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ORIGINAL ARTICLE

Utilization of short message service (SMS) in non-pharmacological management of hypertension. A pilot study in an URBAN public hospital of Multan, Pakistan

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Abstract

Objective To investigate the effectiveness of short message service (SMS) in promotion of non-pharmacological treatment approach in hypertension patients.

Subjects and methods A prospective, randomized control study to measure the effect of short message service in improving self-management of hypertension by educating patients. One hundred and twenty hypertensive patients who had manual sphygmomanometers were selected, and were divided into two groups, i.e., an intervention group and a control group. But only the intervention group had mobile numbers of related health care professionals for SMS assistance. All of them were briefed on how they can improve HTN control by achieving a healthy life style, proper diet, and exercise (non-pharmacological approach in addition to pharmacological therapy). Patients were educated about the non-pharmacological approach for managing hypertension at each clinic visit, and were sent regular text messages about healthy diet, exercise, and adherence. Apart from educational text messages, reminder SMSs were also sent to them twice daily to remind them about taking their medicines. Patients' feedback was collected to assess improvement in adherence and reduction in blood pressure.

Results At the end of the study, the intervention group showed better hypertension control, with systolic blood pressure (SBP) declining by 8 mmHg to 141.15 ± 5.73 mmHg, and diastolic blood pressure (DBP) declining by 6 mmHg to 88 ± 3.97 mmHg. The control group showed a 2 mmHg and 3 mmHg decline in SBP and DBP respectively.

Conclusion SMS proved to be very useful to enhance adherence to non-pharmacological treatment of HTN (hypertension). It also improved patient compliance.

Keywords SMS · Hypertension · Non-pharmacological HTN management · Compliance

Background

Hypertension (HTN) is considered one of the major contributors of cardiovascular diseases (CVDs) all over the world. CVDs are a major cause of death, and responsible for about 17.9 million deaths each year worldwide. Seventy-one percent of these deaths were in low and middle income countries (Cohen et al. 2017). HTN is the significant modifiable risk factor to the emergent burden of CVDs in low and middle income countries: it is placed at third among the top five most complicated non-communicable diseases worldwide, and every fourth adult person is considered to be hypertensive (World Health Organisation 2018). It is one of the major causes of mortality worldwide due to difficulty in controlling it and related complications. According to the World Health

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Organization, HTN is responsible for about 13.5% deaths globally (World Health Organisation 2018).

Prevalence of HTN is increasing with the increase of urbanization and inactive lifestyles, especially in low and middle income countries. The global burden of hypertension is estimated to reach 10% by 2030. It is even more threatening in low and middle income countries. The prevalence of HTN in developing countries is estimated to be 80% in older patients (age ≥ 60 years) (World Health Organisation 2018; Asgary et al. 2013). According to the WHO, HTN is reported to affect 40% of the adult population globally among whom 32% never monitor their blood pressure (BP), and 52% of hypertensive patients do not take antihypertensive drugs (World Health Organisation 2013). In Pakistan, due to increasing urbanization, HTN is becoming a major health problem. Estimated prevalence of HTN in Pakistan is 25.66%. It is more prominent in urban areas as compared to rural areas. The prevalence in urban and rural areas of Pakistan is 26.61% and 21.03% respectively (Nabi Shah et al. 2018). According to the National Health Survey of Pakistan, HTN affected 18% of adults below the age of 45 and 33% of adults of higher age. Data showed only 50% were diagnosed early, and among the diagnosed patients only 12.3% patients were in a controlled state of hypertension. In Pakistan prevalence of hypertension is highest in Baluchistan (25.3% in men and 41.4% in women), then among Pashtuns in North-West Pakistan (23.7% in men and 28.4% in women), in Sindh (24.1% in men and 24.6% in women) and lowest among Punjabis (17.3% in men and 16.4% in women) (Jafar et al. 2003).

