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A Pilot Study of the New IT Based Health Promotion Targeting to Metabolic Syndrome in a Japanese Occupational Setting

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Abstract

According to the 2006 health reform plan, a new health promotion program, so called "Health checkups and healthcare advice with a particular focus on the metabolic syndrome" program was introduced in Japan. In order to adapt to the new scheme, we have conducted a pilot study in an occupational setting. 37 persons (15 men, 22 women) were recruited from A Health Insurance Fund of Kanto Region, Japan. These persons were evaluated as "health education necessary" according to the inclusion criteria set by the Ministry of Health, Labor and Welfare, Japan. This study employed a single group, repeated-measures experimental design. The intervention lasted 5 months. As the intervention method, a mix-approach of face-to-face counseling and e-mail monitoring was adopted. Statistically significant ameliorations were observed for body weight, BMI, waist circumference, systolic blood pressure, fasting blood sugar, and HDL-cholesterol. No improvements were observed for diastolic blood pressure, HbA1c, triglyceride, total cholesterol and LDL-cholesterol. Statistically significant negative correlations were observed between changes in waist circumference and changes in average daily steps. Given the need for cost-effective population based approaches to health promotion, it is pivotal to develop the IT-based intervention program.

Key words: Health reform 2006, health promotion, metabolic syndrome, IT, Japan

❖ Introduction

Along with the socio-economic development, the Japanese disease structure has changed from the acute diseases dominant to the life-style related chronic diseases dominant pattern. The life style related diseases account for two-thirds of death, and one third of health expenditures in Japan[1)]. In order to realize a healthier nation, the Ministry of Health, Labor and Welfare (MHLW) published the Health care reform plan in 2006. According to the new law, a new health promotion program called "Health checkups and healthcare advice with a particular focus on the metabolic syndrome" is for the insured over 40 years old. It is obligatory for public health insurers to organize a health promotion program from April, 2008. If an insured is evaluated as "intervention necessary", the insurer must organize a health support program for the insured.

It is estimated that about 30% of the insured between 40 to 74 years old fall into this category. It is a big challenge for the insurer to manage this program in a cost-effective way[1)]. Core programs focus on reduction of visceral fat measured by the proxy variables; body weight, BMI and waist circumference. The position paper of the American College of Sports Medicine recommends targeting on both physical activity and diet for weight loss and prevention of weight gain in adults[2)].

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Considering the recent increase of obesity prevalence in Japan, the social value of the new program must be positively evaluated. However, the authors think that the new system is too heavy and complicated to cover the entire population. With the actual constraints in available materials and human resources, the development of strategies to facilitate healthier life-style in a cost-effective way is a research priority. Along with the rapid development of information technology, the Internet provides a new opportunity for promoting health behavior change through interactive information, education and support[3]. Especially e-mail provides rapid communication for a large number of people at a relatively low cost.

This time we developed a mix-type of intervention scheme; combination of face-to-face counseling and e-mail monitoring, and evaluated its effectiveness in an occupational setting in Japan.

❖ Subjects and Methods

We recruited 37 persons (15 men, 22 women) of A Health Insurance Fund of Kanto Region, Japan. These persons were evaluated as "health education necessary" according to the inclusion criteria set by Ministry of Health, Labor and Welfare (MHLW). After the explanation of research purpose, we obtained written consent from the participants. For privacy purpose, all analyses were conducted anonymously.

This study employed a single-group, repeated-measures experimental design. The intervention lasted 5 months from August to December 2007. As the intervention method, a mix-approach of face-to-face counseling and e-mail monitoring was adopted. The initial face-to-face personal health counseling typically lasted 20 to 30 min. The session began with a short lecture on the concept of "metabolic syndrome", its potential risk for cardio-vascular diseases and appropriate life-style, by using a brochure. Then, each participant was helped to set their target of reduction in body weight and waist circumference by dieticians and public health nurses. The default target was 2 to 5% reduction of body weight and waist circumference. During the 5 months follow-up period, participants have received support from the research team by e-mail, and by letter and telephone when necessary. The contents of the intervention were dietary education and advices on physical exercise and daily activities. Each participant was encouraged to ask any questions and required to record the results of their pedometers and the contents of meals periodically. The staffs of research team replied to these questions and sent appropriate suggestions to the participants by tailored manner. In October, the inter-rim group intervention was organized in order to consolidate the healthy behavioral change.

