Wolters Kluwer

Medknow

ISSN 2249-4863

Journal of Family Medicine and Primary Care

www.jfmpc.com

Official Publication of the Academy of Family Physicians of India

Volume 9 / Issue 7 / July 2020

Name of the authors of the painting: Gaby and Marc Gomez,Ibiza, Balearic Islands, Spain
Event Date: April 7, 2020

Submitted by Elena Klusova N.
Specialist in Family and Community Medicine, Spain

jfmpc

Original Article

Prevalence of hypertension and diabetes morbidity among adults in a few urban slums of Bangalore city, determinants of its risk factors and opportunities for control – A cross-sectional study

Vinod K. Ramani[1], Suresh K.P.[2]

[1]Preventive Oncology Unit, Healthcare Global Enterprises Ltd., Bengaluru, Karnataka, [2]National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru, Karnataka, India

Abstract

Introduction: In World Health Organization's(WHO) South-East Asia region(SEAR), India accounts for >2/3rd of total deaths due to non-communicable diseases(NCD). Annually, NCDs account for ~60% of all deaths in India. Apart from the known risk factors, an individual's physical environment, behavioral and biological susceptibility are known to associated with NCDs. Social factors tend to create barriers for accessing healthcare among the poor people. **Objectives:** i)To screen and diagnose hypertension and diabetes among individuals aged >30 years, and its associated risk factors such as obesity and tobacco consumption. ii) To deliberate on the social determinants influencing this survey, and suggest suitable recommendations for the National Programme for prevention and control of Cancer, Diabetes, Cardiovascular disease and Stroke (NPCDCS). **Methods:** As a component of NPCDCS, the present survey was conducted in a few urban slums of Bangalore city during 2010. The collaborators for the conduct of this survey include the Ministry of health and family welfare, Director of health and family welfare services and Medical colleges in Bangalore city. **Results:** In our study, we found a prevalence proportion of 21.5% for hypertension, 13.8% for diabetes and 30.4% were co-morbid with both the diseases. Consumption of tobacco(any form) was present in 5.1% of the study subjects, overweight among 32.4% and obesity among 20.0%. The study population comprises 18.96% of the source, and the main reason for inadequate utilization was lack of Programmatic awareness. **Conclusion:** NPCDCS program needs to conceptualize the relevant social factors which determine access to screening and diagnostic healthcare services, including behavior change initiatives. For Program effectiveness, changes at the level of healthcare system need to adopted.

Keywords: Diabetes, hypertension, NPCDCS, Social determinants, survey

Introduction

In India, non-communicable diseases (NCD) currently account for 60% of all annual deaths which is projected to 66% by 2020.[1]

Address for correspondence: Dr. Vinod K. Ramani, #109, 4th Cross, AGB Layout II, Mahalakshmipuram, Bengaluru – 560096, Karnataka, India.
E-mail: vinodramani77@gmail.com

Received: 08-02-2020 **Revised:** 13-03-2020
Accepted: 24-04-2020 **Published:** 30-07-2020

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_234_20

Indians tend to experience CVD deaths at least a decade earlier than people from developed countries.[2] The high prevalence of communicable diseases among the poor hastens subsequent cardiovascular and nervous system morbidities. Developing countries like India are often limited by population-based data on the burden of hypertension (HTN) and diabetes mellitus (DM), which are crucial for the planning and implementation of relevant prevention and control strategies.

How to cite this article: Ramani VK, Suresh KP. Prevalence of hypertension and diabetes morbidity among adults in a few urban slums of Bangalore city, determinants of its risk factors and opportunities for control – A cross-sectional study. J Family Med Prim Care 2020;9:3264-71.

India accounts for >2/3rd of total deaths due to NCDs in the South-East Asia region (SEAR) of World Health Organization (WHO). Among NCD-related deaths, 45% are due to CVDs (coronary heart disease, stroke, and HTN), 22% are chronic respiratory diseases, 12% are cancers, and 3% are due to DM. During 2014, one in four Indian aged >18 years was a known hypertensive and age standardized prevalence for raised blood glucose was 9%. During 2014, the per capita consumption of pure alcohol among Indians (aged > 15 years) was estimated at 5.2 L/year which is significantly higher when compared with SEAR's average consumption of 3.2 L/year.[3]

