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The Small Monetary Incentive for Blood Pressure Self-monitoring Behavior in Online Hypertension Management

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ABSTRACT

Objective: To assess the effectiveness of two methods of delivering a fixed total monetary incentive to improve blood pressure self-monitoring behavior in hypertensive patients. Design: This study is a randomized, double-blinded controlled trial. Methods: A 3-arm trial with 99 participants, randomly assigned to a control group and two intervention groups (1:1:1 ratio). Participants utilized internet-based blood pressure monitors and implemented guideline-based standardized hypertension management through an online platform. The two intervention groups received different time-dependent incentives (1 RMB per day) over a 3-month period: immediate or delayed. Results: In the first month, no significant difference was observed in blood pressure self-monitoring among three groups ($P > 0.05$). In the second month, the intervention groups showed significantly higher monitoring days compared to the control (immediate incentive: 21.5 days vs. 16.3 days, P = 0.009; delayed incentive: 21.3 vs. 16.3 days, $P = 0.029$). In the third month, the intervention groups had significantly more measurements (31.1 and 31.4 vs. 17.9 times, $P = 0.013$ and $P = 0.014$). Monitoring behavior declined in all groups over 6 months, with the delayed incentive group declining at a slower rate ($p < 0.001$ for regression coefficient comparison). Conclusions: Monetary incentives effectively improved blood pressure monitoring behavior in the short term. However, their impact diminished after the incentives were withdrawn, with

delayed incentives resulting in a slower decline. Small, delayed monetary incentives may provide benefits for remote hypertension management. Future research should investigate the long-term effects and clinical outcomes.

Keywords: monetary incentive, health behavior, hypertension management, home blood pressure monitoring.

INTRODUCTION

Hypertension is a global public health challenge. According to the "Summary of the 2020 China Cardiovascular Health and Disease Report," there are currently 330 million people in China living with cardiovascular diseases, 245 million of whom are hypertensive. [1]As a modifiable risk factor, an individual's active engagement in both pharmacological and non-pharmacological treatments, including proper medication adherence, a healthy diet, regular physical activity, and blood pressure monitoring, can help mitigate the risks of related complications.[2] Despite significant advances in hypertension treatment and management, the majority of individuals with hypertension still experience uncontrolled blood pressure.[3]

Self-monitoring of blood pressure is a critical strategy in hypertension management, and regular monitoring is essential in controlling hypertension and reducing the risk of cardiovascular disease. However, this approach can pose challenges for patients, such as low adherence to monitoring practices and financial constraints.[4] Additionally, patients' self-management behaviors are often marked by persistence and complexity, as they frequently face barriers when determining whether to adhere to monitoring practices.[5] Targeted interventions must be designed to encourage self-monitoring of blood pressure among hypertensive populations.

Recent research has demonstrated that monetary incentives serve as an effective strategy for promoting healthy behaviors, not only enhancing the initiation and sustained engagement of healthy behaviors, thus mitigating the adverse effects linked to non-communicable diseases (NCDs), but also boosting patient adherence and addressing obstacles to consistent treatment compliance.[6,7] In a recent literature review, Vlaev et al[8] believed that key principles underlying the effective design of incentives for improving habitual health behaviors encompass immediate rewards, contingent reinforcement schedules, and the observation that even relatively modest monetary incentives can exert a positive influence on health-related behaviors.

We hypothesis that even a small amount of monetary reward for completing a specific behavior will be more likely to promote blood pressure monitoring behavior than other form of reward that encourages behavior change.

However, how to structure incentives to be more effectively promote behavioral change is unknown, and it is also unclear how behavior change can be sustained and habit-forming after the incentive is inevitably removed as studies that have demonstrated the benefits of monetary incentives, few have measured behavior after the intervention.[9-12]

Therefore, the main aim of this study was to explore the effect of two type of small monetary incentives on blood pressure self-monitoring behavior on an online platform for health

management compared to routine management and the afterwards effects when incentives removed.

