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Primary prevention of cardiovascular diseases among women in a South Asian population: a descriptive study of modifiable risk factors

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ABSTRACT

Objective The aim of this study was the assessment of modifiable risk factors of cardiovascular diseases (CVD) among women versus men at a newly developed preventive cardiology clinic of a large tertiary care cardiac centre in Pakistan.

Design Observational study.

Setting Tertiary care cardiac hospital in Karachi, Pakistan.

Participants Data for this study were obtained retrospectively from a prospectively collected ongoing registry. We have included all female and male individuals who have presented or were referred to our clinic for primary prevention. All the participants had no history of ischaemic heart disease.

Outcome measure In this study, we evaluated the CVD risk factors, estimated risk of CVD, and glycaemic and cholesterol control at baseline and at subsequent follow-ups for high-risk patients.

Results A total of 535 patients, 314 females, were included with a mean age of 48.3±12.5 years. At baseline, 57.9% (128) of men versus 73.2% (230) of women (p<0.001) were known cases of hypertension (HTN); 18.1% (40) vs 26.8% (84) (p=0.019) were diabetic; 40.5% (89) vs 9.2% (29) (p<0.001) were tobacco users; 26.0% (56) vs 3.2% (10) (p<0.001) were smokers; and 26.9% (57) vs 50.5% (153) had BMI ≥30 kg/m^2, respectively. Baseline atherosclerotic cardiovascular disease (ASCVD) risk score was available for 348 (65%), 61.5% (136) of men versus 67.5% (212) of women. The median ASCVD risk score was 6.8% (2.8%–16.1%) vs 2.25% (1%–5.1%) (p<0.001 for men and women, respectively). The ASCVD risk score was ≥20% (high risk) for 22.1% (30) vs 1.9% (4), while the ASCVD risk score was <5% (low risk) for 40.4% (55) vs 74.1% (157) of men and women, respectively.

A repeat ASCVD assessment at a median follow-up of 49.5 (7.0–231) days was available for 259 (48.4%) patients, 26.2% (58) of men vs 64% (201) of women, respectively. The median follow-up ASCVD score was 6.55% (2.8%–15.4%) vs 2.1% (0.9%–4.8%) (p<0.001 with ≥20% (high risk) in 19% (11) vs 2% (4) and <5% (low risk) in 34.5% (20) vs 77.1% (155) of men and women, respectively).

Conclusion(s) There is a high prevalence of modifiable risk factors for atherosclerotic CVD such as HTN, diabetes and obesity in women as compared with men, but interestingly, ASCVD risk score at the baseline as well as at the follow-up is high in men versus women. Some other non-modifiable risk factors like age, gender and blood lipid profile may also contribute to this difference between the high prevalence of risk factors and low ASCVD risk score in women. With appropriate follow-up and proper counselling, the looming CVD can be better prevented in this population. A dedicated preventive cardiology clinic for the identification of high-risk women and systematic follow-up is needed to predict their actual CVD risk.

Trial registration NCT06503341.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses a registry-based approach to systematically collect data on modifiable cardiovascular disease risk factors.
⇒ The atherosclerotic cardiovascular disease risk score was used due to the lack of validated alternatives for our population, which may limit its accuracy in this cohort.
⇒ Key risk factors relevant to women, such as anxiety, depression and pregnancy-related complications, were not included, as they were not part of the initial registry design.
⇒ The registry is currently in its early stages, limiting the ability to report meaningful long-term outcomes at this time.

INTRODUCTION

Cardiovascular diseases (CVD) are among the leading causes of fatality worldwide, both in males and females. Indeed, it poses a significant challenge in South Asia, a region with a vast population and diverse ethnicities, cultures, healthcare systems and socioeconomic statuses. Among the 18.6 million deaths worldwide, the ultimate cause was CVD in 2019; 58% occurred in Asia.[1] In 2019, 10.8 million deaths were due to CVD, which were around 35% of the total deaths in Asia.[1] Nearly 39% of these cardiovascular deaths were categorised as premature deaths, that is, the death of a person before 70 years of age.[2]

When compared with other ethnic subgroups, the South Asian population has a disproportionately greater burden of 'atherosclerotic cardiovascular disease (ASCVD)', which often occurs at a younger age, that is, before 50 years of age, and is more aggressive. In this setting, the recent scientific statement from the National Lipid Association emphasises the primary prevention of CVD among the South Asian population.[3]

Regarding gender, CVD is greater among South Asian women than men despite comparatively low rates of smoking.[4] High triglyceride and low high-density lipoprotein cholesterol concentrations cause atherogenic dyslipidaemia, which leads to insulin resistance and is commonly found among Asian women.[5] High levels of lipoprotein (a) found in 35%–40% of Asian Indians may have a strong correlation.[6]

