Original Article

e Health initiatives for screening and management of hypertension in Rural Rajasthan

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Abstract

Context: Electronic health (e health) initiatives are being employed in various health programs for disease monitoring. Very few such studies have been conducted in India, so this study was planned. **Aims:** Assess feasibility and usefulness of e health interventions for health workers, ASHA (accredited social health activist) in screening and management of hypertension. **Setting and Design:** Prospective observational cohort study. ASHA's were recruited in two selected villages of Rajasthan and trained to use this technology. **Methods and Material:** A web-based application was developed for use on portable device (tablet) to screen and diagnose hypertension, provide health education focused on diet, physical exercise and promote adherence to therapies by repeated sessions of one-to-one health education. Statistical analysis was done by Excel. **Results:** With the use of e health initiatives, among population above 18yrs, we found 19.1% hypertensives (464/2430) with 46.5% new cases of hypertension and 38.9 % (945/2430) prehypertensive. Mean age of hypertensives was 52.6 yrs. ± 15.2 and 36.8 yrs. ± 14.2 for prehypertensive and highly significant ($p < 0.001$). Mean systolic blood pressure level of hypertensives decreased from 147.14 Hg ±13.86 to 133.3 Hg ±13.07 and for prehypertensive from 123.18 mm Hg ± 4.5 to 117.55 mm Hg ± 6.9 after follow up, the difference in change was highly significant ($P < 0.001$). Also, could start 27.4% hypertensives on treatment, while 50.2% were already on treatment. **Conclusion:** Training ASHA worker in e health technology is feasible and can assist in screening and management of diseases.

Keywords: Hypertension, Prehypertension, e health, App, ASHA, Rural

Introduction

E-health refers to the use of information and communication technology within healthcare environments. It also includes initiatives on mobile phones, tablets, and other e-health initiatives.

The utilization of Information and Communication Technologies, as in e-health, can improve reach to quality health care and enhance the quality of health-related data, especially in developing countries.[1,2]

This study is an attempt to see the changes a technologically equipped grass-root level health worker can do in bringing down the burden of hypertension in rural India. Through this study, we aim to use e-health in screening and providing timely intervention for hypertension and prehypertension. We used conventional methodologies, such as digital BP apparatus, to screen and diagnose patients, as well as e-health initiatives in surveillance and management.

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Methods

This prospective observational cohort study was approved by the Ethics Committee, S.P. Medical College and A.G. Hospital, Bikaner on June 2, 2015. Written informed consent was obtained from participants.

Location

Two villages with difficult approach and inadequate health services were identified: Lakhesra and Kapurwala.

Study population

The total population covered under this study was 3,853. ASHA's of the concerned villages were identified and contacted.

Study conduct

The study was conducted in three steps in one year.

Vanguard phase (1 month)

All aspects of the protocol were refined and tailored, development of an android application for tablet, development of training module for ASHA, final training, and standardization of methods.

Recruitment phase (3 months)

After taking written informed consent from the head of all households, all individuals of the village were recruited and underwent detailed baseline assessments. We numbered all the households starting from the entry point of the village consecutively. Initial cross-sectional analysis using baseline data was initiated.

Follow-up phase (8 months)

Follow-up of all hypertensive and prehypertensive subjects (above 18-years old) every month for up to 1 year of the beginning of the project (i.e., 8 months) to document any changes in their health profile and educate them about their diet, physical activity, increase awareness among them about complications of these disease states through videos in our app and our monthly specialist visits and follow them for the compliance of these, in addition to making them aware of the need for regular treatment and removing their myths about the disease and treatments and tracking their compliance with treatment.

E-health application (Health smart app)

An android-based application was designed and used on tablets. It has some pop-up videos for information and education on the relevant problem. These pop-up videos automatically appear for the health education of the participants as soon as the app identifies the risk, e.g., on a high BMI (obesity), W/H ratio, high blood pressure, high blood sugar (diabetes), and anemia.

There were various types of questionnaires in the application.

