Material : Fitness and Physical Activities

Evaluation of the relationship between sedentary behavior and physical activity and correlation factors of sedentary behavior in male university students

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The purpose of this study was to evaluate the relationship between sedentary behavior and parameters related to physical activity in Japanese male university students. Further, we examined the decisional balance for exercise, which is a correlation factor of physical inactivity. The study participants were 638 male freshmen from an institute of technology in Japan who were rated on the time spent on sedentary behavior and the use of TV/PC as a measure of sedentary behavior. The physical activity assessment scale (exercise/sports and daily activity), and the stages of change in the exercise behavior scale were used as measures of physical activity. The following variables were measured as potential correlates: self-efficacy and decisional balance for exercise. A significant negative correlation was observed between the time spent on the use of TV/PC and the exercise/sports score. An ANOVA showed that the participants in the 'precontemplation' group reported a significantly longer time spent on the use of TV/PC when compared with those in the 'action' and 'maintenance' groups. A significant relationship was observed between the time spent on the use of TV/PC, the 'pros for exercise', and self-efficacy for exercise. On the other hand, no significant relationship was observed between time spent on sedentary behavior and any parameters related to physical activity. As a result of multiple regression analysis, the decisional balance for exercise significantly explained the time spent on the use of TV/PC. In conclusion, it was suggested that time spent on the use of TV/PC might be preferable as a measure of sedentary behavior in future research on sedentary behavior.

Keywords: time spent on sedentary behavior, time spent on use of TV/PC, the stages of change for exercise behavior, decisional balance for exercise, self-efficacy for exercise

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1. Introduction

There is a growing interest in increasing and maintaining the physical activity of university students (Arai et al., 2005). The health condition of university students is better in general than people in other age brackets, but there is room for improvement in terms of health-related behavior (Sarkin et al., 1998). One factor that needs to be taken into consideration is that students are at an age where physical activity tends to decrease. A study by Caspersen et al. (2000), for example, finds that the decline of physical activity in young people is most visible from15 to 18 years old; and, according to Bray and Born (2004), the number of young people who do not implement intensive physical activity around the period of high school graduation, or when they enter university, decreases by a significant degree. These findings suggest that there is a need to reduce the sedentary behavior and increase their physical activity of university students.

In part, because of a traditional belief that they induce some chronic diseases (Schmitz et al., 2002), physical inactivity and frequent sedentary behavior

in leisure time were considered to be almost equal concepts. However, some researchers, such as Biddle et al. (2004), propose different ideas about the relationship between levels of physical activity and sedentary behavior: instead of being at opposite ends of the same spectrum, they belong to separate and independent concepts of their own. Findings that support this theory include those of Tucker (1990) who states that there is a very weak relationship between time spent watching TV and physical activity, or Robinson et al. (1993) who state that there is no relationship at all between the two. Schmitz, et al., (1992) state that the parameters that define physical activity and sedentary behavior in leisure time are different, and that such tendencies are more obvious in males. All these findings seem to suggest that it is important to examine physical activity and sedentary behavior as being separate entities, instead of dealing with them as behaviors within a single concept. Until now, however, very few studies have been conducted on the relation between the parameters of physical activity and those of sedentary behavior (time spent on sedentary behavior such as watching TV), although Ishii (2003) examined such relations, this study only focused on four to sixth grade pupils. Thus, there is a need to collect basic data on the relation between physical activity and sedentary behavior, and on the correlates of sedentary behavior.

With regard to parameters used to assess sedentary behavior, not only the total time of sedentary behavior but also the amount of time spent watching TV seem appropriate. The former is considered to be one of the preferential behaviors that should be reduced among various kinds of sedentary behavior, and it has also been used as an assessment parameter in many previous studies. For example, in a six-year forward tracking cohort study on 68,297 nurses (33-55 years old) by Hu et al. (2003), it is reported that every two-hour increase of TV time adds an obesity risk of 23 % and a diabetes risk of 14%. Williams et al. (1990) examined the relationship between psychosocial factors of physical activity and time spent watching TV among university students. Some relation between perceived hindrance of physical activity and time spent watching TV was indicated. Buckworth and Nigg (2004) suggest that in addition to time spent watching TV, the inclusion of time spent using a personal computer (PC) in assessment parameters is appropriate. Leenders et al. (2003) and Buckworth and Nigg (2004), found that male university students watched TV/video and used PC longer than female students. This implies that it is more important to examine the sedentary behavior of male students rather than that of females.