METHODS

Study Design

This study was a randomized double-blind controlled trial with three parallel arms. The study was approved by the Research Ethics Committee of Chongqing Medical University (2021089). Participants signed an informed consent to participate in the study.

Participants

Participants who lived in community with uncontrolled hypertension were recruited from the People's Hospital of Nan'an District, Chongqing. Recruitment occurred from April 27th, 2023 to July 8th, 2023. In order to attract the candidates to participate, a wireless upper arm digital sphygmomanometer (A666G, Shenzhen, China) was provided as a gift (valued 200 RMB).Inclusion criteria for the participants included: (1) aged between 35 - 75 years, (2) have primary hypertension with clinic diagnosis, (3) be proficient in using WeChat ,a popular social smartphone App in China.Exclusion criteria for participants included: (1) secondary hypertension, (2) severe hypertension complications, (3) disabilities that rendered them unable to live independently, (4) other major illnesses that made them unsuitable for home management.

Randomization and Blinding

Eligible participants were assigned to one of 3 groups in a 1:1:1 ratio by the random number in the envelope they chose. Participants were blinded to the incentive program when enrolled in. Staffs responsible for routine hypertension management were also blinded about the group allocation. Staffs responsible for the money distribution did not involve in the management of hypertension. Details of randomization were kept confidential until data analysis was completed.

Monetary Incentive Interventions and Follow-ups

All participant was recommended to measure their blood pressure two times, one is in the morning before breakfast and hypertension medicine taking, the other is in the evening within 1 hour before their bedtime. This blood monitoring schedule is from the guidelines issued by Clinical practice guidelines for the management of hypertension in China. According to their blood monitoring behaviors, small monetary will be given as interventions, there are two type of small monetary incentives used as intervention:

Immediate Incentive:

¥1 RMB (value for half bottled of water in retail market) as reward for completing at least one time of blood pressure measurement was given in the each day. The monetary was transferred at 10:00 p.m through Wechat electronic payment for today’s blood pressure self-monitoring behaviors.

Delayed Incentive:

¥1 RMB as reward for completing at least one time of blood pressure measurement was counted, the same as immediate incentive.

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However, the reward was accumulated weekly and transferred at the each seventh day from the beginning of the enrollment by Wechat.

Control:
Participants were asked to measure their blood pressure at the same frequency as intervention groups, but no incentive money was given. Interventions lasted for 3 months (90 days). For participants in each intervention groups, the maximum reward was RMB 90. After intervention, another 3 months follow-up was continued. The total observation period is 6 months.

Self-monitoring Behavior Measurements
The primary outcome was the count of blood pressure self-monitor behavior. When participants measured their blood pressure by using the gift digital sphygmomanometer which was integrated with technology of internet of things (IOT), the blood pressure readings were automatically uploaded to the internet-based hypertension management platform named Guanxiaoai™ (Western (Chongqing) Institute of Health Management Co., Ltd). Researchers can access these records for management.

Definition of Outcomes
- **Blood pressure measurement**: the number of any recorded measurement of blood pressure in a period of time.
- **Valid blood pressure measurement**: when there are more than two measurements of blood pressure in a day, only those two measurements with maximum time interval are recognized as valid measurements. That means in a day the maximum valid measurement is two.
- **Day in half adherence**: the day of having at least one measurement of blood pressure for a person.
- **Day in complete adherence**: the day of having two valid measurement of blood pressure.
- **Person in half adherence**: person who have at least one measurement in a day over three weeks (21 days) in a month.
- **Person in complete adherence**: person who have 2 valid measurements in a day as required over three weeks (21 days) in a month.
- **Person being followed:** person with at least 1 measurement of blood pressure in a month.

Procedures of Study
Eligible patient who took their routine health checks at the Nan'an District People's Hospital in Chongqing, China, were invited and an appointment was made to visit the research site. At the research site, informed consent for participating was obtained. Then a face-to-face interview with structured questionnaire was conducted. Items of questionnaire included demographic and lifestyle characteristics, such as gender, age, smoking, alcohol consumption, and physical activity, the information of health problem and the using of medications were also collected.