Management of HTN is important to control blood pressure. Self-management of HTN aided by self-monitoring, patient education, adherence, and health care professional-induced intervention has showed a significant effect in reducing BP. Educating the patient about disease, its management, and medication can enhance the willingness of the patient to control the disease (Glynn et al. 2010). Apart from pharmacotherapy, secondary preventive measures are of equal importance in managing the hypertension. According to the World Health Organization (WHO), hypertension can be prevented by adopting healthy nutritional habits and regular exercise (World Health Organisation 2018). Healthy life style comprising increased physical activity and exercise is a key factor in management and prevention of hypertension. Physical exercise has a positive effect on weight, fitness, and self-esteem, thus helping to reduce BP and risk of cardiac diseases (Roessler and Ibsen 2009; Faramawi and Caffrey 2010). Intake of healthy food rich in fruits and vegetables and low in saturated fats is helpful in preventing disease and improving quality of life of hypertensive patients (Cembranel et al. 2018; Moore et al. 2001). Similarly, weight reduction in overweight patients, aerobic exercise in sedentary people (Blumenthal et al. 2000), increased consumption of potassium and magnesium in diet, and reduction of dietary sodium have positive effects in lowering blood pressure of hypertensive patients.

A DASH-like diet (Dietary Approaches to Stop Hypertension) could significantly protect against cardiovascular diseases (CVDs), chronic heart diseases (CHD), stroke, and heart failure (HF), and reduces the risk by 20%, 21%, 19%, and 29% respectively. Furthermore, there exists a significant reverse linear association between adherence to a DASH diet and CVDs, CHD, stroke, and HF risks (Salehi-Abargouei et al. 2013). Adherence to pharmacotherapy and healthy life style is very uncommon in Pakistan due to lack of awareness about the management of disease (Hashmi et al. 2007). The increasing prevalence of HTN in Pakistan can be controlled by adopting measures to improve adherence, thus reducing BP and risk of CVDs.

Use of cell phones in the health management system has proved its efficiency in developed countries, but in low and middle income courtiers its use is still limited and needs validation. Cell phones are used to improve patient adherence (by giving regular reminders), to educate patients to take an appointment with a physician, to aid patients in communication with the physician about disease management, and to motivate patients about self-management in developed countries (Déglise et al. 2012). Much less work has been done regarding this in low and middle income countries, especially in Pakistan. In Pakistan, cell phones are readily available to the majority of the population, and cell phone companies introduce various SMS packages which can be used to enhance patient adherence by regular reminders. Text messages can also be used to educate patients and enhance patient–physician communication in a cost-effective manner. They can be incorporated as a daily routine tool to improve management of severe disease. The use of text messages to improve adherence has been validated in asthma, and showed encouraging results in improving adherence and quality of life of asthmatic patients (DiBello et al. 2013). Hypertensive patients require self-management and motivation in addition to pharmacotherapy for proper management of disease and controlling BP. Adherence is also a problem in hypertensive patients. They often forget to take medicines, which causes problems. Text messages can be used to overcome these problems by giving regular reminders, thus improving adherence, controlling BP, and enhancing quality of life.

This study focused on awareness of hypertension patients about non-pharmacological management of hypertension through a mobile SMS service. Patients were counseled regularly about DASH and life-style modification to manage hypertension. The aim of the study was to assess the effect of the SMS service on improving patient knowledge and adherence to control blood pressure. Results showed that use of mobile SMS improved patients' compliance toward non-pharmacological management and showed better results.

Methodology

A prospective, randomized control study was held in the outpatient ward of Ch. Pervaiz Elahi institute of Cardiology Multan, Pakistan between September 2014 and September 2015. Patients' inclusion and exclusion criteria was developed. Inclusion and exclusion criteria are shown below in Table 1. The convenience sampling method was used to randomly select 120 patients who satisfied the inclusion criteria, on the basis of assessment of their medical record. Selected patients were divided randomly into two groups, i.e., a control group and an intervention group. To avoid bias, names of selected patients were arranged in alphabetic order and even-number patients were assigned to the intervention group. The control group relied only on medication therapy to control hypertension. The intervention group, besides taking medicines to manage hypertension, was also counseled by SMS about different life-style modifications.

To educate patients (intervention group) about DASH (Dietary Approaches to Stop Hypertension) and life-style modifications, PowerPoint slides were used and lectures were delivered during their clinical checkup visits. Patients in the intervention group were briefed how adherence and a healthy life style could improve their control of hypertension and avoid risk of cardiovascular diseases. The patient education team consisted of a physician, pharmacist, and nutritionist. Different messages related to diet, exercise, and adherence were selected from the literature review (Strandbygaard et al. 2010) and finalized by the experts with necessary amendments. The expert team consisted of researchers, physician, pharmacist, and nutritionists. Messages were saved in a specific cell phone containing the list of those in the intervention group. The intervention group began to receive five messages per week (in Urdu or English) relating to nutrition (benefits of low fat diets, fiber diets, and fruit- and vegetable-rich diets), physical activity, and motivation. Time was set according to the medication of patients, and they also began to receive two messages daily as a reminder to take medicine on time as well as a once-weekly text requesting them to report their blood pressure readings. Peer-to-peer communication was used, text messages were sent over the network to all members.

