

The Effect of Healthcare Service of Employees at a Workplace Using Mobile

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Abstract

Background/Objectives: This study was conducted to investigate the effectiveness of mobile-based healthcare program on indicators of chronic disease.

Method/Statistical Analysis: This study was conducted on 149 participants from the A company employees who had a Health Check-up at S hospital Health Screening Center (Yong-in, Korea) in 2017 then found to be exceeding the prediabetes standard (Fasting Glucose ≥ 100 mg/dL). 109 participants completed the 12 weeks mobile healthcare program. The final data were analyzed from these participants. Participants are divided into two groups; General care group (HbA1c $< 6.4\%$, n=62) and intensive care group (HbA1c $\geq 6.5\%$, n=47).

Findings: After 12 weeks, participants' average HbA1c was decreased to $0.38 \pm 0.65\%$ ($p < 0.001$). HbA1c of the intensive care group was decreased to $0.78 \pm 0.79\%$, which was more effective than the $0.08 \pm 0.25\%$ reduction of HbA1c from the general care group. In addition, with adjustment of the age, body mass index, glucose, the improvement of HbA1c of intensive care group was even more effective than another group (Odds ratio [OR]=4.385, 95% CI 1.043-18.440).

Improvements/Applications: The mobile healthcare program provided to pre-diabetes and diabetes patients was found to be effective in enhancing the indicators of chronic diseases. In particular, the program is more effective to the intensive care group than the general care group.

Keywords: Diabetes, Health Care, Mobile, Health Management Service, Employee

Introduction

Many International Organizations recognized the seriousness of chronic diseases and ask their each nations to make policies to improve it. World Health Organization (WHO) declared WHO Global Action Plan for the 'Prevention and Control of Non-Communicable Diseases (NCDs) 2013-2020 (resolution WHA66.10)' in 66th World Health Assembly then WHO set a goal to decrease the death rate by the chronic disease, such as diabetes, to 25% lower, then to make a realistic goal, WHO advised member countries to establish national

policies^[1]. In addition, during United Nations (UN) 'General Assembly on the Prevention and Control of Non-communicable Diseases' held on September 19-20, 2011, UN addressed a declaration of the high-level meeting that prevention and management of the NCDs are a basic duty of countries^[2].

According to Atlas 8th, the global number of diabetics in 2017 is expected to be 425 million and by 2025 the number is to be 629 million, which is 48% increase. In addition, one of three adults over 20 years of age in the Western Pacific countries (Korea, etc.) has diabetes and one third of deaths were due to diabetes^[3]. International Diabetes Federation (IDF) estimates that health care costs increased to \$ 732.7 billion in 2017, more than three times of \$ 232 billion in 2006^[3]. According to the 2017 Organization for Economic Cooperation

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and Development (OECD)'s Health Glance, deaths by diabetes are 700,000 people per year in OECD countries. Already 9 million adults which are 7% of the OECD population, has diabetes and the number continues to be increased and they suffer from cardiovascular diseases such as heart attacks, strokes, loss of vision, diabetic foot and kidney diseases^[4].

There needs to be a serious attention to medical situation regarding Korea's diabetes in the OECD's Health Glance^[5]. The rate of hospitalization due to diabetes was decreasing, but Korea still has 281 inpatients per 100,000 people and it is more than the double of the OECD's average, 137, so Korea is No.2, after Mexico of 292^[5]. According to Korea Center of Disease Control (KCDC), the rate of diabetes of the people older than 30 was increased by 1.8%p from 9.5% in 2005 to 11.3% in 2016^[6]. In addition, the treatment rate increased by 18.2%p from 49.0% to 67.2%. However, in 2016, only one third of diabetes patients was able to manage their blood glucose (HbA1c<6.5%)^[6].

There have been national efforts regarding diabetes management. Most of domestic diabetes-related prevention programs are driven by public health centers. In September 2007, Daegu launched a pilot project of high-risk cardiovascular risk groups (hypertension / diabetes) registration. 10 new locations were newly added from 2012^[7]. In addition, according to the general health screening project (Article 5 of Framework ACT On Health Examinations, Article 52 of National Health Insurance ACT, Article 25 of Enforcement Decree of The National Health Insurance ACT, Article 14 of Medical Care Assistance ACT), the screening targets are defined as a law and the targets are expanding^[8]. The subjects of medical examination are beneficiaries of medical benefits and health insurance and as of the end of November 2015, the number of people is about 20.8 million. The goal is to conduct primary and secondary screening for early detection of 13 diseases with a focus on cardiovascular diseases including diabetes^[9, 10].

However, the assessment level of public management was not positive. The given level by the program was high, but each individual's self-management level was low. Health centers currently does not play an effective role in the clinical information system^[11]. The need for improvements shall have many agrees, but there are limitations as a country to manage all chronic diseases^[12].