Many risk factors, such as hypertension (HTN), diabetes and obesity, have been associated with the development of CVD.[7 8] However, in ageing adults, gender differences are often observed in both the prevalence and onset of CVD.[7] In the American Heart Association (AHA) 2019 Heart Disease and Stroke Statistical Update, the reported incidence of CVD is 77.2% in males and 78.2% in females among individuals between 60 and 79 years of age.[9] Furthermore, the incidence of CVD was reported to be 89.3% in males and 91.8% in females after 80 years of age.[9]

Age and family history of ischaemic heart disease (IHD) are non-modifiable risk factors in the development of CVD. The predicted risk of CVD is associated with many factors and is not simply a consequence of ageing. The higher prevalence of comorbid risk factors, including HTN, obesity, diabetes and tobacco use, are among the factors for developing CVD.[10 11]

There are different CVD risk score systems available that are being used worldwide in CVD risk assessment and risk reduction for the primary prevention of CVD. Each CVD scoring system has its own merits and limitations. However, these can be used for the initial assessment of a particular population so that their own guidelines and CVD risk assessment tools can be made. On the basis of these assessment and management guidelines, we can reduce the burden of CVD in a particular population.

The aim of this study was the assessment of modifiable risk factors of CVD among women versus men at a newly developed preventive cardiology clinic of a large tertiary care cardiac centre in Pakistan.

METHODS

Study design and setting

This observational study was conducted at the Cardiac Risk Assessment Clinic (CRAC) of the 'National Institute of Cardiovascular Diseases (NICVD)', Karachi, Pakistan, between October 2021 and January 2024.

Ethics

The study was approved by the institutional review board (Ref. #: IRB-20/2023). As part of our routine protocol, we obtain verbal consent from all the patients regarding their participation in the registry and for the publication of results obtained from the de-identified data of the registry. This hospital based registry is registered on ClinicalTrials.gov against NCT06503341 with a title 'A Hospital-Based Registry of Preventive Cardiology Clinics (PREVENT-CARD)'.

Study population

This is a retrospective analysis of data from a prospectively collected registry (NCT06503341). This hospital based registry was developed to enrol patients coming to the newly developed preventive cardiology clinic at our institution. We have included all female and male individuals presented or referred to our clinic for primary prevention. All the participants had no history of IHD.

Diagnosis and management

As per our routine practice, all participants underwent physical and clinical examinations. Routine clinical assessments included general physical examination and relevant systemic examination, including pulse (beats per minute), blood pressure (mm Hg), height (cm), weight (kg), waist circumference (inch) and body mass index (BMI; kg/m^2). Further, electrocardiography, lipid profile, blood glucose level (fasting and random) and haemoglobin A1c (HBA1c) (%) were assessed. The 10-year risk of ASCVD was calculated using the online calculator (available at https://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx#1). For the purpose of calculation, the age of females under 40 years of age was taken as 40 and more than 79 years as 79. Individuals were managed and followed in accordance with the ASCVD risk level as per the American College of Cardiology (ACC)/AHA primary prevention guidelines.[12] Statin therapy was considered for all diabetic patients and individuals with borderline to high-risk ASCVD scores.

Study variables

Individuals with a confirmed history of HTN or who have been taking anti-hypertensive medication for a minimum of 6 months were categorised as having HTN. Similarly, individuals with a confirmed history of diabetes mellitus (DM) or who have been taking anti-diabetic medication for at least 6 months were categorised as having DM. A positive family history of IHD was indicated if the individual had a family history of coronary artery disease (CAD) in first-degree relatives, with males under 55 years of age or females under 65 years of age. Obesity was diagnosed if the BMI exceeded 30 kg/m^2. Smoking was identified if the individual currently smokes any form of smoking, including cigarettes, cigars and water pipes.

Data collection

Consecutive patients presenting with possible risk factors that may cause CVD were included in this registry.

