Effects of mobile-based exercise intervention on health indices by the comparison of personal training time in male workers

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Abstract

Background: In the case of large companies, exercise programs for workers need to be operated effectively. However, programs could be limited to managing many employees using just a few exercise trainers, depending on circumstances, and exercise programs are likely to be more effective through the use of applications on mobile devices. In this research, we examine the effects of the degree of personal training (PT) time on health indices and stress by conducting an exercise program through the use of mobile devices used by male workers.

Methods: We recruited 60 applicants who wanted to participate in the study of their own free will in H Company, Seoul, South Korea. The participants in the mobile-based exercise (MBE) programs were divided into three groups: mobile-based exercise with 30 minutes of personal training (PT) group (n=21), MBE with 5 minutes of PT group (n=20), and MBE self-exercise group (n=19). For data processing, SPSS was used to derive the mean (M) and standard deviation (SD) values of all measured items. The results were analyzed by repeated two-way ANOVA, paired t-test, one-way ANOVA and least significant difference (LSD). The significance level of all statistical values was set at .05.

Results: In the MBE with 30 minutes PT group and MBE with 5 minutes PT group, body fat mass and percentage of body fat significantly decreased, and fat-free mass significantly increased. It was noted that all variables related to physical fitness (muscular endurance, muscular strength, flexibility, cardiopulmonary endurance, movement screen) improved significantly in all three groups. Incidentally, HR rest, SBP and MAP significantly decreased in the MBE with 30 minutes PT group and MBE with 5 minutes PT group. PP and RPP significantly decreased in all groups, while stress significantly decreased in the MBE with 5 minutes PT group.

Conclusions: The use of mobile-based exercise training had positive effects on the health status of workers, and the positive effects were augmented as the degree of PT time by an exercise trainer increased. In addition, it is noteworthy that the MBE with 5 minutes PT group improved to the same extent as the MBE with 30 minutes PT group. The study indicates that it is possible to manage large numbers of employees' exercise programs using mobile applications. Any follow-up study would need to develop ways to motivate and tailor content and verify exercise programs, while using mobile devices of the workers for participation in continuous and voluntary exercise. [*Ethiop. J. Health Dev.* 2020;34(Special issue-3):10-17]

Key words: Exercise, personal training, mobile based.

Introduction

We can generally agree that changes in the body can be fulfilled by participating in exercise steadily over 3 months, and to achieve the best results, it is important to train and exercise consistently during this time. Moreover, creating a lifestyle of regular workouts needs at least 6 months of participation to notice changes and results. Berger *et al.* report that 60% of people quit most workouts within 6 months (1). Health care programs operated in the workplace can induce personal health promotion, prevention of ill health (2-6), and have various effects on weight loss, fitness improvement, stress reduction and medical costs reduction, as well as improvement of job performance and productivity, a reduction in the rate of turnover and absenteeism, and help to improve staff morale (7-14).

In a company's drive for profits and to save labor costs, such an exercise program could be limited to managing many employees using a few exercise trainers in certain circumstances.

The use of a mobile device is a common tool to augment daily exercise and can be used regardless of time and place (15). Most people have a mobile phone with them all the time, because of their personal attachment to mobile communication technology and staying connected to others. Moreover, considering research results about how people spend much more time with their mobiles than they do with their co-workers in the workplace (16), so that it might be effective to operate an exercise program with the help of mobile device applications.

Most research in the literature regarding the use of IT-based exercise management offers information such as daily physical activity and physiological information to improve the participant's physical activity (17). However, it is also limited to an increase in persistence, because of the one-way information delivery and the absence of trainers in the use of programs.

Offering a health management service using a mobile device with face-to-face training is the most effective means of increasing the amount of physical activity (18), and people in general prefer to receive feedback from a trainer rather than via a short message on their mobiles (19). As such, with the availability of content, trainers' ongoing feedback, which is an essential factor for exercise intervention, is being presented as an alternative for consistent use of an exercise program by workers using their mobile devices (20). Numerous research results of using a mobile device (21) report a positive effect of encouraging daily amounts of physical activity using only the monitoring function. However, there is a lack of research on verifying the effect of mobile-based personal training.

