

Feasibility and Outcome of Community-based Screening for Cardiovascular Disease Risk Factors in a Remote Rural Area of South India: The Chunampet Rural–Cardiovascular Health Assessment and Management Program

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Abstract

Background: As committed by India in Global Action Plan, Sustainable Development Goals and National Health Policy 2017, India has the responsibility to provide accessible, affordable noncommunicable disease care to the people. Our study aimed to find out the burden of cardiovascular risk factors among hypertension and diabetic patients, through a community-based screening, in a remote rural area of South India. **Methods:** A special program named “Chunampet Rural–Cardiovascular Health Assessment and Management Program” (CR-CHAMP) was launched in August and September 2017 in a Rural Health Training Center (RHTC), functioning under a private medical college in South India. In this program, participants with hypertension (HT) and diabetes (DM) were line listed from 10 remote villages, and then history, initial biochemical, hormonal, and hematological screenings were done to assess the cardiovascular diseases (CVDs) risk factors among these patients, following which special consultation was offered in RHTC. **Results:** Out of 415 eligible patients with HT and DM, 389 were approached; among them, 328 were willing to participate and were screened initially; among them, 235 were attended special consultation. Higher CVD risk was found in 21%. Prevalence of chronic kidney disease was 14%, deranged lipid profile was more than 50%, metabolic syndrome was 49%, anemia was 68%, abnormal waist-hip ratio was 56%, abdominal obesity was 59%, and overweight and obesity using body mass index (BMI) was 59%. Females’ participation was more in our community-based screening procedure (66%) than male participation (34%). **Conclusion:** CR-CHAMP demonstrated feasibility and value of implementing a screening program for high-risk individuals with HT and DM for CVD risk through existing primary care in a remote rural area of South India. This will help the National Program and policymakers to plan for interventions in the remote rural area in future.

Keywords: Cholesterol, diabetes, hypertension, public health, screening

INTRODUCTION

As per the latest World Health Organization (WHO) report, cardiovascular diseases (CVDs) are the leading cause of mortality at a global level (31%) as well as in India (27%).^[1] Above this, 78% of all noncommunicable disease (NCD) deaths and 85% of premature adult NCD deaths occur in low and middle income countries.^[1] Among the total NCD deaths, nearly half (47%) of them contributed by major NCDs (CVDs and DM), followed by accidents (20%) and cancer (12%).^[2] The Global Action Plan (GAP) endorses 25% reduction in premature mortality by 2020 and 80% availability of affordable all essential medicines and technologies for NCD

treatment.^[3] As per Sustainable Developmental Goals (SDGs), India has committed to reduce the premature mortality due to NCDs by one third by 2030, using various modalities of NCDs prevention and treatment.^[4,5] The National Health

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How to cite this article: Newtonraj A, Selvaraj K, Purty AJ, Nanda SK, Arokiaraj MC, Vincent A, *et al.* Feasibility and outcome of community-based screening for cardiovascular disease risk factors in a remote rural area of South India: The Chunampet rural–cardiovascular health assessment and management program. *Indian J Endocr Metab* 2019;23:628-34.

Access this article online

Quick Response Code:



Website:
www.ijem.in

DOI:
10.4103/ijem.IJEM_528_19

Policy of India (NHP-India) rolled out in 2017 has thrown more emphasis on reversal of growing incidence of NCDs by preventive and curative approach and integration of NCD diagnosis and management with all levels of health care services. NHP-India also assured free availability of drugs for selected NCDs throughout the year in all health centers, especially at primary health care level.^[6] At present, there is a screening strategy for diagnosis of selected NCDs with the help of ASHAs (Accredited Social Health Activists) and ANMs (Auxiliary Nurses Midwives) at primary care level under NPCDCS (National Program for Prevention and Control of Diabetes Cardiovascular Diseases and Stroke) program. This program also ensures the availability of drugs to major NCDs through NCD clinics. These are the clinics where high-risk individuals for CVDs [Diabetes (DM) and Hypertension (HT) patients] attending. These clinics open up a new opportunity to screen and assess the HT and DM patients for appropriate management and referral at the primary care level itself. This targeted approach at the primary care setting will help in achieving the main goal of SDG, GAP, and NHP-India by reducing premature mortality. This study assesses the feasibility of such targeted screening in a primary care setting. Another important thing is India is a country where about 70% of population lives in rural area. In a recent study conducted in a rural area of South India has estimated high prevalence of cardiovascular diseases (CVDs) risk and therefore raised a question whether rural population India are neglected from getting proper NCD health care services.^[7] Considering all the above facts, our study aimed to find out the burden of cardiovascular risk factors through a community-based screening, in a remote rural area of South India.