The 2010 Global Adult Tobacco Survey (GATS)[4] reports that 35% of adults use tobacco in any form (sniffing, chewing, smoking, application on gums). Among them, 21% adults use smokeless tobacco, 9% use smoke forms, and 5% of adults use both smoke and smokeless forms. These proportions when projected to Indians, a potential 274.9 million tobacco users can be estimated. Reports from the Indian Council of Medical Research (ICMR)[4] study on risk factors for NCD shows that 61% of urban population were sedentary at work when compared with 44.8% among peri-urban and 39.0% among rural areas. Physical activity during leisure time was absent among 84.3% of urbanites, when compared with 87.9% among peri-urbanites and 86.0% among rural dwellers. When compared with WHO standards, >2/3rd of adolescents aged 11–17 years are physically inactive in India.[3] Various reports indicate that 30–65% of adult Indians in urban areas are either overweight (body mass index: BMI ≥25 to <30) or obese (BMI ≥30) or have central obesity. Projection studies estimate that the prevalence of overweight individuals will rise from 12.9% in 2005 to 27.8% by 2030 and for obesity from 4.0% in 2005 to 5.0% by 2030.[4]

Epidemiological transition is the process of shift in disease pattern from communicable to NCD.[2] Susceptibility to NCD could be influenced by gene–environmental interactions, demographic and health transitions, and implications of fetal and early life malnutrition.[5] In recent times, changes in living habits (urban to rural migration) of Indians have transformed behavioral risk factors to biological risk factors. For NCD prevention in India, we require a paradigm shift in approach from addressing individual risk factors to a comprehensive risk factor management.

Social determinants of health include occupation, income, family structure, education, access to healthcare services, hazardous exposures, sanitation, social support, and racial discrimination.[6] Some others such as marginalization, economic inequality, gender expectations, and racial discrimination create chronic stress among individuals, which could hasten the pathology of NCD.

Initially presumed as a disease of the affluent rich who practiced sedentary lifestyle and consumed excessive unhealthy food, NCD have been equivocal in their distribution among the middle and poor classes of the society. As the NCD epidemic matures, a graded reversal is evident across the social gradient. Studies indicate similarity in the prevalence of obesity and hypertension among both illiterate and literate population (subsequent to controlling for age, sex, and geographic location).[7] In a survey among rural dwellers in 45 villages across India, CVD was the cause of death among 32% evidently more than infectious diseases (13%).

Social barriers prevent the poor people from accessing Institutional healthcare. An unmet barrier for accessing care is exists because the technology for screening and diagnosis is institutionalized. Socioeconomic strata significantly influences NCD management, as evident in Thakur J.S. *et al.*'s[7] study reporting the following events among higher and lower strata: percutaneous coronary intervention (15.3% vs. 2.0%) and coronary artery bypass graft surgery (7.5% vs. 0.7%).

Through the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular diseases and Stroke (NPCDCS), outreach camps are being organized at the sub-center level (peripheral units of a primary health center) since October 2010, for opportunistic screening of diabetes, hypertension, oral, breast, and cervical cancer. Subsequent diagnosis will be done at block level hospitals (by-passing the primary health center). Apart from building health system capacities, the program intends to promote civic engagement for health promotional initiatives (behavior modification and lifestyle interventions). The data was reported through a separate surveillance system, and it was planned to integrate this system to a health information platform in the future.[8]

This study includes data from the NCD survey which was conducted as a component of NPCDCS during October to December 2010. Its aim was to estimate the prevalence of DM and HTN and its risk factors such as obesity and tobacco consumption among the residents of a few urban slums in Bangalore city, India. The results of this study will enable the assessment of facilitators and barriers for the implementation of NPCDCS and the relevant recommendations therewith.

Materials and Methods

This initiative was a collaboration between MOHFW-GOI (through their Regional Director's Office) framing the program initiatives, the Directorate of Health & Family Welfare Services, Karnataka State (DH&FWS) (through their Project Directors) coordinating the Program and providing educational materials, Bruhat Bengaluru Mahanagara Palike (BBMP) (through their Chief/City/Zonal Health Officers) acting as nodal agencies involved in community mobilization, and Medical colleges in Bangalore city (totally seven in number) implementing the survey.

The Department of Community Medicine, Rajarajeswari Medical College & Hospital (RRMCH), Bangalore, through its personnel from the outreach health centers at Rotary Muthappa Attavar

Hospital, Channasandra and Rotary Lalithamma Hospital, Agara village coordinated the implementation of the survey. The Institutional Ethics Committee of RRMCH has approved the conduct of the survey.

In this cross-sectional study, 5,119 beneficiaries were screened. The slum areas surveyed include Goripalya, Gangodanahalli, Bapujinagar, Nayandahalli, Avalahalli, Azadnagar, Gavipuram – Guttahalli, Govindrajanagar, and Uttarahalli. The survey was scheduled for 10 consecutive weeks during the following days: Wednesday to Saturday from 2 to 6 pm and on Sundays from 10 am to 1 pm. The screening activities at the notified slums were conducted by mobile clinics comprising of a trained doctor and paramedical personnel.