In this research, we examine the effects of the degree of

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personal training (PT) time – during which participants carrying out their exercise program used mobile devices – had on the health indices and stress levels in workers. Through this study, we hope that mobile applications will play an increasingly important
role in helping workers who do have not much time to participate in exercise consistently. However, we have to inquire not only about the role that a mobile-based exercise service to help users participate in exercise by themselves, but also about the amount of exercise
consistency that is achieved when a mobile-based service and personal training are offered at the same time. We expect that this study will provide important resources to review the exercise trainers' role in a rapidly changing market environment, with the technological development of exercise programs for workers.

Methods

Participants: Sixty-seven male office workers in their 20s and 40s who were employees working in H Company in Seoul, South Korea voluntarily participated in the study. The inclusion criteria to participate in this study were that participants: 1) had not participated in systematic exercise training, 2) had not been participating in other exercise programs, and 3) hypertensive with 140 over 90 or above, and 4) had no history of heart surgery or cardiovascular problems such as unstable angina and heart attack. A total of three groups formed the basis of the study: MBE with 30 minutes PT group (n=21), MBE with 5 minutes PT group (n=20), and MBE self-exercise group (n=19). During the participation period, of the 67 participants who agreed to take part, 1, 2, and 4 participants dropped out of these groups, respectively, resulting in a total of 60 subjects.

In the MBE with 30 mins PT group, the trainer provided PT and management for 30 minutes while the participants exercised using the mobile application (H-Lifefit, Korea). In the MBE with 5 minutes PT group, the trainer provided PT and management for 5 minutes while the participants exercised using the mobile application. Finally, in the MBE self-exercise group, participants were allowed to exercise on their own using mobile apps, with no access to trainers' PT and management. All the subjects participated in a customized exercise program, separated into three levels (7-16 RPE: rated perceived exertion, 30-70 minutes/session, 3 sessions/week for 12 weeks).
The specific characteristics of the subjects who completed the exercise program are shown in Table 1 – Sixty subjects; age: 36.36 ± 7.20 years; height: 174.53 ± 5.63 cm; weight: 75.85 ± 9.17 kg; and BMI: 24.90±2.92 kg m^2. There was no significant difference between the groups in the pre-test.

Experimental design: In the study, all participants visited a fitness center located in H company and took a fitness level pre- and post-test. In general, all participants had refrained from vigorous physical activity for 48 hours prior to the test, and had been fasting over 12 hours, had slept for more than 7 hours), and then they took a test. The test was set to measure stress scale, blood variables, body composition, cardiovascular function, and physical fitness. The testing lasted for about an hour for each individual participant. The pre- and post-tests were conducted by the same method and tester, after which the research team compared the results of the pre- and post-tests. After completing the pre-test, each participant was told how to use the mobile application (H-Lifefit) and given instructions of how to carry out the exercises.

Measurement: To begin with, the variables in this study were a mobile based exercise intervention on health indices by personal training time. The dependent variables were body composition, physical fitness, cardiovascular function, blood variables, and stress scale. Participants were randomly assigned to three groups in the pre- and post-test. All participants had their biometric information measured, as shown in Table 2.

Table 2: **Variable descriptions and measurements**

Variable		Measurement
Body composition		Weight (kg), BMI (kg m^2), body fat mass (kg), percentage body fat (%), fat-free mass (kg)
Physical fitness	-Muscular endurance -Muscular strength -Flexibility -Cardiopulmonary endurance -Movement screen	-Sit up (rep) -Grip strength/left (kg) -Toe touch (cm) -12-min run test (km) -Overhead squat, toe touch, back touch
Cardiovascular function	Heart rate and blood pressure	HR rest (beat: min-1), SBP (systolic blood pressure: mm Hg), DBP (diastolic blood pressure: mm Hg), MAP (mean arterial pressure: mm Hg), PP (pulse pressure: mm Hg), RPP (rate pressure product)
Survey	Stress scale	Perceived Stress Scale: PSS

Exercise program: Generally speaking, the MBE program in this study was constructed based on the part

of the resistance exercise program which was developed by one of the researchers(20). The program was based on the result of the movement screening, corrective stretching for the first four weeks, circuit exercises using body weight for the next four weeks, and strength exercises using machines for the final four weeks (Table 3).