METHODS

Setting

Chunampet Rural Health Training Center (RHTC) is an MCI (Medical Council of India) recognized rural health training center for training of undergraduate and postgraduate medical students, which is functioning under Department of Community Medicine under a private medical college named Pondicherry Institute of Medical Sciences (PIMS), Puducherry. This center is located in a remote rural area, about 30 km away from the main campus. This center is functioning with more than 20 medical and paramedical staffs round the clock, providing both hospital-based care and community-based care to the rural community. Apart from this, this center is also functioning along with the Government Primary Health Center (PHC), which is located 100 feet away in terms of delivering government health programs and training interns. This RHTC covers 10 villages around the health center. Individuals residing in these 10 villages are enrolled in an electronic database called CHIMS (Community Health Information Management System).^[8,9] CHIMS also captures self-reported morbidity status like DM, HT, Asthma, etc.

Voluntary screening

In the view of observance of World Heart Day in September 2017, a voluntary screening and management program was launched in August 2017 to screen the high-risk population for various cardiovascular risk factors and the program was named as CR-CHAMP (Chunampet Rural-Cardiovascular Health Assessment and Management Program). Patients with a history of HT and DM were invited to participate in this program. Line of action was divided into two major parts, first was *Line listing and initial screening* of high-risk individuals for cardiovascular risk factors and the second was providing *special consultation* on the day of World Heart Day.

Line listing and initial screening

Line listing of the high-risk individuals was extracted from the already existing electronic database (CHIMS). After line listing, participants were approached house to house and invited to participate in this program, following detailing of the program. Support from village head man also sought to disseminate this information to the participants to participate in this program. Nearby 3 villages (Illedu, Chunampet, and Kavanur) within walkable distances (2 km) were invited to come to the center. For the other distant villages, 2 days of camps were arranged in each village to facilitate these individuals to participate in this program. Oral consent was obtained before participation. Data was collected with a pretested proforma containing (i) demographic details, (ii) family history and common CVDs risk factors including smoking, alcohol, DM, HT, etc., and (iii) investigations including fasting serum for cholesterol profile, urea, creatinine, thyroid-stimulating hormone (TSH), fasting plasma sugar, and blood for hemoglobin. Hemoglobin was tested using Sahli's Hemoglobinometer method in RHTC. Plasma and serum of each patient were collected in a separate tube transferred from the village to RHTC. In RHTC, these samples were centrifuged, separated, and transferred into Eppendorf tubes. Then, the samples were transferred to main campus (PIMS), where rest of the analysis was done. Even though we have facility to analyze the tests in RHTC, samples were transferred to main hospital for better reliability of the test, because the main hospital labs are accredited with National Accreditation for Testing and Calibration Laboratories (NABL) (NABL ref no: MC 2629). Tests were performed using fully Automated Chemistry Analyser (Cobas Integra 400 plus) and Fully Automated Chemiluminescence Analyser (Cobas e411). Creatinine tested by kinetic colorimetric assay based on the Jaffé method, glucose tested by enzymatic reference method with hexokinase, TSH tested based on Sandwich principle, cholesterol and triglycerides by enzymatic-colorimetric method, and HDL and LDL by homogeneous enzymatic colorimetric assay.

