

Cardiovascular risk using WHO-ISH chart among Diabetes and Hypertensive patients in a remote rural area of South India

David Gregg Smith Ponraj¹, Sri Keerthana Gopikrishnan¹,
Ariarathinam Newtonraj¹, Mark Christopher Arokiaraj², Anil Jacob Purty¹,
Sunil Kumar Nanda³, Mani Manikandan¹, Antony Vincent¹

Departments of ¹Community Medicine, ²Cardiology and ³Biochemistry, Pondicherry Institute of Medical Sciences, Puducherry, India

ABSTRACT

Introduction: Cardiovascular diseases (CVDs) are major problems in India and many other developing and developed countries. As India is committed to provide universal health care for the population, there is a need to find out the prevalence and determinants of CVD risk among high-risk individuals (Diabetes and Hypertensive patients) in the remote rural area of India to deliver appropriate services, as they are considered as neglected population. **Methods:** We screened high-risk individuals (Hypertension and Diabetes patients) for CVD risk using WHO/ISH chart, in a remote rural area of south India, covering ten villages surrounding the Rural Health Training Centre (RHTC), in August–September 2017. After line-listing the participants from the electronic database of RHTC, screening with questionnaire and biochemical tests was done at village level as the first step. Thereafter, the participants were invited to the hospital on a particular day where electrocardiography (ECG) and echocardiography (ECHO) were done with special consultation. **Results:** Among the total of 303 individuals screened at the village level, 64 [21% (CI 17–25)] had a higher risk for CVD. 235 people attended the special consultation; among them, 212 underwent ECG and 88 underwent ECHO. Among those screened with ECHO, 18 had some cardiac pathologies. The relationship between CVD risk and other factors is shown in. After final adjustment, illiteracy [adjusted prevalence ratio (aPR) 1.8 (0.1–3.1)], anemia [aPR 1.8 (1–3.6)], and chronic renal diseases [aPR 1.8 (1.0–3.4)] were found to be associated with high risk for CVD among hypertension and diabetes groups. **Conclusion:** Cardiovascular disease risk assessment using WHO/ISH chart showed an association with poor education, anemia, and chronic kidney disease.

Keywords: Cardiovascular, India, ISH chart, rural

Introduction

Cardiovascular diseases (CVDs) are the leading cause of mortality at a global level as well as in India.^[1] Like many other

low and middle income countries (LMICs), India is also in a major epidemiological transition, where the disease burden is transforming from communicable to noncommunicable diseases.^[2] Considering the burden of CVD and the huge population in India, task shifting of CVD risk assessment and communication to grass root level workers like Nurses are emerging in rural areas of India.^[3] In case of risk behavior, a recent study from rural north India has shown that people with

Address for correspondence: David Gregg Smith Ponraj,
Department of Community Medicine, Pondicherry
Institute of Medical Sciences, Pondicherry - 605014, India.
E-mail: davidgreggsmithp10@gmail.com

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Table 1: Association between WHO/ ISH cardiovascular risk and other factors in a remote rural area of south India, in August and September 2017