Exercise group: The health care application (H-Lifefit, Korea) that was used was developed by H company for its workers. In this case, the MBE with 30 minutes PT group members used a 30-minute PT to guide the whole program (four people). On the other hand, the MBE with 5 minutes PT group members used a 5-minute PT, which asked for help with a movement that was difficult to follow (two people). Finally, the MBE self-exercise group members were provided with a mobile app service only and an attendance check (one person).

Table 3: **Exercise program**

1–4 weeks	**5–8 weeks**	**9–12 weeks**
Strength: RPE 12–14 Time: Total 30 min, each 30 sec (10 min x 3 times)	Strength: RPE 7–11 (Stretching) RPE 12–14 (Exercise) Time: Total 55 min, each 18 times (15 min x 3 times)	Strength: RPE 12–14 Time :Total 70 min/each 15 times (20 min x 3 times)
① Hip-gluteal stretch ② Knee-vastus med stretch ③ Ankle-GCM stretch ④ ER-infraspinatus stretch ⑤ IR-post capsule stretch ⑥ ABD-pec major stretch ⑦ ASLR-hamstring stretch ⑧ Thomas hip flexor stretch	– Warm-up stretching (5 min) ① Push-up ② Stick bent over row ③ Stick military press ④ Support pull-up ⑤ Normal crunch ⑥ Rotation ⑦ Superman ⑧ Hip hinging deadlift ⑨ Squat ⑩ Stick lunge – Cool down stretching (5 min)	– Warm-up stretching (5 min) ① Machine chest press ② Machine row ③ Machine shoulder press ④ Machine lat pull-down ⑤ Machine abdominal ⑥ Machine side crunch ⑦ Machine back extension ⑧ Machine leg press ⑨ Machine hip extension – Cool down stretching (5 min)

Data analysis: For data processing, SPSS for Windows (21.0 version) was used to derive the mean (M) and standard deviation (SD) values of all measured items (body composition, physical fitness, cardiovascular function, blood variables, stress scale). Additionally, the results were analyzed by the use of one-way ANOVA to verify the mean difference among the three groups, repeated two-way ANOVA to simultaneously analyze between the mean difference among the three groups and the mean difference between the two tests, paired t-test to verify the mean difference between within-group tests, and Least Significant Difference(Scheffe) for post-analysis. The significance level of all statistical values was set to .05.

Table 4: **Effects of MBE intervention on body composition by personal training time**

Variable	Group	Test		Δ%		P		
		Pre	Post					
Weight (kg)	MBE+30mins	74.43±6.15	74.15±6.05	-0.39		Group	.549	
	MBE+5mins	75.46±9.34	75.98±9.45	0.69		Test	.890	
	MBE+self	77.67±12.03	77.36±11.48	-0.40		Group×Test	.169	
BMI (kg m^2)	MBE+30mins	24.51±2.70	24.37±2.53	-0.56		Group	.210	
	MBE+5mins	24.32±2.56	24.40±2.37	0.31		Test	.415	
	MBE+self	25.86±3.50	25.75±3.32	-0.41		Group×Test	.383	
Body fat mass (kg)	MBE+30mins	16.52±5.64	14.65±5.61	-11.30	***	Group	.699	
	MBE+5mins	16.62±5.22	15.82±4.51	-4.84	*	Test	.012	+
	MBE+self	16.64±5.22	17.45±6.69	4.90		Group×Test	.000	+++
Body fat percentage (%)	MBE+30mins	21.97±6.45	19.58±6.74	-10.91	***	Group	.892	
	MBE+5mins	21.59±5.24	20.61±4.34	-4.54	*	Test	.008	++
	MBE+self	21.10±3.88	22.08±5.77	4.67		Group×Test	.000	+++
Fat-free mass (kg)	MBE+30mins	57.92±5.55	59.49±5.70	2.73	***	Group	.680	
	MBE+5mins	58.84±5.80	60.16±6.25	2.25	**	Test	.034	+
	MBE+self	61.03±7.90	59.90±7.17	-1.85		Group×Test	.000	+++