After that, the participant was randomly allocated to one of three arms of the study. A personal account for patient of the smart-phone based Guanxiaoai™ hypertension management platform was created without showing any allocation hints. Participant then received a digital

sphygmomanometer bound to his/her account. At the site of interview, participant was instructed on when and how to use this device to do blood pressure monitoring.

All participants were managed online with standardized hypertension procedures including health education, medication using, diet and physical activity consulting and blood pressure self-monitoring reminder provided by 4 professionals through the smartphone-based hypertension management system. When the system detected no blood pressure measuring for 1 consecutive week, an automatic reminder on blood pressure monitoring was sent to the participants' smartphone. Researchers assistants checked the self monitoring records daily and give the incentive monetary by Wechat electronic payment as planned. Participants were allowed to dropped off from the study at their will at any time.

Statistical Analysis

Intention to treat principle was used in data analysis. Variables were summarized as mean, standard deviation or percentage as appropriate. Between group comparisons were conducted by using chi-square or ANOVA analysis according to the type of variables. Analyses followed an intention-to-treat principle and were performed using SPSS version 26.0, $P<0.05$ was considered statistically significant.

RESULTS

Characteristics of Participants

Ninety-nine participants with uncontrolled hypertension were included. The overall mean age of the participants was 61 years and 64% were female. The overall mean body mass index (BMI) and years of hypertension were 24.7 kg/m^2 and 8.5 years, respectively. There were no significant differences in the baseline characteristics of the participants in the three groups (Table 3.1).

Table 3.1: Baseline Characteristics of The Study Sample

Characteristic	Immediate incentive (n=33)	Delayed incentive (n=33)	Control (n= 33)	*P* Value
Age, (years)	60.3±7.7	60.1±6.8	64.0±6.0	0.057
Female, No. (%)	20(60.6)	25(75.8)	19(57.6)	0.254
BMI, (kg/m^2)	24.3±2.4	25.2±2.9	24.7±2.5	0.369
Educational level, No. (%)				
Grade school	5(15.2)	1(3.0)	7(21.2)	0.096
Secondary or High school	19(57.6)	26(78.8)	21(63.6)	
College or university	9(27.3)	6(18.2)	5(15.2)	
Marital Status, No. (%)				
Currently married or living with partner	25(75.8)	29(87.9)	28(84.6)	0.135
Single, Widowed or divorced	8(24.2)	4(12.1)	5(15.4)	
Smoking status yes, No. (%)				
Never	26(78.8)	28(84.6)	20(60.6)	0.215
Quit	3(9.1)	2(6.1)	4(12.1)	
Current	4(12.1)	3(9.1)	9(27.3)	
Drinking status, No. (%)				
Never	23(69.7)	26(78.8)	22(66.7)	0.570

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Sometime	8(24.2)	5(15.2)	6(18.2)	
Often	2(6.1)	2(6.1)	5(15.2)	
Duration of hypertension, (years)	10(5.0,13.0)	8(3.0,10.0)	5(2.0,12.0)	0.306
Other chronic disease, No. (%)				
Diabetes	4(12.1)	9(27.3)	9(27.3)	0.232
CHD	2(6.1)	3(9.1)	2(6.1)	0.862
Dyslipemia	5(15.2)	3(9.1)	2(6.1)	0.595
Liver disease	3(9.1)	2(6.1)	0	0.365
Antihypertensive drug intake, No. (%)				
No	1(3.0)	2(6.1)	4(12.1)	0.375
Regular	31(93.9)	27(81.8)	28(84.8)	
Sometimes	1(3.0)	4(12.1)	1(3.0)	
Physical activity, No. (%)				
Hardly Moderate Frequent	12(36.4) 14(42.4) 7(21.2)	13(39.4) 11(33.3) 9(27.3)	11(33.3) 15(45.6) 7(21.2)	0.884

Notes. Frequencies/percentages (categorical variables) compared using χ2-Tests and means (continuous variables) compared using ANOVA or non-parametric Kruskal-Wallis Tests as appropriate.
BMI indicates body mass index; CHD, Coronary Heart Disease.