Variables	Total (n=303)	High risk (n=64) n (%)	%	P#	Crude PR 95% CI	aPR 95% CI
Age [§]				<0.01		
30-40	43	1	(2)		Ref	-
41-50	72	4	(6)		2.3 (0.2-21.3)	-
51-60	86	24	(28)		11.9 (1.6-88)	-
61-70	75	25	(33)		14.3 (2.0-124)	-
>=71	27	10	(37)		15.9 (2.0-124)	-
Percapita income				0.5		
<=2000	203	46	(23)		Ref	-
2001-4000	85	16	(19)		0.8 (0.4-1.4)	-
>4000	15	2	(13)		0.5 (0.1-2.4)	-
Gender [§]				<0.01		
Male	103	15	(15)		Ref	-
Female	200	49	(25)		1.6 (0.9-2.9)	-
Occupation				0.2		
Farming in own land	73	12	(16)		Ref	-
Farming as a daily wage	109	29	(27)		1.6 (0.8-3.1)	-
Others	121	23	(19)		0.1 (0.5-2.3)	-
Work-related physical activity				0.7		
Sedentary	83	20	(24)		Ref	-
Moderate	189	38	(20)		0.8 (0.4-1.4)	-
vigorous	31	6	(19)		0.8 (0.3-2.0)	-
Smoker [§]				<0.01		
Yes	69	33	(48)		3.6 (2.2-5.8)	-
No	234	31	(13)		Ref	-
BMI				0.4		
Underweight	37	10	(27)		1.0 (0.5-2.2)	-
Normal	87	22	(25)		Ref	-
Overweight	52	9	(17)		0.7 (0.3-1.2)	-
Obese	127	23	(18)		0.7 (0.3-1.2)	-
Abdominal obesity				0.6		
Abnormal	179	36	(20)		0.8 (0.5-1.4)	-
Normal	124	28	(23)		Ref	-
Waist hip ratio above normal				0.8		
Abnormal	169	35	(21)		0.9 (0.5-1.5)	-
Normal	134	29	(23)		Ref	-
Hypercholesterolemia [§]				<0.01		
Yes	141	39	(28)		1.7 (1.0-2.9)	-
No	162	25	(15)		Ref	-
Hypertriglyceridemia [§]				0.3		
Yes	121	29	(24)		1.2 (0.7-2.0)	-
No	182	35	(19)		Ref	-
Low HDL [§]				0.07		
Yes	208	38	(18)		0.6 (0.4-1.0)	-
No	95	26	(27)		Ref	-
High LDL [§]				<0.01		
Yes	130	38	(29)		1.9 (1.1-3.2)	-
No	173	26	(15)		Ref	-
High Total Cholesterol-HDL [§] ratio				0.2		
Yes	179	34	(19)		0.7 (0.4-1.2)	-
No	124	30	(24)		Ref	-
Isolated Hypercholesterolemia [§]				0.1		
Yes	63	18	(29)		1.4 (0.8-2.5)	-
No	240	46	(19)		Ref	-

Contd...

Table 1: Contd..						
Variables	Total (n=303)	High risk (n=64) n (%) %		P#	Crude PR 95% CI	aPR 95% CI
Isolated hyper triglyceridemia [§]				0.6		
Yes	43	8	(19)		0.8 (0.4-1.8)	-
No	260	56	(21)		Ref	-
Isolated low HDL-C [§]				0.01		
Yes	79	9	(11)		0.4 (0.2-0.9)	-
No	224	55	(25)		Ref	-
Metabolic syndrome				0.7		
Yes	147	32	(22)		1.0 (0.6-1.7)	-
No	156	32	(20)		Ref	-
Education				0.01		
Illiterate	159	44	(28)		1.9 (1.1-3.3)	1.8 (1.0- 3.1)
Literate	144	20	(14)		Ref	Ref
Current alcoholic				0.08		
Yes	32	3	(9)		0.4 (0.1-1.3)	0.5 (0.1 - 1.6)
No	271	61	(22)		Ref	Ref
High salt intake				0.1		
Yes	227	53	(23)		1.6 (0.8-3.0)	1.6 (0.8 - 3.3)
No	76	11	(14)		Ref	Ref
Anemia				<0.01		
Yes	207	53	(26)		2.2 (1.1-4.2)	1.8 (1.0 - 3.6)
No	96	11	(11)		Ref	Ref
TSH levels				0.1		
≥10	9	3	(33)		1.7 (0.5-5.6)	1.3 (0.3 - 4.6)
4.5-9.9	29	7	(24)		1.2 (0.5-2.8)	1.3 (0.3 - 4.6)
2.5-4.4	88	17	(19)		0.9 (0.5-1.8)	1.1 (0.6 - 2.2)
<2.5	128	25	(20)		Ref	Ref
Not tested	49	12	(24)		1.2 (0.1-0.2)	1.5 (0.7 - 3.0)
Chronic Kidney disease				<0.01		
Yes	41	15	(37)		1.9 (1.0-3.4)	1.8 (1.0 - 3.4)
No	262	49	(19)		Ref	Ref

