Gender Difference in the Relationship between Physical Fitness and Mental Health

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The purpose of this study was to examine the relationship between physical fitness and mental health in men and women. Twenty-five students (12 men and 13 women) aged 19 to 23 years participated in this study as subjects with low life stress who did not participate in competitive sports. Their physical fitness level was determined according to $\dot{V}O_2$ max test results obtained using a cycle ergometer, and their mental health status according to the results of psychological measurement using the Profile of Mood States (POMS) and Spielberger's State-Trait Anxiety Inventory (STAI). In the men, there was significant correlation of $\dot{V}O_2$ max with each of the POMS subscores for tension ($r=-0.61$), depression ($r=-0.61$), fatigue ($r=-0.60$), and total mood disturbance ($r=-0.59$), as well as with STAI state ($r=-0.66$) and trait ($r=-0.76$) anxiety scores. On the other hand, no similar correlation was found in the women. These results suggest that the relationship between physical fitness and mental health in men differs from that in women.

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Long-term and short-term physical activity is known to be accompanied by not only physiological but also psychological benefits. One psychological benefit is a positive effect on mental health; anxiety, tension, depression and stress are reduced, and mood and mental well-being are improved (Folkins & Sime, 1981; ISSP, 1992; Morgan & Goldston, 1987). In addition to these benefits, long-term physical activity can increase physical fitness. It is considered reasonable, therefore, that physical fitness is positively correlated with mental health.

Several studies have been conducted to clarify this relationship. It has been suggested that mental health is dependent on physical fitness level (Brandan & Loftin, 1991; Heaps, 1978; Morgan, 1968; 1969). However, the characteristics of the subjects of these studies have not been described in detail.

Since a variety of factors, such as age, sex, life stress, and exercise type, are thought to influence mental health, careful selection of subjects is necessary. For example, life stress may lead to mental health problems (Rabkin, et al.; 1976), and competitive sports are not effective in decreasing stress (Berger, 1987). In this study of the effect of physical activity on mental health, therefore, particular care was taken in subject selection.

It has been found that men are less anxious (Nakazato, 1989) and less depressed (King, 1982) than women. Thus, it seems reasonable that the degree to which physical activity results in psychological changes would differ in the two sexes. In fact, Martinsen (1987) has reported the gender differences in the psychological effects of both long-term physical activity. On the other hand, Berger and Owen

(1983) and Peter et al. (1991) failed to demonstrate any gender difference in this relationship. In this regard, there is no agreement among the results reported in the literature.

The objective of this study, therefore, was to examine whether there is a gender difference in the relationship between physical fitness and mental health. For this purpose, we studied male and female subjects in a narrow age range who participated in recreational sports and whose life stress was low.

METHODS

Subjects. Twenty-five healthy Japanese students (12 men and 13 women) enrolled at Hiroshima University volunteered to take part in the study. They ranged in age from 19 to 23 years, and had not engaged in competitive sports or exercises for at least the past year. Some subjects enjoyed recreational physical activities, and some were sedentary. Each subject's stressful life events (SLE) experienced by score during one-month period was low, and the Social Readjustment Rating Questionnaire (Holmes and Rahe, 1967) score was less than 50. The physical characteristics of the subjects are presented in Table 1.

Measurement of physical fitness. To assess physical fitness level, maximum oxygen uptake ($\dot{V}O_{2\max}$) was measured. The subject rested a minimum of 30 min after arriving at the laboratory, and then cycled at the rate of 50 rpm on a Monark bicycle ergometer at the initial power of 15 to 25 watts, which was increased by 15 to 25 watts every minute. The workload was selected so that the subject would be

exhausted within 12 min. The test was terminated upon volitional fatigue or when the subject was unable to maintain the required rate. $\dot{V}O_{2\max}$ was considered to be obtained when at least two of the following criteria were noted: levelling off ($150\text{ml}\cdot\text{min}^{-1}$) of oxygen uptake ($\dot{V}O_2$) values despite an increase in work rate, heart rate within 10 beats per minute of the age-adjusted maximum ($220 - \text{age}$ in years), respiratory exchange ratio greater than 1.1, and Borg's rating of perceived exertion scale (1973) greater than 19.

