jindal

Section 10: Miscellaneous
Anubha Rathi

1. Women and Eye Health 357
Anubha Rathi, Madhushmita Mahapatra, Supriya Sharma, Namrata Sharma

2. Dry Eye in Women 366
Manpreet Kaur, Swapna Shanbhag, Anubha Rathi, Namrata Sharma

3. Uveitis in Women 373
Supriya Arora, Anubha Rathi, Somashiela Murthy

4. Otolaryngorhinology in Women 379
Bhumika Sharma, Neha Chauhan

5. Ear, Nose, and Throat Disorders in Pregnancy 383
Neha Chauhan, Bhumika Sharma

6. Women and Mental Health 387
Navkiran Mahajan

7. Women and Skin Ailments 394
Aditi Jha, Parul Verma, Divya Seshadri

8. Medical Ailments in Adolescent Girls 402
Puneet A Pooni, Sujata Bhatti

9. Sex Education of Adolescent Girls 407
Ruchita Shah, Sana Yumnam Devi

10. Medical Problems in Women Undergoing Infertility Treatment 414
Suman Puri, Rupinder Kaur

11. Dental Health in Women 423
Ena Sharma, Amit Lakhani, Savita Kapila, Divya Arora

12. Women and Transfusion Medicine 426
Kusum Thakur

13. Challenges for Lady Physicians in India 431
Roopali Khanna, Vinita Mani Daniel

Index *435*

2

CHAPTER

Cardiovascular Risk Assessment and Primary Prevention Strategies in Women

Jyotsana, Naveen Kumar, Lalitha Nimani

ABSTRACT

Several risk assessment models have been developed for the estimation of cardiovascular disease (CVD) risk. Despite the vast knowledge of understanding of the pathophysiology of coronary heart disease (CHD), an ideal risk assessment tool is still nonexistent. Moreover, females owing to their phenotypic and genotypic variations to men need a special risk assessment model. The present chapter highlights the available tools for CVD risk assessment along with their advantages and limitations. Also, a new risk model for women with special emphasis on female-specific risk factors has been proposed.

INTRODUCTION

Women are a different subset than men as regards their cardiovascular disease (CVD) risk. The present chapter discusses the available and suggested risk scores for CVD risk assessment. It also highlights the components of primary and secondary prevention strategies in females.

FRAMINGHAM RISK SCORE

Among the many studies that contributed to the understanding of cardiovascular (CV) risk factors, the FHS (Framingham Heart Study) was a landmark achievement. The FHS gave a simple coronary disease prediction algorithm, FRS (Framingham Risk Score), using categorical variables, which allows physicians to predict multivariate coronary heart disease (CHD) risk in patients without overt CHD and provides a 10-year estimate of CVD risk.

Factors Included

Several risk factors were identified as strong independent predictors of CHD in the FHS. These include age, sex, total cholesterol, high-density lipoprotein cholesterol (HDL-C) level, blood pressure (BP), cigarette smoking, and diabetes.

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The importance of the FRS is underscored by its inclusion in guidelines as the NCEP ATP III (National Cholesterol Education Program Adult Treatment Panel III) in 2001. Those individuals with two or more above-mentioned risk factors were recommended to get their FRS calculated. FRS of >20% was considered to be at risk of developing CHD.

Interpretation of the Framingham Risk Score

Table 1 represents the correlation of FRS to heart disease risk percentage.

Limitations of Framingham Risk Score

Though a rich source of information regarding risk assessment, FRS is not without limitations. It can only predict the development of CHD and not other vascular diseases. Young patients were underrepresented in the cohort of FHS, and the young patients in the study had few events, thereby making FRS an unreliable tool in young patients. While it was found to be a useful risk assessment tool in white males and females, it failed to do so in the subsequent studies in Japanese American men and women, Hispanics, and Native American men and women and north and south European populations, where it overestimated the prevalence of CHD. Diabetes considered as a coronary disease equivalent, is not given the importance it deserves in FHS as it is not devised for the diabetic population. Another potential limitation is that FHS did not take a family history of coronary artery disease (CAD) into account as a risk factor.

Even though short-term cardiovascular risk is less in women,
lifetime cardiovascular risk is high.

TABLE 1: Interpretation of Framingham Risk Score (FRS) for coronary heart disease (CHD) risk assessment.