PR – Prevalence Risk, aPR – adjusted Prevalence Risk, [§] contributing variables, # Chi-square, bold - significance p<0.05

Table 2: Echocardiographic finding at the end of screening after risk assessment using WHO/ ISH chart in a remote rural area of South India in August and September 2017.

Echocardiography	Number
Left Ventricular Hypertrophy	6
Aortic Valve Stenosis (RHD)	1
Trivial MR, mildly dilated LA	3
Dilated LV, LA	2
Anterior Wall Myocardial Infarction (old) changes	1
CAD severe LV Dysfunction	1
DCM with moderate LV dysfunction	1
DCM with mild LV Dysfunction	1
DCM with Ejection Fraction of 25%	1
Severe mitral stenosis, RHD	1
Total	18

LVDF - Left Ventricular Diastolic Failure, CAD – Coronary Artery Disease, MS – Mitral Stenosis, RHD - Rheumatic Heart Disease, LA – Left Atrium, LV-Left Ventricle, DCM – Dilated Cardiomyopathy

low socioeconomic position were having higher risk behavior for CVDs.^[4] Another concern is even though Indians have good knowledge and attitude on CVD, they have poor practices in adopting healthy lifestyles.^[5] Recent days, modern technologies like smartphones are coming to play in monitoring treatment adherence and educating the public in risk reduction.^[6]

Mean time Indian health system has also taken some earnest steps to prevent CVDs. The important concern in India is providing universal healthcare to the population.^[7] In this, the major challenge is reaching the rural population. In India, more than 70% of the people live in rural areas with limited access to the higher health facilities.^[8] Some studies have shown that even though the rural community has a higher prevalence of cardiovascular risk, in general, they are neglected and the health care delivery system at this level is comparatively poor.^[9] With this background, the government has recently taken some notable steps to provide affordable healthcare to all in need through various commitments. In National Health Policy 2017, government has committed to reverse the growing incidence of noncommunicable diseases (NCDs).^[7] Through sustainable development goals, the government has committed to reduce the premature mortality due to NCDs by one-third by 2030 using various modalities of NCDs prevention and treatment.^[10,11] To support these initiatives, at present in India, NPCDCS (National Programme for Prevention and control of Cancer Diabetes Cardiovascular Diseases and Stroke) is the national health program in place at every level of health care.^[12] Under NPCDCS, a particular day in a week is designated as a NCD clinic day and the patients with common NCDs visit the health center on this day for treatment and follow-up.^[12-14] As per this program,

front line workers and Medical Officers are supposed to assess the CVD risk among the diabetes and hypertensive patients once in year using World Health Organization/International Society of Hypertension (WHO/ISH) chart and appropriate management should be carried out. This WHO/ISH Chart is one of the most widely used and extensively studied tools to predict the cardiovascular disease for the subsequent 10 years of an individual.^[15–18] Charts with cholesterol predict the risk better than charts without cholesterol.^[17] Even though this has been incorporated in the program, only very few studies are available on this topic, particularly in a remote rural population. Hence, we targeted the high-risk people (DM and/or HT) in a rural community in south India and assessed their risk for CVD using WHO/ISH chart and further screened the high-risk patients with electrocardiography (ECG) and echocardiography (ECHO).

