

Mobile health checkup intervention to improve factory workers' health awareness, attitudes, behaviors, and clinical outcomes in Jaipur District, India

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ABSTRACT:

Background: Although several studies have investigated the effectiveness of health checkup services, very few have been conducted in developing countries. **Objective:** The study examined factory workers' health awareness, attitudes, behaviors, and non-communicable disease (NCD) outcomes before and after receiving mobile health checkups using a portable health clinic system in India. **Methods:** Data were collected from 141 factory workers at the largest dairy factory in Jaipur who participated in the baseline and 6 months follow-up health checkup surveys in 2018. The questionnaire and health checkup data included participants' sociodemographic information, awareness, attitudes, behaviors, and NCD outcomes. The significance of differences in these data between the first and second health checkups was compared using paired sample t-tests and McNemar tests. **Results:** The mean blood glucose level decreased significantly from 139.3 to 123.9 mg/dL after 6 months. The mean value of body mass index (BMI) was significantly reduced from 25.0 to 24.8 after 6 months. The proportion of participants who were aware of their hypertension status increased significantly after 6 months (8.5% to 25.5%). The percentages of participants who reported "currently taking medicine or drugs for hypertension or type 2 diabetes" increased significantly after 6 months (5.7% to 17.7% and 6.4% to 12.8%, respectively). The percentage of participants who reported "already trying to improve their eating habits" significantly increased from 5.7% to 17.7%, and who reported "already trying to improve their exercise habits" increased significantly from 3.5% to 12.1%. The proportion of participants who reported "I am willing to pay more than 500 Indian rupees [approximately 800 Japanese yen] for mobile health checkup services" rose significantly from 4.3% to 39.7%. **Conclusions:** The levels of participants' awareness, attitudes, behaviors, and NCD outcomes improved after 6 months. Regular mobile health checkup services could be an effective approach in

developing countries.

Key Words: Mobile health checkups, non-communicable diseases, health awareness, attitudes, behaviors, factory workers, India

Introduction

Regular health checkup services have been recognized as a key approach for non-communicable diseases (NCDs) prevention and management [1,2]. In India, NCDs such as type 2 diabetes, hypertension, and other cardiovascular diseases account for more than 60% of all deaths [3]. Under current Indian labor laws, regular health checkups are recommended for all full-time employees and their family members. However, most private factories and companies do not offer health checkups [4]. The effectiveness of health checkups has previously been well documented in Japan and other developed countries [1,2,5,6,7]. However, few studies have examined the effectiveness of health checkups on participations' behaviors, attitudes, awareness, and clinical outcomes in developing countries. Thus, there is little empirical evidence on whether health checkup services can actually improve regular participants' health status as well as their health-related behaviors, attitudes, and awareness in developing countries.

A mobile health check-up system called "portable health clinic" (PHC) was developed by Kyushu University and Grameen Communications, Bangladesh in 2010. PHC is an e-health service delivery system that includes a set of medical sensor devices in a briefcase to allow mobile health checkups and a remote doctor' counseling using Skype [8-12] (Fig. 1). This PHC service has been implemented and has reached more than 40,000 patients in Bangladesh [12]. Previous studies conducted by Dr. Nakashima and his research team found some improvement in patients' blood pressure and blood glucose levels after mobile health checkups and telemedicine services

in Bangladesh. [8, 10]. This study is an expansion of the Bangladesh PHC in India and investigates factory workers’ health-related behaviors, attitudes, and NCD outcomes before and after receiving mobile health check-ups using the PHC system in Jaipur District, India.