The purpose of the SMS service was to keep them motivated for controlling blood pressure by non-pharmacological means in addition to pharmacological management, improving adherence towards medication, and reducing BP. Patients sent their blood pressure readings when needed and were advised about any food or exercise according to their BP reading. The frequency of received texts from the participants was monitored regularly. Every participant was encouraged to participate actively and send the BP readings regularly. In case of inactivity by a patient, a reminder SMS was sent after 7 days. Patients were interviewed at each clinic visit to assess the level of adherence and diet control. After the completion of 3 months, a questionnaire was given to each candidate to get their feedback with regard to this program. Every participant was briefed about the purpose and details of the study before entering into the project, and each participant signed the patient informed consent form. Ethical approval for conducting the study was obtained from the Hospital Ethical Committee.

Results

At the end of study, both groups had a significant decrease in blood pressure. The BP reduction in the intervention group was greater both in quantity and consistency (Fig. 1). The control group pattern of BP reduction was very inconsistent. Table 2 shows the detailed comparison of blood pressure decline in the intervention and control groups. Figures 1 and 2 demonstrate the total reduction of blood pressure in the intervention group. The intervention group felt fresher and more energetic than the control group, and the intervention group mood was better than that of the control group at the end of the study.

Feedback via SMS questionnaire was received about the program, and was very positive. All members of the

Table 1 Inclusion and exclusion criteria of selected patients

	Inclusion criteria	Exclusion criteria
Age	Greater than 25 years and less than 65 years	Age less than 25 years and greater than 65 years
Systolic blood pressure	Greater than 140 mmHg and less than 160 mmHg for last 2 years	Less than 140 mmHg or greater than 160 mmHg for last 2 years
Diastolic blood pressure	Greater than 90 mmHg and less than 100 mmHg for last 2 years	Less than 90 mmHg or greater than 100 mmHg for last 2 years
Comorbidity	No	Yes
Manual sphygmomanometer	Present	Absent
Measure blood pressure daily in morning and evening	Yes	No
Can read and send SMS	Yes	No

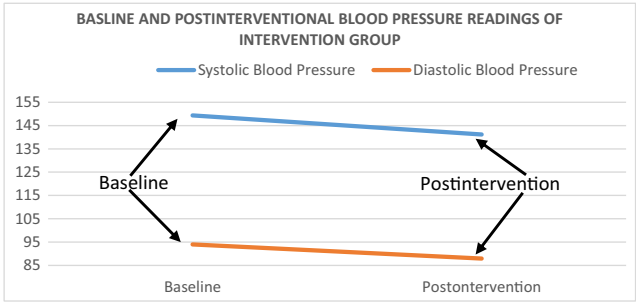

Fig. 1 Baseline and post-interventional blood pressure reading of intervention group

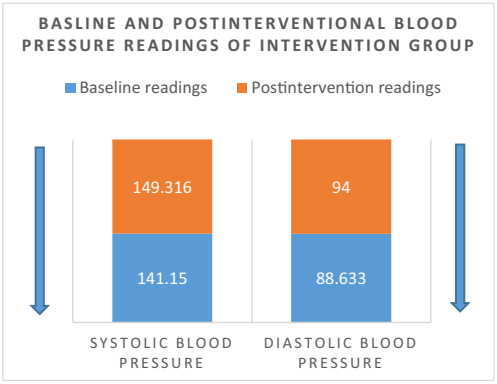

Fig. 2 Total decline in blood pressure of intervention group

intervention group showed a positive response toward the SMS service, and rated this 4 out of 5. They found this service very useful (three ratings of level were possible: useless, useful, and very useful) in enhancing adherence by regular reminders. They also found this service informational and educational, especially in relation to adherence to HTN therapy and use of medicines on time. They found the service helpful in managing their HTN, and found it very cost-effective (almost free) and time-effective too. All members recommended the use of this tool in management of HTN. In particular, they found consultation with pharmacist, nutritionist, and physician very useful and convenient.