Estimated target population (as per the Program guideline)

- Slum dwellers were estimated to constitute 23.5% of the City's population (Census of India 2001),
- Out of this source population, ~50% were ≥30 years age and ~50% of this population were expected to participate in the study,
- As per 2011 census, Bangalore's population was 57,01,446 and its slum dwellers were 14,26,362,
- As per BBMP's 2009 survey, our Institute was allotted 9 slum areas. The total population was 1,08,131, and we were expected to screen 27,000 beneficiaries.

Material

The Medical College provided the manpower for survey, logistics such as BP apparatus, transport services (for healthcare team), and computers for data entry. MOHFW-GOI provided the glucometers, glucose strips, lancets, and stationaries. DH&FWS through their funds from National Health Mission (NHM) provided confectionaries for the Medical college team. The City Nodal Officer, BBMP, provided training to the health teams. Link workers from BBMP UFWCs performed information, education, communication (IEC) activities, mobilized the beneficiaries, and guided the health teams in the outreach areas. Informed consent was taken from the beneficiaries for examination of blood glucose.

HTN classification[9]

Joint National Committee VII criteria (National Heart Lung Blood Institute-NHLBI): for age >18 years

Category	BP (and/or)
Normal	<120/<80
Pre-HTN	120-139/80-89
Stage I	140-159/90-99
Stage II	≥160/≥100

During the survey, capillary whole blood (instead of venous plasma) level was used for screening of blood glucose at the outreach areas. During the screening component of the survey, glucometers (not semi auto-analyzers) were used for blood glucose assessment. For glucometer readings, evidence from the research findings of Dr. Mohan's Diabetes research Foundation, Chennai, India provides the following values:

Cut-off values for diagnosis of diabetes using glucometer

Capillary whole blood	Glucose level (mg/dl)
Fasting	≥126
Post-prandial	≥220
Random	≥140

DM Classification[10]

American Diabetes Association (ADA) guideline for Diabetes:

1. Symptoms of Diabetes + Casual Plasma glucose concentration ≥200 mg/dl,

(Casual means any time of the day without regard to time since last meal),

2. Fasting plasma glucose ≥126 mg/dl, (Fasting means no calorie intake for at least 8 h),
3. 2 h plasma glucose during Oral Glucose Tolerance Test ≥200 mg/dl (Glucose tolerance as per WHO criteria)
4. HbA1c ≥6.5%.

People with high blood pressure and high blood sugar measured on their first reading (using BP apparatus and glucometer, respectively) were referred from the outreach areas to the nearest Urban family welfare center (UFWC). The link workers from BBMP initially line listed these potential hypertensives and diabetics, and subsequently navigated them for clinical and biochemical assessment at the earliest convenient opportunity. The average of two BP recordings was used for the diagnosis of hypertension (JNC criteria VII), and fasting and post-prandial blood sugar assessment (ADA guidelines) was done using a semi-auto-analyzer at UFWC.

Patients with uncontrolled HTN and DM were given referral cards at the UFWC and were duly referred to the nearby Government Hospitals (Victoria, Bowring, K.C. General, Jaynagar General Hospital).

Obesity I guideline (from NHLBI)[9]

- Underweight: <18.5 kg/m^2,
- Normal: 18.5–24.9 kg/m^2
- Overweight: 25–29.9 kg/m^2,
- Obesity I: 30–34.9 kg/m^2,
- Obesity II: 35–39.9 kg/m^2,
- Extreme obesity: ≥40 kg/m^2

Statistical methods: Descriptive analysis of data presents continuous measurements as mean and standard deviation (min–max), and categorical measurements as proportions (%). Chi-square/Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups. One proportion Z test has been performed under the binomial assumption of 0.5 for frequency distribution of the variables.

Table A.1: Distribution of personal characteristics among the study subjects

Sl. No.	Characteristics	Number of subjects (%)
1	Age (years)	
	<20	3 (0.1)
	21-30	720 (14.1)
	31-40	1678 (32.8)
	41-50	1314 (25.7)
	51-60	776 (15.2)
	61-70	498 (9.7)
	71-80	111 (2.2)
	>80	199 (0.37)
	Mean ± SD:	44.99 ± 12.53
2	Gender	
	Male	1168 (22.8)
	Female	3951 (77.2)
3	H/o Tobacco use	
	Absent	4856 (94.9)
	Present	263 (5.1)
4	Family history of Diabetes, Hypertension and Heart disease	
	Diabetes	127 (2.5)
	Hypertension	129 (2.5)
	Heart disorder	13 (0.3)
5	BMI distribution (kg/m^2)	
	Normal (<25.0)	2433 (47.6)
	Overweight (25-30)	1660 (32.4)
	Obesity (>30.0)	1026 (20.0)
Total		5119

Results

Table A.1 depicts that one-third (32.8%) of the study population were in 31–40 year age group and 25.7% comprised the 41–50 year group. 77.2% of the study cohort were females, and only 5.3% recollected their family history of NCDs. 5.1% of the subjects consumed any form of tobacco. 32.4% of them were overweight and 20.0% were obese.

