

【Brief Communication】

The acute effect of practical three-minute high-intensity interval training on office workers' mood: application in the office environment

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Introduction

The increasing number of working people with mental disorders is a major social problem in industrial countries, including Japan. Since many studies have revealed that physical activity has a positive effect on mental health, the introduction of active workstations, such as standing, treadmill, and cycling desks, has been attracting much attention⁸⁾. However, although it has promising benefits, it is difficult for most offices to introduce active workstations due to their high cost.

Aside from active workstations, recent studies have also focused on the effect of exercise during work breaks on employees' mood^{1,11)}. However, what type of exercise could enhance mood and be feasible for office workers is still being debated. Since there are limited resources, such as time and space, in an office environment, time-efficient exercise that can be performed without any equipment could be adopted in offices. Therefore, we focused on high-intensity interval training (HIIT), which is characterized by repetition of short high-intensity exercise followed by a brief period of rest. HIIT has recently attracted much attention because of its time-efficiency and numerous health benefits⁴⁾. Moreover, HIIT could be perceived

as enjoyable even by inactive individuals⁵⁾. Our recent study also showed that 10-min HIIT (two-min warm-up and eight sets of 30-s cycling exercise at 60% of maximal aerobic power with 30-s rest) increased arousal level and cognitive function in young adults⁷⁾. HIIT could thus be adopted in an office environment as a tool for enhancing office workers' mood.

Although most previous studies on HIIT used cycle ergometer, its use is impractical in most offices. To apply HIIT to practical settings, we recently developed a three-min HIIT program without any equipment named "Office HIIT." The program consists of six bouts of 20-s quick full-body workout with a 10-s recovery period. We have already confirmed that the exercise intensity is high and that people with hypertension could perform it safely⁶⁾. In this study, we aim to reveal the immediate and delayed effects of Office HIIT on mood and sleepiness in a real office environment.

Methods

A. Participants

Twenty office workers of an insurance company in Japan voluntarily participated in this study. Four participants were excluded from the analysis because

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Table 1. Demographic characteristics.

Variables	Male (n = 11)		Female (n = 5)	
	Mean	SD	Mean	SD
Age (years)	46.3	10.6	39.6	13.4
Height (cm)	171.8	4.0	156.7	7.6
Weight (kg)	67.8	10.8	48.1	7.0
K6 (scores)	1.1	2.2	2.4	1.5

they smoked during the experiment. All participants were Japanese-speaking individuals. They were psychologically normal (screened using the Kessler Screening Scale for Psychological Distress; K6, score less than 7) and had no contraindications to high-intensity exercise (screened using the Physical Activity Readiness Questionnaire; PAR-Q). Written informed consent was obtained from all participants prior to the experiment. This study was approved by the institutional review board of the Physical Fitness Research Institute, Meiji Yasuda Life Foundation of Health and Welfare, Japan (Approval number: 28005). Participants' characteristics are presented in Table 1.

B. Experimental procedure

The study was conducted over a three-day period in a meeting room at the insurance company's office. On the first day, participants filled out self-reported questionnaires to determine their height, weight, contraindications to high-intensity exercise (PAR-Q), and psychological condition (K6). After completing the questionnaires, they practiced Office HIIT to familiarize themselves with the exercise. On the second and third days, they participated in either the REST or HIIT condition. The order of the two conditions was randomized for each participant.

Participants were asked to come to the meeting room at 14:00 p.m. or 14:30 p.m., and their subjective sleepiness and mood were assessed using a visual analogue scale (VAS) and the Two Dimensional Mood Scale (TDMS), respectively (pre-session). Subsequently, they performed the three-min Office HIIT (HIIT condition) or sat on a chair for three min

(REST condition). At the end of the exercise, perceived exertion was measured using Borg's Rating of Perceived Exertion (RPE) scale. In twenty to thirty seconds after completion of the exercise, their sleepiness and mood were measured again (post-session). They then returned to their work. After one hour (1-hr post-session) and two hours (2-hrs post-session), they were asked to come back to the meeting room and their sleepiness and mood were measured again. Three to five participants were simultaneously involved in one session. On the days of the experiments, participants were instructed to refrain from caffeine and smoking after 10:00 a.m. and were asked to drink only water during the experiments.

C. Office HIIT

Figure 1 shows the procedure of Office HIIT. This program consists of six bouts of 20-s exercise with a 10-s recovery period. It includes four movements: 1) Butterfly, 2) Squat, 3) Punching, and 4) Knee Strike (Figure 1). Participants repeated one of these movements in one set. The exercise was performed while listening to 140 bpm music.

D. Sleepiness

To evaluate subjective sleepiness, we used a 100-mm VAS. Participants rated their sleepiness by making a slash on the 100-mm line, anchored at the left end with "not at all" and at the right end with "very much."

