# Poor Physical Fitness of Adolescents with Mental Retardation at Rajanukul School, Bangkok

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**Abstract**

**Objective.** To study the physical condition of adolescents with mild to moderate mental retardation (MR), twenty-eight MR students from Rajanukul school were evaluated for their fitness components compared to 14 normal students.

**Method.** Per cent body fat (%BF) was calculated from three sites of skinfold thickness. The cardiorespiratory endurance was assessed using graded exercise testing and Quinton gas analyzer. Isometric leg strength was measured with dynamometer, and flexibility was measured by sit and reach test.

**Results.** Compared between MR and normal subjects, %BF was higher in the MR group without statistic significance. Five MR females had %BF > 30. The mean VO2peak was about 70 per cent of normal. The leg strength and flexibility were very poor.

**Conclusion.** The MR adolescents had a significantly lower level of physical fitness and more prevalence of obesity than normal students. Appropriate physical activities should be emphasized for health promotion and disease prevention.

**Key word** : Physical Fitness, Mental Retardation, Cardiorespiratory Endurance, Exercise Testing

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**J Med Assoc Thai 2000; 83: 1387-1392**

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Adequate physical activity is recognized as an essential requirement for good health[1,2]. The impacts of physical inactivity include obesity, hypercholesterolemia, hypertension, and hyperinsulinemia, are known as major risk factors of coronary artery disease and stroke[2-4]. Since the incubation period of atherosclerosis begins during the early years of childhood, disease prevention should be emphasized starting from within the family and the school[5-7].

Mentally retarded individuals are born with cognitive and behavioral deficits. They are usually separated from society for reasons of safety and cultural beliefs. This, along with their inactive behavior results in a low level of physical performance and puts them at risk[8-11]. The purpose of this study was to evaluate the components of health related physical fitness of adolescent students with mental retardation (MR). The results will be useful in future plans for health promotion, disease prevention, and quality of life improvement in this group.

## MATERIAL AND METHOD

A cross sectional analytical study was performed at the exercise laboratory in the Department of Physiology, Faculty of Medicine, Chulalongkorn University from July to September 1999. Twenty-eight mild to moderately mentally retarded students without physical disability, aged 15-18 years from Rajanukul School, Department of Mental Health, Bangkok, were enrolled into the study. They had been physically examined to assure that there were no contraindications for entry into exercise testing. Fourteen sedentary normal students with the same socioeconomic status from Wimuttitarampitayakorn School volunteered to be the control group. All subjects were willing to be tested and had their parents' informed consent. Four components of health related physical fitness[12] were assessed as follows:

**1) Body composition.** Body mass index (BMI) was calculated as (body weight in kg) / (height in meter)$^2$. Per cent of body fat (%BF) was calculated from skin fold thickness at the triceps, subscapula, and abdominal regions[13].

**2) Cardiorespiratory fitness.** Cardiorespiratory function was evaluated by using Fernhall et al's treadmill walking protocol[14], which used a constant speed of 4.8 km/hour, starting at 0 per cent grade for 2 minutes, followed by 2.5 per cent grade for 2 minutes, and then increased by 2.5 per cent every minute until exhaustion. During the test, electrocardiographs were obtained *via* Quinton 4500 ECG monitoring, and metabolic data were collected using Quinton metabolic cart breath by breath gas analyzer. The parameters recorded were; peak oxygen consumption (VO2peak), maximum heart rate (HRmax), exercise time, minute ventilation (VE), and respiratory exchange ratio (RER = VCO2/VO2).

**3) Muscular strength.** Isometric leg strength was measured by using a strength dynamometer (TKK 5102), performed three times and the highest force obtained was recorded in kilograms.

**4) Flexibility.** Flexibility of the back was evaluated using the sit and reach test, performed three times, and the best result was recorded in centimeters.

The data were analyzed with program SPSS for Windows version 9.0. Distributions of data were tested with a histogram and a probability plot. The descriptive results were reported in mean $\pm$ SD; unpaired *t*-test and Pearson correlation test were used where appropriate, with 95 per cent confidence interval and significance set at $P \leq 0.01$.

## RESULTS

Every subject in the normal and MR group completed the tests. General data of both groups is shown in Table 1. The mean age and BMI of both groups were not different, but subjects whose BMI was more than 27 kg/m$^2$ were found more frequently in the MR group. There were 5 MR subjects who had %BF more than 30, and all were female.

Table 2 shows comparison of the parameters representing fitness components between MR and normal subjects. The MR group had a significantly lower level of fitness in all areas except for %BF.

Table 3 displays differences between MR and normal subjects for both sexes. Mentally retarded males had lower value of all parameters except %BF compared to the controls. But MR females differed from normal females only in HRmax, exercise time and leg strength. Compared between sexes, the MR females had higher %BF and flexibility than MR males.