Table 1 Distribution of clinical and demographic characteristics

Characteristics	Total	Male	Female	P value
Total (N)	**535**	**221**	**314**	
Age (years)	48.3±12.5	48.1±12.6	48.4±12.5	0.830
Below 40	133 (24.9%)	59 (26.7%)	74 (23.6%)	0.048
40 to 50	180 (33.6%)	72 (32.6%)	108 (34.4%)	
51 to 60	130 (24.3%)	43 (19.5%)	87 (27.7%)	
More than 60	92 (17.2%)	47 (21.3%)	45 (14.3%)	
Risk factors				
Hypertension	358 (66.9%)	128 (57.9%)	230 (73.2%)	<0.001
Diabetes	124 (23.2%)	40 (18.1%)	84 (26.8%)	0.019
Tobacco use	118 (22.1%)	89 (40.5%)	29 (9.2%)	<0.001
Smoking	66 (12.5%)	56 (26.0%)	10 (3.2%)	<0.001
BMI categories				
Underweight (< 18.5 kg/m^2)	13 (2.5%)	5 (2.4%)	8 (2.6%)	<0.001
Normal (18.5–24.9 kg/m^2)	118 (22.9%)	62 (29.2%)	56 (18.5%)	
Overweight (25–29.9 kg/m^2)	174 (33.8%)	88 (41.5%)	86 (28.4%)	
Obese (≥ 30 kg/m^2)	210 (40.8%)	57 (26.9%)	153 (50.5%)	
Family history				
Coronary artery disease	290 (54.2%)	122 (55.2%)	168 (53.5%)	0.70
Cerebrovascular accident	162 (30.3%)	66 (29.9%)	96 (30.7%)	0.84
Peripheral arterial disease	50 (9.4%)	21 (9.5%)	29 (9.3%)	0.93
Hypertension	401 (75.1%)	163 (73.8%)	238 (76.0%)	0.55
Diabetes	347 (65.1%)	151 (68.6%)	196 (62.6%)	0.15
Systolic blood pressure (mm Hg)	128.8±19.5	127±19.7	130.1±19.2	0.069
≤130	334 (62.4%)	148 (67%)	186 (59.2%)	0.145
131 to 160	178 (33.3%)	63 (28.5%)	115 (36.6%)	
>160	23 (4.3%)	10 (4.5%)	13 (4.1%)	
Diastolic blood pressure (mm Hg)	76.9±10.3	76.8±11.1	77±9.7	0.845
≤90	517 (96.6%)	212 (95.9%)	305 (97.1%)	0.663
91 to 100	11 (2.1%)	6 (2.7%)	5 (1.6%)	
>100	7 (1.3%)	3 (1.4%)	4 (1.3%)	
Total cholesterol (mg/dl)	181.7±48.6	181.8±53.3	181.7±45.2	0.974
Normal	261 (48.8%)	105 (47.5%)	156 (49.7%)	0.547
Abnormal	137 (25.6%)	54 (24.4%)	83 (26.4%)	
NA	137 (25.6%)	62 (28.1%)	75 (23.9%)	
HDL (mg/dl)	42.4±9.0	39.8±7.9	44.2±9.3	<0.001
Normal	143 (26.7%)	81 (36.7%)	62 (19.7%)	<0.001
Abnormal	255 (47.7%)	78 (35.3%)	177 (56.4%)	
NA	137 (25.6%)	62 (28.1%)	75 (23.9%)	
LDL (mg/dl)	126.4±46.2	126.7±48.8	126.1±44.4	0.896
Normal	114 (21.3%)	47 (21.3%)	67 (21.3%)	0.453
Abnormal	283 (52.9%)	111 (50.2%)	172 (54.8%)	
NA	138 (25.8%)	63 (28.5%)	75 (23.9%)	

BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 2 Distribution of ASCVD risk score and HbA1c level at baseline and follow-up among male and female individuals

	Total	Gender		P value
		Male	Female	
Total (N)	**535**	**221**	**314**	–
ASCVD risk score at baseline				
Available	348 (65%)	136 (61.5%)	212 (67.5%)	0.153
Median level	3.3% (1.4%–8.45%)	6.8% (2.8%–16.1%)	2.25% (1.0%–5.1%)	<0.001
<5%	212 (60.9%)	55 (40.4%)	157 (74.1%)	<0.001
5% to <7.5%	41 (11.8%)	18 (13.2%)	23 (10.8%)	
7.5% to <20%	61 (17.5%)	33 (24.3%)	28 (13.2%)	
≥20%	34 (9.8%)	30 (22.1%)	4 (1.9%)	
ASCVD risk score at follow-up				
Available	259 (48.4%)	58 (26.2%)	201 (64%)	<0.001
Median level	2.7% (1.1%–6.7%)	6.55% (2.8%–15.4%)	2.1% (0.9%–4.8%)	<0.001
<5%	175 (67.6%)	20 (34.5%)	155 (77.1%)	<0.001
5% to <7.5%	26 (10%)	10 (17.2%)	16 (8%)	
7.5% to <20%	43 (16.6%)	17 (29.3%)	26 (12.9%)	
≥20%	15 (5.8%)	11 (19%)	4 (2%)	
HbA1c level at baseline				
Available	355 (66.4%)	144 (65.2%)	211 (67.2%)	0.623
Median level	5.81% (5.4%–7.0%)	5.75% (5.3%–6.95%)	5.9% (5.4%–7.0%)	0.225
<7.0%	264 (74.4%)	108 (75%)	156 (73.9%)	0.974
7 to 7.5%	15 (4.2%)	6 (4.2%)	9 (4.3%)	
≥7.5%	76 (21.4%)	30 (20.8%)	46 (21.8%)	
HbA1c level at follow-up				
Available	246 (46%)	50 (22.6%)	196 (62.4%)	<0.001
Median level	5.87% (5.4%–7.0%)	6.4% (5.4%–7.6%)	5.8% (5.45%–6.9%)	0.266
<7.0%	182 (74%)	33 (66%)	149 (76%)	0.331
7 to 7.5%	17 (6.9%)	4 (8%)	13 (6.6%)	
≥7.5%	47 (19.1%)	13 (26%)	34 (17.3%)	
Median follow-up days	49.5 (7.0–231)	42.5 (7.0–223)	53 (7.0–266.5)	0.368