Special consultation

After this initial screening, a special consultation was offered to all those participated in the initial screening on the day of World Heart Day (29th September 2017), where the participants were invited to RHTC. Cardiologist, Diabetologist,

Ophthalmologist, and Neurologist consultations were provided. All patients who have attended and unable to attend were linked to Government Primary Health Center's *NCD clinic* for regular medications and follow-up. NCD clinic is a special clinic on every Friday, running under National Health Program (NPCDCS), in every PHCs to manage patients with NCDs coming under their service area. This clinic is mainly attended by patients diagnosed with DM, HT, or CVDs. In Chunampet, NCD clinic is running in Government PHC with the help and support of RHTC interns and doctors. In our study, all the investigations, consultations, and medications were provided free of cost as a service to rural community. Patients required special attention were referred to tertiary hospital (PIMS).

To carry out this program, a team of eight interns, three Medical Social Workers (MSWs), and one lab technician were formed and a 2 days training was imparted regarding data collection, sample collection, separation, labelling of samples, and transport of samples to PIMS. The whole activity was supervised by two Assistant Professors from Department of Community Medicine Qualified as MD in Community Medicine. Ethical Committee approval was obtained from PIMS ethical committee (Reference Number - RC-18/55) as per Indian Council of Medical Research (ICMR) Guideline 2017.^[10] *Data entry and analysis:* Data was double entered using Epidata software V.3.1 and analysis and Chi-square tests were done using SPSS Version 22.0.^[11] Mapping of the villages was done using QGIS Software, Version 2.18.16.^[12]

Operational definitions

Following operational definitions were used while analyzing the data. *Obesity:* for Indian population, BMI 18.5 to 22.9 is normal, 23 to 24.9 is considered as overweight, and BMI of 25 to 29.9 is considered as obese class 1 and ≥ 30 is considered as obese class 2. *Abdominal obesity:* If waist circumference is ≥ 90 cm for men and ≥ 80 cm for women. Waist Hip Ratio (WHR): Normal WHR is < 0.85 for women and < 0.95 for men.^[2] High salt intake was defined as consuming salt more than 5 g per day. Smoking was defined as usage of any smoke form of tobacco products in the last 1 year and current alcoholic was if a person consumed alcohol at least once in the last 1 year.^[13] *Dyslipidemia:* Following definitions were used based National Cholesterol Education Program (NCEP) guidelines,^[14,15] *Hypercholesterolemia*—serum cholesterol levels ≥ 200 mg/dl (≥ 5.2 mmol/l), *Hypertriglyceridemia*—serum triglyceride levels ≥ 150 mg/dl (≥ 1.7 mmol/l), *Low HDL cholesterol*—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*—LDL cholesterol levels ≥ 130 mg/dl (≥ 3.4 mmol/l), *High total cholesterol to HDL-C ratio:* Total cholesterol to HDL-C ratio of ≥ 4.5 , *Isolated hypercholesterolemia:* Serum cholesterol ≥ 200 mg/dl and triglycerides < 150 mg/dl, *Isolated hypertriglyceridemia:* Serum triglycerides ≥ 150 mg/dl and cholesterol < 200 mg/dl, *Isolated low HDL-C:* HDL-C < 40 mg/dl (male) and ≤ 50 mg/dl (female) without hypertriglyceridemia or hypercholesterolemia. *Metabolic syndrome* was

defined based on the International Diabetes Federation Global Consensus Definition, where the individual must have 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.^[16,17] 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.^[18] Based on American Thyroid Association and American Association of Clinical Endocrinologists (ATA/AACE) guideline, hypothyroidism was classified based on TSH (Thyroid Stimulating Hormone) level, where TSH ≥ 10 is classified as Overt hypothyroidism, 4.5–9.0 as highly abnormal TSH, 2.5–4.4 as intermediate abnormal and < 2.5 as normal.^[19] Based on WHO criteria, anemia was classified as hemoglobin < 13 mg/dl for men and < 12 mg/dl for women.^[20]

RESULTS

In a total of 415 cases line listed from CHIMS electronic database, 389 were approached and invited for the screening program. Among the 389 invited, 328 voluntarily participated in the initial screening program (response rate = 84.3% for initial screening), rest were either not available during our visit or were not willing to participate. Among the 328 participated in the initial screening, 235 were visited the RHTC for special consultation (response rate for special consultation = 60.4%), rest were either not interested or unable to attend the special consultation on that specific day due to other commitments.