Thus, as explained so far, the focus of this research is on the relationship between sedentary behavior (time spent on sedentary behavior and time spent on the use of a TV/PC), and the physical activity of male university students, and on the potential correlates of sedentary behavior.

2. Method

2.1. Data collection and participants

The data in this research was collected in a 'Health-Related Physical Education I' course at an institute of technology in Japan. More than 95% of the freshmen take the course, of whom 638 (18.57 ±0.81 years old) agreed to participate in the survey. One student who was over 30 years old was not included in the participants.

2.2. Measurement scales

2.2.1. Demographic data

Age, height and weight of the participants were collected.

2.2.2. Time spent on sedentary behavior

Parameters to examine time spent on sedentary behavior used in this research followed the Japanese short version (Murase et al., 2002) of the IPAQ, International Physical Activity Questionnaire, which was develped by a working group of the World Health Organization (WHO) to assess physical activity using a universal standard. The question asked in the research was as follows: 'You are asked a question below. It is about the time you spend sitting or lying on the floor (at work and home and in your study time and leisure time). Include all such time as: time spent sitting at a desk, talking with your friends, reading a book, doing something while sitting on the floor, watching TV while lying on the floor, and so on. Sleeping time, however, should not be included. Now, the question is: How many hours a day in total do you usually spend on such sedentary behavior on the weekday and at the weekend?' The students gave their answers to the question for both weekdays and

the weekend, and the daily average time spent on sedentary behavior was calculated in the following way: Sedentary time on weekdays (five times the daily sedentary time) and that on weekends (two times the daily sedentary time) were added together and the total time was divided by seven.

2.2.3. Time spent watching TV and using a PC

To measure the time spent watching TV and using a PC in their leisure time, the following question, after Williams, et al., (1999), was asked: 'How many hours a day do you watch TV/video, play TV games or use a PC other than in study and work-related situations?' The inclusion of time spent on use of TV/PC as a parameter follows Arai and Nakamura (2005). As with time spent on sedentary behavior, the participants were asked about time spent on TV/PC for both weekdays and the weekend, and the daily average for TV/PC time was calculated as follows: TV/PC time on weekdays (five times the daily TV/PC time) and that on weekends (two times the daily TV/PC time) were added and then the total time was divided by seven. While time spent on sedentary behavior included both leisure time and study and working time, TV/PC time only referred to free time. This means that time spent on TV/PC can be made explicit regarding sedentary time that could be reduced which has priority over other kinds of sedentary behavior. In order to examine stability test-retest survey on time spent on use of TV/PC was conducted two weeks interval using 120 of the subjects in this study (18.36±0.68 years old). This indicates good stability with $r = .80$ ($p < .001$).

2.2.4. Physical activity assessment scale

To assess the daily physical activity patterns of the subjects, a physical activity assessment scale (Wakui and Suzuki, 1997) was used. The scale is composed of three factors with 19 measurement items: 'exercise/sports' (seven items), which measures behavior related to exercise and sports; 'time management' (five items), which measures how one can make time in a situation where some factors hinder one's physical activity; and, 'daily physical activity' (seven items), which measures physical activity in daily life. This study used two of the measurement parameters, following Oka (2003b): 'exercise/sports' and 'daily activity'. The former is composed of such items as 'participation in exercise/sports club' and 'working out until exhaustion', which were used to assess above moderate intensity exercise behavior. The latter is comprised of such items as 'walking in daytime', and 'use of stairs' which are used to assess lower intensity physical behavior. (Score ranges are 7-35, for both factors).

For each item the following question was given to the students: 'How much did you or actually conduct, exercise/physical activities in the past few months?' Five answers to choose from were presented ranging from: 'I did not think about it or acted at all' (level 1) to 'I thought about it or acted quite well' (level 5). Validity (criterion-related validity) and reliability (internal compatibility and stability) of the physical activity assessment scale used in the study were confirmed by using a pedometer as a criterion-related parameter as in Wakui and Suzuki (1997).