Expired air was collected in Douglas bags during each minute at each workload stage after the heart rate reached $160\text{beats}\cdot\text{min}^{-1}$. Analysis of expired air using an electrochemical O_2 and CO_2 analyzer (NEC-Sanei, Respina 1H26) yielded values for percentage of O_2 and CO_2 . The expired air volume was determined using a dry gasmeter. $\dot{V}O_2$ was calculated from percentage expired O_2 and CO_2 and the expired air volume.

Assessment of mental health status. Mood and anxiety during a recent month period were assessed using psychometric instruments, the Profile of Mood States (POMS; McNair, 1971), and the State-Trait Anxiety Inventory (STAI; Spielberger, 1970) to assess mental health status.

The POMS is a 65-item adjective rating scale which yields subscores for tension, depression, anger, vigor, fatigue, confusion and, total mood disturbance (TMD). TMD is the sum of these scores minus that for vigor. The POMS has been shown to have test-retest reliabilities value ranging from 0.65 to 0.70 during untreated periods ranging from 3 to 110 days, which are considered reasonable values

Table 1 Physical characteristics of subjects.

Variable	Men (n=12)			Women (n=13)		
	Mean	SD	Range	Mean	SD	Range
Age (yr)	21.7	0.6	20–23	21.4	1.2	19–23
Height (cm)	169.9	6.1	160.9–185.0	159.5	3.8	152.5–164.8
Weight (kg)	62.3	7.4	52.0–75.0	51.7	4.3	43.5–56.5
Body fat (%)	12.9	3.2	9.2–21.2	21.0	3.4	15.0–28.0

reflecting fluctuating mood state (McNair, 1966).

The STAI is a 40-item adjective rating scale which is used to assess state and trait anxiety. State anxiety refers to the experience of anxiety and tension at the time that the questionnaire is completed (i.e., how the subject feels "now"), whereas trait anxiety refers to the general level of anxiety (i.e., how the subject "usually" feels).

Statistical analysis. The mean, standard deviation, and range were calculated for each variable in each group. The unpaired t-test was utilized for statistical comparison of psychometric data in men with those in women. To clarify the relationship between $\dot{V}O_2\text{max}$ and psychometric state, correlation coefficients were calculated. All P values less than 0.05 were considered significant.

RESULTS

The mean $\dot{V}O_2\text{max}$ in men and women was 51.4 ± 7.3 and 37.1 ± 5.6 $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, respectively. These values were within Åstrand's average range (Åstrand, 1960).

The mean, standard deviation, and range for men and women for each POMS subscore and STAI are shown in Table 2. For all of these scales except confusion (POMS) and trait anxiety (STAI), the score in the men was greater than that in the women. However, there was no significant difference between men and women for any scale.

Examples of the correlation analysis used to examine the association between physical fitness and psychometric status are shown in Figures 1 and 2. Figure 1 illustrates the relationship between $\dot{V}O_2\text{max}$ and depression score on the POMS. In men, $\dot{V}O_2\text{max}$ was negatively correlated ($P < 0.05$) with the depression score on the POMS. On the other hand, in women, no such relationship was found. Figure 2 shows the relationship between $\dot{V}O_2\text{max}$ and trait anxiety score on the STAI. Again, there was a negative correlation ($P < 0.01$) in men but no the correlation in women.

The correlation analysis results for $\dot{V}O_2\text{max}$ with

Fig. 1 Relationship between $\dot{V}O_2\text{max}$ and the POMS depression raw score in men (closed circles and regression line) and women (open circles).

Table 2 Profile of Mood States (POMS) and State-Trait Anxiety Inventory (STAI) scores.