Table A.2 shows a prevalence proportion of 21.5% for HTN, 13.8% for DM, and 30.4% for comorbidity with both illnesses.

Table A.3 reports equivocal association for HTN among all age groups, and thus no inference can be drawn regarding their relative predisposition. Similar inference is applicable to DM also, but only the elderly population (>70 years) did not show any association. Males were significantly predisposed to independently developing HTN or DM. Consumption of tobacco was significantly associated with HTN but not with DM. Family history of DM and/or HTN was significantly associated with either of the morbidities. Either being normal weight or obese was significantly associated with both the morbidities. However, obesity was profoundly found to cause HTN or DM.

Discussion

Our study population includes individuals ≥30 years of age. Phase I of ICMR-INDIAB diabetes study by Anjana R.M.

Table A.2: Morbidity of non-communicable diseases

Sl. No.	Morbidity	Number of subjects (n=5119) (%)
1	Hypertension	
	Absent	4019 (78.5)
	Present	1100 (21.5)
2	Diabetes mellitus	
	Absent	4411 (86.2)
	Present	708 (13.8)
3	Diabetes and Hypertension	
	Absent	3565 (69.6)
	Present	1554 (30.4)

et al.[11], Khadilkar H.A. *et al.*'s[12] and Satman Ilhan *et al.*'s[13] studies include individuals ≥20 years. Maher D *et al.*'s[14] study includes individuals ≥13 years of age.

The prevalence proportion of HTN in our study was 21.5%, DM was 13.8%, and comorbid with both illness was 30.4% [Table A.2]. Reports for 2016–17 from NCD clinics pan-India in the NPCDCS[8] show a prevalence proportion of 12.09% for HTN, 9.7% for DM, 0.55% for CVD, and 0.17% for common cancers (oral, cervical, breast). Anjana R.M. *et al.*[11] reported DM prevalence of 8.4%, 10.4%, 5.3%, and 13.6% in different states of India. The prevalence of HTN was 22.0% in Maher D *et al.*'s[14] and 5.92% in Khadilkar H.A *et al.*'s[12] study. Satman Ilhan *et al.*[13] in the Turkish Diabetes Epidemiology (TURDEP) study reported a prevalence of 29% for HTN, 22% for obesity, 7.2% for DM, and 6.7% of impaired glucose tolerance. Thankappan *et al.*[15] reported a DM incidence of 14.9% for the intervention and 17.1% for the control groups. Bansal S *et al.*'s[16] study reported a HTN prevalence of 32.3%.

In our study, beneficiaries moved through a vertical healthcare landscape. However, epidemiological assessment by the capture–recapture (CR) method done in Gill G.V *et al.*'s[17] study enables the assessment of hidden diabetes, which provides insights to the conceptualization of future prevention programs. During 2016-17, sub-center level data from health camps in NPCDCS[8] report that the individuals screened positive for DM were 8.4%, HTN were 8.7% and common cancers were 0.2%. The Program also reports counseling ~ 7.9 million people on health promotional measures.

In our study, males were significantly predisposed to independently developing HTN or DM. Age shows an equivocal association with either of the morbidities, and tobacco consumption was significantly associated with HTN but not with DM. The attribute family h/o DM and/or HTN, and the variable either being normal weight or obese were significantly associated with either of the morbidities [Table A.3]. Anjana R.M *et al.*'s[11] study reports a significant association with DM for age, male sex, generalized obesity, abdominal obesity, HTN, and family h/o DM. Maher D *et al.*[14] reported an association with BMI and increasing age for HTN. Khadilkar H.A *et al.*[12] also reported an association between age and HTN. Satman Ilhan *et al.*'s[14] study