The questionnaire consisted of various parts:

Community (village) Profile Questionnaire

Family level forms

- Family Census – records demographic information, tobacco use, education, and morbidities in all inhabitants of the household.

- Household Questionnaire – covers domains related to house structure, amenities, access to water, and sanitation

Individual-level forms/measurements

- Records information about lifestyle-related diseases, maternal and child health, and different morbidities.

- Physical measures: Blood pressure (above 18 years), height, weight, heart rate, and waist circumference.

- Blood sample: For blood sugar determination (fasting) by glucometer and Hb estimation by Hemoglobin color scale strips.

The health worker (ASHA) was provided with tablets which were GPS, Skype, and 3G enabled for real-time data collection with visualization and real-time processing of information at a central location. Automatic data transfer and report generation at a central location were vital characteristics of this application.

Follow-up of all subjects every month for up to 1 year of the beginning of the project (i.e., 8 months) to document any changes in the health profile of all the participants. For those households being recruited in the first month, the follow-up started from the consecutive month and so on.

Work plan of ASHA

ASHA was trained for 2 weeks to use the tablet. She was trained to do entry in the tablet, using questionnaires in it to take physical measurements such as height, weight, measuring blood pressure through digital BP instrument, blood sugar through glucometer, hemoglobin estimation through color scale, etc., She collected baseline data [3 months] and then did monthly follow-up. ASHA tracked changing lifestyles, risk factors, and screening of non-communicable diseases (NCDs) using periodic standardized data collection in the two villages. She provided health education to subjects through pop-up videos in the app.

The hypertension status of the study participants (above 18 years) was assessed using standard criteria formulated by Joint National Committee -7(JNC -7). This definition does not include hypertensives who decreased the blood pressure by non-pharmacological means to normal.[3]

Regular follow-up was done by ASHA for those who were at high risk (Hypertension, Diabetes Mellitus, and Anemia) in the form of BP monitoring, blood sugar estimation, and hemoglobin estimation). For those found hypertensive and prehypertensive,

monthly BP monitoring was done, in addition to health education through pop-up videos. ASHA referred such patients to the first referral unit. Specialist visits were organized once a month to the village itself so as to provide treatment and health education to the patients individually there itself. Tracking of these newly diagnosed cases and old cases for regular treatment and follow-up was done by ASHA. Reporting of any new event in the household in form of morbidity, mortality, and birth was done on daily basis. Supervision and monitoring of ASHA by the coordinating team were done weekly. ASHAs were trained and retrained to use these e-health initiatives so as to empower them in providing better services at the grass-roots level to the people and be able to screen the population for various NCDs and provide timely referral so that occurrence of these diseases can be controlled.

Data collection

The data was transferred directly to the central computer, and reports on various aspects were generated automatically on daily basis. This helped to capture any deviation from normal in the health status of the community and family.

Statistical analysis

Statistical analysis was done using Excel, and analysis was done in the form of percentage, mean, standard deviation, and tests of significance. A significance level of 0.05 was regarded for interpretation of analysis.

Results

A total of 825 families (405 in Lakhesra and 420 in Kapurwala) were surveyed using e-health initiatives through our health smart app on tablets by ASHAs. A total population of 3,853 (1807 and 2046 at Lakhesra and Kapurwala respectively) were covered in 3 months and then followed up for 8 months. Out of this total surveyed population, individuals above 18 years (2430 making for 63% of the total population) were considered for blood pressure measurement.

Demographic characteristics of the participants showed maximum number in the age group 18–35 years with an almost equal proportion of males and females. There were 19.1% (464/2430) hypertensives; 53.5% (248/464) were known hypertensives. Significant difference was found in prevalence of hypertension at Lakhesra [23.9% (256/1067)] and Kapurwala [15.3% (208/1363)] $P < 0.001$. In total, 38.9% (945/2430) were categorized as prehypertensive. Men showed a higher occurrence of hypertension and prehypertension than women. Mean age was significantly higher among hypertensives as compared to prehypertensive ($P < 0.001$) [Table 1].