Discussion

This project evaluated the utility of SMS; specifically in patient adherence to non-pharmacological management of HTN and it showed significant results. Result showed enhanced adherence towards life-style modification, DASH-like approach and consistency in level of BP reduction. Figure 3 shows the consistency in BP reduction level in the intervention group.

Text messages provide an opportunity to improve health interventions as advancement in IT has made cell phones economical and easily accessible. Cell phones are widely used in Pakistan, in fact all over the world. The major reason of using the SMS tool in HTN management is its cost. It is almost free for both ends, i.e., researcher and patients. SMS cost rates in Pakistan are negligible. Different leading telecom service providers offer an SMS bundle from 0.02$/day or 0.09$/week. Mobile phones are now replacing computers for delivering information due to their omnipresence at low cost and their flexibility (Yoon and Kim 2008).

SMS has also been in use in several healthcare centers, in reminding patients about their visit, to help in quitting smoking, in severe disease [chronic obstructive pulmonary disease (COPD) and diabetis mellitus (DM)] management (Hussein et al. 2011; Wangberg et al. 2006; Vervloet et al. 2012; Faridi et al. 2008), in increasing chiropractic patient compliance toward home exercise (Newell et al. 2012), in ENT outpatients (Geraghty et al. 2008), and in HIV/AIDS management (Da Costa et al. 2012).

Hence the SMS tool has proved its worth; it is not an alternative to direct patient–doctor communication but can be used to improve and enhance self-management to control blood pressure. Other web-based internet-enabled devices are also in use for patient communication, but their major drawback is their availability; many patients do not have any of these devices.

Information during this project demanded by intervention group via SMS included; BP reading review, food effect on HTN and useful food to eat, exercise time and type, the amount of salt to use, use of available salt for HTN patients, and low-fat diet. These results are in accordance with the earlier research done by Årsand and colleagues, in which they found that diabetic patients are more concerned about their BP control, what food to take, and exercise (Årsand et al. 2010).

The high majority of candidates participated actively; the number of SMSs was highest in first 2 months. Participants who reported 80–100% of their BP readings throughout the study and responded to each query of the researcher were considered active, whereas participants who reported 60 to 80% of their BP readings were considered less active, and participants who reported less than 60% of their BP readings were considered as inactive. Eighty percent of participants were considered active, whereas 8% of participants were less

Table. 2 Comparison between intervention & control group blood pressure reading

Comparison	Intervention group	Control group
Systolic blood pressure, mmHg		
1. Baseline	149.31 ± 5.57	148.91 ± 5.58
2. Post intervention	141.15 ± 5.73	146.78 ± 5.73
Diastolic blood pressure, mmHg		
1. Baseline	94.00 ± 3.23	94.25 ± 3.61
2. Post intervention	88.63 ± 3.97	91.28 ± 3.05

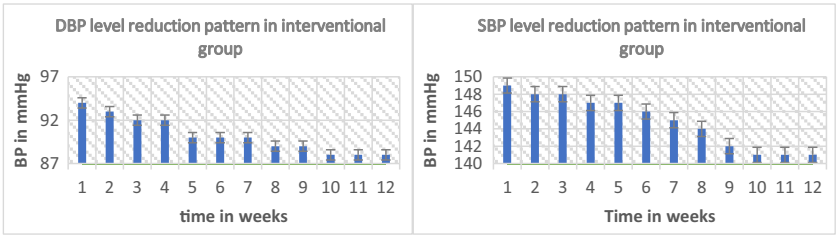

Fig. 3 Pattern of blood pressure decline in intervention group

active and 12% of participants were inactive. Participants who participated actively and sent regular readings of blood pressure and followed instructions strictly got more benefits than those which participated less actively. The difference may be due to a lower awareness about health and less control over diet. It is also possible that a given participant did not received all the texts due to cellular network or recipient cell phone issues. The reliability of SMS receipt was limited to participants' self-reported feedback through an end of study survey. Only four participants reported missing ten or more text messages during the period of the study. The majority of the participants reported receiving all the text messages during the study.

Diet control and exercise showed very positive effects in controlling hypertension. BP readings sent by participants showed that patients who were following regular guide lines about food and had changed their food habits were more satisfied and well controlled. Patients who did not control their diet regularly showed up and downs in controlling BP. Some participants controlled diet only after an increase in BP, and did not follow instructions regularly. Such patients were considered as second grade and benefited less.