FRS points	Heart diseases risk percentage over 10 years
<0	0%
0–8	<1%
9–12	1%
13–14	2%
15	3%
16	4%
17	5%
18	6%
19	8%
20	11%
21	14%
22	17%
23	22%
24	27%
≥25	>30%

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In an attempt to improve the accuracy of FHS, high-sensitivity C-reactive protein (hs-CRP) was incorporated into the FRS by Wilson and associates, who found that it did not add further prognostic information. While it is challenging to improve predictive accuracy substantially, new models that include family history and coronary artery calcium assessment are forthcoming. Even though short-term CV risk is less in women, lifetime CV risk is high. Many important female-specific factors such as pregnancy-related risk or family history or subclinical CVD were not included in CV risk estimation.

SCORE RISK CHARTS

By using FRS, CAD risk was overestimated in Danish and German people, and then the European Society of Cardiology (ESC) did a project based on a large pool of representative European data sets. This led to the establishment of the SCORE (Systematic COronary Risk Evaluation) project.

The SCORE project in liaison with the Third Joint Taskforce developed a system of risk estimation for clinical use in Europe. It pooled a dataset of cohort studies from 12 European countries. Thus being derived from a heterogeneous population, it could accommodate more parameters and widened its range of application to different populations.

Advantages of SCORE over FRS

It gave the 10-year risk of fatal CVD events for 400 combinations for the high-risk and low-risk populations in the form of charts for both males and females. This has the main advantage of calculating the total CV risk apart from the CHD risk, the major setback of FRS. Unlike FRS, where only low-density lipoprotein cholesterol (LDL-C) is given primary importance, low HDL-C was given equal importance in these charts. Hence, the risk estimation is given with the help of two charts in relation to cholesterol and cholesterol/HDL ratio.

Assessment of Risk by SCORE

These risk assessment scores as there are designed for detection high- or intermediate- or low-risk category from the general population and not applicable to already known as high-risk categories, such as known CVD or CHD, and type 2 diabetes mellitus (T2DM) or type 1 diabetes mellitus (T1DM) with target organ damage.

The important thing about this score is that these charts show (**Figs. 1** and **2**) the relative risk but not the absolute risk in the form of percentages. For example, a young woman with low total CV risk may not have a low relative risk. This can be known only when relative charts are applied. As the age of the women increases, then this high relative risk will translate into a high total risk. So, this particular woman requires intense lifestyle advice from the first time testing (at a younger age), not after the increase in the total CV risk in the advanced age.

The second approach to detect the risk in younger women is by determining the CV risk age. For example, a 50-year female, hypertensive with severe dyslipidemia and smoker, has 2% 10-year risk of CAD, which is the same as a 65-year female without any risk factors, so her risk age is 65. This risk can be modified by controlling the BP and lipid abnormality along with the cessation of smoking.

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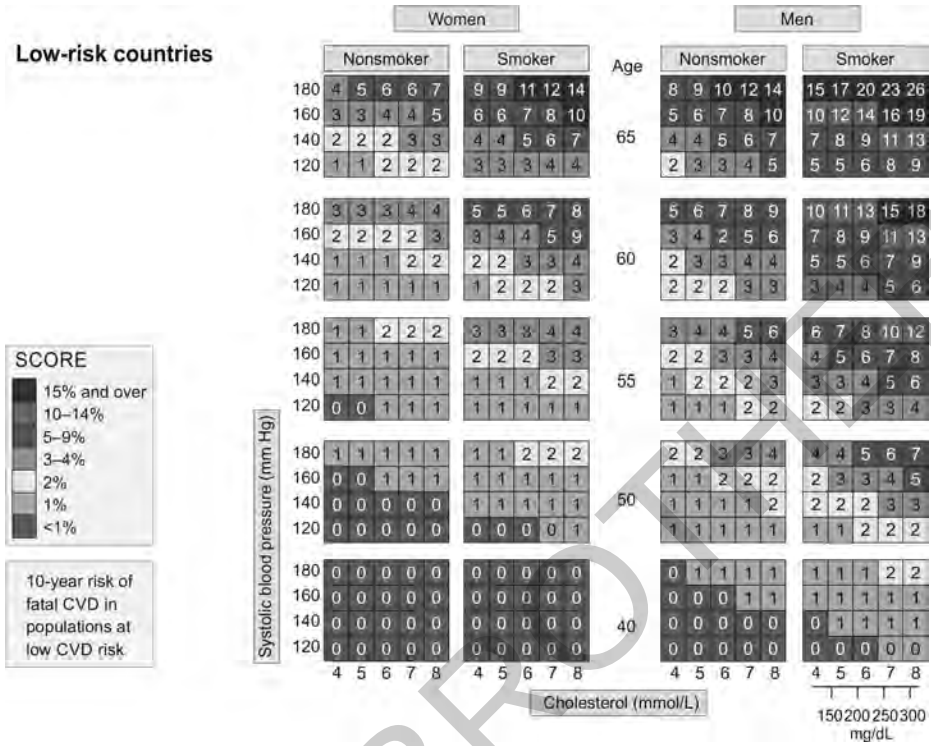

(CVD: cardiovascular disease; SCORE: Systematic Coronary Risk Evaluation)

FIG. 1: SCORE calculation in low-risk countries. ***(For color version, see Plate 1)***
(*Source:* Tomasik T et al.)