The Blood Pressure Self-monitoring Behavior During Intervention

In the first month of the intervention, the overall blood pressure measurement behavior across the three groups showed minimal differences. Although both the immediate incentive group and the delayed incentive group slightly but not significantly outperformed the control group in terms of blood pressure monitoring frequency (P> 0.05).

In the second month, the adherence rates of the delayed and immediate incentive groups were significantly higher than those of the control group, particularly with respect to the day in half adherence (Immediate incentive group: 21.5 days vs. Control group: 16.3 days, P=0.009; Delayed intervention group: 21.3 days vs. Control group: 16.3 days, P=0.029).

In the third month, the differences in blood pressure monitoring behavior became more pronounced. The number of valid measurements (Immediate incentive group: 31.1 times vs. Control group: 17.9 times, P=0.026; Delayed incentive group: 31.4 times vs. Control group: 17.9 times, P=0.021) and the number day of half adherence (Immediate intervention group: 19.8 days vs. Control group: 13.6 days, P=0.013; Delayed incentive group: 20.4 days vs. Control group: 13.6 days, P=0.014) were significantly higher in both intervention groups compared to the control group. During the second and third months, the complete adherence rates in both incentive groups were significantly higher than those in the control group (P=0.04 and P=0.01, respectively). (Table 3.2).

Table 3.2: Blood Pressure Measurements by Incentive Method During the 90-day Intervention Period

	Immediate incentive (n=33)	Delayed incentive (n=33)	Control (n=33)	P value
1st month				
Blood pressure measurement	42.9(34.4,51.3)	40.2(29.7,50.7)	33.0(25.7,40.3)	0.148

Valid blood pressure measurement	38.8(31.5,46.1)	34.8(27.5,42.0)	30.0(23.7,36.2)	0.125
Day in half adherence	23.6(20.1,27.2)	21.3(17.7,24.9)	20.0(16.5,23.6)	0.079
Day in complete adherence	15.8(11.4,20.2)	13.4(9.3,17.5)	9.9(6.5,13.4)	0.196
Person being followed	31(93.9%)	32(97.0%)	31(93.9%)	1.000
Person in half adherence	25(75.8%)	20(60.6%)	18(54.5%)	0.182
Person in complete adherence	15(45.5%)	12(36.4%)	7(21.2%)	0.111
2nd month				
Blood pressure measurement	36.1(27.2,45.1)	39.0(29.0,49.1)	25.2(17.8,32.7)	0.082
Valid blood pressure measurement	34.2(26.0,42.5)	34.0(26.6,41.3)	23.0(16.3,29.7)	0.057
Day in half adherence	21.5(17.2,25.7)*	21.3(17.4,25.3)*	16.3(12.2,20.4)	0.020
Day in complete adherence	12.7(7.8,17.6)	12.8(8.7,16.7)	6.7(3.4,10.0)	0.231
Person being followed	30(90.9%)	28(84.8%)	28(84.8%)	0.807
Person in half adherence	22(66.7%)	22(66.7%)	17(51.5%)	0.344
Person in complete adherence	13(39.4%)	10(30.3%)	4(12.1%)	0.040
3rd month				
Blood pressure measurement	33.2(24.3,42.2)*	35.2(26.3,44.0)*	19.7(13.2,26.1)	0.029
Valid blood pressure measurement	31.1(23.0,39.2)*	31.4(24.1,38.8)*	17.9(12.3,23.5)	0.032
Day in half adherence	19.8(15.4,24.2)*	20.4(16.4,24.4)*	13.6(9.8,17.3)	0.017
Day in complete adherence	11.4(7.0,15.9)	11.4(7.3,15.5)	4.5(1.8,7.2)	0.110
Person being followed	28(84.8%)	29(87.9%)	29(87.9%)	1.000
Person in half adherence	21(63.6%)	20(60.6%)	12(36.4%)	0.052
Person in complete adherence	12(36.4%)	10(30.3%)	2(6.1%)	0.010