It was also found that the VO2peak had weak negative correlation with %BF ($r = -0.47$ at $p = 0.01$), and positive correlation with IQ ($r = 0.54$ at $p = 0.01$).

**Table 1. General data and descriptive characteristics (X ± SD).**

| | | MR (n = 28) | Normal (n = 14) |
|---|---|---|---|
| Age | (yr.) | 16.2 ± 0.7 | 16.5 ± 0.9 |
| Sex | (M:F) | 14 : 14 | 7 : 7 |
| Down syndrome | (M:F) | 7 : 2 | 0 |
| IQ | | 43 ± 7 | normal |
| Weight | (kg) | 57 ± 14 | 55 ± 10 |
| Height | (m) | 1.57 ± 0.1 | 1.61 ± 0.8 |
| BMI | ($kg/m^2$) | 23 ± 4 | 21 ± 3 |
| BMI > 27 $kg/m^2$ | (n) | 8/28 | 1/14 |
| %Body fat > 30 | (n) | 5/28 | 0 |

**Table 2. Comparison of physical fitness components (X ± SD) between MR and normal subjects.**

| Variable | | MR | Normal |
|---|---|---|---|
| Body fat | (%) | 20.6 ± 9.4 | 16.0 ± 7.2 |
| VO2peak | (ml/kg/min) | 24.5 ± 5.8 * | 35.1 ± 10.7 |
| HRmax | (bpm) | 153.5 ± 15.7 * | 184.7 ± 6.3 |
| VE | (l/min) | 47.1 ± 14.4 * | 62.2 ± 20.9 |
| Exercise time | (min) | 6.6 ± 3.5 * | 15.6 ± 4.0 |
| Leg strength | (kg) | 40.1 ± 17* | 109.4 ± 42.4 |
| Flexibility | (cm) | -2.4 ± 11* | 9.6 ± 5.8 |

* significantly different at $p < 0.001$

**Table 3. Fitness components (X + SD) of MR and normal subjects showed in different sex.**

| Variables | | Male | | Female | |
|---|---|---|---|---|---|
| | | MR | Normal | MR | Normal |
| Body fat | (%) | 17.1 ± 7 | 12.3 ± 2 | 24.2 ± 9 ** | 19.7 ± 5 |
| VO2peak | (ml/kg/min) | 25.0 ± 5 * | 44.5 ± 6 | 23.9 ± 6 | 25.6 ± 1 |
| HRmax | (bpm) | 158.7 ± 14 * | 186.7 ± 7 | 148.7 ± 15 * | 182.7 ± 5 |
| VE | (l/min) | 49.9 ± 12 * | 80.9 ± 9 | 44.4 ± 15 | 43.5 ± 6 |
| Exercise time | (min) | 7.1 ± 3 * | 19.1 ± 1 | 6.1 ± 3* | 12.1 ± 1 |
| Leg strength | (kg) | 45.3 ± 15 * | 149.0 ± 13 | 34.9 ± 17* | 69.9 ± 8 |
| Flexibility | (cm) | -7.0 ± 2 * | 11.0 ± 2 | 2.1 ± 11 ** | 8.2 ± 5 |

* significantly lower than normal subjects at $p < 0.001$
** significantly higher than MR males at $p < 0.05$

## DISCUSSION

The recruited MR and normal students had been matched for age, sex, and socioeconomic status. The mean BMI and %BF of both groups were not significantly different. But when a BMI of > 27 $kg/m^2$ was considered as a cut-off point of cardiovascular risk[3,12], the MR group had 4 times more risk than the normal group (8/28 *vs* 1/14). Five of 28 (18%) MR subjects had %BF greater than 30, which was about 1/3 of MR females. These findings agreed with studies reported by Rimmer et al[14], Fernhall et al[15], and Rubbin et al[16], that the incidence of overweight and obesity are high among adults with MR, and highest in MR females.

In evaluation of the cardiorespiratory function of an individual with mental retardation, the test reliability is mostly dependent on subject motivation. Fernhall et al[17,18] demonstrated the feasibility and reliability of laboratory maximal exercise testing in mild to moderate MR subjects. The criteria employed to evaluate the state of maximal exercise are: 1) a plateau in VO2 where the work load is increased, 2) no increase in HR during an increase in work load, and 3) a RER value greater than 1.0[19,20]. In the present study, we used Fernhall's treadmill walking protocol which enabled the subjects to become familiar with the instruments, machines, and the laboratory, and allowed them to practice until they had confidence and motivation before being tested. All subjects were tested to volitional exhaustion, 73 percent of them achieved an RER > 1.0 (mean RER = 1.05), but not all of them reached the plateau VO2. Therefore, the highest VO2 obtained from the test was reported as "VO2 peak"[9,10,21] instead of "VO2 max".