E. Mood

To evaluate mood states, we used the TDMS¹⁰⁾. The TDMS consisted of eight questions about present psychological state, and participants responded on a six-point Likert scale. By calculating these points, their pleasure, arousal, vitality, and stability levels were determined.

F. Statistical analyses

The VAS and TDMS scores were analyzed using repeated measures two-way analysis of variance (ANOVA) with condition (REST/HIIT) and session (pre/post/1-hr post/2-hrs post) as factors. When the

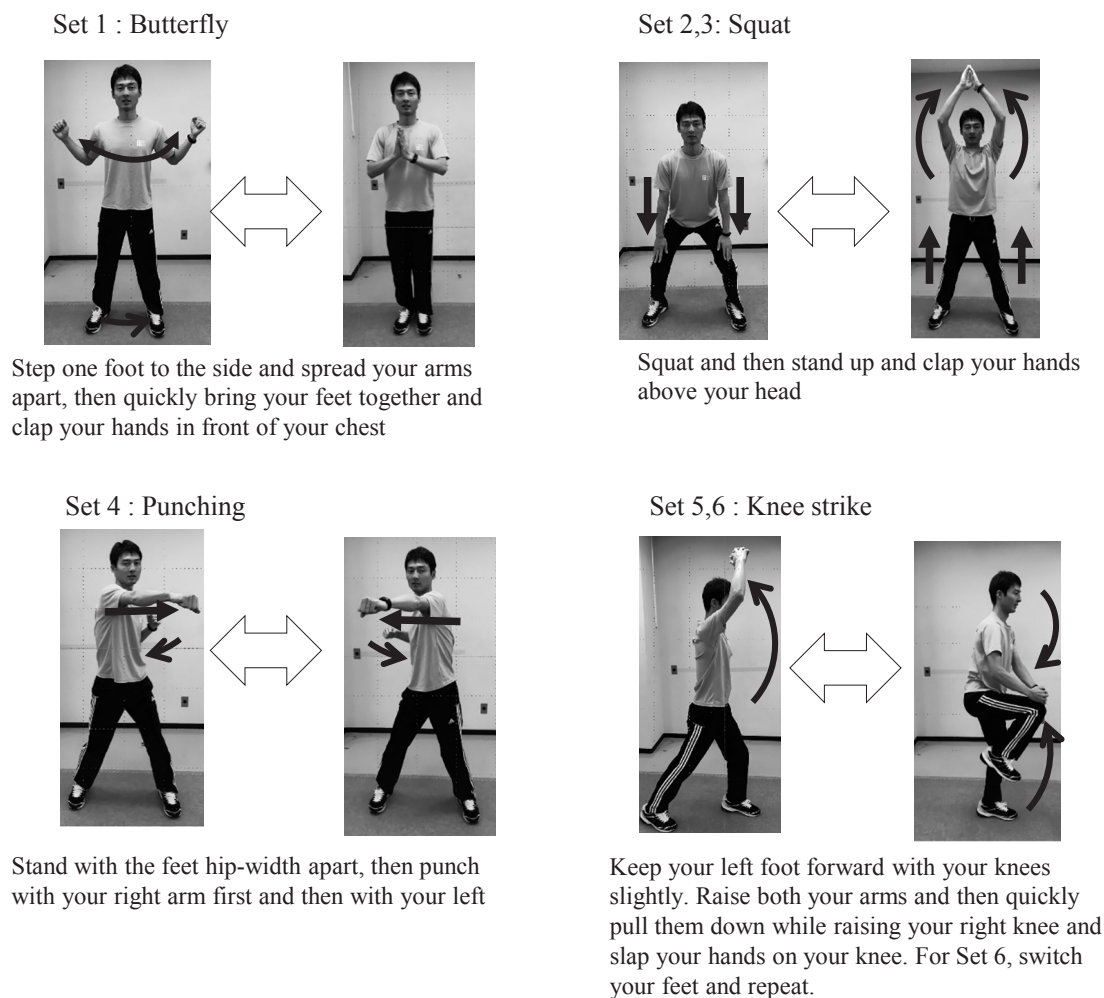


Figure 1. Illustration of the basic four component of the Office HIIT program (refer to Kai et al.)⁶⁾

interaction effect was significant, a post hoc analysis was performed with Bonferroni correction to compare the differences between conditions in each session. All statistical analyses were performed using SPSS version 24 (SPSS, Inc., USA). The significance level was set to $P < .05$ for all analyses.

Results

A. RPE

RPE at the end of the exercise was 13.0 ± 2.2 (10–18), which corresponds to moderate intensity⁹⁾.