Methodology

This study was done in a Rural Health Training Centre (RHTC) which is functioning as per the Medical Council of India directions for teaching and training activities of MBBS students and Interns. This RHTC covers 10 villages around the health center. From the electronic database called CHIMS (Community Health Information Management System) which maintains the health-related details of these individuals belong to the ten villages, patients with diabetes and hypertension were line-listed, approached, and invited to participate in the study.^[19–21] After getting consent, data was collected in the concerned villages of the participants by setting up a camp with a pretested proforma. Plasma and serum were collected at fasting state and transferred to the main campus situated 30 km away, which has the NABL accredited labs (National Accreditation for Testing and Calibration Laboratories). A special consultation was offered to all those participated in the initial screening, on the day of World Heart Day (29th September 2017) at the RHTC. All those who attended were further screened with ECG and then with ECHO on that day and Cardiologist, Diabetologist, Ophthalmologist, and Neurologist consultations were provided. All the investigations, consultations, and medications were provided free of cost as a service to the rural community. A team of eight interns, three Medical Social Workers (MSWs), and one lab technician were trained for 2 days and the data were collected under the supervision of two Assistant Professors from Department of Community Medicine qualified as MD in Community Medicine. *Data entry and analysis:* Data was double entered using Epidata software V.3.1 and analyzed using SPSS Version 22.0. Prevalence ratio (PR) and adjusted prevalence ratio (aPR) were calculated using STATA 14.^[22,23] aPR was calculated for independent variables with significant *P* value < 0.2. WHO/ISH chart uses sex, age, smoking status, blood pressure, and cholesterol as a tool to predict the next 10-year risk of CVDs and these variables and the variables related to cholesterol were omitted for final aPR analysis. A detailed description of screening procedures is described elsewhere.^[24]

Operational Definitions: High risk for CVD—risk $\geq 20\%$ using WHO ISH chart.^[25] *Abdominal obesity:* waist circumference of ≥ 90 cm for men and ≥ 80 cm for women. *Normal waist-hip ratio:* <0.85 for women and <0.95 for men.^[12] *High salt intake per day:* per capita intake of >5 g. *Current smoker:* smoking of any smoke form of tobacco products in the last 1 year. *Current alcoholic:* consumed alcohol at least once in the last 1 year.^[26] *Dyslipidemia:* Defined based on National Cholesterol Education Programme (NCEP) guidelines^[27,28] where *Hypercholesterolemia* as serum cholesterol levels ≥ 200 mg/dl (≥ 5.2 mmol/l), *Hypertriglyceridemia* as serum triglyceride levels ≥ 150 mg/dl (≥ 1.7 mmol/l), *Low HDL cholesterol* as HDL cholesterol levels <40 mg/dl (<1.04 mmol/l) for men and <50 mg/dl (<1.3 mmol/l) for women, *High LDL cholesterol* as LDL cholesterol levels ≥ 130 mg/dl (≥ 3.4 mmol/l), *Isolated hypercholesterolemia* as serum cholesterol ≥ 200 mg/dl and triglycerides <150 mg/dl, *Isolated hypertriglyceridemia* as serum triglycerides ≥ 150 mg/dl and cholesterol <200 mg/dl, *Isolated low HDL-C* as HDL-C ≤ 40 mg/dl (male) and ≤ 50 mg/dl (female) without hypertriglyceridemia or hypercholesterolemia, *Metabolic syndrome based on International Diabetes Federation Global Consensus Definition:* central obesity (waist circumference ≥ 90 cm for men and ≥ 80 cm for women) with two or more of the following four criteria: (i) Triglycerides 150 mg/dl or greater, (ii) HDL-cholesterol <40 mg/dl in men and <50 mg/dl in women, (iii) BP 130/85 mmHg or greater, and (iv) fasting glucose 100 mg/dl or greater.^[29,30] Estimated glomerular filtration rate (eGFR) was calculated using Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation and the participants having eGFR ≤ 60 ml/min/1.73 m² were classified as CKD.^[31] Based on American Thyroid Association and American Association of Clinical Endocrinologists (ATA/AACE) guideline, hypothyroidism was classified as TSH (Thyroid Stimulating Hormone) level (TSH) ≥ 10 - Overt hypothyroidism, 4.5–9.0 - highly abnormal TSH, 2.5–4.4 - intermediate abnormal, and <2.5 as normal).^[32] *Anemia:* hemoglobin <13 mg/dl for men and <12 mg/dl for women (WHO criteria).^[33]