We conducted a questionnaire survey on life-style (including average daily steps measured by a pedometer and nutritional behavior), medical examinations (blood pressure, blood examination of LDL cholesterol, HDL cholesterol, total cholesterol, triglyceride, fasting blood sugar, Hb_{A1C}), measurement of body weight and waist circumference for three times: at the beginning, inter-rim evaluation and the end of the course. For nutritional behavior and physical activity, dieticians and public health nurses evaluated the adherence level of each participant by monitoring sheets.

We analyzed the changes in life style, results of medical examinations, body weight and waist circumference before and after the five months intervention.

❖ Results

There was no drop out case. Data of some clients were excluded from some of the analyses because of incomplete information. Table 1 shows the age and sex distribution of the participants. The average and standard deviation of age were 50.2 and 6.0, respectively (male: 49.8 and 6.7, female: 50.5 and 5.7). The age distribution was as follows: 19 persons for 40–49 (male: 8, female 11), 17 persons for 50–59 (male: 6, female 11), 1 persons for 60–69 (male: 1, female 0).

Table 2 shows the results of the intervention. Statistically significant ameliorations were observed for body weight, BMI, waist circumference, systolic blood pressure (SBP), fasting blood sugar (FBS), HDL-cholesterol (HDLC), and average daily steps. No improvement was observed for diastolic blood pressure (DBP), Hb_{A1C}, triglyceride (TG), total cholesterol (TC) and LDL-cholesterol (LDLC).

Table 3 shows the correlation coefficients between changes in observed valuables. Statistically significant positive correlations were observed among $\Delta weight^{Note}$, ΔBMI, and $\Delta waist$ circumference, between ΔSBP and ΔDBP, between ΔBS and ΔHb_{A1C}, and among $\Delta HDLC$, ΔTC and $\Delta LDLC$. Statistically

Table 1 Age and sex distribution of participants

Age category		Sex		Total
		Female	Male	
40–49	N	11	8	19
	% age-cat	57.9	42.1	100.0
	% sex	50.0	53.3	51.4
50–59	N	11	6	17
	% age-cat	64.7	35.3	100.0
	% sex	50.0	40.0	45.9
60–69	N	0	1	1
	% age-cat	0.0	100.0	100.0
	% sex	0.0	6.7	2.7
Total	N	22	15	37
	% age-cat	59.5	40.5	100.0
	% sex	100.0	100.0	100.0
Mean Age		50.5	49.8	50.2
SD of Age		5.7	6.7	6.0

Table 2 Results of intervention

	First evaluation			Inter-rim evaluation			Final evaluation			Statistical analysis*	
	N	Mean	SD	N	Mean	SD	N	Mean	SD	Z score	p-value
Height	37	161.4	8.4								
Weight	37	69.7	10.4	34	68.3	10.1	37	67.6	10.8	–4.156	0.000
BMI	37	26.8	3.9	35	25.4	5.6	37	26.0	4.0	–4.202	0.000
Waist C	37	93.7	9.3	32	92.0	7.9	37	89.9	9.1	–4.399	0.000
SBP	37	145.7	20.0	18	130.2	10.6	36	130.6	12.3	–4.292	0.000
DBP	37	81.8	13.6	18	82.1	8.8	36	81.6	8.8	–0.024	0.981
BS	37	97.2	18.9	37	104.4	19.2	37	105.4	22.8	–3.729	0.000
HbA1c	37	5.7	0.9	37	5.7	0.8	37	5.8	0.9	–0.736	0.462
HDLC	37	52.2	12.4	37	53.4	10.7	37	55.4	11.4	–3.186	0.001
TG	37	173.4	134.6	37	153.6	79.4	37	137.7	77.5	–1.396	0.163
TC	37	205.1	28.3	37	208.6	33.7	37	206.3	32.8	–0.033	0.974
LDLC	37	126.5	25.9	37	126.8	29.3	37	127.6	29.6	–0.196	0.844
Daily steps**	32	4837.8	2925.0					12044.8	4560.5	–4.937	0.000

*: Wilcoxon sign rank test (paired). **: Final evaluation of daily step is the average value during the intervention period. BMI: Body Mass Index, Waist C: Waist circumference, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure. FBS: Fasting Blood Sugar, HDLC: HDL cholesterol, TG: Triglyceride, TC: Total cholesterol, LDLC: LDL cholesterol.

significant negative correlations were observed between Δwaist circumference and Δsteps, between ΔSBP and ΔTC, between ΔDBP and ΔTC and between ΔTG and ΔLDLC.