ASCVD, atherosclerotic cardiovascular disease; HbA1c, haemoglobin A1c.

Demographic characteristics, physical examination, clinical history, family history, risk modification, clinical course and patient outcomes were obtained using a structural questionnaire. Individuals were followed in the CRAC outpatient department, and treatment was optimised. Collected data were stored in a secure location and were accessible to the primary investigators and co-investigators only.

Sample size

A total of 535 individuals fulfilling the inclusion criteria were included in this study through a non-probability consecutive sampling method.

Data analysis

Statistical software IBM SPSS (V.21) was used for the analysis of baseline characteristics. Descriptive statistics such as mean±SD and frequency and percentages were computed. For the variables with skewed distribution, such as ASCVD risk score and HbA1c level at baseline and follow-up, median (IQR) was computed, and the Mann-Whitney U-test was employed to compare the two measures between men and women. Clinical profiles and assessments were compared between men and women with the help of an appropriate χ^2 test or independent sample t-test. Comparison of ASCVD risk level and HBA1c levels between baseline and last follow-up were compared using the χ^2 test, and p value<0.005 was considered significant.

Patient and public involvement

None.

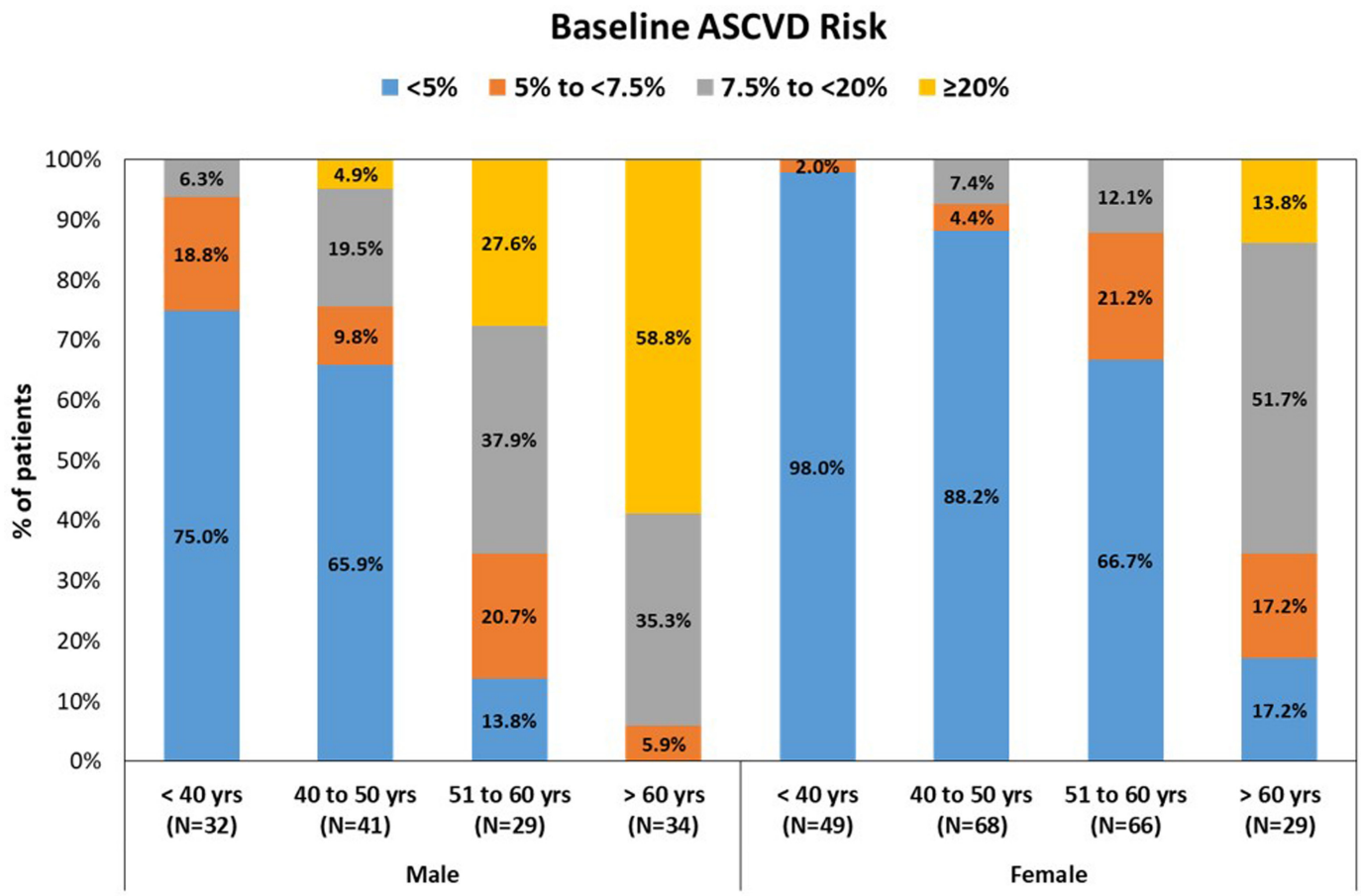

Figure 1 Comparison of baseline atherosclerotic cardiovascular disease (ASCVD) risk score by age and gender.

RESULTS

A total of 535 patients, 314 females, were included, with a mean age of 48.3±12.5 years. At baseline, 57.9% (128) of men vs 73.2% (230) of women (p<0.001) were known cases of HTN; 18.1% (40) vs 26.8% (84) (p=0.019) were diabetic; 40.5% (89) vs 9.2% (29) (p<0.001) were tobacco users; 26.0% (56) vs 3.2% (10) (p<0.001) were smokers; and 26.9% (57) vs 50.5% (153) had BMI ≥30 kg/m^2, respectively. The mean waist circumference for women was 38.5±5.6 inches, and 83.1% (261) had a waist circumference >32 inches.