Variable	Men (n=12)			Women (n=13)		
	Mean	SD	Range	Mean	SD	Range
POMS						
Tension	10.7	5.2	3–21	9.0	5.6	2–17
Depression	13.7	9.9	4–35	9.9	5.1	4–21
Anger	7.2	6.6	1–19	6.3	6.4	0–24
Vigor	18.3	5.4	11–28	17.4	4.4	8–24
Fatigue	8.0	6.9	0–19	3.6	2.6	0–7
Confusion	7.9	3.8	3–15	8.5	3.1	4–14
Total Mood Disturbance (TMD)	29.1	32.7	–7–89	20.0	20.8	–9–57
STAI						
State anxiety	40.0	6.7	29–52	37.8	5.7	28–47
Trait anxiety	39.8	8.7	27–54	40.3	7.7	30–57

Fig. 2 Relationship between $\dot{V}O_{2\max}$ and the STAI trait anxiety raw score in men (closed circles and regression line) and women (open circles).

each psychometric measure are summarized in Table 3. In men, $\dot{V}O_{2\max}$ was significantly ($P < 0.05$) correlated with the POMS score for tension ($r = -0.61$), depression ($r = -0.61$), fatigue ($r = -0.60$), and TMD ($r = -0.59$), as well as with the STAI state ($r = -0.66$) and trait ($r = -0.76$) anxiety scores. On the other hand, in women, there was no significant correlation of $\dot{V}O_{2\max}$ with any psychometric measure.

DISCUSSION

A number of studies have examined whether the level of physical fitness is correlated with the score on a psychological index (Brandan & Loftin, 1991; Heaps, 1978; Morgan, 1968; 1969). In these studies, however, little attention has been paid to the selection of subjects. In the examination of the relationship between physical fitness and mental health, the selection of subjects is very important, because mental health may easily be affected by physiological and psychological status. Therefore, certain conditions must be taken into consideration in subject selection. First, the SLE score of the subjects during the month prior to the test should be low, since SLE can lead to physical and psychological health problems (Rabkin, et al.: 1976). Paykel et al. (1969) found that depressed patients had experienced a greater number of SLE than the general population had. In addition, the ages, occupation, living environments and educational histories of the subjects should be similar. Nakazato and Shimomura (1989) observed that anxiety declined linearly with age group. Finally, the subjects should not have taken part in any competitive sports or exercises in the most recent year. Athletes frequently experience anxiety or tension prior to a game or match. Berger and Owens (1987) have suggested that competitive

Table 3 Correlation coefficients for $\dot{V}O_{2\max}$ with each psychometric measure.

Psychometric measure	$\dot{V}O_{2\max}$ (ml·kg ⁻¹ ·min ⁻¹)	
	Men	Women
POMS		
Tension	-0.611*	0.113
Depression	-0.614*	0.004
Anger	-0.462	0.045
Vigor	0.170	-0.290
Fatigue	-0.595*	-0.262
Confusion	-0.521	0.288
Total Mood Disturbance (TMD)	-0.591*	0.117
STAI		
State anxiety	-0.659*	0.271
Trait anxiety	-0.757**	0.272

* $p < 0.05$, ** $p < 0.01$

sports or exercises is not effective in decreasing stress. Athletes may not obtain the beneficial psychological effects of exercise. Some of the subjects of this study had taken part in recreational sports or exercises and others had been sedentary. Accordingly, this study is considered to be so designed that it accurately reflects the effect of physical activity on mental health.

In this study, while a significant correlation between physical fitness and mental health was observed in men, no such correlation was found in women. These results are consistent with those of Martinsen (1987). Martinsen (1987) reported that the antidepressive effect of a training program was more pronounced in men than in women. Based on the results of these investigations, it is concluded that women obtain a less pronounced psychological effect from physical activity than men.

A possible explanation for this gender differences may be attributable to a gender difference in the psychological effects of short-term physical activity. Wood (1977) indicated that men who participated in a 12-min run showed significant decreases in state anxiety, while there was no evidenced change in women. Namely, psychological effects of short-term physical activity are different between men and women. If we assume that psychological effects of short-term physical activity influence those of long-term physical activity, psychological effects of long-term physical activity should be different between men and women.

In summary, the relationship between physical fitness and mental health was examined in men and women. In men, there was a negative correlation between physical fitness and the POMS tension, depression, fatigue, and TMD scores, and the STAI state and trait anxiety scores, while no significant correlation was found in women. These results suggest that men could improve mental health by increasing physical fitness level, but women could not, even if their physical fitness level was improved.

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