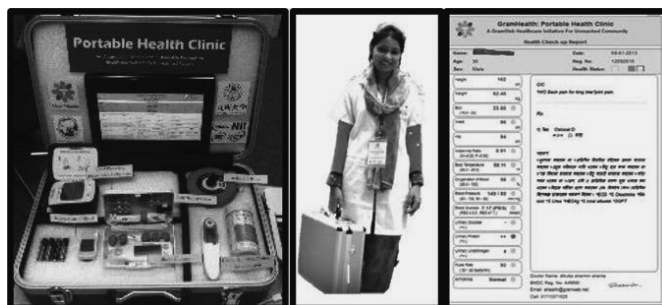


Figure 1: PHC box, healthcare entrepreneur, and health checkup result

Methods

Data Source and Data Collection Procedures

Baseline data were collected from randomly selected 284 factory workers who agreed to participate in PHC health checkup services in March 2018 at the “Saras Jaipur Dairy” (SJD) in Jaipur, India. After 6 months, a second health checkup survey was performed in September 2018. Of 284 participants who participated in the baseline survey, only 141 (49.6%) completed the second survey, as some workers had resigned, lost contact, or were otherwise unavailable. SJD is one of the largest government milk product companies located in Jaipur District, Rajasthan State (Map 1). According to SJD’s 2018 company profile, it has more than 500 office and factory employees. SJD was chosen due to the scarcity of regular health checkups for their

employees and the high demand for PHC services from the managers. The participants' eligibility criteria were those who aged 18 years or older, provide written consent forms, and were voluntarily willing to participate in. Prior to implementation of PHC services, our field research coordinators had several initial preparatory meetings with SJD's managers to schedule and arrange for the health checkups survey. Randomly selected participants were identified and scheduled by local research coordinators for 4-day PHC service camps in a large room in the SJD factory building. The field research team consisted of field research coordinators, field supervisors, healthcare workers, survey interviewers, IT data managers, and registration staff from the Biyani Group of Colleges (BGC). The PHC services and survey questionnaires were implemented in Hindi to all participants during the baseline period (4 days) and after 6 months for the second round of surveys (3 days). The interviewers explained the survey's purpose and the confidentiality in accordance with the principles of the Declaration of Helsinki. At each survey, participants' basic sociodemographic characteristics, health awareness, attitudes, and behavioral data were collected using standardized questionnaires. In addition, the following clinical data were measured or tested using PHC health checkups without any charges; (1) height, (2) weight, (3) hip circumference, (4) waist circumference, (5) body temperature, (6) systolic blood pressure, (7) diastolic blood pressure, (8) blood glucose, (9) blood hemoglobin, (10) urinary glucose, (11) urinary protein, (12) pulse rate, and (13) blood cholesterol. The results of each health check-up test were ranked into one of four different color-coded risk levels as follows: green (healthy), yellow (caution), orange (affected), and red (emergent). The study was approved by Kyushu University Hospital's ethics committee in 2018. More detailed methodologies, including color-coded logic, privacy, and the security of collecting patients' personal health data have been described elsewhere [13-15].



Map 1: Location of Rajasthan State and the city of Jaipur

Measurements

Blood pressure was measured using the OMRON HEM 7130 (OMRON Corporation, Kyoto, Japan). Blood glucose was measured using the OMRON HGM-112 Glucometer (OMRON Corporation, Kyoto, Japan). A drop of blood was taken from each participant's middle fingertip. Body mass index (BMI) was calculated as weight (kg)/height (m)².

Data analysis

Paired sample t-tests were performed to compare the mean differences in systolic blood pressure, diastolic blood pressure, blood glucose, and BMI between the baseline and second health checkup surveys after 6 months. McNemar tests were conducted to compare the differences in the percentages of participants who answered "yes" to the following behavioral- and attitude-related questions;

- (1) Have you previously been diagnosed with hypertension or type 2 diabetes? (Awareness)

- (2) Are you currently taking any medicine or drugs for hypertension or type 2 diabetes? (Behavior)
- (3) Do you want to improve your eating habits? (Attitude)
- (4) Do you want to improve your exercise habits? (Attitude)
- (5) How much are you willing to pay for a mobile health checkup? (Attitude)

All statistical analyses were performed using SPSS, Version 21 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $P < 0.05$.