2.2.5. Stage of change for exercise behavior

The stage of change for exercise behavior was examined by using a five-item-measurement scale (Oka et al., 2000). This is a core construction factor of a trans-theoretical model of behavioral change (Prochaska and DiClemente, 1983), which combines the concept of past and present behavior and the concept of readiness for/motivation towards the behavior. The five measurement items of the scale are as follows, where 'regular exercise' is defined as exercise conducted for 20-30 minutes two to three times a week: 'I currently do not exercise and do not intend to exercise' (precontemplation); 'I currently do not exercise, but I intend to exercise within the next six months' (contemplation); 'I currently get some exercise, but not regularly' (preparation); 'I currently exercise regularly, but have only begun doing so within the past six months' (action); and, 'I currently exercise regularly and have been doing so for longer than six months' (maintenance). The subjects were asked to choose one answer out of the five items best representing their current situation. The reliability of the scale is confirmed in Oka (2003b) and its validity is confirmed in Oka et al. (2000) and Oka (2003b), in studies which examined male and female university students and middle-aged and elderly people.

2.2.6. Scale of decisional balance for exercise

This research measured the perceived benefits and burdens of regular exercise, by using a scale of decisional balance for exercise (Oka et al., 2003). This is comprised of two factors: 'pros for

Table 1 Demographic characteristics of participants

	Mean ± SD
Age (years)	18.79 ± 0.81
BMI (kg/m^2)	21.40 ± 3.14
Sedentary behavior (hours/day)	5.83 ± 3.19
Use of TV/PC (hours/day)	2.66 ± 1.75
Exercise /sports (score)	20.17 ± 6.74
Daily activity (score)	21.71 ± 5.18
Pros for exercise (score)	33.70 ± 6.36
Cons for exercise (score)	24.26 ± 5.90
Self-efficacy for exercise (score)	12.27 ± 4.24

exercise', referring to the perceived benefits of exercise, and 'cons for exercise' – the perceived burdens of exercise. (score ranges are 10-50, for both). 'decisional balance' refers to the balance of individual assessment between the benefits and burdens of exercise at different stages of change for exercise behavior. In the trans-theoretical model of stage of change for exercise behavior, it is defined as a controllable factor affecting the change of stage (Prochaska and DiClemente, 1983). 'pros for exercise', or benefit of exercise, is comprised of such measurement items as 'Regular exercise keeps you in shape, makes you feel fit, and increases physical strength,' and, 'Regular exercise reduces stress'. 'cons for exercise', or burden of exercise, include such items as 'Regular exercise interferes with work and family life,' and, 'Regular exercise consumes too much physical strength'. Each item was measured in five levels, from 'I strongly disagree' (level 1) to 'I strongly agree' (level 5).

2.2.7. Scale of self-efficacy for exercise

Self-efficacy refers to the perceived sense that you can continue exercise when being placed in unusual circumstances or experiencing interference during a regular exercise period (Bandura, 1977). To measure self-efficacy, this study used the scale of self-efficacy for exercise after Oka (2003a). It is comprised of five measurement items, one of which was an unrelated item (The score range was 4-20). The reliability and validity of the scale are confirmed in Oka (2003a), and also in many other studies that suggest the important role of self-efficacy for exercise in continuing exercise behavior (McAuley and Blissmer, 2000).

2.3. Procedures

This study is cross-sectional, conducted in early July in the class under the supervision of the teacher. The purpose and concept of the study was stated clearly at the top of the survey form and the participants' consent to participate in the survey was obtained by way of asking them to write their names on the form. It was also stated that they were allowed to leave questions unanswered, and that their answers would not affect their grade.

2.4. Analysis

All data were analyzed by using SPSS 11.0J. The relationship between time spent on sedentary behavior/use of TV/PC, physical activity (daily physical activity score) and exercise (exercise/sports score), and potential correlates (BMI; 'pros for exercise'; 'cons for exercise'; and self-efficacy for Exercise) was examined by calculating the Pearson correlation coefficient. For the comparison of time spent on sedentary behavior or use of TV/PC (dependent variable) at each stage of change for exercise behavior (independent variable), a one-factor ANOVA was applied, and if any main effects were suggested in the analysis, a Tukey HSD post-hoc test was conducted. Multiple regression analyses was conducted by forced entry method, where time spent on sedentary behavior/use of TV/PC was used as a criterion variable, and potential correlates were used as explanatory variables. If missing data were found in the scale, the scores of the corresponding factors were excluded from the analysis.