At the end of the follow-up, the blood pressure levels of one-third hypertensive were brought down to the prehypertension range. There was a fall in the blood pressure levels of little more than half of prehypertensive to normal range, while few converted to hypertensives. About a quarter of hypertensive could be started on treatment, while half were already on treatment. Highly significant ($P < 0.001$) decrease in mean systolic blood pressure level of hypertensives and prehypertensive was noted after follow-up [Table 2].

Table 1: Characteristics of participants

Age Group No. (%)			
18-25 yr	627 (25.8)		
25-35 yr	703 (28.9)		
35-45 yr	485 (19.9)		
45-60 yr	389 (16.0)		
≥60 yr	226 (9.3)		
Total	2430 (100.0)		
Gender No. (%)			
Male	1239 (51.0)		
Female	1191 (49.0)		
Total	2430 (100)		
Prevalence of Hypertensives and Prehypertensives (18 years and above)			
	Male	**Female**	**Total *N*=2430**
Hypertensives % (No.)	51.5 (239)	48.5 (225)	19.1 (464)
Prehypertensives % (No.)	57.8 (546)	42.2 (399)	38.9 (945)
Mean age of Hypertensives and Prehypertensives			
	Mean age in years (±SD)		
Hypertensives	52.6 (±15.2)		
Prehypertensives	36.8 (±14.2)		

Table 2: Follow-up data Prevalence after F/U of Hypertensives and prehypertensives

	Hypertensives (*n*=464)	**Prehypertensives (*n*=945)**
Normal % (No.)	0 (0)	56.5 (534)
Prehypertensives % (No.)	34.7 (161)	43.2 (408)
Hypertensives % (No.)	65.3 (303)	0.3 (3)
Progress of treatment of Hypertensives after F/U		
Hypertensives (*n*=303)		
Not on T/T % (No.)	22.4 (68)	
Started T/T % (No.)	27.4 (83)	
Already On T/T % (No.)	50.2 (152)	
Mean BP (mm Hg) of Hypertensives and prehypertensives after F/U		
	Mean (±SD)	
Hypertensives at start	147.14 (±13.86)	
Hypertensives at end	133.3 (±13.07)	
Prehypertensives at start	123.18 (±4.5)	
Prehypertensives at end	117.55 (±6.9)	

Discussion

The current study has emphasized the application of e-health in the Indian health care system. A simplified tablet-based application that can be used by village-level health functionaries (ASHAs) to store data, provide health education, and get timely reminders to visit patients. A total of 825 families were surveyed, covering a total population of 3,853, focusing on population above 18 years

of age for blood pressure measurement. Most of the studies conducted to determine the burden of the abovementioned diseases have included this age group.[4]

Prehypertension

Prevalence of prehypertension (38.9%) in our study is similar[5] but higher than some other studies,[6,7] but the mean age of prehypertension (36.8 years ± 14.2) is lower in comparison to other studies. Similar to the present study, high prevalence of prehypertension among men than women has been shown;[5-7] also, mean systolic blood pressure is lower compared to other studies.[6] Higher prevalence can be due to the methodology used, i.e., all above 18 years were screened instead of just a sample. This occurrence of prehypertension is a distress sign for an upcoming eruption of hypertension and its complexities.

Hypertension

Hypertension is one of the most important risk factors for chronic diseases. Fourth National Family Health Survey (NFHS-4) and Fourth District Level Household Survey (DLHS-4) records overall hypertension as 11.3% and 25.3%, respectively.