Results

A total of 141 individuals participated in both the baseline and second PHC health checkup surveys. Table 1 shows the participants' sociodemographic characteristics. More than half of them (56.7%) were 40 years of age

Table 1: Sociodemographic characteristics of the factory workers who participated in the baseline and 6 months follow-up health checkup surveys

Items	N	%
Age (years)	141	Mean = 44.8 SD = 13.2 Range = 21-66
Age groups 1	141	
15–29 years	20	14.2
30–39 years	41	29.1
40–49 years	15	10.6
50–59 years	44	31.2
≥60 years	21	14.9
Sex		
Female	28	19.9
Male	113	80.1
Level of education		
No education/	6	4.3
Primary or secondary school completed	23	16.3
High school or vocational school completed	24	17.0
College/University completed	71	50.4
Higher education completed	17	12.1
Can read or write Hindi, English or any Indian languages?		
No	18	12.8
A little bit	9	6.4
Yes	114	80.9
Marital status		
Never married	21	14.9
Currently married	119	84.4
Divorced/separated/widowed	1	0.7

- Repeat participants = Those who participated both the baseline and the 6 month follow-up surveys.

or older, with a mean age of 44.8. Most (80.1%) were men. Only 4.3% had no education, while nearly 80% (79.5%) had completed high school or higher levels of education, and 80.9% were literate. Most participants (84.4%) were married.

Figures 2-5 present the results of the paired sample t-tests to describe the mean differences in blood pressure, blood glucose, and BMI between the baseline period and 6 months later during the second survey. Figure 2 indicates that the mean systolic blood pressure declined from 131.5 mmHg to 130.4 mmHg after 6 months, but this difference was not statistically significant. In contrast, Figure 3 depicts the significant mean difference in diastol-

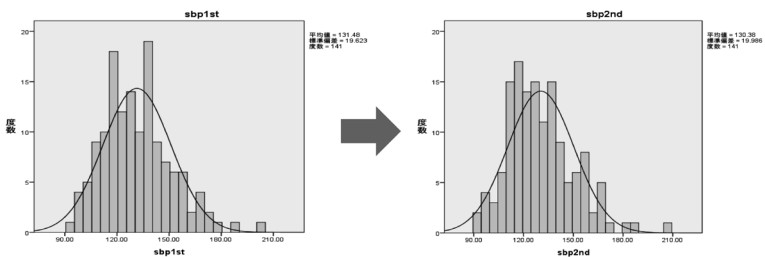


Figure 2: Systolic blood pressure distribution (mmHg) among participants at baseline (left) and after 6 months (right) (N=141)

- Paired sample t-test showed no significant improvement (p value = 0.328)

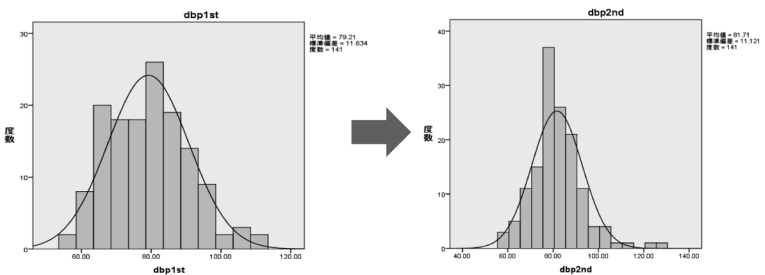


Figure 3: Diastolic blood pressure distribution (mmHg) among participants at baseline (left) and after 6 months (right) (N=141)

- Paired sample t-test showed significant improvement (p value = 0.001)