*P<.05, **P<.01, ***P<.001 , +P<.05, ++P<.01, +++P<.001

Results

The body composition variations in this study that were noted were: body fat mass, percentage body fat, and fat-free mass, and the interaction effect between the group and test appeared in the resulting data. Body fat mass and body fat percentage significantly decreased in the MBE+30mins group (p<.001) and MBE+5mins group (p<.05). Fat-free mass significantly increased in the MBE+30mins group (p<.001) and MBE+5mins group (p<.01)(Table 4).

Physical fitness variations in this study that were in this study noted all variables is the interaction effect between the group and test appeared in the resulting data. All variables significantly increased in the MBE+30mins group (p<.001), MBE+5mins group (Grip strength, Toe touch, Sit up, p<.001; 12-min run test, VO2max, p<.01) and MBE+self group (Sit up, 12-min run test, VO2max, p<.01)(Table 5).

Table 5: **Effects of MBE intervention on physical fitness by personal training time**

Variable	Group	Test		Δ%		P		
		Pre	Post					
Grip strength (left)	MBE+30mins	37.87±6.06	42.92±6.63	13.32	***	Group	.337	
	MBE+5mins	35.60±6.75	40.02±5.43	12.40	***	Test	.000	+++
	MBE+self	38.84±4.97	39.84±5.38	2.56		Group×Test	.005	++
Toe touch (cm)	MBE+30mins	5.96±9.16	10.38±8.46	74.21	***	Group	.848	
	MBE+5mins	6.75±7.65	9.40±6.39	39.26	***	Test	.000	+++
	MBE+self	5.78±5.79	8.00±6.57	38.36		Group×Test	.133	
Sit up (rep)	MBE+30mins	25.00±4.35	29.05±5.53	16.21	***	Group	.058	
	MBE+5mins	23.30±6.28	26.60±5.99	14.16	***	Test	.000	+++
	MBE+self	21.92±4.58	24.37±4.54	11.18	**	Group×Test	.289	
12-min run test (km)	MBE+30mins	1.47±0.22	1.63±0.21	10.53	***	Group	.329	
	MBE+5mins	1.49±0.32	1.63±0.30	9.39	**	Test	.000	+++
	MBE+self	1.40±0.28	1.49±0.26	6.82	**	Group×Test	.440	
VO2max (ml/kg-1/min-1)	MBE+30mins	22.44±4.99	26.08±4.88	16.20	***	Group	.332	
	MBE+5mins	22.82±7.26	26.02±6.80	14.03	**	Test	.000	+++
	MBE+self	20.82±6.33	23.01±5.99	10.52	**	Group×Test	.399	

**P<.01, ***P<.001 , ++P<.01, +++P<.001

Cardiovascular function variations in this study noted all variables except DBP showed the interaction effect between the group and the test which appeared in the results. HR rest, SBP, MAP, PP and RPP significant decrease in the MBE+30mins group (HR rest, SBP, PP, RPP, p<.001; MAP, P<.05), MBE+5mins group (SBP, MAP, RPP, p<.001; HR rest, p<.01; MAP, p<.05) and MBE+self group (PP, p<.01; RPP, p<.05)(Table 6).

