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RECENT ADVANCES IN DOPING ANALYSIS (5)

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Changes of Steroid Profiles in Male and Female Athletes

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1. Introduction

It is generally accepted that physiological ratio of testosterone to epitestosterone (T/E) is stable at the level of about 1,5 with a variation not exceeded 30% of the value (Donike et al. 1993). This finding has been confirmed by a population-based studies as well as by the individual subjects-based studies. In result of these basic investigations, the value of T/E ratio between 6 to 10, thus much above the physiological level, was accepted by the IOC Medical Commission to detect anabolic steroids in the sportsmen organism . From the legal point of view the situation is clear when the ratio is greater than 10, what classifies the case as a positive. However, it is possible that some athletes would use exogenous testosterone, or other manipulations of the endocrine system by various substances, to keep their T/E ratio at the level lower than 6. If such manipulation would be practised on a large scale by considerable number of athletes the " physiological " T/E ratio should be shifted towards greater values, but still legally accepted. A study was therefore performed to verify whether the increasing level of T/E ratio, being accepted as a discrimination values for positive cases and gradually changed during recent years by IOC Medical Commission, would have any impact on the steroids profile in the polish athletes.

Thus, the aim of the present work was to compare the distribution of T/E ratios in male and female athletes who were routinely tested, according to the anti-doping procedures, in the Department of Antidoping Research of the Institute of Sport in Warsaw. The data were analysed for the period from 1991 to 1996 year. Additionally, the ratio of androsterone to etiocholanolone (A/E) was checked in these subjects. The A/E ratio has been regarded as an important indicator of natural androgens metabolism. For the value of A/E close to 1.0 the

androgens metabolism is assumed to be within the physiological range. When A/E is lower than 0.5 it may indicate some changes in the androgens metabolism.

2. Material and Methods

The material for the study was collected from the annual reports of the Department of Antidoping Research of the Institute of Sport in Warsaw for the period of six years (1991-1996). Table 1. shows the number of samples including men and women. The positive cases (T/E >10.0) were excluded from the analysis.

Table 1: The number of negative samples in men and women during the period of 1991-1996.

YEAR	1991	1992	1993	1994	1995	1996
SAMPLES (n)	1053	969	1549	1012	1758	2014
COMPETITION (in %)	61,0	59,8	73	69,1	53,6	64,5
OUT OF COMPET.(in %)	39,0	40,2	27,0	30,9	46,4	35,5
MEN (n)	731	773	1132	717	1279	1505
WOMEN (n)	322	196	417	295	479	509
AGE OF MEN	22,7	23,4	22,5	22,4	21,4	21,4
AGE OF WOMEN	20,7	22,1	21,2	20,0	20,5	20,4
T/E IN MEN (n)	358	770	1129	717	1279	1505
T/E IN WOMEN (n)	172	196	417	295	479	509
A/E IN MEN (n)	731	773	1132	686	1279	1503
A/E IN WOMEN (n)	322	196	417	282	479	509

Among the analysed samples about 60% were taken during competition and about 40% during unannounced out of competition tests. The age of the athletes did not differ significantly between the years nor between the gender. Since T/E and A/E ratios were not always analysed in each sample the differences between the number of these ratios is also indicated in Table 1.

In the total number of samples the large contribution (over 50 samples per year) had the following sports federations: athletics, cycling, swimming, basketball, weight-lifting, boxing, body-building, canoeing, skating, wrestling, judo, football; handball, rowing and volleyball.

3. Results

Fig. 1 shows a normal distribution within a negative samples (T/E < 10.0) analysed in men. A clear tendency towards lower mean values of T/E can be observed during the last six years. The mean T/E value decreased from 2.10 in 1991 to 1.60 in 1996 year. The tendency become statistically significant and more pronounced beginning from the year 1995 (Fig. 2).

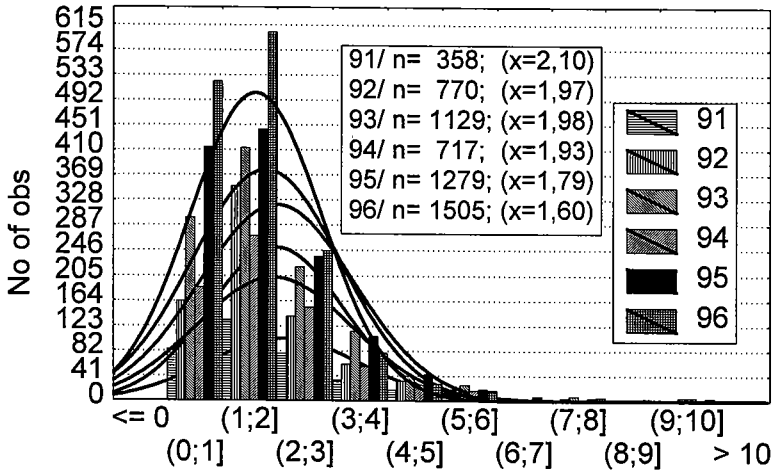

Fig. 1: Distribution of T/E ratio of negative samples in men.