B. Sleepiness

There was a significant interaction between condition and session for sleepiness ($F(3, 45) = 5.2$, $P < .05$). Post hoc analyses revealed that sleepiness was lower in the HIIT condition than in the REST condi-

tion in post-session ($t(15) = 3.0$, $P < .05$, Bonferroni corrected).

C. Mood

We observed a significant interaction between condition and session for vitality ($F(3, 45) = 5.5$, $P < .01$), stability ($F(3, 45) = 5.4$, $P < .01$), and arousal levels ($F(3, 45) = 10.8$, $P < .01$), based on TDMS scores. Post hoc analyses revealed that vitality and arousal levels for the HIIT condition were greater than those for the REST condition in post-session ($t(15) = 3.0$, $P < .01$; $t(15) = 4.1$, $P < .01$, respectively, Bonferroni corrected). The stability level for the HIIT condition was lower than that for the REST condition in post-session ($t(15) = 3.2$, $P < .01$, Bonferroni corrected). Regarding the pleasure level, no significant interaction or main effects were observed.

Table 2. Changes in subjective sleepiness and mood (n = 16).

			Pre	Post	1-hr post	2-hrs post
			Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
VAS for sleepiness (cm)	REST		4.6 (2.4)	4.9 (2.8)	4.7 (2.7)	4.4 (2.6)
	HIIT		4.3 (2.0)	2.8 (2.2)*	4.1 (2.3)	4.4 (2.6)
The Two Dimensional Mood Scale						
Arousal (points)	REST		-0.5 (3.1)	-3.2 (4.1)	-1.9 (3.4)	-1.9 (3.5)
	HIIT		-1.1 (3.7)	1.4 (2.7)*	-2.4 (3.1)	-2.3 (3.3)
Pleasure (points)	REST		6.6 (4.9)	6.9 (5.0)	6.7 (4.2)	7.3 (4.6)
	HIIT		7.1 (4.7)	7.9 (4.5)	7.7 (4.0)	7.9 (4.1)
Vitality (points)	REST		2.9 (2.6)	1.7 (3.5)	2.3 (2.5)	2.5 (2.4)
	HIIT		2.9 (2.9)	4.4 (2.7)*	2.5 (2.3)	2.6 (2.4)
Stability (points)	REST		3.8 (2.9)	5.2 (2.6)	4.4 (2.7)	4.8 (3.0)
	HIIT		4.2 (2.9)	3.4 (2.4)*	5.2 (2.3)	5.3 (2.4)

VAS; visual analogue scale. REST = sitting rest condition, HIIT = Office-HIIT condition.

*; $P < .05$ vs. REST.

Discussion

This study examined the immediate and delayed effects of one bout of the three-min Office HIIT on subjective sleepiness and mood in office workers in a real office environment. We found that subjective sleepiness decreased immediately after performing Office HIIT. A previous study in a simulated office environment reported that the standing position did not affect sleepiness²⁾. The results of this study suggest that Office HIIT could be useful for reducing daytime sleepiness compared to just standing.

Further, Office HIIT immediately increased vitality and arousal levels of participants, while it decreased their stability level. These results suggest that just a three-min Office HIIT could energize office workers. However, the immediate effect on subjective sleepiness and mood did not last for an hour. In a simulated working environment, a previous study revealed that while one bout of 30-min moderate-intensity treadmill walking has only an immediate effect on vigor level, six hourly 5-min moderate-intensity treadmill walking can maintain vigor level throughout work hours¹⁾. Thus, in order to maintain mood throughout a working day, it is necessary to perform short exercises several

times during the day.

This study has some limitations. First, contrary to the result of our prior validation test, the average subjective exercise intensity of the Office HIIT program was found to be moderate in this study, with significant individual differences. This is probably due to participants' fitness level and exercise proficiency. Since exercise intensity and proficiency are important factors for mood³⁾, more practice prior to the experiment and changes in exercise speed according to each participants' fitness level are needed to control relative intensity. Second, since this experiment was conducted in a real office environment, we could not control physical activities and any work-related intellectual activities in working hours during the experiment. Thus, in the 1-hr and 2-hrs post-sessions, activities other than Office HIIT might have affected participants' sleepiness and mood.

In summary, our findings indicate that one bout of a three-min practical HIIT program, Office HIIT, can immediately improve sleepiness and vitality and arousal levels of workers in a real office environment. Although a lasting effect was not observed, there was no negative effect at least after two hrs. This study applied an original practical HIIT program without

any equipment to a real office environment. The results of this study support the possibility of introducing Office HIIT to office workers. Future studies should examine its long-term effect as well as its effects on productivity or other health outcomes to obtain additional information to support the application of this exercise program in offices.

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