*indicate p value<0.05 compared to control group

The Blood Pressure Self-monitoring Behavior After Intervention

The number of day in complete adherence in the immediate incentive group fell sharply at month 4 (from 11.4 at month 3 to 2.9 at month 4) and did not differ from the control group at 4th month (2.9 vs 2.4, *P*=0.181), 5th month (1.1 vs 1.5, *P*=0.381), and 6th month (1.4 vs 1.2, *P*=0.554). Similarly, the number of day in complete adherence in the delayed incentive group did not differ from the control group at 4th month 4 (4.1 vs 2.4, *P*=0.181), 5th month (2.5 vs 1.5, *P*=0.381), and 6th month (1.3 vs 1.2, *P*=0.554). see table 3.3

Table 3.3: Blood Pressure Measurements by Experimental Conditions After the 90-day Intervention Period

	Immediate incentive (n=33)	**Delayed incentive (n=33)**	**Control (n=33)**	***P value***
1st month				

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Blood pressure measurement	13.5(7.6,19.4)	15.9(10.4,21.3)	10.5(5.9,15.0)	0.348
Valid blood pressure measurement	12.2(7.4,16.9)	14.7(9.6,19.9)	9.9(5.5,14.3)	0.336
Day in half adherence	9.2(6.1,12.4)	10.6(7.2,14.0)	7.5(4.5,10.5)	0.389
Day in complete adherence	2.9(0.9,4.9)	4.1(2.0,6.3)	2.4(0.7,4.2)	0.181
Person being followed	25(75.8%)	26(78.8%)	26(78.8%)	0.943
Person in half adherence	4(12.1%)	5(15.2%)	3(9.1%)	0.926
Person in complete adherence	1(3.0%)	1(3.0%)	1(3.0%)	1.000
2nd month				
Blood pressure measurement	8.2(4.3,12.2)	10.5(5.3,15.7)	7.0(3.5,10.4)	0.719
Valid blood pressure measurement	7.6(4.2,10.9)	9.6(5.0,14.1)	6.3(3.0,9.5)	0.644
Day in half adherence	6.5(3.6,9.4)	7.1(3.9,10.2)	4.8(2.5,7.0)	0.601
Day in complete adherence	1.1(0.3,1.9)	2.5(0.9,4.1)	1.5(0.1,2.9)	0.381
Person being followed	22(66.7%)	23(69.7%)	21(63.6%)	0.873
Person in half adherence	3(9.1%)	3(9.1%)	2(6.1%)	1.000
Person in complete adherence	0	0	0	NA
3rd month				
Blood pressure measurement	7.3(3.8,10.8)	6.7(3.1,10.2)	5.5(1.9,9.2)	0.713
Valid blood pressure measurement	6.3(3.6,10.2)	6.9(2.8,9.7)	5.2(1.8,8.6)	0.715
Day in half adherence	5.5(2.8,8.2)	4.9(2.2,7.6)	4.0(1.5,6.5)	0.739
Day in complete adherence	1.4(0.6,2.3)	1.3(0.3,2.4)	1.2(0.1,2.3)	0.554
Person being followed	20(60.6%)	21(63.6%)	20(60.6)	0.958
Person in half adherence	2(6.1%)	3(9.1%)	2(6.1%)	1.000
Person in complete adherence	0	0	0	NA

Abbreviation: NA, not applicable.

The Linear Trend of the Monthly Measured Behaviors in 6 Months of Observation

From the beginning of the intervention and after the removal of the incentives, the overall effect of the behavior followed a monotonic trend, decaying over time (showing as linear negative correlation, all $p<0.05$).