Table 6: **Effects of MBE intervention on cardiovascular function by personal training time**

Variable	Group	Test		Δ%		P		
		Pre	Post					
HR rest (min)	MBE+30mins	74.86±9.78	72.38±10.04	-3.31	***	Group	.232	
	MBE+5mins	75.70±10.59	73.95±10.41	-2.31	**	Test	.000	+++
	MBE+self	79.32±8.00	77.89±7.51	-1.79		Group×Test	.389	
SBP (mm Hg)	MBE+30mins	127.14±10.97	121.81±10.11	-4.19	***	Group	.365	
	MBE+5mins	127.25±8.86	122.20±9.95	-3.97	***	Test	.000	+++
	MBE+self	129.26±8.99	127.42±8.90	-1.43		Group×Test	.030	+
DBP (mm Hg)	MBE+30mins	77.33±9.72	77.43±9.12	0.12		Group	.449	
	MBE+5mins	77.65±8.58	77.65±9.33	0.00		Test	.267	
	MBE+self	79.84±5.34	80.84±4.82	1.25		Group×Test	.399	
MAP	MBE+30mins	93.94±9.69	92.22±9.03	-1.82	*	Group	.371	
	MBE+5mins	94.18±8.03	92.50±8.94	-1.79	*	Test	.003	++
	MBE+self	96.32±5.95	96.37±5.63	0.05		Group×Test	.082	
PP (mm Hg)	MBE+30mins	49.81±6.45	44.38±5.98	-10.90	***	Group	.877	
	MBE+5mins	49.60±6.95	44.55±7.06	-10.18	***	Test	.000	+++
	MBE+self	49.42±6.88	46.58±6.77	-5.75	**	Group×Test	.075	
RPP	MBE+30mins	9,507.29±1490.32	8,815.33±1476.26	-7.28	***	Group	.077	
	MBE+5mins	9,620.30±1392.26	9,019.20±1318.43	-6.25	***	Test	.000	+++
	MBE+self	10,253.26±1267.83	9,931.37±1237.21	-3.14	*	Group×Test	.069	

*P<.05, **P<.01, ***P<.001, +P<.05, ++P<.01, +++P<.001

Additionally stress scale(p<.01) significantly decreased in the MBE+5mins group (Table 7).

Table 7: **Effects of MBE intervention on stress scale by personal training time**

Variable	Group	Test		Δ%		P		
		Pre	Post					
Stress scale	MBE+30mins	15.24±5.66	15.62±6.00	2.50		Group	.743	
	MBE+5mins	17.30±4.80	14.90±5.06	-13.87	**	Test	.040	+
	MBE+self	15.63±5.37	14.21±4.16	-9.09		Group×Test	.109	

**P<.01, +P<.05

Discussion

Body composition variation: Body composition is one of the most common ways to find out the noted body changes through exercise, and increase of body fat mass and decrease of fat-free mass, especially where a decrease of skeletal muscle mass is related to factors such as aging (22).

In a previous study, when employees participated in an exercise program, weight (9,23) and BMI (9,24) both decreased, and the group which received online personal counselling and e-mail feedback showed a significant decrease in their body fat percentage (25). Our finding that a noted decrease of body fat percentage in MBE with 30 minutes PT group and MBE with 5 minutes PT group was consistent with the previous literature review and research. Likewise, when offering a customized exercise program with feedback service before proceeding with the exercise program, it seems likely to have had a positive effect on participants' body compositions. In addition, we found that when offering 30 minutes PT and 5 minutes PT with a customized exercise program, there were positive changes to the body composition of the participants. These results reveal that the trainer's intervention, even if it is over a short time, has a positive effect on participants in an exercise program.

Physical fitness variation: Physical fitness improvement is indispensable to employees, and in this

respect, several researchers such as Kraemer *et al.* found that muscle strength and muscle endurance improved (26), Zavanela *et al.* found that flexibility and muscle endurance had improved (27) and Genaidy *et al.* found that muscle strength and flexibility had improved (28). In effect, resistance exercise significantly affects the improvement of overall physical fitness (29).

