Life Style Modification by Peer Monitoring of Physical Activity

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ABSTRACT

We investigated whether peer monitoring of daily activities among a group of workplace colleagues will help to improve their daily physical activities. Peer monitoring of actigraphic data did not affect significantly exercise energy consumption or step count. It rather reduced the time of physical activities >3 Mets and increased heart rate during working hours. Peer monitoring of actigraphic among workplace colleagues may cause complicated psychologic effects and may not improve physical activities.

CCS CONCEPTS

• **Applies computing → Life and medical sciences →** Health care information systems

KEYWORDS

Peer monitoring, physical activity, heart rate variability, autonomic nerves

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1 INTRODUCTION

Improving daily physical activity is recommended for the prevention of diseases.[1,2] In general, however, lifestyle modifications depending only on the individual motivation are hard to succeed or to continue, particularly among individuals with sedentary lifestyle. Recently, wearable devices for monitoring own daily activities are widely spread and recent devices provide not only step count but also energy consumption calculated from exercise intensity. These devices, however, seem ineffective for people who are not motivated to improve physical activity. To further improve the usefulness, it may be desirable for these devices to have additional functions to increase motivation.

In this study, we examined the usefulness of a peer monitoring function of wearable actigraphic sensors for improving physical activity. We developed a network system by which individual daily physical activities detected by wearable actigraphic sensors can be monitored mutually among a group of workplace colleagues and examined its effects on their physical activities and autonomic nervous functions. There is limited scientific evidence for the usefulness of peer monitoring of physical activities for lifestyle modification.

2 METHODS

2.1 Subjects

We studied a group of 5 healthy male office workers (age ± SD, 39 ± 10, range, 26-52 yr; body mass index, 23.0 ± 2.5, 20.8-26.1 kg/m^2) in the same research and development division of a company. The present study was performed according to the protocol that was approved by the Institutional Review Board of Nagoya City University Graduate School of Medical Sciences and Nagoya City University Hospital (No. 60160163). All subjects of this study gave their written informed consent to participate in this study.

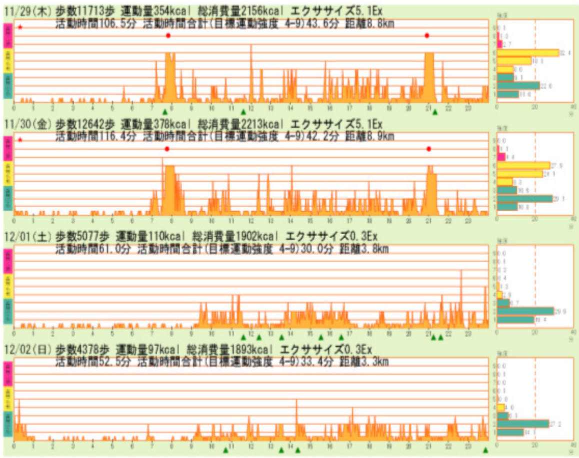

Figure 1: Sample report of daily physical activities. Horizontal axis is clock time of day and vertical axis is intensity of physical activity. Bar graphs at right side are distribution of intensity during the day (modified from web page).

2.2 Protocol

They wore a wearable actigraphic device (Lifecorder GS, Suzuken Co., LTD, Nagoya, Japan) and monitored their physical activity at every 2 min for 2 experimental weeks separated by one washout week. During experimental weeks, they uploaded actigraphic data to their own personal computers every morning at 10 AM The data were analyzed with dedicated software (Lifelyzer05 Coach Network, Suzuken Co., LTD, Nagoya, Japan), which generated a graphic report of daily physical activities as well as daily exercise energy consumption,[3] total step count, and total time of physical activities >3 Mets [4] (Fig. 1).

During the first experimental week, the reports were able to be viewed only by that subject on the own personal computer, while during the second experimental week, the reports were uploaded to network attached storage through a local-area network and were able to be viewed by all subjects in the group. At the beginning of experiment, subjects were explained about this system and were instructed to view the reports of all other members every day during the second week.

Additionally, to examine the autonomic function, 24-hr ECG was also recorded by a Holter recorder (Cardy pico 303+) for 4 times on Monday and Wednesday during 2 experimental weeks. The ECG data were analyzed for heart rate variability (HRV) including mean heart rate, power of high-frequency component (HF, 0.15-0.4 Hz), and low-frequency to high-frequency ratio of power (LF/HF), which were averaged over 4 time zones: morning (00-09 h), daytime (09-17 h), evening (17-24 h), and nighttime (00-06 h).

2.3 Statistical analysis

Statistical analyses system version 9.4 (SAS institute Inc., Cary, NC, USA) was used for the statistical analysis. The effects