3. Results

3.1. Demographic data

The demographic characteristics of the participants are shown in **Table 1**.

3.2. Relations between sedentary behavior and physical activity

Table 2 shows the correlation between time spent on sedentary behavior or use of TV/PC, and the scores of exercise/sports or daily activity. This indicates that there is a significant correlation between time spent on use of TV/PC and the scores for exercise/sports.

Table 2 Correlations between the time spent on sedentary behavior or the time spent on use of TV/PC, and exercise behavior or physical activity

	Sedentary behavior	Use of TV/PC
Exercise /sports	-.06	-.16***
Daily activity	-.03	-.07

***p <.001

Table 3 Correlations between the time spent on sedentary behavior or the time spent on use of TV/PC, and potential correlates

	Sedentary behavior	Use of TV/PC
BMI	.04	.07
Pros for exercise	-.05	-.15 ***
Cons for exercise	.02	.06
Self-efficacy for exercise	-.07	-.15 ***

**p <.01. ***p <.001

Table 4 Results of multiple regression to explain the time spent on sedentary behavior or the time spent on use of TV/PC

Y: sedentary behavior	
BMI	.05
Pros for exercise	-.03
Cons for exercise	.01
Self-efficacy for exercise	-.06
R^2	.01

Y: use of TV/PC	
BMI	.05
Pros for exercise	-.10*
Cons for exercise	.02
Self-efficacy for exercise	-.08
R^2	.03**

*p <.05, **p <.01

3.3. Relations between sedentary behavior and stage of change for exercise behavior

The results of the ANOVA on time spent on sedentary behavior indicate no main effects [F (4, 541) = 0.31, n.s.], but the ANOVA on time spent on TV/PC indicate main effects [F (4, 562) = 3.93, p <.01]. As is shown in **Figure 1**, the contemplation stage group spent a significantly longer time on the use of TV/PC than the action and maintenance stage groups.

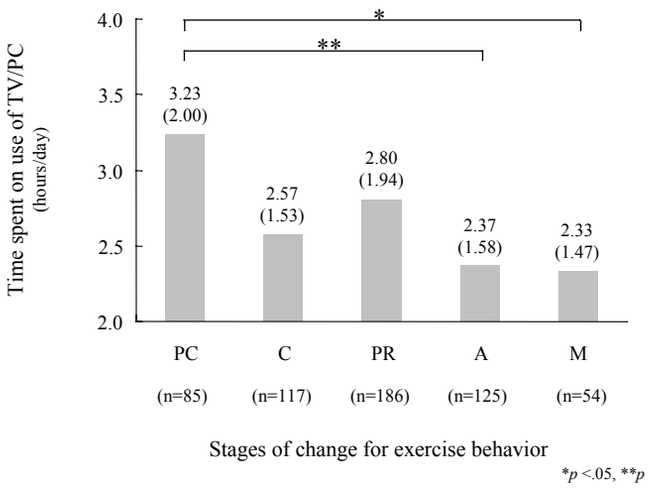

Figure 1 Mean values (SD), and results of Tukey post-hoc comparison test for time spent on use of TV/PC in each stage of change for exercise behavior (precontemplation: PC, contemplation: C, preparation: PR, action: A, and maintenance: M)

3.4. Relations between sedentary behavior and potential correlates

Table 3 shows the relation between sedentary behavior (time spent on sedentary behavior and use of TV/PC) and their potential correlates. It indicates that time spent on sedentary behavior was not related to any of the potential correlates, while time spent on use of TV/PC was significantly related to the score of the benefits of exercise ('pros for exercise') and the score of self-efficacy for exercise.

It was found from the multiple regression analysis conducted using sedentary behavior (time spent on sedentary behavior/use of TV/PC) as a criterion variable, that the score of the benefit of exercise ('pros for exercise') was significantly explained to the amount of time spent on use of TV/PC (**Table 4**). As for the coefficient of multiple determination, a significant value was gained only with time spent on use of TV/PC.