Table A.3: Correlation of baseline variables with incidence of HTN and DM

Variables	Total number of subjects	Hypertension			Diabetes		
		Number	Incidence (%)	*p*	Number	Incidence (%)	*p*
Age (years)							
<30	723	31	4.3	<0.001**	22	3.0	<0.001**
31-40	1678	219	13.1	<0.001**	138	8.2	<0.001**
41-50	1314	324	24.7	0.005**	237	18.0	<0.001**
51-60	776	263	33.9	<0.001**	174	22.4	<0.001**
61-70	498	206	41.4	<0.001**	113	22.7	<0.001**
71-80	111	48	43.2	<0.001**	22	19.8	0.067+
>80	19	9	47.4	0.006**	2	10.5	0.676
Gender							
Male	1168	278	23.8	0.056+	187	16.0	0.029+
Female	3951	822	20.8	0.284	521	13.2	0.274
H/o tobacco							
Absent	4856	1017	20.9	0.308	669	13.8	1.000
Present	263	83	31.6	<0.001**	39	14.8	0.638
Family history							
Diabetes	127	39	30.7	0.006**	30	23.6	0.001**
Hypertension	129	50	38.8	<0.001**	30	23.3	0.002**
Heart disorder	13	3	23.1	0.888	1	7.7	0.523
BMI(kg/m^2)							
Normal (<25.0)	2433	480	19.7	0.032*	267	11.0	<0.001**
Overweight (25-30)	1660	358	21.6	0.920	243	14.6	0.344
Obesity (>30.0)	1026	262	25.5	<0.002**	198	19.3	<0.001**
Total	5119	1100	21.5	-	708	13.8	-

found an association for HTN with being a female and for DM with increasing BMI, age, family h/o DM, and HTN. Bansal S.K *et al.*[16] report increasing age and high BMI as independent predictors of HTN.

The low purchasing power of poor in urban slums directly impacts their eating habits. It deprives their quality of life, which has an indirect psychosocial effect (hesitation) toward seeking healthcare. This creates barriers for the uptake of health promotion programs addressing their risk behaviors. Studies[7] indicate that the social determinants of health have a larger impact on NCD, as compared with behavioral risk factors. Daivadanam *et al.*[18] in their evaluation of Kerala Diabetes Prevention Program (KDPP) report the determinants of unhealthy lifestyle changes as misconceptions related to the risk, cultural barriers to access healthcare, inability to purchase healthcare, and low self-efficacy for behavioral change.

Rising NCD morbidity could impede the achievement of United Nations millennium development goals (MDG) as it is closely linked with MDG 2, 4, 5, 6, and 8e. Mondal S *et al.*[19] discuss the MoHFW's focus areas on NCDs during the SDG (Sustainable development goal) era, which include a shift in approach from treatment to locally led prevention initiatives, increasing civic accountability, and multisectoral cooperation. WHO's action plan for global strategies on NCD prevention and control activities during 2008–13,[20] provides guidelines for India's multi-sectoral framework for NCD related activities. Such actions include collaborative initiatives by the Government with non-governmental organizations (NGO), private sector, civil society, media and social service organizations. A good example of horizontal integration in the Indian public sector includes the MoHFW's "Inter-ministerial task force for Tobacco control."[20] This has representation from other Ministries such as: Information and broadcasting, Industrial policy and promotion, Agriculture, Commerce, Labor, Revenue, Rural development, Food standards and safety authority of India, Drug controller General of India and some civil society members.

In India, HRIDAY-CATCH[20] (Child and adolescent trial for cardiovascular health) during 1996–98 and MYTRI[20] (Mobilizing youth for tobacco related initiatives in India) during 2002–07 are the prominent tobacco related randomized trials which focus on worksite CVD wellness interventions. MARG[20] (Medical education for children/adolescents for realistic prevention of obesity and diabetes and for healthy ageing) is a school based intervention, which has found significant association between promoting intake of healthy food, reduced consumption of energy dense foods, involvement in outdoor physical activity with improvement in glycemic and lipid profiles. Zahra *et al.*[21] reported that among a cohort of KDPP participants, 68% were very interested in participating in group based lifestyle interventions for DM and such activities reached 41% and 31% of participants in the walking and yoga training group, respectively. Thankappan *et al.*[15] reported a significantly greater reduction in Indian Diabetes Risk Score (IDRS) and alcohol use among the behavior intervention participants, along with increase in fruit and vegetable intake and a favorable physical

functioning score on health-related quality of life (HRQoL) scale. Mathews *et al.*[22] reported the gap between research and action as an impediment for DM control programs in India, and that effective uptake of Program can be enabled by implementing evidence-based behavior change techniques. The North Karelia Project in Finland[20] successfully reduced the CVD risk factors at the community level. The approach was multi-sectoral including relevant policies such as regulation of tobacco and shift in agricultural practices towards low-fat produce.

Lall D. *et al.*'s[23] study address barriers to provide quality care for chronic conditions. The high workload of a Public sector Doctor impedes any opportunity for patient counseling at the point-of-care. Other staffs at the health facility need to be designated with supportive tasks, for the better management of chronic conditions at the primary care level. This enables building their capacities and off-loads tasks from the Specialist hospitals.