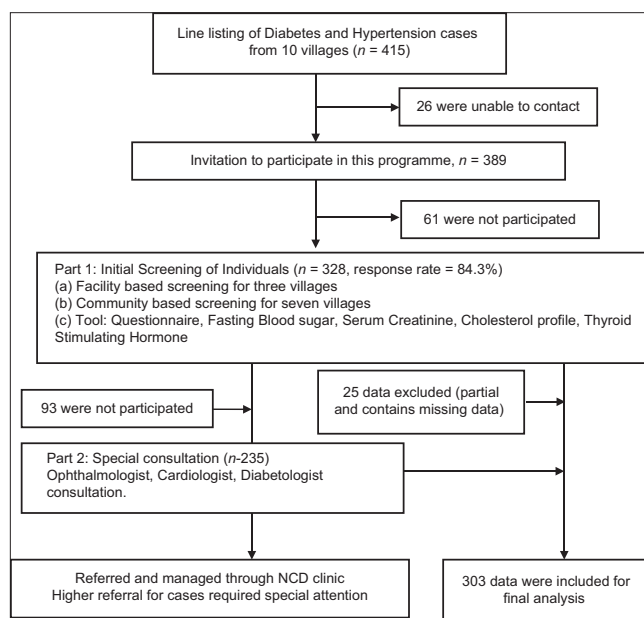


Figure 1: Flow diagram of Chunampet rural-Cardiovascular health assessment and management program (CR-CHAMP)

Table 1: Sociodemographic and laboratory findings of the Diabetes (DM) and Hypertension (HT) patients in a remote rural area of South India: Chunampet Rural-Cardiovascular Health Assessment and Management Program (CR-CHAMP)

