

# Biochemical and physiological examination of intellectually disabled table tennis players

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**Abstract** The table tennis event for the intellectually disabled players was introduced into the 2000 Sydney Paralympic Games (in October, 2000) for the first time and players participated from Japan. A table tennis strength-training camp including the Paralympic players with intellectual disability was held in Sendai (Tohoku Fukushi University) in September, 2000; four women and four men took part. By measuring the fluctuation of salivary cortisol and urinary 17-ketosteroid, we studied whether the practice of table tennis placed a big burden on the intellectually disabled players or not. Most of them were estimated to be mentally relaxed during the practice, although they were physically tired. The pleasing table tennis practice was considered not to provide mental stress, even if it was physically hard exercise. An enjoyable sporting practice, such as table tennis, is considered useful for the persons with intellectual disability to lead their meaningful, balanced lives.

## 1 Introduction

Participation in sports activities is the right of every individual, and is an integral part of leading a meaningful, balanced life. Table tennis is one of the most popular sports for the disabled as well as non-disabled people in Japan. Table tennis (including wheelchair table tennis and blind table tennis) is an official individual event of the 1st National Sports Games for the Disabled in Japan (in October, 2001).

A table tennis strength-training camp including the Paralympic players with intellectual disability was held in Sendai (Tohoku Fukushi University) in September, 2000. We studied whether the practice of table tennis placed a big burden on the intellectually disabled players or not. Measurement of salivary cortisol and urinary 17-ketosteroid were used to estimate the stress conditions of the players.

Cortisol has been reported to increase under stressful conditions. Salivary

sampling is a good method for stress assessment for all persons including the aged and the disabled, because collecting saliva is comparatively simple and does not burden the subjects. In the case that the communication of will is not carried out well, the application of this method is conceivable.

Urinary 17-ketosteroid is the one that the precursor of various steroid hormones was excreted into urine. 17-ketosteroid has reported to decrease when people are under stress. Thus, we examined salivary cortisol level and urinary 17-ketosteroid level to estimate the subjects' mental and physical conditions.

## 2 Materials and methods

Four women (16-22 years old) and four men (18-55 years old) players participated in the camp for two days.

Stimulated salivary fluid was absorbed on a cotton dental roll for 2 min. The fluid was then separated from the dental roll in a saliva-collecting tube (Salivette AG, Germany) by centrifugation. The salivary and urinary samples were frozen at  $-80^{\circ}\text{C}$  until assayed.

Salivary cortisol level was estimated by enzyme-linked immunosorbent assay (ELISA). The Cortisol Enzyme Immunoassay Kit (Oxford Biomedical Research INC, Oxford, UK) was employed. Urinary 17-ketosteroid was measured by spectroscopic analysis (OS-Kit, Kanto Kagaku, Japan).

Informed consent was obtained from all subjects and the study was approved by the Ethical Committee of Tohoku Fukushi University.

## 3 Results

Figure 1 and Figure 2 show the cortisol levels of the four women players during the two day table tennis exercise; they decreased on both days. The women were considered to be mentally relaxed during the practice.

The cortisol levels of two men players (E, G) decreased and the levels of other two men players (F, H) were not changed significantly in the first day (Figure 3). No one suffered from excessive stress during the 3-hour exercise.

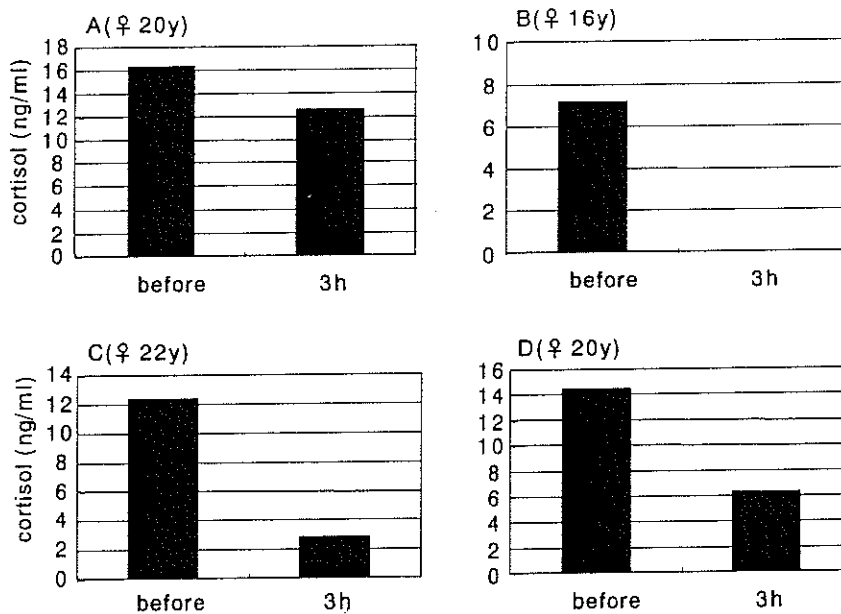
However, a different pattern was observed on the second day. In the case of E, the cortisol level decreased after 3-hour exercise on both days, but after 8 hours the cortisol level increased remarkably on the second day (Figure 4), when an intimate person visited to encourage him. After the 8-hour exercise he complained of shoulder-stiffness, leg languidness, malaise and eye-fatigue. Inappropriate encouragement seemed to increase his stress level. Suitable communication is considered necessary to the intellectually disabled players.