When compared to other rural studies in India using JNC 7 criteria, the prevalence of hypertension (19.1%) in our study is similar[7-14] to that reported in other studies. Basu P[15] and Godara R[16] reported 32.6% and 21% prevalence of hypertension, respectively, among adults in underserved areas of Rajasthan, India. The mean age of hypertension is higher compared to other studies.[7] Studies have shown high prevalence of hypertension among men than among women[5,7,12] as in the present study; also, the mean systolic blood pressure is in line with other studies.[5]

A notable difference was recorded in the prevalence of HT of studied villages 23.9% in Lakhesra and 15.3% in Kapurwala. Also, the mean age of hypertensives was lower at Lakhesra and this difference was found to be highly significant statistically ($P < 0.001$). This can be attributed to the difference in their drinking water source in Lakhesra, the main source being deep wells and boring pumps (high in sodium content), while in Kapurwala, the main source being river water (low in sodium content).

Approximately half (53.5%) of individuals with HT were previously diagnosed; other studies also showed varying data ranging from 30.1% to 38.4%.[5,12,17,18] The present study shows a slightly better level of hypertension awareness but suggests for regular screening programs to further identify left out cases.

Prehypertension and hypertension post-intervention

The blood pressure levels of little more than half of the prehypertension patients could be brought down to the normal range and of one-third of hypertensive patients to prehypertension range due to constant follow-up and health education through videos in the app. A statistically highly significant ($P < 0.001$) decrease in mean systolic blood pressure level of hypertensives and prehypertensive was observed after follow-up. The intervention groups in different studies on hypertensives (physical activity, reduced salt intake, and yoga) showed a significant reduction in BP by Subramanian H.[4] Murthy SN[19] intervened through yoga and naturopathy and 24% of hypertensives converted to normal levels. In a study in China using mobile health applications, a significantly greater systolic and diastolic blood pressure reduction was seen along with better medication adherence.[20] Health-related technology helped in bringing more improvement when used by a dedicated worker by constant follow-up, motivation, providing regular health education sessions, and pointing out lags and rectifying them in the monitoring of diseases.[21] 27.4% of hypertensives could be started on treatment (previously not on treatment) at the end of the intervention, similar to other studies.[5,12,17,21]

Key points

With the use of e-health initiatives among populations above 18 years, we found 19.1% hypertensives and 38.9% prehypertensive. The mean age of hypertensives was higher than for prehypertensive. Mean systolic blood pressure level of hypertensives decreased by about 14 pts and about 6 pts for prehypertensive. Also, through our study we could start more than a quarter of hypertensives (previously not on treatment) on treatment for hypertension.

Our interventions proved that lifestyle and diet modifications and adherence to therapies by repeated sessions of one-to-one health education can be successfully implemented in large community-based settings in rural India to control hypertension and other NCDs by training ASHA workers in e-health technology and can assist in screening and management of hypertension.

This in turn will decrease the workload on primary care physicians. In addition, burden of diagnosed and undiagnosed cases can be reduced by early diagnosis and screening and thus reducing complications and physicians can focus more on complicated cases. If this initiative becomes successful, we can develop an updated application for the primary care physicians too which can open doors for the health and wellbeing of people.

Limitations

We covered only two villages, that too located nearby the capital of Rajasthan. A similar study done in the remotest of the village would bring forward the real challenges. This article will serve as a seed for further research to cover more villages and tribal areas with e-health initiatives. Also, similar studies can be further planned in urban areas, where the prevalence of NCDs is showing an increasing trend. Moreover, studies based on e-health at different sites should evaluate their cost-effectiveness and replicability.

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Conflicts of interest

There are no conflicts of interest.