Table 3.4: The Linear Regression of Behaviors by The Month of Observation

	B	**SE**	***P value***
Immediate incentive			
Blood pressure measurement	-256.3	38.3	0.002

Valid blood pressure measurement	-243.7	38.0	0.003
Day in half adherence	-137.9	20.6	0.003
Day in complete adherence	-108.6	17.9	0.004
Person being followed	-2.3	0.2	<0.001
Person in half adherence	-5.4	1.1	0.007
Person in complete adherence	-3.6	0.7	0.007
Delayed incentive			
Blood pressure measurement	-259.5	40.2	0.003
Valid blood pressure measurement	-221.3	35.9	0.004
Day in half adherence	-128.5	22.5	0.005
Day in complete adherence	-92.7	13.9	0.003
Person being followed	-2.1	0.3	0.002
Person in half adherence	-4.5	1.1	0.016
Person in complete adherence	-2.8	0.6	0.008
Control			
Blood pressure measurement	-191.5	20.9	0.001
Valid blood pressure measurement	-173.3	18.3	0.001
Day in half adherence	-115.2	11.5	0.001
Day in complete adherence	-58.1	8.8	0.003
Person being followed	-2.3	0.4	0.004
Person in half adherence	-3.8	0.7	0.005
Person in complete adherence	-1.4	0.3	0.005

The Comparisons of Behavior Changes by Month Among Three Intervention Groups

In Table 3.5 we compared those regression coefficients in table 4 between groups. It revealed that significant differences between two type of incentive and the control group in all variables (all P<0.001), it means both incentives decayed more quickly in blood pressure measurement behavior. When compare the regression coefficients between two incentives, delayed incentive group decayed a little more slowly (all p<0.001), which means that delayed incentive may be more useful of persistent self-monitoring behavior.

Table 3.5: The Comparisons of Regression Coefficient of Behaviors by the Time of Month of Observation Among Three Groups

Blood pressure monitoring	Immediate incentive Vs Control	Delayed incentive Vs Control	Immediate incentive Vs Delayed incentive
Blood pressure measurement	-256.3 vs -191.5***	-259.5 vs -191.5***	-256.3 vs -259.5***
Valid blood pressure measurement	-243.7 vs -173.3***	-221.3 vs -173.3***	-243.3 vs -221.3***
Day in half adherence	-137.9 vs -115.2***	-128.5 vs -115.2***	-137.9 vs -128.5***
Day in complete adherence	-108.6 vs -58.1***	-92.7 vs -58.1***	-108.6 vs -92.7***
Person being followed	-2.3 vs -2.3***	-2.1 vs -2.3***	-2.3 vs -2.1***
Person in half adherence	-5.4 vs -3.8***	-4.5 vs -3.8***	-5.4 vs -4.5**
Person in complete adherence	-3.6 vs -1.4***	-2.8 vs -1.4***	-3.6 vs -2.8***

immediate incentive group n=33, delayed incentive group n=33, control group n=33

*p <0.05, **p<0.01, ***p<0.001

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DISCUSSION

We implemented two incentive schemes to promote adherence to blood pressure monitoring among hypertensive patients through the use of an internet-based platform and monitoring devices. The incentive structures influenced blood pressure monitoring behavior during the monetary intervention period, with both immediate and delayed incentives significantly improving monitoring performance compared to the control group. However, these effects diminished once the monetary incentives were withdrawn. This behavioral pattern mirrors findings from previous studies, where behavioral performance typically declined across all conditions following the cessation of monetary incentives. [13-17]For instance, Shapiro et al[13] provided participants in the intervention group with a combination of monetary incentives, including fixed payments, contingent payments, and lotteries (e.g., raffle cards for blood pressure measurements taken on more than 15 days within the month to meet health goals established by the researchers) among a highly vulnerable minority group. This study demonstrated that these incentives helped improve medication adherence by encouraging participants to measure their blood pressure more frequently. However, the positive effects of the incentives diminished during the follow-up phase. Volpp et al[16] study showed that short-term adherence to warfarin was enhanced through lottery-based monetary incentives, although this effect waned once the incentive was withdrawn. In a separate study, Wong et al[17] investigated the effect of monetary incentives grounded in deposit contracts on adherence to blood glucose monitoring in adolescents with type 1 diabetes who exhibited poor glycemic control. The findings revealed that adherence to glycemic monitoring was significantly greater in the incentive group compared to the control group during the intervention phase, but no notable difference was found during the follow-up phase.