Variables n=303	HT only n=102 n (%)	DM only n=76 n (%)	Both DM&HT n=125 n (%)	Overall n=303 n (%)	Chi-square
Gender					0.23
Male	28 (27)	29 (38)	46 (37)	103 (34)	
Female	74 (73)	47 (62)	79 (63)	200 (66)	
Occupation					0.46
Farming in own land	28 (27)	21 (28)	24 (19)	73 (24)	
Farming as a daily wage	34 (33)	24 (32)	51 (41)	109 (36)	
Others	40 (40)	31 (40)	50 (40)	121 (40)	
Education					0.06
Illiterate	59 (58)	31 (41)	69 (55)	159 (52)	
Literate	43 (42)	45 (59)	56 (45)	144 (48)	
Per capita income					0.55
<=2000	67 (66)	51 (67)	85 (68)	203 (67)	
2001-4000	28 (28)	20 (26)	37 (30)	85 (28)	
>4000	07 (7)	05 (7)	03 (2)	15 (05)	
Work-related physical activity					0.01
Sedentary	38 (40)	11 (16)	28 (24)	77 (28)	
Moderate	48 (50)	51 (75)	76 (64)	175 (62)	
vigorous	09 (10)	06 (09)	14 (12)	29 (10)	
Smoker	30 (30)	09 (12)	30 (24)	69 (23)	0.02
Current alcoholic	11 (11)	05 (07)	16 (13)	32 (11)	0.40
BMI					0.56
Underweight	16 (16)	07 (9)	14 (11)	37 (12)	
Normal	26 (25)	23 (30)	38 (30)	87 (29)	
Overweight	18 (18)	18 (24)	16 (13)	52 (17)	
Obese	42 (41)	28 (37)	57 (46)	127 (42)	
Abdominal obesity	57 (56)	45 (59)	77 (62)	179 (59)	0.68
Waist-hip ratio above normal	56 (55)	43 (57)	70 (56)	169 (56)	0.97
High salt intake	79 (78)	49 (64)	99 (79)	227 (75)	0.05
Anemia	68 (67)	44 (58)	95 (76)	207 (68)	0.02
TSH levels					0.98
>=10	04 (04)	02 (03)	03 (03)	09 (03)	
4.5-9.9	10 (10)	7 (09)	12 (09)	29 (10)	
2.5-4.4	31 (30)	22 (29)	35 (28)	88 (29)	
<2.5	39 (38)	32 (42)	57 (46)	128 (42)	
Not tested	18 (18)	13 (17)	18 (14)	49 (16)	
Hypercholestroemia	44 (43)	39 (51)	58 (46)	141 (47)	0.55
Hypertriglyceridemia	33 (32)	33 (43)	55 (44)	121 (40)	
Low HDL	75 (74)	52 (68)	81 (65)	208 (69)	0.37
High LDL	45 (44)	33 (43)	52 (42)	130 (43)	0.92
High Total Cholesterol-HDL ratio	59 (58)	46 (61)	74 (59)	179 (59)	0.93
Isolated Hypercholestroemia	25 (25)	17 (22)	21 (17)	63 (21)	0.33
Isolated hyper triglyceridemia	14 (14)	11 (15)	18 (14)	43 (14)	0.98
Isolated low HDL-C	31 (30)	18 (24)	30 (24)	79 (26)	0.47
Metabolic syndrome	44 (43)	33 (43)	70 (56)	147 (49)	0.09
Chronic Kidney disease	14 (14)	08 (11)	19 (15)	41 (14)	0.64
CVD high risk	13 (13)	05 (07)	46 (37)	64 (21)	<0.01
CVD Risk					<0.01
<10%	60 (59)	60 (79)	52 (42)	172 (57)	
10-<20%	29 (28)	11 (15)	27 (22)	67 (22)	
20-<30%	05 (05)	04 (05)	24 (19)	33 (11)	
30-<40%	02 (02)	00 (00)	08 (06)	10 (03)	
40 and above	06 (26)	01 (01)	14 (11)	21 (07)	

Bold: Chi-square - P<0.05 is significant

Among the data of 328 attended initial screening, 25 data were excluded due to incomplete data and 303 were included for analysis [Figure 1]. Characteristics of patients participated in the study are shown in Table 1. Among 303 analyzed, “HT only” participants were 102, “DM only” participants were 76, and “DM and HT” participants were 125. If a participant is initially listed as known HT but has been newly diagnosed as DM, then while analysis this participant was considered as having both HT and DM and the same for known DM with newly diagnosed HT. Among the studied variables, significant association of HT only or DM only or HT and DM group with CVD risk, anemia, smoking, and physical activity was noted ($P < 0.05$).

DISCUSSION

This is one of a unique study demonstrating the feasibility of CVD risk screening among the high-risk individuals (HT and DM), with the help of existing primary health care setting in a remote rural area of South India. This study demonstrated initial steps in assessing the CVD risk burden. This is a type of translational research (moving from research to practice).

In our study, while assessing CVD risk based on WHO chart, risk score was expected to be higher in this group as HT and DM are one of the predictors while calculating CVD risk. In our study higher CVD risk was found in 21%, which is double when compared to general population.^[21] Prevalence of CKD (chronic kidney disease) was 14% in our study, which is also two times higher than the prevalence in general population of South India (6.3%).^[22] As per Tamilnadu Kidney Research Foundation study, Diabetic Nephropathy is the most common cause in South India (31%), whereas hypertensive nephrosclerosis contributes 13%.^[23] In our study, nearly half of the participants have deranged lipid profile and when compared to a similar study from general population, the prevalence is almost double in all the lipid profile parameters.^[14] Prevalence of metabolic syndrome (MS) is also higher in our study group (49%). This HT, DM, and MS association is a well-established one.^[24,25] TSH level was abnormal ($>=4.5$) among 13% of the individuals. We have included TSH in our study as recent evidences showing hypothyroidism is one of the important risk factors for CVDs.^[19,26] Approximately, 10% of patients with type 1 diabetes mellitus will develop chronic thyroiditis during their lifetime, which leads to the insidious onset of subclinical hypothyroidism.^[19] Anemia was noted in more than two-third of the population (68%). Anemia was more common among the “HT and DM group” when compared to other groups (76%, $P = 0.02$). This is worse than the national data from general population in rural area of South India (56.9% for females and 24.3% for male).^[27] Anemia is one of the major issues in rural population. NCD clinics will get additional opportunity to treat anemia based on national guideline (Iron Plus Initiative- India and Anemia Mukh Bharat).^[28,29] Lifestyle factors like sedentary physical activity during work time (28%), high-salt intake (75%), smoking (23%), and alcohol (11%) were found to be higher