The family history of various conditions such as CAD, cerebrovascular accident, peripheral arterial disease, HTN and diabetes was not statistically significant between men and women (table 1).

Baseline ASCVD risk score at baseline was available for 348 (65%), 61.5% (136) of men vs 67.5% (212) of women. The median ASCVD risk score was 6.8% (2.8%–16.1%) vs 2.25% (1%–5.1%) (p<0.001 for men and women, respectively). The ASCVD risk score was ≥20% (high risk) for 22.1% (30) vs 1.9% (4), while the ASCVD risk score was <5% (low risk) for 40.4% (55) vs 74.1% (157) of men and women, respectively (table 2).

A repeat ASCVD assessment at a median follow-up of 49.5 (7.0–231) days was available for 259 (48.4%) patients, 26.2% (58) of men vs 64% (201) of women, respectively. The median follow-up ASCVD score was 6.55% (2.8%–15.4%) vs 2.1% (0.9%–4.8%) (p<0.001 with ≥20% (high risk) in 19% (11) vs 2% (4) and <5% (low risk) in 34.5% (20) vs 77.1% (155) of men and women, respectively) (table 2).

Similarly, HbA1c levels at baseline were available for 355 (66.4%) patients, and median HbA1c was 5.75% (5.3%–6.95%) for men vs 5.9% (5.4%–7.0%) for women (p=0.225) with the level of ≥7.5% in 20.8% (30) vs 21.8% (46), respectively. Follow-up HbA1c levels were available for 246 (46%), and median HbA1c was 5.87% (5.4%–7.0%) vs 5.8% (5.45%–6.9%) (p=0.226) with the level of ≥7.5% in 26% (13) vs 17.3% (34) of men and women, respectively (table 2).

As compared with women, men had a higher risk of ASCVD at baseline across all age groups, with 0% vs 27.6% high risk for ages between 51 and 60 years and 13.8% vs 58.8% high risk for >60 years age group, respectively (figure 1).

Among 58 men with baseline and follow-up ASCVD assessments, the distribution of high-risk ASCVD (≥20%) decreased from 27.6% to 19.0%, while the low-risk group (<5%) increased from 32.8% to 34.5% while among 201 females with baseline and follow-up ASCVD assessments, the low-risk group (<5%) increased from 72.6% to 77.1%, with a stagnant 2% high risk on both intervals (figure 2).