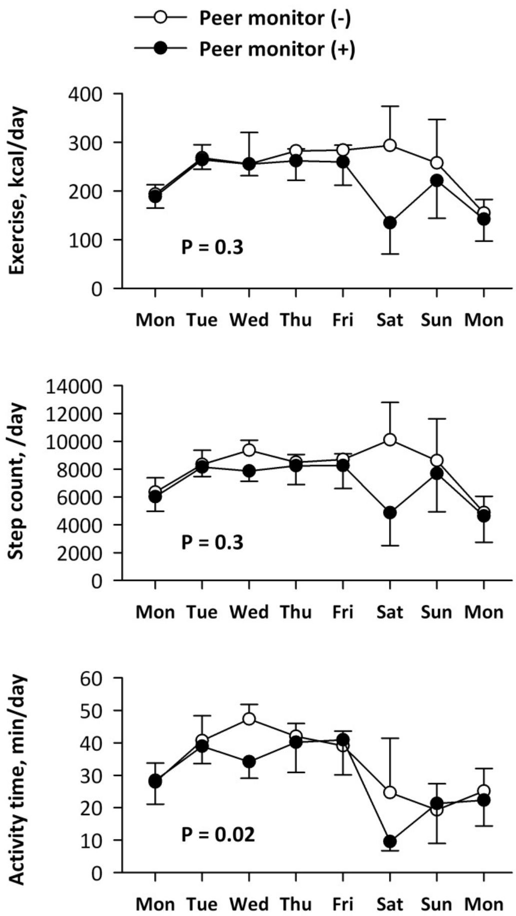

Figure 2: Effects of peer monitoring on daily physical activities
From the top, daily exercise energy consumption, daily total step counts, and daily total time of physical activities >3 Mets. Data are presented as mean and standard error of the mean (error bar).

of peer monitoring on daily exercise energy consumption, step count, activity time, and HRV measures at 4 time zones of the day were evaluated by the Mixed-model analyses of variance (ANOVA) for repeated measures with peer monitoring and day of week as the fixed effects and subject as random effect. $P < 0.05$ was considered to be statistically significant.

3 RESULTS

Physical activity data of the wearable device were uploaded every day during 2 experimental weeks from all subjects. Holter ECG was recorded 4 times as scheduled in all subjects but one in whom data from 21 h to 09 h were not recorded due to the trouble of electrodes.

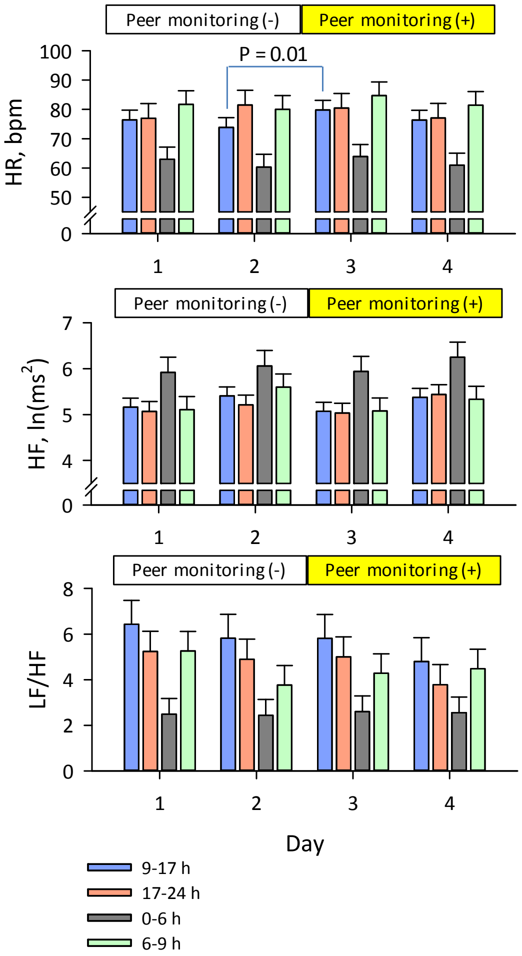

Figure 3: Effects of peer monitoring on heart rate (HR) and Heart rate variability (HRV) measures in different time zones of the day.

Day 1 and 2: Monday and Wednesday during week without peer monitoring. Day 3 and 4: Monday and Wednesday during week with peer monitoring.

HF = power of high-frequency component of HRV and LF/HF = low-frequency to high –frequency power ratio of HRV.

Figure 2 shows the measures of physical activities during the weeks without and with peer monitoring for each day of the week. No significant effect of peer monitoring was detected for daily exercise energy consumption or daily total step counts, while the daily total time of physical activities >3Mets reduced significantly (P = 0.01) during week with peer monitoring compared with week without peer monitoring.

Figure 3 shows the heart rate and HRV indices for 4 time zones that were measured on Monday and Wednesday during 2 experimental weeks. No significant effect of peer monitoring was detected on HF power or LF/HF for any time zones of the day. Heart rate during daytime (working hours) showed an increase with peer monitoring, while heart rate during the other time zones did not differ with peer monitoring.

4 DISCUSSIONS

In this study, we examined the usefulness of a peer monitoring of actigraphic data of wearable sensors for improving physical activity among a group of workplace colleagues. We observed that peer monitoring had no significant effect on daily physical activity level and rather decreased the time of physical activity >3 Mets. While peer monitoring has no significant effect on autonomic neural function either, it increased heart rate during working hours on Monday and Wednesday. Our observations do not seem to support the hypothesis that peer monitoring of actigraphic data is useful for improving physical activities.

Our results, however, should be interpreted as those obtained under the experimental conditions that may be unique to this study. First, the group of subjects recruited for this study was workplace colleagues in the same division of a company. This might cause psychological stress that could affect their behaviors. An increase in heart rate during working hours with peer monitoring may be attributable to this effects. Second, as the method of peer monitoring we simply allowed to view the reports of individual daily physical activities each other. Using other methods that can facilitate comparison/competition of physical activities among participants, such as ranking and graphic comparison, results may be different. Third, although experimental weeks without and with peer monitoring were separated by one washout week, there might be order effects on the results. Finally, the length of observations was only one week for the effects of peer monitoring. Longer duration of exposure may be necessary to obtain positive results.

5 CONCUSIONS

Peer monitoring of actigraphic data among workplace colleagues may cause complicated psychologic effects and may not improve physical activities.

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