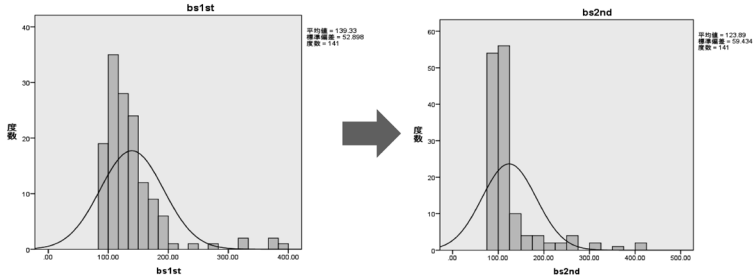


Figure 4: Blood glucose distribution (mg/dL) among participants at baseline (left) and after 6 months (right) (N=141)

- Paired sample t-test showed significant improvement (p value = 0.002)

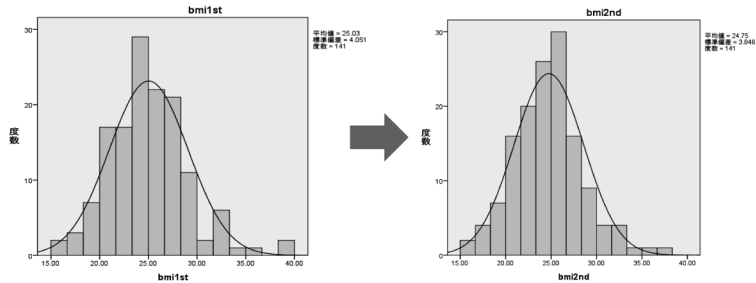


Figure 5: BMI distribution among participants at baseline (left) and after 6 months (right) (N=141)

- Paired sample t-test showed significant improvement (p value = 0.007)

ic blood pressure from 79.2 mmHg at baseline to 81.7 mmHg after 6 months ($P=0.001$). Figure 4 reveals that the mean blood glucose level decreased significantly from 139.3 mg/dL to 123.9 mg/dL after 6 months ($P=0.002$). Figure 5 presents that the mean BMI was significantly reduced from 25.0 to 24.8 after 6 months ($P=0.007$).

Table 2 shows the results of the McNemar tests to describe the differences in the percentages of participants' awareness, behaviors, and attitudes toward health checkup services between the baseline period and the time of the second surveys. The proportion of participants who were "aware of having hypertension" increased significantly after 6 months (8.5% to 25.5%,

P<0.001). Similarly, the percentage of those who reported “currently taking any medicine or drugs for hypertension” was significantly higher after 6 months (17.7%; P<0.001) than the baseline (5.7%). The percentage of participants who reported “currently taking any medicine or drugs for type 2 diabetes” was significantly higher after 6 months (12.8%; P=0.035) than the baseline (6.4%), whereas the percentage of those who were “aware of having type 2 diabetes” was insignificant between the baseline period and after 6 months.

Table 2 also shows that participants who reported “I am already trying to improve my eating habits” and/or “exercise habits” after 6 months had significantly higher percentages (17.7%; P=0.003, and 12.1%; P=0.017 respectively) than the baseline (5.7% and 3.5% respectively). The percentage of those who reported “I am willing to pay more than 500 Indian rupee for health check-up services” was significantly higher after 6 months (39.7%; P<0.001) than the baseline (4.3%).

Table 2: Differences in participants' awareness, behaviors, and attitudes between the baseline and after 6 months follow-up surveys (N=141)

Items	Baseline		After 6 months follow-up		McNemar test P for diff
	N	%	n	%	
Are you aware of having “hypertension”?					
Yes	12	8.5	36	25.5	<0.001
Are you currently taking any antihypertension drugs?					
Yes	8	5.7	25	17.7	<0.001
Are you aware of having “type 2 diabetes”?					
Yes	13	9.2	20	14.2	0.167
Are you currently taking any diabetic drugs?					
Yes	9	6.4	18	12.8	0.035
Do you want to improve your eating habits?					
Yes, I am already trying to improve them	8	5.7	25	17.7	0.003
Do you want to improve your exercise habits?					
Yes, I am already trying to improve *1	5	3.5	17	12.1	0.017
How much are you willing to pay for health checkup services?					
More than 500 Indian rupees (approximately 800 Japanese yen)	6	4.3	56	39.7	<0.001

Conclusions

Levels of participants' behaviors, attitudes, awareness and NCD outcomes improved after 6 months. Regular mobile health check-up services could be an effective approach for improvement in developing countries.