Therefore, it is necessary to have an alternative solution for efficient management of chronic diseases.

Improving diabetes requires interventions among appropriate exercise, eating habits and blood sugar management. In order to make an effective strategy, the method shall be established through location and tools which are closely connected to daily lives then the method shall be easy of use and cost efficient^[13-15]. Office is the place where the majority of employees stay and it is where they stay for the longest time outside of homes, therefore it is an important place to manage their lifestyles for the prevention and management of chronic diseases^[16]. In addition, previous studies have shown that mobile healthcare program can improve self-management in a cost-effectiveness way^[17]. Especially according to the related regulations and law, Auxiliary medical institution that are built in the workplaces, can be the legally assured institution that can support employees' management and prevention of diseases in the safest way^[18, 19].

Therefore, it is necessary to evaluate and see the effectiveness of mobile diabetes management program, which can manage diabetes anywhere and anytime, provided to the employees by Auxiliary medical institution to manage diabetes.

Method

This study was conducted in the auxiliary medical institution then provided an intervention service between the medical staff and diabetic patients through mobile health care program.

149 participants were the A company employees who received a health Check-up at S Hospital Health Screening Center in 2017 who showed indicators exceeding the prediabetes standard (Fasting glucose \geq 100 mg/dL). Among them, 40 participants were excluded due to any of the following: participants who refused to participate the program (n=33), who did not conduct post-inspection (n=7). Finally, 109 participants were enrolled in this study.

A mobile healthcare program from June to August 2018 was provided. Participants had Check-up before and after the program for measurements such as blood and blood pressure. Eating and physical habits was checked by a Google survey.

There were 4 small group training session for participants. The doctor explained purpose of the mobile healthcare program. The nurse trained blood sugar management method. The nutritionist taught how to manage eating habits. The IT specialist trained how to use mobile healthcare applications.

After the sessions, each portable Bluetooth blood glucose meter and consumables (blood needles, strips and alcohol swabs) was provided to check diabetes for 12 weeks. During the period, 3 mobile messages sent every week which is individualized health information such as participant’s blood records, eating habits and health information. There were a team for writing messages by doctors from family medicine department, nurses and dietitians.

The message provided evidence-based information, including dietary and behavioural recommendations on exercise habits. Notification of users and delivery of disease information is based on the 2019 Diabetes Guidelines of the Korean Diabetes Association^[20]. Participants were trained to check pre-prandial blood sugar, post-prandial blood sugar and fasting blood sugar daily and asked to write their physical activities, diet and medications so they could manage own records by themselves. The results were delivered to participants by the doctor within 7 days of the examination and a report containing an assessment of changes in self-care habits was sent through mobile app within 3 weeks after finishing programs.

Chronic conditions were determined on the basis of HbA1c. More than 6.5% of HbA1c was defined as diabetes^[20]. Participants were assigned into 2 groups, intensive care group (ICG) (HbA1c≥6.5%, n=47) and general care group (GCG) (HbA1c 5.7%-6.4%, n=62) based on the prior HbA1c. To the ICG, additional messages were sent.

Venous blood samples were collected in the morning (AM 8:00-9:00) after an overnight fast of more than 8 hours. Concentrations of HbA1c, fasting plasma glucose (FPG), total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were measured.

Blood sugar level were measured by blood Glucose meter (CareSens N Premier; i-SENS, Seoul, Korea) and obesity were measured by BMI (BSM370; Biospace, Seoul, Korea)

Logistic regression analysis was performed to assess the factors of HbA1c improvement in the GCG and the ICG. The effects on HbA1c between two groups were evaluated using multivariate logistic regression analysis that corrected age and gender. Statistical analysis were performed using SPSS 25.0 (SPSS Inc., Chicago, IL, USA). A p value<0.05 was considered as statistically meaningful.

Prior to this program, participants were aware of their prediabetes status then voluntarily agreed to the program then signed the participation consent. It was informed to participants that they can discontinue the service at any time. After the service closed, the application is disabled within a month and all data will be erased.

Result and Discussion

1. General characteristics of the subjects

The general characteristics of the study subject are given in Table 1.

Table 1. General characteristics of subject (n=109)

Variable	Value
Age	
<40	14 (12.84)
40-49	38 (34.86)
≥50	38 (34.86)
Sex	
Male	105 (96.33)
Female	4 (3.67)
Height	170.31 ± 18.06
Weight	80.241 ± 10.99

Data are presented as n (%) or mean ± standard deviation.

2. Change in forward head posture

Comparisons of parameters before and after using mobile intervention service are given in Table 2. Body mass index (BMI) reduced from 26.92 to 26.47 (p<0.001). HbA1c reduced from 6.53 to 6.15 (p<0.001).