In the case of G, the cortisol level increased gradually and the cortisol level after 8-hour exercise was almost twice that before the practice (Figure 4). Later he confessed that he had a cramp in his leg and a blister in his foot on the second day. He also complained of shoulder-stiffness and eye-fatigue. His poor physical conditions were presumed to have elevated the cortisol levels.

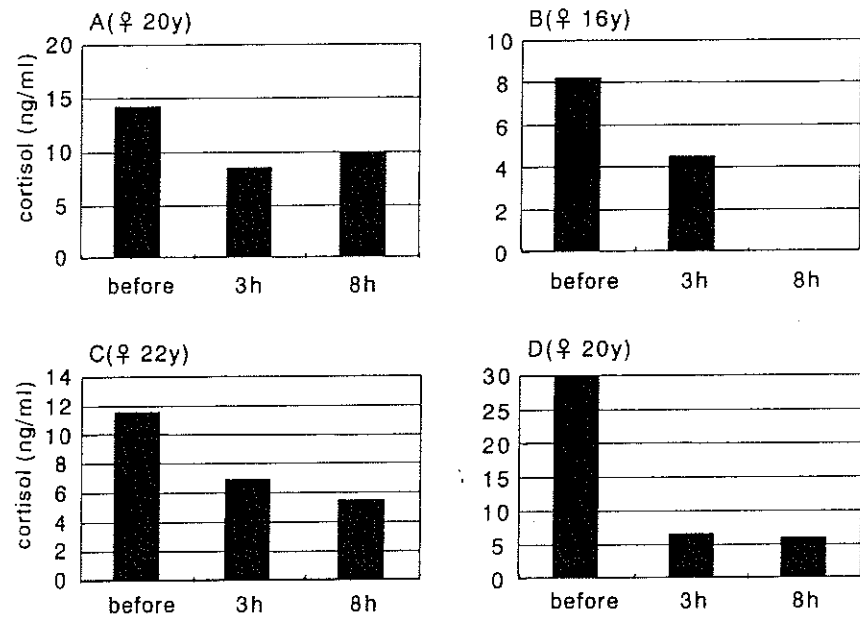
Table 1 shows the results of salivary cortisol changes and urinary 17-

ketosteroid changes on the first day. They cortisol levels of A, C, D, E and G decreased and their 17-ketosteroid levels increased (Table 1); there was significant negative correlation between the value of cortisol and 17-ketosteroid. These data suggest that the players became relaxed during the exercise. In the case of F and H, the levels of salivary cortisol did not change significantly during the practice, nor did those of the urinary 17-ketosteroid (Table 1). Sufficient saliva and urine were not obtained from B.