RISK ESTIMATION USING SCORE

This SCORE should be applied with caution by physicians and have to give be important to the local conditions. In CAD-declining countries, this score may overestimate the risk, whereas, in CAD-epidemic countries, this underestimates the risk. The risk in females is about 10 years older than males. At any given age, the risk appears lower for women than men.

This SCORE may be higher in sedentary or obese persons or persons with a strong family history of premature atherosclerosis or in ethnic minorities. This SCORE should use only in people with diabetes without end-organ damage.

Limitations of SCORE

Despite making up for a few drawbacks of FRS, SCORE charts are not without limitations. Some of them such as, diabetes is not included in the risk function. It takes into account only fatal events; nonfatal events were not endpoints while creating the risk charts. Factors, with uncertain accuracies such as a strong family history of early-onset CVD, milder degrees of impaired glucose regulation, triglycerides, and fibrinogen, were not given the status of risk factors.

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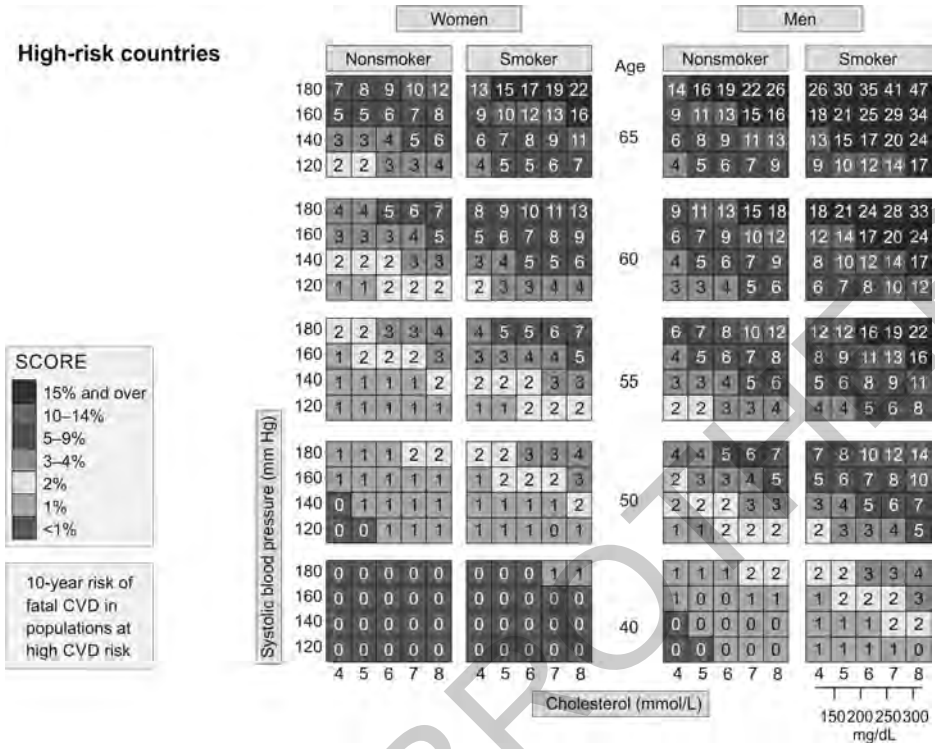

(CVD: cardiovascular disease; SCORE: Systematic Coronary Risk Evaluation)

FIG. 2: SCORE calculation in high-risk countries. ***(For color version, see Plate 2)***
(*Source:* Tomasik T et al.)

WORLD HEALTH ORGANIZATION/INTERNATIONAL SOCIETY OF HYPERTENSION RISK CHARTS

Instead of other guidelines, which focused on single risk factors, the World Health Organization (WHO) and International Society of Hypertension (ISH), gave an integrated and cost-effective approach for managing risk factors in the guidelines published in 2007. They addressed both coronary and noncoronary vascular events. These guidelines took into consideration some important facts—that multiple risk factors are responsible for cardiovascular events that these risk factors and determinants of coronary and noncoronary events were very similar, and therefore prevention approaches are similar.