Table 2: Comparison of chronic disease parameters before and after using mobile intervention service (n=109)

Variable	Baseline	After 3 months	t	p value
BMI	26.92 ± 3.28	26.47 ± 3.26	4.281	<0.001
SBP	129.18 ± 12.74	121.68 ± 11.42	5.919	<0.001
DBP	86.07 ± 10.17	77.20 ± 8.97	8.350	<0.001
HbA1c	6.53 ± 0.90	6.15 ± 0.64	6.124	<0.001
TC	176.21 ± 38.64	168.94 ± 36.69	1.945	0.054
HDL-C	49.62 ± 12.02	46.71 ± 10.68	4.940	<0.001
LDL-C	106.13 ± 33.59	102.94 ± 33.11	0.963	0.338

BMI, body mass index; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

In both ICG and GCG, HbA1c were declined comparing to the baseline during the 12 weeks participation period. Related to the baseline, ICG's HbA1c change was 0.89%p (p<0.001), GCG's HbA1c reduction was 0.60%p (p<0.001).

For the BMI, ICG decreased significantly from 27 to 26.61 (p<0.001) and for GCG from 26.81 to 26.33 (p<0.001) (Table 3).

Table 3: Comparison of chronic disease parameters between intensive care group (n=47) and general care group (n=62)

		Baseline	After 3 months	t	p value
Intensive care group (n=47, 43.1%)	BMI	27.00 ± 0.57	26.61 ± 3.50	2.154	<0.001
	SBP	128.18 ± 1.79	119.36 ± 12.01	4.729	<0.001
	DBP	87.77 ± 9.35	76.28 ± 9.69	5.341	<0.001
	HbA1c	7.33 ± 0.11	6.55 ± 0.71	6.723	<0.001
	TC	170.91 ± 5.47	161.96 ± 31.39	1.430	0.116
	HDL-C	47.34 ± 1.54	45.74 ± 9.22	1.892	<0.001
	LDL-C	102.13 ± 4.84	99.96 ± 31.46	0.406	0.014
General care group (n=62, 56.9%)	BMI	26.81 ± 0.44	26.33 ± 3.07	3.986	<0.001
	SBP	129.92 ± 1.78	123.18 ± 11.19	3.900	<0.001
	DBP	86.30 ± 10.82	78.18 ± 8.45	6.392	<0.001
	HbA1c	5.93 ± 0.04	5.85 ± 0.36	2.574	<0.001
	TC	180.23 ± 4.99	174.23 ± 39.68	1.307	<0.001
	HDL-C	51.35 ± 1.63	47.44 ± 11.68	4.895	<0.001
	LDL-C	109.16 ± 4.30	105.21 ± 34.38	0.941	<0.001

BMI, body mass index; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

3. Logistic regression analysis

Univariate and multivariate logistic regression analyzes were performed to determine whether age and BMI influence HbA1c improvement. The dependent variable is HbA1c improvement and the independent variable is age and BMI. In the crude model, the HbA1c improvement was more effective in the ICG than the GCG (OR=5.676, 95% CI 1.972-16.333). (Table 4).

Table 4: Logistic regression analysis

	Crude	Model 1	Model 2	Model 3
General care group (HbA1c<6.5)	1.000	1.000	1.000	1.000
Intensive care group (HbA1c≥6.5)	5.676 (1.972-16.333)	5.776 (1.954-17.075)	6.501 (1.854-22.803)	4.385 (1.043-18.440)

Model 1: adjusted for age; Model 2: Model 1+body mass index; Model 3: Model 2+glucose.

Discussion

In this study, participants were divided into two groups HbA1c level: ICG (n=47) with the HbA1c level over 6.5% and GCG (n=67) with the HbA1c level below 6.5% and as a result, the ICG showed greater effect on the improvement of the intervention service.

In case of ICG, they received additional customized messages regarding risk of diabetes and its complications so this helped them to have active interests in self-management to make improvements of HbA1c. Participants verified that the effort to improve the HbA1c level was effective for the improvement of BMI and blood pressure.

Conclusion

The study provided mobile intervention service to 149 employees with prediabetes from their health screening and they voluntarily participated in the healthcare program during 12 weeks. As a result, all 109 participants showed a significant statistical decrease in their BMI, SBP, HbA1c after the service.

As result of the study, this is a proposal as follows;

Firstly, this study was during 12 weeks so more

study with longer period to verify the improvement on the indicators of cholesterol is required. This may be the opportunity to identify the improvement of cholesterol through improving HbA1c.

The study was not able to identify the association between HbA1c improvements and characteristic of participants. Therefore, more research is necessary to find which characteristic is effective on improving the HbA1c.

From this study, to satisfy with employees' interests with their health in the workplace, a company shall not stay with just providing health screening to employees but expand to provide an after-service program based on the individual's health examination evaluation result then employees' health condition could contribute to a company's cost effectiveness.

Ethical Clearance: Not required

Source of Funding: Self

Conflict of Interest: Nil

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