Table 4 shows the relationship between changes in nutritional and physical life-style and body composition (body weight and waist circumference). More than 90% of the participants were evaluated as "improved" or "slightly improved" both for nutritional behavior and physical activity. Reductions in body weight and waist circumference were also observed for about 60% of the participants. However, there were no clear relationships between the changes in life-style and those in body composition.

Table 3 Correlation coeficients between changes in observed variables

		ΔWeight	ΔBMI	ΔWaist C	ΔSBP	ΔDBP	ΔBS	ΔHbA1C	ΔHDLC	ΔTG	ΔTC	ΔLDLC	ΔSteps
ΔWeight	Pearson's r	1.000	0.994	0.585	0.102	–0.010	–0.038	0.142	–0.202	0.039	–0.251	–0.182	–0.211
	p-value		0.000	0.000	0.547	0.955	0.823	0.403	0.230	0.819	0.134	0.280	0.246
	N	37	37	37	37	37	37	37	37	37	37	37	32
ΔBMI	Pearson's r		1.000	0.587	0.099	–0.022	–0.025	0.146	–0.172	0.046	–0.219	–0.161	–0.234
	p-value			0.000	0.559	0.898	0.885	0.389	0.307	0.786	0.193	0.342	0.197
	N		37	37	37	37	37	37	37	37	37	37	32
ΔWaist Circumference	Pearson's r			1.000	–0.004	–0.137	0.105	0.136	–0.067	0.165	–0.044	–0.138	–0.402
	p-value				0.983	0.419	0.534	0.421	0.693	0.328	0.794	0.414	0.023
	N			37	37	37	37	37	37	37	37	37	32
ΔSBP	Pearson's r				1.000	0.833	0.210	0.196	–0.221	–0.175	–0.372	–0.158	0.153
	p-value					0.000	0.212	0.244	0.190	0.301	0.023	0.351	0.404
	N				37	37	37	37	37	37	37	37	32
ΔDBP	Pearson's r					1.000	0.281	0.246	–0.256	–0.156	–0.359	–0.222	0.163
	p-value						0.092	0.142	0.126	0.356	0.029	0.186	0.373
	N					37	37	37	37	37	37	37	32
ΔBS	Pearson's r						1.000	0.700	0.345	–0.304	0.306	0.290	–0.300
	p-value							0.000	0.037	0.067	0.066	0.082	0.095
	N						37	37	37	37	37	37	32
ΔHbA1C	Pearson's r							1.000	0.346	–0.047	0.245	0.171	–0.119
	p-value								0.036	0.782	0.144	0.312	0.518
	N							37	37	37	37	37	32
ΔHDLC	Pearson's r								1.000	–0.268	0.731	0.610	–0.311
	p-value									0.109	0.000	0.000	0.083
	N								37	37	37	37	32
ΔTG	Pearson's r									1.000	–0.142	–0.586	0.123
	p-value										0.403	0.000	0.503
	N									37	37	37	32
ΔTC	Pearson's r										1.000	0.823	–0.330
	p-value											0.000	0.065
	N											37	32
ΔLDLC	Pearson's r											1.000	–0.275
	p-value												0.128
	N												32
ΔSteps	Pearson's r												1.000
	p-value												
	N												32

Δvalue = Pre-intervention value - post-intervention value.

❖ Discussion

In order to test the effectiveness of the new health promotion program starting from 2008, we conducted a pilot study in an occupational setting. The results showed a possible usefulness of the life-style modification for amelioration of metabolic syndrome. More than 60% of the participants succeeded in the reduction of body weight, BMI and waist circumference. And more than 90% of them improved their life-style, such as nutrition and physical activity. For example, average daily steps increased from 4838 to 12,045 during the intervention period.

Schneider *et al.* reported the effectiveness of 10,000 steps per day goal for the reduction of body weight, BMI, waist circumference, hip circumference and HDL cholesterol[4]. They suggested the effect of using pedometers for motivating the participants to

Table 4 Relation of changes in nutritional and physical life-style and body composition

	Nutrition behavior					
	Improved		Slightly improved		No change	
	N	%	N	%	N	%
Body weight						
Reduction of more than 2%	11	52.4%	4	57.1%	1	100.0%
Change between –2 and +2%	8	38.1%	3	42.9%	0	0.0%
Increase of more than 2%	2	9.5%	0	0.0%	0	0.0%
Total	21	100.0%	7	100.0%	1	100.0%
Waist circumference						
Reduction of more than 2%	15	71.4%	4	57.1%	1	100.0%
Change between –2 and +2%	4	19.0%	3	42.9%	0	0.0%
Increase of more than 2%	2	9.5%	0	0.0%	0	0.0%
Total	21	100.0%	7	100.0%	1	100.0%