The WHO/ISH risk prediction charts indicate a 10-year total CV risk for fatal and nonfatal events. These are two sets of charts from 14 epidemiological subregions that are meant to be used in low-income and middle-income countries, where predefined charts do not exist.

These charts classify an individual at high risk (maroon and red), medium risk (orange and yellow), or low risk (green) risk for coronary heart disease, stroke, or other atherosclerotic diseases. Not only does this predict a CV risk, but these guidelines also suggested prevention strategies. Though applied and studied in various populations and individual levels, the application of these charts in women, in particular, is not validated extensively.

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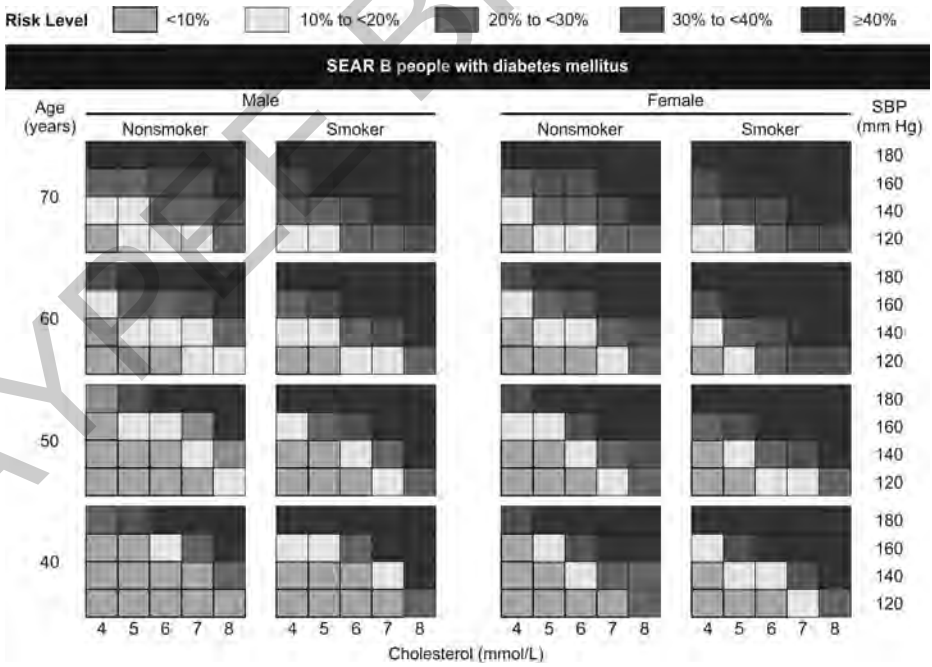
The revision of these charts with extension to 21 global regions has been validated recently and is now available for use. Its application in women can be an advance toward CVD risk assessment in women. For example, here we are mentioning the charts for Southeast Asia subregions (SEAR). The WHO subregions SEAR B and SEAR D charts in color for use in settings where total blood cholesterol can be measured (**Figs. 3** and **4**).

COMPARISON OF FRS, SCORE, AND WHO/ISH MODELS

Four CV risk prediction models were assessed in an Asian population. The WHO/ISH model performed poorly for CV risk stratification. The Framingham and SCORE models could stratify risk in Asian men and women. The SCORE-high model accurately predicted risk for men, but not women. The Framingham model stratified risk better than the SCORE models in women.

REYNOLDS RISK SCORE

The Reynolds Risk Score was calculated from nearly 25,000 Americans. With a better understanding of underlying biological processes, more and more novel inflammatory markers were incorporated into the prediction algorithms; the better validated was of Reynolds Risk Score. Probably the only risk assessment score, which was studied in two separate cohorts of men and women. It included hs-CRP and family history but excluded diabetes as it considers diabetes in itself as a high risk for prediction of CVD.