Among 50 men with baseline and follow-up HbA1c levels, the distribution of uncontrolled level (≥7.5%)

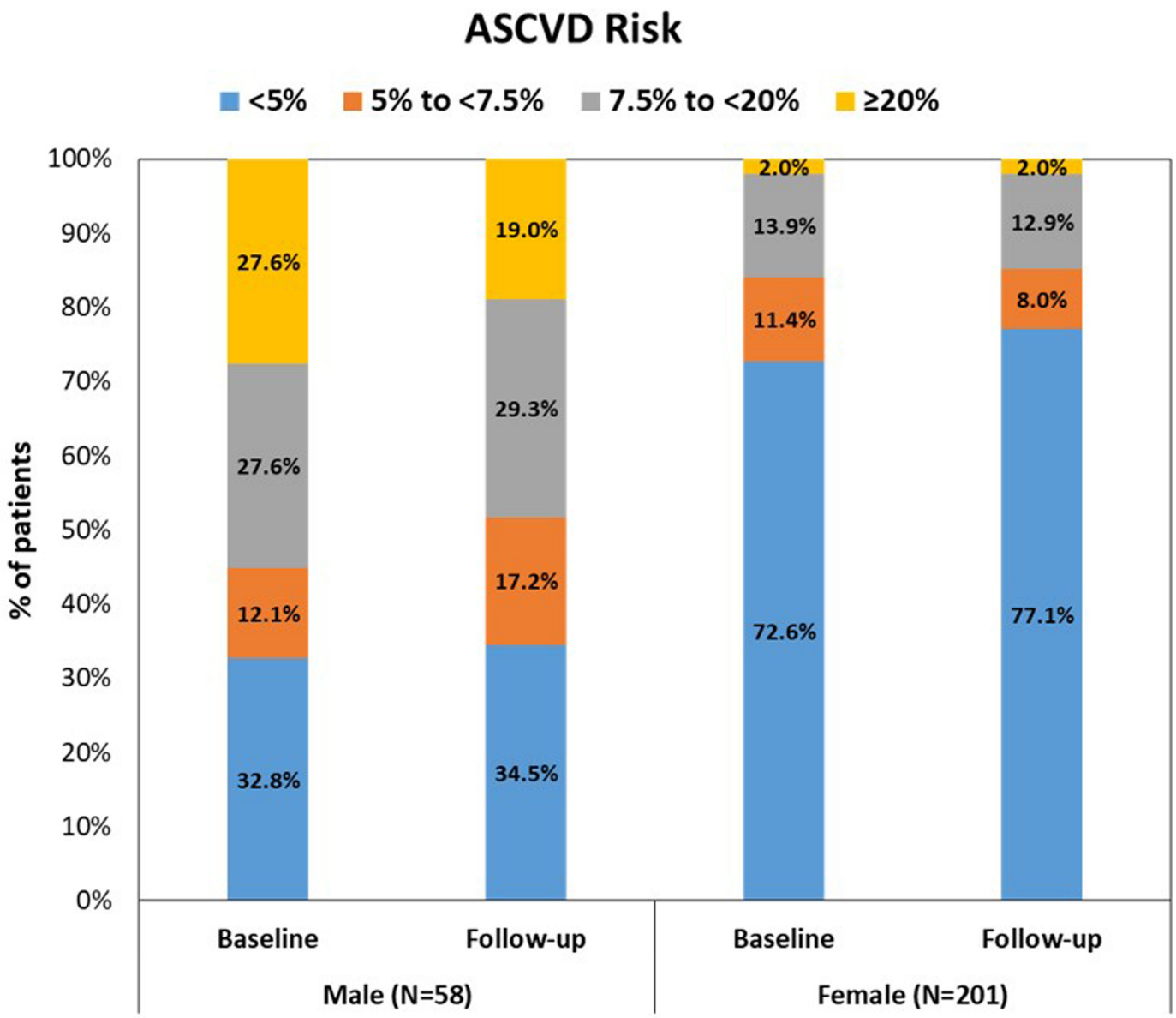

Figure 2 Comparison of baseline and follow-up atherosclerotic cardiovascular disease (ASCVD) risk score.

decreased from 36.0% to 26.0%, while controlled level (<7%) increased from 62.0% to 66.0%, while among 196 females with baseline and follow-up HbA1c levels, uncontrolled-level (≥7.5%) decreased from 20.9% to 17.3%, while controlled level (<7%) increased from 74.5% to 76.0% (figure 3).

DISCUSSION

Globally, CVD is the primary cause of mortality for both genders. The key to lessening the impact of CVD lies in risk evaluation and management. Various scoring systems are used worldwide to calculate the future predicted risk of CVD in specific populations. These traditional scoring systems typically take into account factors such as age, gender, ethnicity, BMI, history of HTN, diabetes, renal insufficiency and medication usage.