References

1. Lewis T, Synowiec C, Lagomarsino G, Schweitzer J. E-health in low- and middle-income countries: Findings from the center for health market innovations. Bull World Health Org 2012;90:332-40.
2. Piette JD, Lun KC, Moura LA Jr, Fraser HSF, Mechael PN, Powell J, *et al.* Impacts of e-health on the outcomes of care in low- and middle-income countries: Where do we go from here. Bull World Health Org 2012;90:365-72.
3. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. 2004. [Last accessed on 2021 Dec 30]. www.nhlbi.nih.gov/files/docs/guidelines/jnc7full.pdf.
4. Subramanian H, Soudarssanane MB, Jayalakshmy R, Thiruselvakumar D, Navasakthi D, Sahai A, *et al.* Non-pharmacological interventions in hypertension: A community-based cross-over randomized controlled trial. Indian J Community Med 2011;36:191-6.
5. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S. Alarmingly high prevalence of hypertension and pre-hypertension in North India-results from a large cross-sectional STEPS survey. PLoS One 2017;12:e0188619.
6. Ravi MR, Ashok NC, Renuka M. Prevalence of prehypertension in a rural district of Southern India. Int J Prev Med 2015;6:84.
7. Rani B, Pal R, Jha SK, Punia A, Singh S, Tarun. Prevalence and risk factors associated with prehypertension and hypertension among attendants of patients at a rural tertiary care institute of Haryana. Int J Community Med Public Health 2019;6:1657-64.
8. Galav A, Bhatanagar R, Chandra S, Jain M. Prevalence of hypertension among rural and urban population in Southern Rajasthan. Natl J Community Med 2015;6:174-8.
9. Premkumar R, Pothen J, Rima J, Arole S. Prevalence of hypertension and prehypertension in a community-based primary health care program villages at central India. Indian Heart J 2016;68:270-7.
10. Bhansali A, Dhandania VK, Deepa M, Anjana RM, Joshi SR, Joshi PP, *et al.* Prevalence of and risk factors for hypertension in urban and rural India: The ICMR-INDIAB study. J Hum Hypertens 2015;29:204-9.
11. Gupta R, Sharma AK. Prevalence of hypertension and subtypes in an Indian rural population: Clinical and electrocardiographic correlates. J Hum Hypertens 1994;8:823-9.
12. By Y, Mr NG, Ag U. Prevalence, awareness, treatment, and control of hypertension in rural areas of Davanagere. Indian J Community Med 2010;35:138-41.
13. Kamlesh K, Kothari RP, Kothari K, Garg S, Khandelwal MK, Gupta R. Prevalence of hypertension in an urban and rural area of Jaipur District. Int J Healthc Biomed Res 2013;1:120-6.
14. Prenissl J, Manne GJ, Jaacks LM, Prabhakaran D, Awasthi A, Bischops AC, *et al.* Hypertension screening, awareness, treatment and control in India. A nationally representative cross-sectional study among individuals aged 15-49 years. PLoS Med 2019;16:e1002801.
15. Basu P, Mahajan M, Patira N, Prasad S, Mogri S, Muwonge R, *et al.* A pilot study to evaluate home based screening for the common non-communicable diseases by a dedicated cadre of community health workers in a rural setting in India. BMC Public Health 2019;19:14.
16. Godara R, Matthews E, Mini GK, Thankappan KR. Prevalence, awareness, treatment and control of hypertension among adults aged 30 years and above in Barmer district, Rajasthan, India. Ind Hrt J 2021;73:236-8.
17. Flor LS, Wilson S, Bhatt P. Community based interventions for detection and management of diabetes and hypertension in underserved communities: A mixed-methods evaluation in Brazil, India, South Africa and the USA. BMJ Global Health 2020;5:e001959.
18. Singh S, Shankar R, Singh GP. Prevalence and associated risk factors of hypertension: A cross-sectional study in Urban Varanasi. Int J Hypertens 2017;2017:5491838.
19. Murthy SN, Rao NSN, Nandkumar B, Kadam A. Role of naturopathy and yoga treatment in the management of hypertension. Complement Ther Clin Pract 2011;17:9-12.
20. Duan H, Wang Z, Ji Y, Ma L, Liu F, Chi M, *et al.* Using goal-directed design to create a mobile health app to improve patient compliance with hypertension self-management: Development and deployment. JMIR Mhealth Uhealth 2020;8:e14466.
21. Riddell MA, Joshi R, Oldenburg B, Chow C, Thankappan KR, Mahal A, *et al.* Cluster randomised feasibility trial to improve the Control of hypertension in Rural India (CHIRI): A study protocol. BMJ Open 2016;6:e012404.