Results

Among the total 303 screened at the village level, 64 [21% (CI 17–25)] were identified as having a high risk for CVD. Relationship between CVD risk and other factors is shown in Table 1. After final adjustment, illiteracy [aPR 1.8 (0.1–3.1)], anemia [aPR 1.8 (1.0–3.6)], CKD [aPR 1.8 (1.0–3.4)] were found to have associated with high risk for CVD among DM and HT individuals. *Among the total of 303, 235 people attended the special consultation and 212 underwent ECG and 88 underwent ECHO, where 18 of them diagnosed to have some cardiac pathologies [Table 2].*

Discussion

Important findings in our study were that first, the CVD risk was found to be two times higher among this high-risk group when compared to the general population.^[17] Second, the CVD risk among the high-risk group was significantly associated with illiteracy, anemia, and CKD.

Association of CVD with anemia is a well-reported fact and one of the reviews done by Kaiyafa *et al.* has found that there is a positive

correlation between anemia and CVDs and the pathophysiology might be due to a complex interaction of iron deficiency, cytokine production, and impaired renal function.^[34] Another review done by Zalunardo and Levin found that anemia contributes to cardiovascular disease in CKD patients.^[35] Like our study where illiterate people seem to be at a higher risk for cardiovascular diseases, other studies also demonstrated people with lower educational status have a higher risk for CVD.^[36,37] Finally, our study also shows that people with chronic kidney disease (CKD) are at a higher risk to get cardiovascular disease. According to a study done by Ballew and Matsushita, CKD management measures such as estimated GFR and albuminuria improve cardiovascular risk prediction beyond traditional risk factors.^[38] The study done by Ma *et al.* postulates that arterial stiffness (AS) is associated with CVD and CKD. It also indicates that arterial stiffness may contribute to the development of CVD in CKD patients suggesting that the pathophysiology indicates a mechanism linking CVD to CKD.^[39] A study done by Liu *et al.* suggests that fibroblast-23, a bone-derived hormone, could be the missing link between CVD and CKD.^[40]

Ours is one of the very few studies done in the rural area of south India, especially among the high-risk individuals for cardiovascular disease. Our study used the standard WHO/ISH chart to predict the CVD risk as recommended by National Guideline. Including cholesterol as one of the indicators strengthened our evidence. Moreover, our study represents the population attributes as we collected the sample having population as base, not hospital based. This study adds more evidence to the association between CVD risk and anemia, poor education, and CKD. This study provides valuable information on promoting screening in the rural areas which have poor accessibility to health care services and also stresses on the importance of strengthening Primary Health Care in the remote rural areas. This study will help the primary care physicians to have an insight on early prediction of CVD risk in rural area. After performing the initial clinical and biochemical screening, ECG and ECHO screenings were performed and consultation was obtained. By targeting the high-risk individuals, we were able to diagnose more people with CVD with a limited resource [Table 2].

This study has few limitations: first, we have assessed CVD risk among the high-risk individual (DM and/or HT patients) only. Screening was done in a population surrounding a particular healthcare setting; hence, generalization should be done cautiously. Providing ECHO and ECG services incurred high cost, which may not be replicable in a resource-constrained setting even though it is fruitful. Finally, only those who showed some changes in the ECG underwent ECHO.

Key message: It is worthwhile to do CVD risk assessment using WHO/ISH chart in clinical and community practice.

Conclusion

Cardiovascular disease risk assessment using WHO/ISH chart showed an association with poor education, anemia, and chronic kidney disease.

Ethics Committee approval was obtained from PIMS ethical committee (Reference Number - RC-18/55).

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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