Besides the influence of demographic shifts, the increasing CVD epidemics in South Asia are probably due to a complex interplay of changes in socioeconomic conditions, lifestyles, the prevalence of associated CVD risk factors, and the ability to prevent and manage CVD.[13 14]

Women are less likely to receive preventive care or advice, such as lipid-lowering therapy, aspirin and lifestyle modifications, compared with men with a similar predicted risk of CVD.[15 16] If medications are prescribed, the treatment tends not to be as aggressive or as effective. For instance, hypertensive women are less likely to achieve their blood pressure targets, and women with high cholesterol, particularly those with concurrent diabetes, are less likely to receive statin therapy to reduce low-density lipoprotein cholesterol levels.[17–19] Furthermore, cardiac rehabilitation is underused,[20–22] with women being 55%

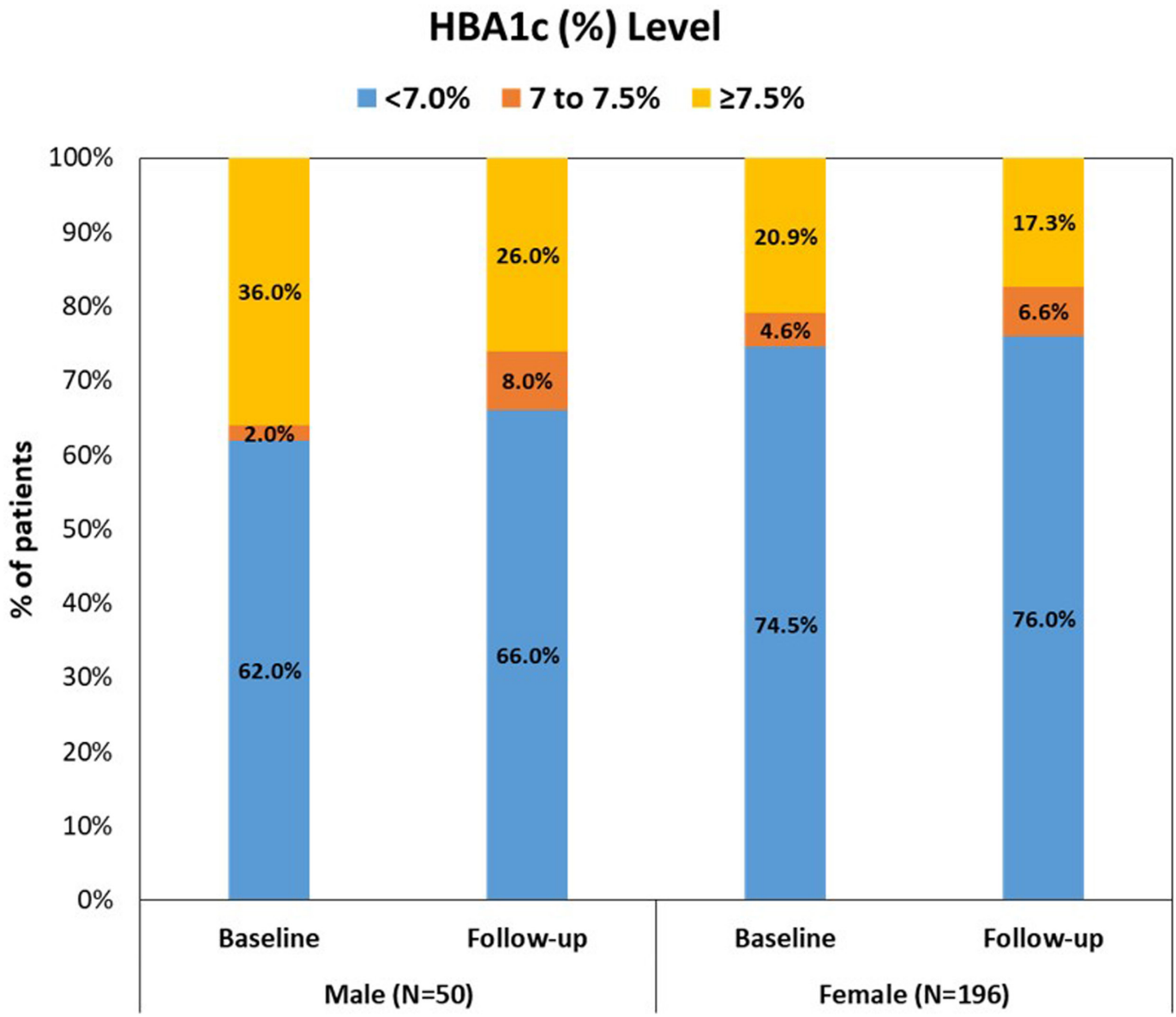

Figure 3 Comparison of baseline and follow-up haemoglobin A1c (HBA1c) level.

less likely to participate than men. This is due to a variety of reasons, one of which is the lack of referral by their treating primary physician.[23]