4. Discussion

This research examines the relationship between time spent on sedentary behavior (time on sedentary behavior and use of TV/PC), physical activity, and potential correlates of sedentary behavior (such as benefits and burdens accompanying exercise and self-efficacy for exercise) by male university students. Firstly, concerning the relationship between sedentary behavior and physical activity it is suggested that

there is a significant negative correlation between time spent on use of TV/PC and the exercise/sports score, although the correlation coefficient is weak (r = -.16). This suggests that time spent on use of TV/PC and exercise may not be at the opposing ends of a cline of concept. On the other hand, time spent on use of TV/PC and physically active behavior in daily life (daily activity score), do not indicate a significant correlation, suggesting that not all physical activity is related to time spent on TV/PC.

The results of the ANOVA indicate no difference in time spent on sedentary behavior by the stage of change for exercise behavior. However, the time spent on use of TV/PC indicates some difference between people in the precontemplation group, who are not interested in conducting exercise, and people in the regular exercise groups (action and maintenance stages). There were no major differences in time spent on use on TV/PC between the contemplation/preparation stage, where people do not exercise regularly, and the action/maintenance stage, where people conduct regular exercise. The precontemplation stage is considered to be a stage in which changing exercise behavior is difficult (Oka, 2000). Thus, having people in this stage improve their exercise behavior is of particular importance. As a way to make this happen, or as a way to upgrade people's stage of exercise behavior, it may be more effective to encourage them to reduce the time they spend on the use of TV/PC, rather than by encouraging an increase in physical activity or exercise.

Regarding the relationship between sedentary behavior and potential correlates, it was found that BMI was not related to the two parameters of sedentary behavior (time spent on sedentary behavior and time spent on use of TV/PC). However, this result does not match that of Sidney et al. (1996), who claim that there was a correlation between time spent watching TV and obesity among the 23 to 35 years olds in their study. Such a difference may come from cultural differences between Japan and other countries, or because the ages of the subjects in the two studies are different, or because the present study includes time spent on use of PC as an examination parameter. Further research is necessary to take into account these factors. The examination of time spent on sedentary behavior did not indicate any significant correlation with potential correlates other than with BMI, and the multiple regression analysis did not show any significant standardized partial regression coefficients or multiple determination coefficients.

Time spent on the use of TV/PC, on the other hand, is significantly related to the score of the benefits of exercise ('pros for exercise') and the score of self-efficacy for exercise. Multiple regression analysis indicates that the standardized partial regression coefficient of the benefit of exercise behavior ('pros for exercise') was at a significant level. These results suggest that an approach focusing on the benefit of exercise ('pros for exercise') may be effective in reducing time spent on TV/PC. Such an approach could include an emphasis on the physiological effects of regular exercise (improved physical fitness and physical strength), the psychological effects (more sense of comfort, less stress), or the social effects (becoming sociable, being able to give more attention to people around). However, the values of the correlation coefficients, standardized partial regression coefficients, and multiple determination coefficients in this research are small, which suggests that the correlations between these variables are not strong, and other correlates may need to be found that more strongly relate to sedentary behavior.

There are two main limitations of this research. Firstly, this study is cross-sectional and as the results were drawn from limited samples taken at a single university the way in which the variables could affect each other is not indicated. Secondly, potential correlates were decided solely based on previous studies that had examined physical activity. However, as there have been only a small number of studies on sedentary behavior and its correlates in Japan, this research has provided some valuable information in this area.

5. Conclusion

This study examined the correlation between sedentary behavior (time spent on sedentary behavior and use of TV/PC), physical activity and correlates of sedentary behavior, using male university students as subjects. The results indicate that there are no differences in time spent on sedentary behavior between different stages of change for exercise behavior, but in terms of time spent on use of TV/PC, some differences are indicated. In addition, unlike the time spent on sedentary behavior, time spent on TV/PC is correlated with potential correlates. This suggests the potential superiority in using time spent

on TV/PC as a parameter in the examination of sedentary behavior. There have been few such studies in Japan. More data collection on sedentary behavior and the provision of knowledge based on such data will be helpful in reducing sedentary behavior.

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