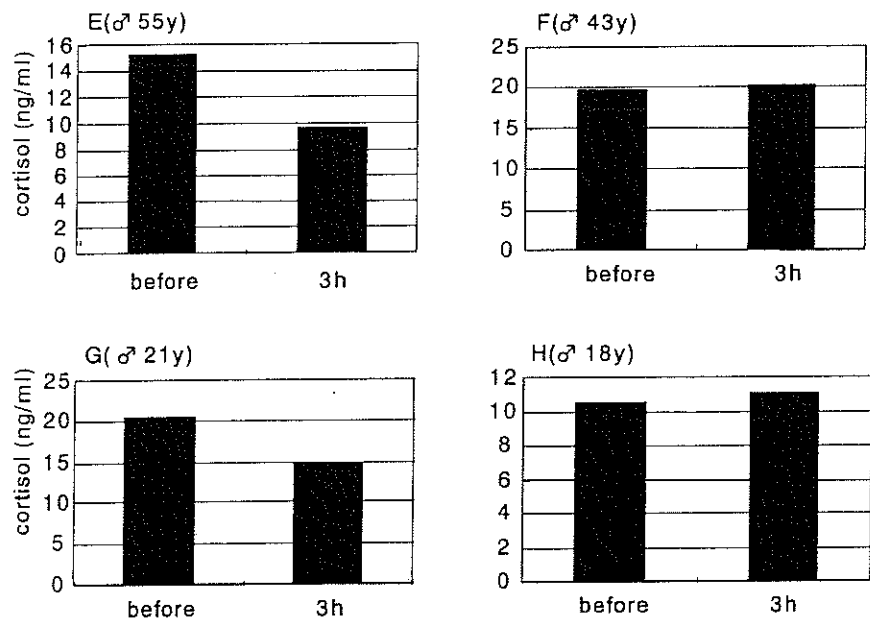
Other examinations were employed to assess the mental and physical conditions of players with intellectual disability: center critical fusion frequency, blood pressure and heart rate. These examinations suggested that everyone was more or less physically tired after the practice. It was difficult to do a detailed interpretation of the data of center critical fusion frequency because of the unavoidable communication gap between the researcher's explanation and the subject's understanding.



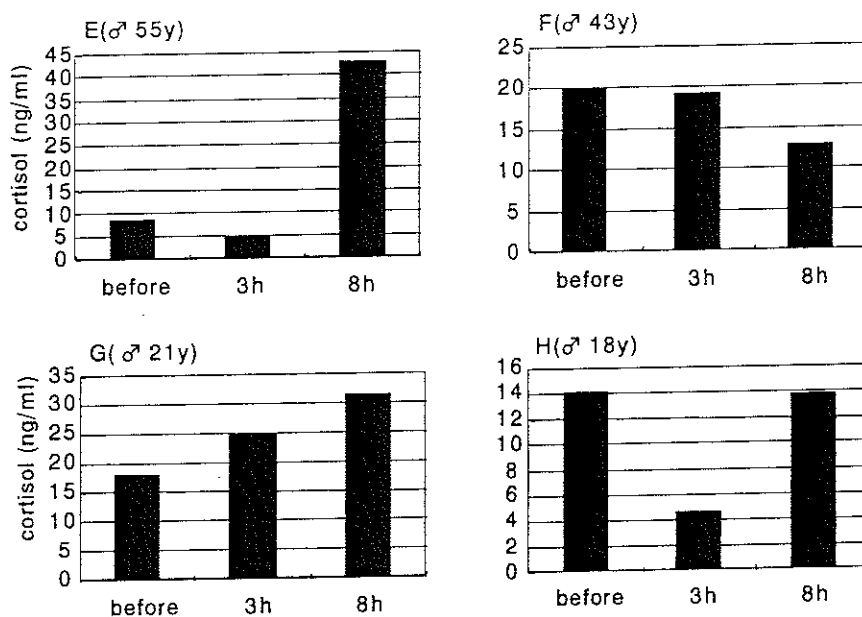
**Figure 1.** Change of salivary cortisol level of four women players of the table tennis strength-training camp in the first day. Table tennis practice was performed from 13:30 to 16:30. Salivary samples were collected before and after the 3-hour exercise, respectively. A sufficient salivary sample was not collected from B after the 3-hour exercise.



**Figure 2.** Change of salivary cortisol level of four women players of the table tennis strength-training camp in the second day. Table tennis practice was performed from 9:30 to 17:30. Salivary samples were collected before, after the 3-hour and the 8-hour exercise, respectively. Lunch break was taken from 12:30 to 13:30. A sufficient salivary sample was not collected from B after the 8-hour exercise.



**Figure 3.** Change of salivary cortisol level of four men players of the table tennis strength-training camp in the first day. Table tennis practice was performed from 13:30 to 16:30. Salivary samples were collected before and after the 3-hour exercise, respectively.



**Figure 4.** Change of salivary cortisol level of four men players of the table tennis strength-training camp in the second day. Table tennis practice was performed from 9:30 to 17:30. Salivary samples were collected before, after the 3-hour and the 8-hour exercise, respectively. Lunch break was taken from 12:30 to 13:30.