	Physical activity					
	Improved		Slightly improved		No change	
	N	%	N	%	N	%
Body weight						
Reduction of more than 2%	14	53.8%	5	50.0%	0	0.0%
Change between –2 and +2%	9	34.6%	5	50.0%	1	100.0%
Increase of more than 2%	3	11.5%	0	0.0%	0	0.0%
Total	26	100.0%	10	100.0%	1	100.0%
Waist circumference						
Reduction of more than 2%	18	69.2%	8	80.0%	0	0.0%
Change between –2 and +2%	5	19.2%	2	20.0%	1	100.0%
Increase of more than 2%	3	11.5%	0	0.0%	0	0.0%
Total	26	100.0%	10	100.0%	1	100.0%

walk more in their daily lives. In our program, many participants suggested the same effect of the pedometer because of its self-monitoring feature. As the "10,000 steps per day" program is simple, cheap and easy to do, it will be an important component of intervention program in the new Japanese health promotion framework. However, similarly to the present results, Schneider *et al.* did not observe any meaningful improvement for SBP, DBP, TC, TG, and LDLC.

There might be three explanations for these results. The first is that the effect sizes were too small to improve clinical conditions in the case of targeted population who are evaluated as having a "high risk" of metabolic syndrome but not "abnormal" by clinical criteria.

The second is the variability of bio-chemical and clinical markers. It is well known that these variables are influenced by the contents and timing of meals just prior to examination and fluctuate daily and seasonal basis. The regression to the mean phenomenon is also a possible confounding factor.

The third is the relatively short time frame for evaluation.

For the Japanese health promotion program, the so called "Health checkups and healthcare advice with a particular focus on the metabolic syndrome", it is required to evaluate the effectiveness of intervention after 6 months based on changes in body composition and clinical findings (i.e., SBP, DBP, HDLC, LDLC, TG, FBS, and Hb_{A1C}). However, all these findings

mentioned above suggest that it will be necessary to re-consider the timing and evaluation items in order to avoid unnecessary confusion. Imai also suggested that 6 months is too short for evaluation of this kind of intervention programs, based on the literature review of the American disease management program[5].

As mentioned earlier, it is estimated that about 30% of the insured between 40 to 74 years old fall into this category of "intervention required". Considering the actual constraints in available materials and human resources, the development of strategies to facilitate healthier life-style in a cost-effective way is a research priority. This is the reason why we have developed an internet based intervention and monitoring system in this study.

Most of the previous studies indicated the usefulness and cost-effectiveness of IT-based programs[6–10]. Because of the rapid advance in IT programs, it is very possible to construct personalized and tailored programs for each client. As Brug *et al.* suggested[6], interventions that use personalized, or tailored feedback hold great promise for promoting health behavior changes. Tate *et al.* reported the successful reduction of body weight by continuous behavioral education using e-mail, individual feedback from therapists, and self monitoring by participants[7]. Plotnikoff *et al.* reported the usefulness of e-mail based intervention for modification in physical activity and nutritional behavior. They showed that the intervention group exhibited a higher increase in mean scores on healthy eating practices, trying to balance food intake and activity, and stages of change for healthy cooking and general diet. The advance in the IT field has made it possible to implement more sophisticated intervention methods in health promotion. For example, Glanz *et al.* have reported the usefulness of hand-held computer for improving diet monitoring and diet adherence[9].

All these findings mentioned above have practical appeal in terms of supporting the use of electronic medium targeting on health behavior change. In the case of Japan, the development of the Internet and e-mailing functions of mobile phones will be a key technology for the e-based health promotion program.

However, Araki *et al.* reported that face-to-face health education was more effective than the e-mail program based on their research on drinking behavior modification in an occupational setting[10]. This finding indicates that the IT is not a miracle solution for the health promotion program. Given the need for cost-effective population based approaches to health promotion, it must be the most appropriate and practical way to construct the mix model of e-based and face-to-face intervention.

Limitations of this study include its short time frame, small sample size, non-randomized design and pre-post test design without a control group. Therefore, generalization of this study must be cautiously evaluated.

Finally, although the effect size of this study was relatively limited, the findings suggest that the newly introduced Japanese health promotion program will be a promising scheme for realizing a healthier nation. It is strongly recommended to modify the program in order to make it more feasible and flexible.

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❖ Note

Δvalue = Pre-intervention value – Post-intervention value for each item

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