in our study group. Prevalence of sedentary physical activity during work time and smoking were more among the “HT only group” (40%, $P = 0.01$ and 29%, $P = 0.02$). More attention needs to be paid in these aspects while managing these patients for better long-term outcomes.^[30] More than half of the participants were classified as obese in our study (abnormal waist-hip ratio of 56%, abdominal obesity of 59%, overweight and obese using BMI of 59%). This is an alarming risk factor and is two times higher than the general population in the same area (25%).^[27] Females’ participation was higher (66%) in our study when compared to males (34%), maybe because females are available during our house visits and screening camps in the village, whereas most of the males were going out for work. In terms of health care seeking behavior, females prefer local, culturally accepted, and easily accessible facilities. In such situation, our study in rural areas provided additional opportunity to mainstream and reduce gender bias in health care-seeking.^[31] This will also prevent the females from seeking healthcare from illegal medical practitioners.

This screening could be replicated in a similar setting in India and other parts of the world. India being a second populous country, having 70% population in rural area, having more than 600 medical colleges both private and government and having a mandatory Rural Health Training Centers in each medical college as per government norms, most of the steps of this program could be replicable in such settings with the help of affiliated Medical Colleges.^[32] Our study is also an example of public-private partnership in rural area. For the Government Primary Health Centers which are not affiliated with medical colleges, even though entire procedure would not be replicable, most of the initial screening steps could be replicable in their rural setup with the help of grass root level workers [Accredited Social Health Activists (ASHAs) and Auxiliary Nurses Midwives (ANMs)] and with the help of medical team and NCD clinics available in PHCs. Similar to developed countries, our study also strengthens the emerging family medicine concept in India. In this study, lab-based findings not only helped in pharmacological management but also helped to convince and counsel the patients in non-pharmacological managements related to smoking, alcohol, exercise, and diet. This type of accountability to the serving population will have positive impact on reducing mortality and morbidity in future. India being a major contributor of NCDs, this study will help the policymakers to take policy decisions at rural health care level to achieve global and national targets committed in SDG, GAP, and NHP India. This study may also help the policymakers to implement such a similar screening program in RHTCs and PHCs.

An important limitation in our study was entire procedure may not be replicable in other similar settings, as we got extensive support from our medical college. Our study was mainly directed toward finding out additional CVD risk factors among already known HT and DM patients and a 1-day consultation offers a limited treatment. This study has been done only in one RHTC. As a way forward, this initiative may be tried

in multicentric setting in future. Patient's treatment-seeking behavior and response to the treatment could also be studied in future. Future follow-up cohort has been started for these patients to assess the outcome.

CONCLUSION

CR-CHAMP demonstrated the feasibility and value of implementing a screening program for high-risk individuals with CVD risk through an existing primary health care setting in a remote rural area of South India. This will help the National Health Program and policymakers to plan for screening, intervention, and better management of major NCDs in rural India.

Acknowledgement

We acknowledge following interns participated in this program Leeann Esmeralda Zachariah, Goutham Kumar, Kitty Soosan, Sushmita Cherian, Keerty Raj, Kasmira Robin George, Bennet Joseph, Minitta Maria Regy.

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.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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