All variables collected from the cardiorespiratory function test were significantly lower in the MR group. The mean VO2 peak was 24.5 ml/kg/min, approximately 70 per cent that of the control group. This value is lower than that previously reported, in which VO2 peak/max was about 28 to 35 ml/kg/min[8,15,17,18,22-27]. This may be due to the younger age and lower IQ of the

subjects in this study. It was also demonstrated that MR individuals with Down syndrome (DS) had lower cardiorespiratory fitness compared to non-DS[22]. This study included 9-DS subjects (7 males, 2 females) in the analysis, which could have affected the mean VO2 peak value, even though there was no significant difference between the DS and non-DS group. The mean HRmax of 153 bpm was about 83 per cent that of the control group. This could be explained by a poor chronotropic responsiveness to exercise[17]. When sex differences were analyzed, MR males showed all variables of cardiorespiratory function lower than normal subjects, but MR females were different from normal females only in HRmax, and exercise time. This reflected the low level of cardiorespiratory fitness of the normal female students (M *vs* F = 44.5 *vs* 25.6 ml/kg/min).

The correlation between IQ and VO2 peak supports the hypothesis of sedentary life style among MR populations. The negative correlation between VO2 peak and %BF indicates the adverse impact of deteriorating physical condition upon body composition and vice versa.

Research on muscle strength has been of interest since the last decade. Muscle strength and flexibility are important in self-care activities, recreation, and work. Adequate muscle strength also helps increase daily energy expenditure, which is useful in weight control. Pitetti et al[28], Croce et al[29], and Horvat[30] reported isokinetic strength of adults with DS that was about 30-45 per cent of normal, and about 50-60 per cent of normal in non-DS MR. The MR adolescents in our study had isometric strength of only 36 per cent of normal, and the flexibility measured was very poor, especially in males. The poor muscular strength may have been another reason that caused some subjects to terminate their graded exercise tests. These subjects would probably have been limited by muscular fatigue (peripheral factor) rather than cardiovascular function (central factor).

Initial reports have been mainly concerned with exercise programs aimed to improve aerobic capacity in MR individuals[15,23,24], and few studies have been designed to improve muscle strength[31]. From the findings of our study, it is essential to provide programs for improving every component of physical fitness in MR populations.

## SUMMARY

The MR adolescents in Rajanukul School had a lower level of aerobic capacity, muscle strength, and flexibility compared to normal students. More prevalence of obesity was found among MR females. These most likely resulted from their inactive behavior and inadequately assigned physical activity. Appropriate exercise and recreational programs should be emphasized to improve the functional capacity of this group and to prevent concurrent diseases.

(Received for publication on August 15, 2000)

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# ความบกพร่องของสมรรถภาพทางกายของเด็กปัญหาอ่อนที่โรงเรียนราชานุกูล กรุงเทพมหานคร

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ศึกษาสมรรถภาพทางกายของเด็กนักเรียนปัญหาอ่อนจากโรงเรียนราชานุกูล จำนวน 28 คน เปรียบเทียบกับนักเรียนปกติ 14 คน โดยคำนวณค่าร้อยละของไขมันจากความหนาของไขมันใต้ผิวหนังสามแห่ง ประเมินสมรรถภาพของหัวใจและปอดโดยการทดสอบออกกำลังกายด้วยลู่วิ่งสายพานและเครื่องวิเคราะห์ก๊าซ ประเมินความแข็งแรงของกล้ามเนื้อขาด้วยไดนาโมมิเตอร์ วัดความยืดหยุ่นโดยการเหยียดมือแตะปลายเท้าในท่านั่ง

**ผลการศึกษา** พบค่าเฉลี่ยค่าร้อยละของไขมันในเด็กปัญญาอ่อนสูงกว่าเด็กปกติอย่างไม่มีนัยสำคัญ แต่พบว่ามีเด็กปัญญาอ่อน 5 คนมีไขมันมากกว่าร้อยละ 30 ค่าเฉลี่ยการใช้ออกซิเจนสูงสุดของเด็กปัญญาอ่อนเท่ากับร้อยละ 70 ของเด็กปกติ ความแข็งแรงของขาและความยืดหยุ่นมีค่าต่ำมาก

**สรุป** เด็กปัญญาอ่อนมีสมรรถภาพทางกายต่ำและมีภาวะอ้วนมากกว่าเด็กปกติ ควรให้โปรแกรมส่งเสริมที่เหมาะสม

**คำสำคัญ** : สมรรถภาพทางกาย, ปัญญาอ่อน, สมรรถภาพหัวใจและปอด, การทดสอบออกกำลังกาย

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**จดหมายเหตุทางแพทย์ ฯ 2543; 83: 1387–1392**

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