Our study is similar with the study by Villeval et al[18], who directly compared the difference between continuous incentives (similar to immediate incentive in our study) and intermittent incentives (similar to delayed incentive in our study) in relation to task withdrawal rates. They found that intermittent incentives led to more sustained and higher levels of effort. Furthermore, with regard to promoting physical activity, a field trial by Arad et al[19] demonstrated that intermittent incentives had a greater impact on the physical activity levels of infrequent exercisers than continuous incentives after the incentives were removed. Additionally, Axon et al[20] concluded that hypertensive patients who preferred to focus on current rather than future goals (preferring immediate incentives) were less likely to monitor their blood pressure regularly compared to hypertensive patients who preferred delayed incentives.

Few studies on monetary incentives for hypertension control have measured and demonstrated changes in behavior following the intervention. These studies differ from ours in several ways: nearly all have focused on incentivizing and measuring changes in blood pressure values and medication adherence, rather than measuring blood pressure-related behaviors; the duration of the interventions was 3 months or longer; and the total value of the incentives was several times higher than the value in our study (90 RMB).[13,15,21,22]

Our study observed that delayed incentives exhibit a slower decline compared to immediate incentives. A potential explanation for this effect is that delayed rewards enhance self-control and facilitate the internalization of behavior, thus fostering greater persistence.[23] For example, in a regular savings scheme, despite the delayed nature of incentives, such as interest payments

or government subsidies, individuals internalize these incentives as habitual behaviors through regular savings, ultimately fostering long-term persistence.[24] However, during the first month of the intervention, behavioral performance was higher in the immediate incentive group compared to the delayed incentive group (though not statistically significant), while the condition reversed in the second and third months. The delayed incentive effect's slow performance may be attributed to challenges in learning instrumental conditioning during the delay, as well as the perceived difficulty and the adaptation to the incentive value of the delayed reward during the waiting period.[25]

Overall, monetary incentives were effective in improving blood pressure monitoring behavior in the short term, but the long-term effects were not sustained in the context of remote internet-based management.

LIMITATIONS AND STRENGTHS OF THIS STUDY

There are some strengths in this study. Firstly, this study used a randomized, double-blind controlled trial methodology and the results are from real-world Second, most of the other studies on monetary incentives for hypertension have focused on changes in the outcome of blood pressure values, while there are few studies on behavioral changes, our findings provide some explanations for those studies focused on blood pressure. This study also has several limitations. Firstly, we used remote monitoring of blood pressure measurement behavior in hypertensive patients, and although we had one-to-one identity binding for each internet-based blood pressure measurement device, there was still the possibility of multiple family members using the devices. Second, we only deployed the incentive for three months, so we do not know how adherence rates might have changed if the incentive lasts for a longer period of time. third, our sample population was from part of the urban area of Chongqing, generalizing the results of this study to other Chinese must be with caution. Finally, this pilot study only evaluate behavior of blood pressure measurement, the clinic benefits are unknown.

CONCLUSION

This randomized controlled trial (RCT) conducted among individuals with hypertension demonstrated that small monetary incentives were effective in enhancing blood pressure monitoring behaviors in the short term. However, no long-term effect on behavioral change was observed. The impact of delayed incentives decreased more gradually than that of immediate incentives over the course of the study, a period during which overall income was likely consistent. The delayed provision of small monetary incentives could be considered as a strategy in the remote management of hypertension. Further research on the long-term effects and clinical outcomes of small monetary incentives in hypertension management is essential.

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Ethics
This study was approved by the Ethics Committee of ChongQing Medical University (2023002).

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Data Availability Statement
The data that support the findings of this study are available on request from the corresponding author, AT. The data are not publicly available due to reasons of sensitivity.

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