Correia J.C. *et al.*'s[24] review shows the variety and complexity of approaches that have been tested to address HTN and DM in low and middle income countries (LMIC). This study addresses the WHO package of Essential NCD interventions (WHO PEN) for primary care in low resource settings with special focus on the integrated management of the burden of HTN and DM. Since the interventions are multi-component and complex, and other research studies provide little information on implementation processes, study designs should include process evaluations rather than just outcome evaluations.

Engel N. *et al.*[25] report the disconnect between Providers and patients during patient encounters, as barriers for completion of the test and treat cycle. They also note the lack of professional camaraderie among Provider peers in the locality. Yellapa V *et al.*[26] report that patients undergo laboratory testing only when appropriately counseled by the Provider. Given the complex healthcare landscape, Lall D. *et al.*[23] propose adapting the health information system for ensuring the continuity of care and supporting self-management by the patients. NPCDCS can improve patient management at point-of-care through supportive supervision of Providers, for ensuring adherence to diagnostic and treatment protocols.

Raban Magdalena Z *et al.*[27] report that among the core indicators for biological risk factors recommended by WHO, some of the National and sub-National surveys in India do not use standard definitions for indicators. Krishnan Anand *et al.*[28] propose the constructs of M & E for NPCDCS wherein different timeframes need to be considered for fixing targets for each indicator. The Program could retrieve information from the established research infrastructure and national household health surveys.

Thematic analysis of data from qualitative studies conducted by Elias *et al.*,[29] reveals that a large number households access care for chronic diseases from private healthcare facilities. The reasons include lack of laboratory facilities (>70% of PHCs) and regular stock-out of medicines in the public sector (>60% of PHCs). The Program should consider the WHO Global Action Plan and Monitoring Framework,[29] which proposes an availability of at least 80% essential medicines including generics and affordable basic technologies in both Government and private facilities for the treatment of NCDs.

Limitations of the Study

1. Alcohol as a behavioral risk could not be assessed during the survey as it was not included in the proforma provided by DH&FWS. Qualitative component of the study includes a random survey of beneficiary opinions, however a structured focus group discussion or key informant interview were not conducted,
2. The cumulative data from NPCDCS reported vertically through the health system creates a gap of knowledge and translation. It hardly measures the process level indicators. This compounds the already existent "know-do" gap,
3. Each health team was expected to screen 150 individuals/day. Ideally, 60–70 people could be screened per day and beneficiaries did not turn out in the expected numbers,
4. Some Government departments in the non-health sector fail to understand their role in NCD prevention and perceive the domain as strictly restricted to the health sector. This belief tends to absolve their ownership of health and related promotional initiatives.

Conclusion and Recommendations

WHO's health report of 1998 states that HTN ranks fourth considering the prevalence of any disease in the World.[12] The DM burden in India ranks second in the Globe.[28] The increasing morbidity due to HTN and DM could be attributed to the changing lifestyle and the social environment.

Only 18.96% of the source population could be screened in our study. The study subjects disregard the effectiveness of interventions and treatment modalities in the public sector. NPCDCS should counter this unmet need by streamlining the supply chain systems and providing quality training to the manpower. NPCDCS needs to factor the Private Practitioners, alternative medicine Practitioners (ayurveda, unani, sidda, homeopathy) as empanelled Providers, faith healers, formal and informal leaders in the community as lay reporters, respectively. This will reduce the false propaganda of the Program. Involvement of the Gram Panchayat (rural administrative unit at village level in India) leaders and members will enable strong political will, wherein public health action takes precedence over trade interests.

Training programs should focus on the continuum of care approach for chronic disease management, and that divergent practices will result in fragmented care. Multi-speciality services in the private sector enable provision of integrated care under one roof, closer to the residential locality of the community. However, referral hospitals in the public sector are uniquely located in District/Taluk headquarters, and traveling involves

direct and indirect costs (due to loss of daily wages) for patients. The Program should establish referral linkages and incentivize patient navigation.

Lifestyle changes are proven measures to effectively reduce the risk of Type 2 DM.[28] K-DPP program[15,18,21,22] shows that lifestyle behaviors among high-risk individuals need to be addressed through group-based community DM/HTN prevention programs. The awareness initiatives in NPCDCS should project the lifestyle of individuals from their community who had a premature death due to NCDs. Behavior change communication (BCC) methods should include targeted campaigns, peer support leaders should be nominated for promoting lifestyle changes and communities need to be empowered for actively seeking healthcare services. Legislation in the form of building walking lanes and play grounds is essential, to enable a supportive physical environment.