(ISH: International Society of Hypertension; SEAR: Southeast Asia subregions; SBP: systolic blood pressure; WHO: World Health Organization)

FIG. 3: The WHO/ISH risk prediction chart SEAR B with Diabetes. ***(For color version, see Plate 3)***

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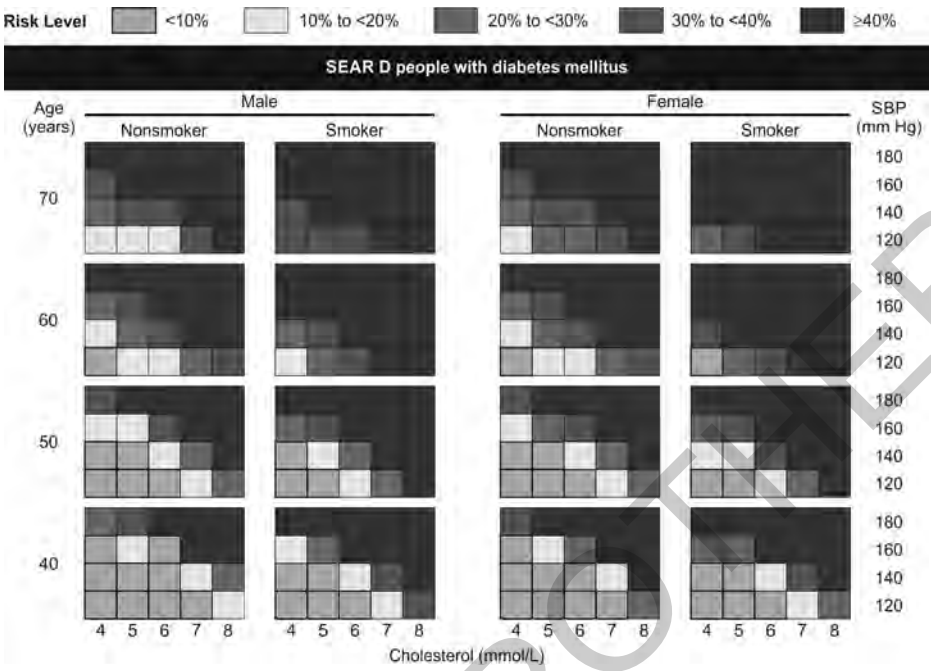

(ISH: International Society of Hypertension; SEAR: Southeast Asia subregions; SBP: systolic blood pressure; WHO: World Health Organization)

FIG. 4: The WHO/ISH risk prediction chart SEAR D with Diabetes. ***(For color version, see Plate 4)***

High-sensitivity C-reactive protein, by its role as an acute phase reactant, can be elevated in trivial conditions making it a less reliable marker in low- and middle-income countries with a high incidence of subclinical infections. Nevertheless, Reynolds Score can be a handy tool in women, especially with chronic inflammation (atherosclerosis).

2011 EFFECTIVENESS-BASED GUIDELINES FOR THE PREVENTION OF CAD IN WOMEN

The American Heart Association (AHA) published its women-specific clinical recommendations for the prevention of CVD in 1999. The update in 2004 classified women into high risk, intermediate risk, lower risk, and optimal risk—this is completely based on clinical criteria and FRS. The latter update in 2007 classified women into high risk, at-risk, or at optimal risk. These guidelines questioned the conventional thinking that women should be treated the same as men, quoting the lack of adequate representation of women in clinical trials.

The 2011 guidelines are a significant evolution in comparison to earlier updates in that substantial role was given to the effectiveness of preventive therapies, thereby transforming it to "effective-based" guidelines for the prevention of CVD in women.

This identifies women's ideal cardiovascular health, at-risk, or high-risk for CVD so that those appropriate preventive strategies can be planned.

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2013 ATHEROSCLEROTIC CARDIOVASCULAR DISEASE POOLED COHORT RISK EQUATIONS

The Working group ACC (American College of Cardiology)/AHA guidelines of 2013 made a dramatic turnover in the risk prediction by giving gender-specific pooled cohort equations for establishing the 10-year risk for the development of the first atherosclerotic CVD (ASCVD) event. They included the data from different ethnic groups, from geographically different populations and study patients of Atherosclerosis Risk in Communities (ARIC) and the Coronary Artery Risk Development in Young Adults (CARDIA). However, this data did not include the Indians and Hispanic whites.

UNITED KINGDOM PROSPECTIVE DIABETES STUDY CARDIAC RISK SCORE

This scoring system was mainly derived from the UK population (UK Prospective Diabetes Study). This includes the gender, age, duration of diabetes, smoking status, HbA1c, systolic BP, total cholesterol/HDL, and urinary microalbumin levels.