**Table 1.** Salivary cortisol and urinary 17-ketosteroid levels in the first day of the table tennis strength-training camp.

	Cortisol			17-ketosteroid		
	before	after the exercise		before	after the exercise	
A (♀ 20y)	16.3	12.6 <sup>a</sup> (77.3%)	↘	1.56	1.92 (123.1%)	↗
B (♀ 16y)	7.2	<sup>b</sup> NT		1.56	<sup>c</sup> NT	
C (♀ 22y)	12.4	2.9 (23.4%)	↘	0.84	1.28 (152.4%)	↗
D (♀ 20y)	14.5	6.3 (43.4%)	↘	1.32	1.64 (124.2%)	↗
E (♂ 55y)	15.3	9.5 (62.1%)	↘	0.44	1.90 (431.8%)	↗
F (♂ 43y)	19.5	20.0 (102.6%)	→	2.68	2.56 (95.5%)	→
G (♂ 21y)	20.5	14.6 (71.2%)	↘	2.20	3.20 (145.5%)	↗
H (♂ 18y)	10.5	11.1 (105.7%)	→	3.12	2.96 (94.9%)	→

↘ : Decreased

↗ : Increased

→ : No difference: the difference was within 6% in the measured value

Salivary samples and urinary samples were collected before and after the 3-hour exercise, respectively.

<sup>a</sup>The level of salivary cortisol or urinary 17-ketosteroid before the exercise was regarded as 100%.

<sup>b</sup>A sufficient salivary sample was not collected from B after the 3-hour exercise.

<sup>c</sup>A urinary sample was not collected from B after the 3-hour exercise.

#### 4 Discussion

The control center for cortisol secretion is located in the hypothalamus, which is easily affected by the excessive stress. In other words, cortisol is widely known as the "stress hormone" because it is secreted in excessive amounts when people are under excessive stressful conditions.

In this research, we studied the fluctuation of salivary cortisol and urinary 17-ketosteroid of the table tennis players during exercise. There was no increase in cortisol levels and no decrease in 17-ketosteroid levels in anyone's sample after the 3-hour table tennis exercise (Figure 1, 3, Table 1). This means that no one suffered from excessive stress during that time. We also found that most of the intellectually disabled players were mentally relaxed without feeling excessive stress, even though they were physically tired. Most of the players were considered to be relaxed and enjoyed the table tennis very much. Table tennis is an excellent sport for people with intellectual disability.

Appropriate sports and leisure activities seemed to lower the salivary cortisol concentrations and to increase the urinary 17-ketosteroid ones (Table 1). There was significant negative correlation between the levels of cortisol and 17-ketosteroid. This important finding indicates that the measurements of both salivary cortisol and urinary 17-ketosteroid are applicable for stress assessment.

Participation in sports and recreation activities is the right of every individual, and is an integral part of leading a meaningful, balanced life. Sporting activity is considered important for many individuals with disabilities to be released from everyday tensions.

However, in the second day two players had very high levels of cortisol after the 8-hour exercise (Figure 4); they seemed to suffer from the excessive stress. In the case of E, when an intimate person visited to encourage the player with intellectual disability and made a comment that was unreasonable, giving a big burden to E, his cortisol level increased sharply (Figure 4E). Finally he complained of various physical conditions. Appropriate communication was necessary for him to play and enjoy his sporting life.

In the case of G, he could not convey that he had been in bad physical condition. An unavoidable communication gap was considered to cause the elevation of cortisol level and the worse physical condition.

An appropriate, individual approach must be essential to coach a person with intellectual disability. The persons with disabilities have their own special difficulties to participate in their own social lives and they have their special needs to live their own lives. They must be supported to reduce their special difficulties including in their sporting lives.

It is a misleading idea that the persons with disabilities can not enjoy sports. Whenever environmental conditions and supporting systems are properly arranged, persons with disabilities can enjoy sports and recreation. Individuals with disabilities can access sport and recreational opportunities from which they have traditionally been excluded.

If people with disabilities can be successful in sports, then maybe they can be successful in other facets of life as well. The sporting normalization is expected

to lead to social normalization.

It may be inconvenient for the individuals to have disability, but this does not mean unhappy. By improvement of the individual volition and the environmental conditions, they can enjoy sports and recreational activity. Sports and recreational activities are very important for human "quality of life".

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