The Program should consider social barriers for women when promoting certain lifestyle interventions such as physical activity and prudent diet. Many women in patriarchial Indian families lack resources for health promotional behaviors. Working women are positive deviants for accessing healthcare as a result of informed decision making in their workplaces.[30] The program could target ~ 120 million children[20] from impoverished background studying in Anganwadi centers for nutritional interventions. This will benefit their physical and mental growth as well as inculcate healthy food eating habits.

In India, the private sector sources healthcare to > 80% of outpatients and > 40% of inpatients. Healthcare expenditure is ~ 4.2% of GDP, with the public sector contributing ~ 30% of this expenditure. ~10% of the Indian population are covered by health insurance and 90% of the total expenditure on private healthcare is through out-of-pocket payment.[7] The private sector has long been alleged of providing expensive and syndromic care. NPCDCS will benefit from the "Yeshaswini" micro-insurance scheme and the new initiative "Arogya Karnataka-Ayushman bharat," which ensures entitlement of a universal health benefit package to the family including essential NCD care. Supply of combination medicines in the Program will ease the load of consuming multiple drugs by the patients. Availability of generic drugs at public sector hospitals is a current path-breaking initiative. Hospitalization costs could be reduced by altering NCD care practices such as pay-for-service models and day care hospitalization.

Interventions of NPCDCS should factor the social determinants such as educational status, aging of the population, influence of mass media, technological revolution, values nurtured by the society and quality of life, which contribute to the rising NCD burden in India. Capacity building of health facility includes training of health workers, screening and diagnostic algorithms, streamlining demand-supply chain system, patient counseling sessions and data accountability. The Program's success depends on effectively addressing manpower issues, delineating referral linkages, incentivizing patient navigation, universal health coverage for secondary and tertiary level treatment, and involving link workers in the follow-up of patients.

What is already known?

NPCDCS program's focus is on cardiovascular disease, diabetes, cancer and stroke. This study will enable the baseline health assessment of the urban poor with focus on DM and HTN and their risk factors.

What this study adds?

NPCDCS needs to conceptualize the fabric of community living and social factors influencing health behavior. Unlike treating acute conditions, addressing chronic health conditions needs a harmonious and sustained health system approach.

Acknowledgement

- State Surveillance unit, DH & FWS, Karnataka, India,
- Management, Administrative unit, Interns (2010-11) of RRMCH, Bangalore, India,
- Prof.Daniel Goldstein: Practicum Coordinator, Univ. of Massachusetts – School of Public health and health sciences, Amherst, USA
- Sampath, Suresh, Parashivamurthy, Vinay, Gunasheela, Jayalakshmi, Chinnappa, Mahesh, Prabhu and other health workers from Dept. of Community Medicine, RRMCH, Bangalore,
- Link workers of concerned UFWCs, Bangalore.

Financial support and sponsorship

- Ministry of Health and Family welfare, Government of India
- Directorate of Health and Family welfare services, Karnataka, India

Conflicts of interest

There are no conflicts of interest.

References

1. Thakur, JS. Emerging epidemic of non communicable diseases – An urgent need for control initiative. Indian J Community Med 2005;30:103.
2. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: Part I: General considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation 2001;104:2746-53.
3. Available from: http://www.searo.who.int/india/topics/noncommunicable_diseases/ncd_situation_global_report_ncds_2014.pdf. [Last accessed on 18 Oct 24].
4. Mathur P, Shah B. Research priorities for prevention and control of Non-communicable diseases in India. Indian J Community Med 2011;36:S72-7.