OTHER RISK ASSESSMENT SCORES

Apart from the risk scores mentioned earlier, The PROCAM (Prospective Cardiovascular Münster) study is based on a sample of industrial employees; it may be considered somewhat underpowered for risk estimation for women. The QRISK, QRISK2 and QRISK3 systems are different because they are based on databases of general practice attendees and are, therefore, not random representative samples of the population. However, the advantage of using these data is substantially larger numbers that can be included. QRISK3 (the most recent version of QRISK) is a prediction algorithm for (CVD) that uses traditional risk factors together with body mass index (BMI), ethnicity, measures of deprivation, family history, chronic kidney disease (CKD), rheumatoid arthritis, atrial fibrillation (AF), diabetes mellitus, and antihypertensive treatment.

EMERGING RISK FACTORS: IMPLICATION FOR RISK ASSESSMENT IMAGING-BASED RISK SCORES

Coronary Artery Calcification

Many studies {US MESA (Multi-Ethnic Study of Atherosclerosis), German HNR, [Heinz-Nixdorf Recall (Risk Factors, Evaluation of Coronary Calcium, Lifestyle)], Rotterdam study group, CARDIA studies} proved that coronary artery calcium (CAC) by CT scan without contrast was well correlated with the presence (extent of atherosclerotic plaque burden) of CAD by angiogram, but not with the degree of luminal narrowing. This effect was shown in a wide variety of asymptomatic populations of all ages, people with diabetes, and smokers. A study concentrating only on postmenopausal women was done under the Women's Health Initiative. Even though recent trails created the controversies of the effectiveness of calcium score as a predictor of CAD risk, depending on the MESA study, calcium score was incorporated in the CAD risk model for the prediction of CAD risk at 10 years. However, this risk score does not consider the stroke and all forms of ASCVD.

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The degree of progression, CAC = 0 to >0 less in females, but the rate and degree of the progression are not important risk factors for the CAD risk calculation.

Proposed guideline using 10-year ASCVD risk estimate plus CAC scoring (CACS) to guide statin therapy:

- *ASCVD risk <5%:* Statin is not recommended regardless of CACS.
- *ASCVD risk 5–7.5% + CACS = 0:* Statin not recommended or CACS >1 consider statin.
- *ASCVD risk >7.5–20% + CACS = 0:* Statin not recommended or CACS >0 recommend statin.
- *ASCVD risk >20%:* Recommend statin regardless of CACS.
- *Less than 5% and >20%:* CACS not effective for this population.

Breast Calcification with Coronary Calcium Score

Breast arterial calcification (BAC) with CAC on CT scan are proposed as a sex-specific tool to predict CAD risk in asymptomatic women.

Mitral Annular Calcification

Mitral annular calcification (MAC), along with metabolic syndrome, was associated with an increase in CAD.

Carotid Artery Imaging

Intima medial thickness assessment is associated with CVD risk.

Coronary Artery Wall Thickness

Magnetic resonance imaging (MRI)-derived coronary artery wall thickness in women was proved to be a marker for CAD.

Biomarkers

lncRNA ANRIL

The expression of the long non-coding RNA (lncRNA) antisense non-coding RNA in the INK4 locus (ANRIL) represented good diagnostic value for CAD, and its high expression was associated with increased stenosis degree, raised inflammation, and poor outcomes in CAD patients.

UNFOCUSED RISK FACTORS: IMPLEMENTATION IN RISK ASSESSMENT

Even though anemia or level of hemoglobin was included in the risk assessment for women, it may be important to incorporate this factor also, as precipitation of coronary events occurs by anemia.

Similarly, pregnancy-related complications, oral contraceptive ingestion, surgical intervention for obesity, MAC are also important in the generation of CAD, so important for risk assessment.

As there are advantages and disadvantages of each of these risk scores, conclusively, we cannot say that a single risk score is an ideal one for all. Present risk score modification requires the inclusion of a few more clinical and laboratory parameters.

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PROPOSED NEW RISK MODELS FOR WOMEN

Gender-specific risk factors for women are pregnancy-related problems (preterm delivery, hypertensive disorders of pregnancy, gestational diabetes, abruptio placenta, spontaneous coronary artery dissection, mother with low birth weight baby, and peripartum cardiomyopathy), breast cancer-related treatment, polycystic ovary diseases, menstrual irregularities including functional hypothalamic amenorrhea, and usage of oral contraceptive are associated with subsequent development of CAD latter in the life. Furthermore, some of the risk factors more frequent in females such as depression and stress, autoimmune diseases, physical inactivity, and metabolic syndromes are also associated with CVD risk. According to Lalita et al. (unpublished, personal communication), additional risk factors for later development of CAD are early menarche (<12 years) and early menopause (≤45 years), history of pregnancy complication and loss of pregnancy. Early age at first pregnancy (≤18 years) and multiparity (≥3) also contribute to the risk of later CVD.