In Singapore, the mortality rate from CAD in Asian Indian women aged 30–39 is eight times higher than that of Chinese women in the same age group.[24] Furthermore, Asian Indian women in California were found to have a significantly higher mortality rate from CVD, with 144 Asian Indians compared with 100 whites.[25]

Angiographic research in Indians has revealed a high incidence of severe and widespread conditions, including a three-vessel disease in 40% of cases. This is despite the fact that the majority of these women (56%) were premenopausal.[26] A similar study conducted in Canada found that Asian Indian women were found to have left-main or three-vessel CAD twice compared with their white counterparts.[27]

When using the Pooled Cohort Equations from the 'American Heart Association (AHA)/American College of Cardiology (ACC)', South Asian ethnicity is typically classified as 'white', which can lead to an underestimation of risk. However, the 2016 European prevention guidelines and the 2018 AHA/ACC multisociety cholesterol guidelines have updated this approach and now recognise South Asian ethnicity as a risk enhancer when deciding to start statin therapy.[28 29]

The ASCVD risk calculator was developed based on multiple populations and has been validated for Caucasian and African American men and women. However, when this calculator is used for Hispanic American, Asian American and South Asian American populations, there is a higher likelihood of risk category misclassification.

The INTERHEART study identified nine readily assessable risk factors–HTN, smoking, DM, lipids, obesity, lack

of physical activity, diet, use of alcohol and psychosocial factors–that account for over 90% of the predicted future risk for cardiovascular events.[30] Notably, while the scale of ASCVD risks was comparable for both genders, the effect of risk modification was more pronounced in women. Hence, extensive research has shown that lifestyle interventions for primary prevention can reduce both the occurrence of ASCVD and the related death rates in both men and women. Traditional risk factors for ASCVD, such as smoking and diabetes, have a more pronounced effect on women than men, highlighting a significant disparity. Furthermore, women face unique risk factors, including those related to pregnancy, and are disproportionately affected by others, like autoimmune diseases. These areas should be the focus of preventive measures. To effectively mitigate CVD and enhance outcomes for women, it is crucial that risk evaluation and management strategies are tailored specifically to each sex.[31]

Having up-to-date data on epidemiological characteristics of CVD in Asian countries is essential for comprehending the challenges and guiding the formulation of sensible policies, strategies and actions to tackle the CVD epidemic. Therefore, this article aims to pinpoint and summarise the main aspects of the CVD epidemic and underscore the challenges they pose in terms of CVD prevention in South Asian countries.

We acknowledge the limitations of the ASCVD score. In the absence of validated alternatives for our population, we had no choice but to use the ASCVD score in our cohort, as it has been employed in various other scientific studies. Furthermore, we concur that there is a need to explore indigenous novel risk factors for women, including anxiety, depression and pregnancy-related complications. However, this study was based on a hospital-based registry of individuals referred to a primary prevention clinic, and the lack of such factors was a limitation. Additionally, our registry is currently in progress and is in its very early stages, making it too soon to produce any meaningful results regarding outcomes. Future studies from this registry will help us evaluate the validity of such scores in our population.

CONCLUSION

Modifiable risk factors for atherosclerotic CVD, such as HTN, diabetes and obesity, are more prevalent in Asian women compared with men. However, it is intriguing to note that the ASCVD risk score, both at baseline and follow-up, is higher in men than in women. This discrepancy may be attributed to non-modifiable risk factors like age, gender and blood lipid profile. Despite the high prevalence of risk factors, the ASCVD risk score in women remains low.

With appropriate follow-up and proper counselling, the impending risk of CVD can be better mitigated in this population. There is a pressing need for a dedicated preventive cardiology clinic to identify high-risk women and provide systematic follow-up. This approach will help accurately predict their actual future risk of CVD. Emphasising the primary prevention of CVD is crucial to decreasing CVD-related deaths and the overall burden of CVD. The AHA has prioritised the identification and treatment of risk factors such as HTN, dyslipidaemia, DM, smoking, obesity and physical inactivity to achieve this objective. Regrettably, the prevalence and severity of these risk factors are on the rise, particularly among young women. However, significant challenges persist in integrating this information into existing risk assessment tools.

For a long time, the primary focus of CVD research has been men, resulting in a need for more understanding of the differences between sexes in terms of causes, diagnosis and treatment. The underrepresentation of women in clinical trials means that we need more data to make precise clinical decisions. There is still a lot to learn, which necessitates research approaches specific to sex and gender, with adequate representation of women in clinical cardiovascular studies.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the Institutional Review Board of the National Institute of Cardiovascular Diseases, Karachi (IRB-20/2023). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data and material will be available upon request to the corresponding author of this manuscript.

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