Ramadas *et al.* found that the weight of the group with mobile counselling and the group with e-mail counselling significantly decreased (30), and they reported that the variation of the group with mobile counselling was greater than of the group with e-mail counselling. This suggests that adding an indirect management function is more effective than unilateral information delivery, and this is partially matched by our findings. So, using mobile counseling seems to have high satisfaction among users.

Therefore, it is important to train face to face to obtain the most significant improvement in physical fitness. However, there were no significant differences in the increase range of physical fitness factors between the MBE with 30 minutes PT group and MBE with 5 minutes PT group, and in this way there is no difference in regard to the effect of physical fitness by management time. In conclusion, the longer workers take personal training, the higher positive effect will be noted in relation to improving the worker's physical strength. This indicates the importance of face-to-face training when workers try to exercise using their mobile devices. When participants tried to exercise in regard to grip strength and sit ups by themselves without a trainer, it was difficult to get a similar significant effect. This result indicates that when people don't exercise with correct posture, it is a little difficult to improve muscle and flexibility, because the focus in regard to the goal might decrease during those times.

Cardiovascular function variation: The incidence of overwork in the workplace is a risk factor for cardiovascular disease (31). For this reason, it is shown that the use of resistance exercise positively affects the lowering of resting blood pressure (32), and improves the overall cardiovascular function of participants in this type of program (27,33,34).

Incidentally, Racette *et al.* reported that after group exercise, seminars, and lifestyle management, HR rest, SBP, and DBP were significantly decreased, and similar to our study, a research study on applying an exercise program using mobiles among employees reported that participants' SBP and DBP significantly decreased as a result of participation in this type of program (35-37).

However, Makrides *et al.* found that after applying a customized exercise program to 566 employees, there was no significant change in SBP and DBP (24). Notably, Anderson & Dusenbury and Aldana *et al.* also found that there was no significant change in DBP by initiating a program of health management for employees (9,38,39).

The data reported in this study show the results of a positive variation of HR rest and SBP in the case of the MBE with 30 minutes PT group and MBE with 5 minutes PT group. The MBE self-exercise group showed a decreasing tendency of HR rest and SBP, but the increase in maximum oxygen consumption was smaller than other groups, which indicates that the mean outcome difference was from the degree of trainers' feedback. Thus, trainers' coaching is also required to induce a positive variation in cardiovascular function.

Stress scale variation: Generally speaking, exercise is an activity characterized as one of stress and stimulus, and even though it causes physical exhaustion, it has the effect of relieving physical and mental stress from daily life or work. Accordingly, a number of studies report that exercise participation among employees positively affects stress relief (40-42).

In this respect, the MBE with 5 minutes PT group would likely to feel less stressed about exercise participation, because they experienced working with the exercise program voluntarily, which made for a relatively low level of compulsory effort to exercise. At the same time, the MBE self-exercise group showed stress decreasing tendency of 1.42, so that it revealed that voluntary exercise participation is an important factor to relieve the stress of participants through exercise participation. However, the MBE with 30 minutes PT group showed an increasing tendency of .38, and therefore the trainer's intervention of 30 minutes to aid the participant likely resulted in negatively affecting stress relief.

Nevertheless, 25% of the whole health care program included the use of a stress management program (43), and its purpose was to induce a healthy lifestyle through the strategies of incorporating behavior modification, relaxation technique, and personal counselling into the program for the participants (8). Therefore, in this study, there was limited stress relief in the MBE with 5 minutes PT group, because we offered only an exercise program without the inclusion of additional stress management strategies.

Conclusions

The use of mobile-based training had positive effects for the improved health status of the workers, and the positive effects were augmented as the duration of personal training (PT) by an exercise trainer increased. The MBE with 5 minutes PT group improved significantly compared to the MBE with 30 minutes PT group. This shows that it is possible to manage an increased number of employees for health and exercise service using a mobile-based exercise application in a workplace setting. Any follow-up study would need to develop ways to motivate and tailor content and verify exercise programs, using the mobile phone as a tool for continuous and voluntary exercise participation of the workers.

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