So, there is a need for a new scoring system, including the gender-specific and frequent risk factors for females. We are proposing a new model for the risk assessment in women. At present, we are able to say that below suggested risk factors be included in the new model, but we require specific projects give the exact scoring.

Primary Prevention of Cardiovascular Diseases

Cardiovascular disease, which includes CHD, stroke, and peripheral artery disease, remains the leading cause of death in men and women. CVD is becoming the leading cause of death worldwide.

Rationale for primary prevention of CVD:
The following have been identified as major risk factors for CVD, are modifiable, and should be considered for intervention in all adults:

- Smoking
- Overweight and obesity
- Unhealthy diet
- Physical inactivity
- Dyslipidemia
- Hypertension
- Diabetes mellitus (considered in some guidelines as CHD risk equivalent).

Globally, up to 90% of the stroke burden may be attributable to modifiable risk factors, and up to 75% of this burden may be reduced by specifically addressing lifestyle and metabolic risk factors. Additionally, in the descriptive INTERHEART study of patients from 52 countries, nine potentially modifiable factors accounted for over 90% of the population-attributable risk of a first myocardial infarction (MI). These included cigarette smoking, dyslipidemia, hypertension, diabetes, abdominal obesity, and psychosocial factors. In addition, factors that were associated with lowered risks included regular physical activity, daily consumption of fruits and vegetables, and daily consumption of small amounts of alcohol.

In descriptive data from a nationally representative survey, five modifiable risk factors for CVD (elevated cholesterol, diabetes, hypertension, obesity, and smoking) accounted for one half of CVD deaths in United States adults aged 45–79 years from 2009 to 2010. The preventable fraction of CVD mortality associated with these risk factors was 54% for men and 50% for women.

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The deleterious consequences of multiple risk factors are, at least, additive. In the FHS of over 5,000 men and women, those with five risk factors had a 10-year risk of a first CHD event of 25–30%, which is comparable to the absolute risk of a recurrent event for many patients who have survived a prior MI or occlusive stroke.

The majority of the risk factors for CVD and stroke are modifiable by preventive measures, including both therapeutic lifestyle changes (TLCs) and adjunctive drug therapies of proven benefit. In the United States, since 1975, CVD mortality has declined overall, although men and black people continue to experience higher absolute mortality rates at earlier ages than their female and white counterparts. However, since 2011, the rates of decline have slowed and are no longer evident. It has been estimated that nearly half of the decline is due to earlier diagnosis and more aggressive treatment of modifiable risk factors, especially of lipids and BP with adjunctive drug therapies, including statins, aspirin, angiotensin-converting enzyme (ACE) inhibitors, and beta-blockers. The remaining half of the decline in CVD mortality is attributable to favorable TLCs, such as avoidance and cessation of cigarette smoking.

Further supporting the benefits of the primary prevention of CVD by maintaining a healthy lifestyle was the Nurse's Health Study, a large prospective cohort study of over 120,000 female nurses followed for over 20 years. Women who maintained desirable body weight ate a healthy diet, exercised regularly, and did not smoke cigarettes experienced and 84% reduction in risk of clinical CVD events. Additionally, in the Women's Health Study of almost 40,000 female health professionals, practicing healthy lifestyle behaviors was associated with a 55% lower risk of stroke.

Major Components of Primary Prevention of Cardiovascular Disease

Healthy Diet

Individuals who self-select for a healthy diet have significantly lower risks CVD, including both CHD and stroke. Components of a healthy diet include intakes of:

- Fruits and vegetables
- Fiber, including cereals
- Foods with a low glycemic index and low glycemic load.
- Monounsaturated fat rather than trans-fatty acids or saturated fats.
- Omega-3 fatty acids (from fish, plant sources, or supplements).

Observational studies have consistently shown that individuals consuming diets high in vegetables and fruits, such as the Mediterranean diet, have a reduced risk of CVD. It is possible that the apparent benefit may be due to specific compounds in vegetables and fruits. It is also likely that people who eat more vegetables and fruits tend to eat less meat and saturated fat.

Basic research has suggested mechanisms of benefit, and observational studies have shown that individuals who self-select diets high in antioxidant vitamins or supplements have lower risks. Nonetheless, the most reliable data from large-scale randomized trials have not shown significant benefits of antioxidant vitamin supplementation in the primary prevention of CVD.