END MATERIALS:

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Declaration of Conflicting Interests

The authors report no conflicts of interest.

Ethics and Consent

Data collection was performed in accordance with the Declaration of Helsinki. The study was approved by the ethics committee of the BGC's Institutional Ethical Committee (#24-048). Written informed consent was obtained from all participants who received a detailed explanation of the study's purpose from the research assistants.

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References:

- [1] Hackl F, et al. (2015). The effectiveness of health screening. *Health Economics*. 24: 913–935, DOI: 10.1002/hec.3072
- [2] Krogsbøll T, et al. (2012). General health checks in adults for reducing morbidity and mortality from disease: Cochrane systematic review and meta-analysis. *BMJ*. 345: e7191.
- [3] WHO. (2018). India Country Profile: Noncommunicable Disease (NCD). Available from https://www.who.int/nmh/countries/2018/ind_en.pdf. [Accessed December 24, 2020].
- [4] Saha RK. (2018). Occupational Health in India. *Annals of Global Health*. 84 (3): 330-333.
- [5] Noguchi R and Shen J. (2018). Factors affecting participation in health checkup: Evidence from Japanese survey data. *Health Policy*. 123: 360-366.
- [6] Grooten WJA, Hansson A, Forsman M, et al. (2019). Non-participation in initial and repeated health risk appraisal, -a drop-out analysis based on a health project. *BMC Health Services Research*. 19:130.
- [7] Schulein S, Taylor KJ, Schriefer D, et al. (2017). Participation in preventive health check-ups among 19,351 women in Germany. *Preventive Medicine Reports*. 6, 23-26.
- [8] Nohara Y, Ahmed A, Nakashima N, et al. (2015). Health Checkup and telemedical intervention program for preventive medicine in developing countries: verification study. *J Med Internet Res*. 17, 1, e2.
- [9] Ahmed A, Rebeiro-Hargrave A, Nohara Y, et al. (2014). Targeting Morbidity in Unreached Communities Using Portable Health Clinic System. *IEICE Transactions on Communications*. E97-B (3).
- [10] Nakashima N, Nohara Y, Ahmed A, et al. (2014). An affordable, usable and sustainable preventive healthcare system for unreached people in Bangladesh. *Studies in Health Technology and Informatics*. 192, 1051.
- [11] Nakashim N, Hiramatsu T, Ghosh PP, et al. (2013). Evaluation of “Portable Health Clinic” with BAN standard for 10K subjects in Bangladesh. *Conference Proceedings of the IEEE Engineering in Medicine and Biology Society*. 1672-1675.
- [12] Grameen Communications Website. Global Communication Center. Portable Health Clinic. Available from <http://ghealth.gramweb.net/>. [Accessed 27 June 2017].
- [13] Yokota F, Biyani M, Islam R, et al. (2018). Lessons learned from co-design and co-production in a portable health clinic research project in Jaipur District, India (2016-2018). *Sustainability*. 10 (11): 4148.
- [14] Yokota F, Biyani M, Islam RM, et al. (2021). Co-design, co-production, and co-evaluation processes for a mobile health check-up research project in Jaipur India: Case study of the Portable Health Clinic, 2016-2020. *Decision Science for Future Earth: Theory and Practice*. Chapter 3, Springer. ISBN:9789811586316.
- [15] Yokota F, Biyani M, Hu Y, et al. (2020). PHC and case studies of remote healthcare services in Asian countries. *Mobile Technologies for Delivering Healthcare in Remote, Rural or Developing Regions*. Healthcare Technologies. Chapter 9. IET Book. ISBN-13: 978-1-83953-047-0.