Patient adherence improved during the study, which resulted in better control of blood pressure. The participants gave the feedback that they often took medicines after the reminder SMS, and due to regular reminders they seldom forgot to take medicines. The majority of the patients reported that they took medicines 20 to 30 min after the reminder SMS when at home. These results are in accordance with the study of Strandbygaard et al., in which SMS service enhanced the adherence of asthmatic patients and resulted in improved quality of life (Strandbygaard et al. 2010). One of the limitations in measuring adherence was that the interviews done to assess patient adherence lacked check and balance and may be biased. But overall results to improve adherence were encouraging, as shown by the reduction in BP readings.

At the start, interest and response of the participants were at their maximum, and they were asking about each and every thing. With the passage of time, they learnt many things and required less counseling. Two participants made contact only when they felt some problems in controlling BP. They were inactive and were advised to contact their physician for immediate checkup. Control group patients were not counseled about food habits and exercise. They were relying only on medicines. Their BP readings were measured at baseline and at every clinic visit till end of the study. Their BP readings showed fluctuations, and were not well controlled as compared to intervention group.

This study also highlighted the main areas of patient education to be addressed to enhance patient satisfaction, adherence, and compliance. The total number of SMS sent during this study was 11,025. Our results showed that more SMS were sent to pharmacists and nutritionists than to physicians; and most candidates inquired about their food and exercise.

Feedback statistics were very encouraging, and showed full confidence and acceptance of the utility of the SMS tool in HTN management. Many patients stated in feedback that they became more adherent to their HTN medication due to this SMS service; this is the secondary factor that causes decline in blood pressure. The effect of the SMS service on reducing blood pressure and improving adherence was secondary, as the improvement also involved hypertension management which relied on discussion with health professionals and on education. As a result, improved self-care and health beliefs may have contributed as much to BP reduction as adherence to specific medication to manage hypertension. Moreover, different pharmacotherapeutic strategies recommended by physicians were not noted. It is difficult to differentiate whether differences in primary and secondary outcomes were due to text messages solely or combination of text messages and management strategies that were initiated due to patient–physician communication.

Many patients were uneducated, so local language was used for these patients. For elderly patients, the (attendant) son, daughter, or wife who was taking care of them was used as a source of indirect communication. The attendant carer was taking care of the patient, reporting his BP readings, and asking for management-related advice. This approach is highly useful in Pakistan because clinical pharmacists are very rare there, and there are not enough doctors to give proper time to each patient checkup. This approach not only enhances the ease of patient communication and satisfaction, but it will also increase compliance and adherence. Use of randomized control trial design in our study indicated that use of IT-based health intervention processes such as SMS could significantly affect pathways related to hypertension management (self-management and adherence). It was concluded from this study that SMS played a vital role in enhancing patient compliance

and adherence with a non-pharmacological approach for controlling hypertension, which can lead to significant blood pressure reduction.

One of the limitations of this study was the short time period and the lack of lab findings. A more extensive study could be done in future with lab tests at regular intervals, to explore the effects on improvement of lab findings. Another limitation was that we relied on patient-reported results concerning improvement in adherence. No check and balance was maintained to check the adherence level; thus, there may be some bias in patient-reported adherence results.

Patients ignore physicians' instructions about food control and exercise mainly due to irregular follow-up. SMS played a role in reminding them regularly about different life style modifications and food controls along with medication. Moreover, it also increased the contact between patients and the health care team. A physical visit is not always necessayry, and the health care team is accessible to patients all the time through SMS. Communication and type of questions were improved with the passage of time. It can be used as a very important tool for improving patient compliance and adherence to medication, and as part of a non-pharmacological approach for controlling hypertension.

Conclusion

Lack of patient adherence is the major problem in management of hypertension. In a country like Pakistan with an underdeveloped health system, a high burden falls on physicians. A physician has to work overtime to see excessive number of patients. Sometimes health professionals are unable to give proper time to patients. SMS can overcome this as a tool for education. SMS can be used to educate patients about proper management of disease. In hypertension patients, the SMS service played a beneficial role in improving control of blood pressure by sending reminders at regular intervals. This technique can be used in future to enhance patient adherence for better management of hypertension.

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Compliance with ethical standards

Conflict of interest There is no conflict of interest among authors.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from each patient before participation in the study.

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