Smoking Avoidance and Cessation

Cigarette smoking remains the leading avoidable cause of premature death and a major avoidable cause of premature disability. The totality of evidence indicates that the amount of cigarettes currently smoked increases morbidity and mortality from CVD, and benefits of cessation begin to appear after only a few months and reach that of the nonsmoker in several years, even among older adults. Thus, for CVD, it is never too late to quit, whereas,

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for cancer, it is never too early, as the risks relate largely to duration rather than the amount currently smoked.

All smokers should be counseled to quit on a regular basis. A number of approaches, including behavioral therapy, nicotine replacement therapy, and other pharmacologic therapies, are available.

Hypertension Control

Hypertension is a well-established risk factor for CVD, including morbidity and mortality from stroke, CHD, heart failure (HF), and sudden death.

- *Definition*: Hypertension is defined in the 2017 AHA/ACC guidelines as systolic pressure ≥130 mm Hg or a diastolic pressure ≥80 mm Hg.
- *Goal BP*: Goal BP may depend in part upon comorbidities (e.g., diabetes, and chronic kidney disease) and estimated CV risk.
- *Nonpharmacologic measures*: All patients with hypertension or elevated BP should practice nonpharmacologic TLCs, which include weight reduction if overweight or obese, salt restriction, and avoidance of excess alcohol intake.
- *Pharmacologic therapy*: Antihypertensive drugs are necessary for patients with persistent hypertension, despite TLCs. Most patients will require multiple antihypertensive drug therapies to achieve their BP goals.

Dyslipidemia

Several large-scale randomized trials and their meta-analyses of statins in high-, moderate-, and low-risk primary prevention subjects without clinical evidence of CHD have demonstrated clinical benefits on CVD, including MI, stroke, and CVD death as well as total mortality.

All primary prevention subjects, especially those with dyslipidemia, should be counseled to achieve and maintain desirable body weight, engage in regular physical activity, and eat a prudent diet.

Physical Activity

A number of observational studies have shown that individuals who self-select for increased physical activity have lower morbidity and mortality from CHD.

Regular physical activity is recommended in the early school years and throughout life. Common recommendations include moderate-intensity exercise for 150 minutes a week, vigorous-intensity exercise for 75 minutes a week, or an equivalent combination of these activities. Adults with limited exercise capacity due to comorbidities should stay as physically active as their condition allows. Even the modest amounts of regular physical activity, such as brisk walking for 20 minutes daily, are associated with significant benefits on the risk of CHD.

Weight Loss

Overweight and obesity increase risk for several major risk factors for CVD, including hypertension, dyslipidemia, and insulin resistance, while weight loss has been shown to improve these parameters. Data from large prospective cohort studies have consistently shown that individuals with higher body weights have a linear increase in morbidity and mortality from CHD, after appropriate adjustment for smoking and other confounders.

The selection of treatment for overweight subjects is based upon an initial risk assessment. All should be evaluated for their willingness and ability to adapt therapeutic lifestyle changes as well as other interventions of proven benefit. All individuals who

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Salient Features

- The book *Clinical Approach and Management Strategies of Medical Ailments in Women*, is aimed at all medical professionals in general.
- Highlights gender specific manifestations and management strategies of medical disorders which affect women more; either epidemiologically or in severity.
- Attempts to cover all major organ systems as separate sections.
- Talks of gender bias not only in approach to a diseased woman, but also existent in medical profession at large.
- Unique effort to compile the literature on women-related medical ailments by the expert lady physicians (specialists and superspecialists) across the globe: A book *of the women, by the women, for men and women*.



Shibba Takkar Chhabra the best outgoing student of her school was also awarded for being the best speaker, organizer, and for academic excellence as an undergraduate student at Dayanand Medical College and Hospital (DMCH), Ludhiana, Punjab, India. She did her MD (Medicine) from Christian Medical College (CMC), Ludhiana and was the first DM (Cardiology) candidate from DMCH, Ludhiana. She is the first interventional female cardiologist practicing in Punjab, India. She is Dr DP Basu Award recipient by Cardiological Society of India (CSI) for her work on acute coronary events in the very young patients less than 30 years. Her publications on gender bias in healthcare and cardiac health awareness in women have been appreciated for which she aims at a national campaign.



Aastha Takkar Kapila completed her DM (Neurology) training from the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India, after which she has been working there as faculty in the Department of Neurology. Neurology as a whole fascinates her, but the fields of her special interest are *Neuro-Immunology and Neuro-Ophthalmology*. She has more than 60 indexed publications in peer reviewed national and international journals and 7 book chapters to her credit. She has been a recipient of World Congress of Neurology and Indian Academy of Neurology travel grants during her residency period.



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