5. Reddy KS, Prabhakaran D, Chaturvedi V, Jeemon P, Thankappan, KR, Ramakrishnan L, *et al.* Methods for establishing a surveillance system for cardiovascular diseases in Indian industrial populations. Bulletin WHO 2006;84:461-9.
6. Krieger N. A glossary for social epidemiology. J Epidemiol Community Health 2001;55:693-700.
7. Thakur JS, Prinja S, Garg CC, Mendis S, Menabde N. Social and economic implications of non-communicable diseases in India. Indian J Community Med 2011;36:S13-S22.
8. Available from: http://www.nrhmhpgov.in/sites/default/files/files/NCD_Guidelines.pdf. [Last accessed on 18 Oct. 14].
9. National High Blood Pressure Education Program. National Institute of Health. Available from: www.nhlbi.nih.gov. [Last accessed on 18 Oct. 14].
10. American Diabetes Association. Available from: www.diabetes.org, last accessed on 10/14/18.
11. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, *et al.* Prevalence of diabetes and pre-diabetes in Urban and rural India: Phase I results of the Indian Council of Medical Research – India Diabetes (ICMR – INDIAB) study. Diabetologia 2011;54:3022-7.
12. Khadilkar HA, Ghattargi CH, Thite GH. Study of prevalence of hypertension and sociodemographic factors in a rural community of Maharashtra. South Asian J Prevent Cardiol 2004;8.
13. Satman I, Yilmaz T, Sengül A, Salman S, Salman F, Uygur S, *et al*. Population based study of Diabetes and Risk characteristics in Turkey – Turkish diabetes epidemiology study (TURDEP). Diabetes Care 2002;25:1551-6.
14. Maher D, Waswa L, Baisley K, Karabarinde A, Unwin N. Epidemiology of hypertension in low income countries: A cross-sectional population based survey in rural Uganda. J Hypertens 2011;29:1061-8.
15. Thankappan KR, Sathish T, Tapp RJ, Shaw JE, Lotfaliany M, Wolfe R, *et al.* A peer-support lifestyle intervention for preventing type 2 diabetes in India: A cluster randomized controlled trial of the Kerala Diabetes prevention program. PLOS Medicine 2018;15:e1002575.
16. Bansal SK, Saxena V, Kandpal SD, Gray WK, Walkar RW, Goel D. The prevalence of hypertension and hypertension risk factors in a rural Indian community: A prospective door-to-door study. J Cardiovasc Dis Res 2012;3:117-23.
17. Gill GV, Ismail AA, Beeching NJ, Macfarlane SBJ, Bellis MA. Hidden diabetes in the UK: Use of capture-recapture methods to estimate total prevalence of diabetes mellitus in an urban population. J R Soc Med 2003;96:328-32.
18. Daivadanam M, Absetz P, Sathish T, Thankappan KR, Fisher EB, Philip NE, *et al.* Lifestyle change in Kerala, India: Needs assessment and planning for a community based diabetes prevention trial. BMC Public Health 2013;13:95.
19. Mondal S, Van Belle S. India's NCD strategy in the SDG era: Are there early signs of a paradigm shift? Global Health 2018;14:39.
20. Arora M, Chauhan K, John S, Mukhopadhyay A. Multi-sectoral action for addressing social determinants of non-communicable diseases and mainstreaming health promotion in National health programmes in India. Indian J Community Med 2011;36:S43-9.
21. Aziz Z, Mathews E, Absetz P, Sathish T, Oldroyd J, Balachandran S, *et al.* A group-based lifestyle intervention for diabetes prevention in low and middle income country: Implementation evaluation of the Kerala Diabetes Prevention Program. Implement Sci 2018;13:97.
22. Mathews E, Thomas E, Absetz P, D'Esposito F, Aziz Z, Balachandran S, *et al.* Cultural adaptation of a peer-led lifestyle intervention program for diabetes prevention in India: The Kerala diabetes prevention program (K-DPP). BMC Public health 2017;17:974.
23. Lall D, Engel N, Devadasan N, Horstman K, Criel B. Challenges in primary care for diabetes and hypertension: An observational study of the Kolar district in rural India. BMC Health Serv Res 2019;19:44.
24. Correia JC, Lachat S, Lagger G, Chappuis F, Golay A, Beran D, *et al.* Interventions targeting hypertension and diabetes mellitus at community and primary healthcare level in low and middle-income countries: A scoping review. BMC Public Health 2019;19:1542.
25. Engel N, Ganesh G, Patil M, Yellappa V, Pai NP, Vadnais C, *et al.* Barriers to Point-of-care testing in India: Results from qualitative research across different settings, users and major diseases. PLoS One 2015;10:e0135112.
26. Yellapa V, Devadasan N, Krumeich A, Pai NP, Vadnais C, Pai M, *et al.* How patients navigate the diagnostic ecosystem in a fragmented health system: A qualitative study from India. Global Health Action 2017;10:1350452.
27. Raban MZ, Dandona R, Dandona L. Availability of data for monitoring non-communicable disease risk factors in India. Bull World Health Organ 2012;90:20-9.
28. Krishnan A, Gupta V, Ritvik, Nongkynrih B, Thakur JS. How to effectively monitor and evaluate NCD programmes in India. Indian J Community Med 2011;36:S57-S62.
29. Elias MA, Pati MK, Aivalli P, Srinath B, Munegowda C, Shroff ZC, *et al.* Preparedness for delivering non-communicable disease services in primary care: access to medicines for diabetes and hypertension in a district in south India. BMJ Glob Health 2018;2:e000519.
30. Available from: https://aif.org/the-social-determinants-of-ncds/. [Last accessed on 18 Nov 23].