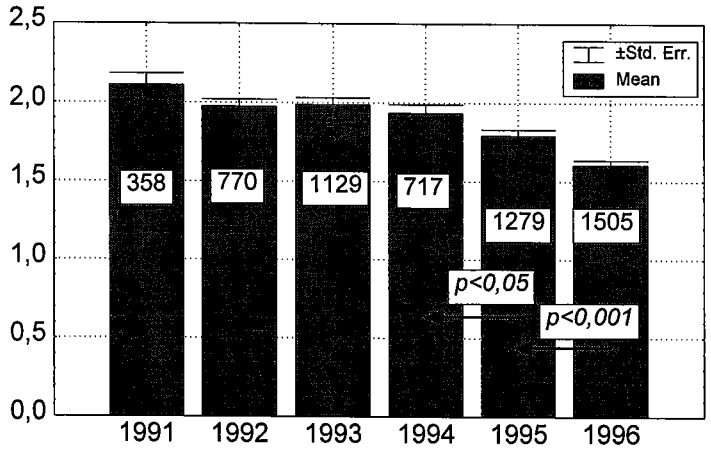

Fig. 2: The statistical significance of changes in mean T/E ratio in men.

A very unstable values of T/E ratio were observed in women (Fig. 3). In this case the ratio increased during the years 1991-1993 and, after reaching a maximum (1.96) in 1993, decreased up to the value of 0,88 in 1996. Fig. 4 indicates the statistically significant fluctuations in mean values of T/E ratio in women.

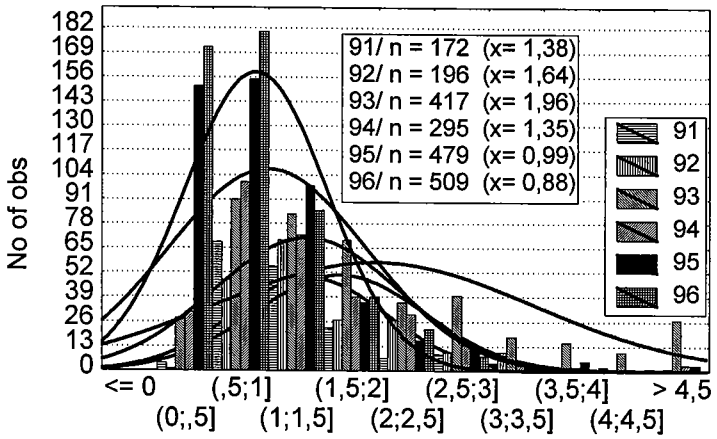

Fig. 3: Distribution of T/E ratio of negative samples in women.

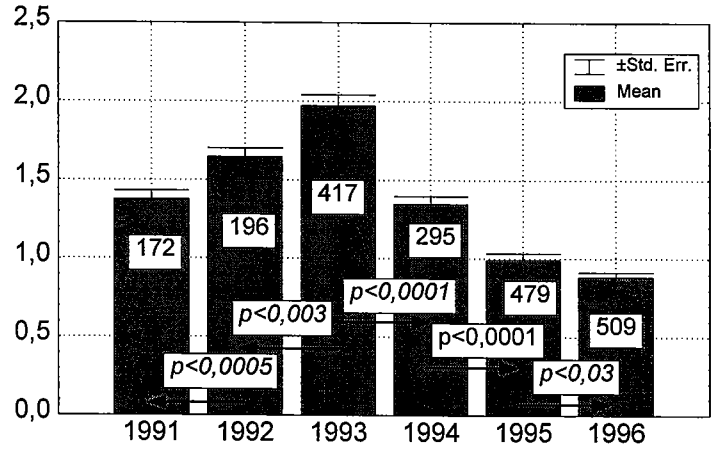

Fig. 4: Fluctuation of mean T/E ratio in women.

Fig. 5 presents a graph of A/E ratio in men. During the analysed period the values of A/E ratio increased in men from 1.06 to 1.43 , $p < 0.0002$ (Fig. 6).

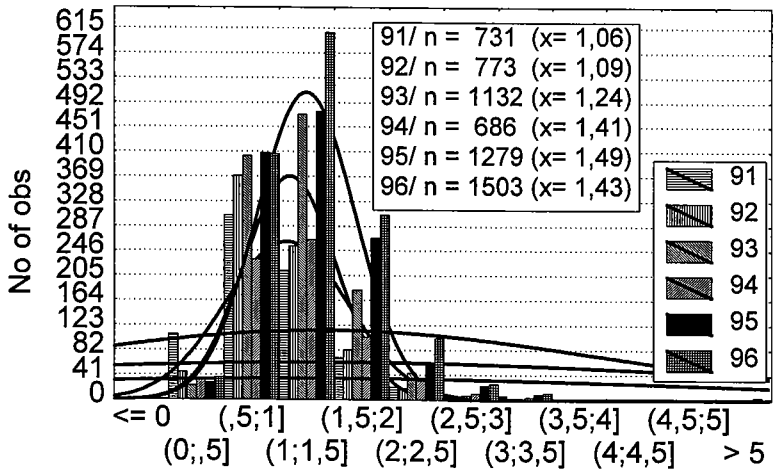

Fig. 5: Distribution of A/E ratio of negative samples in men.

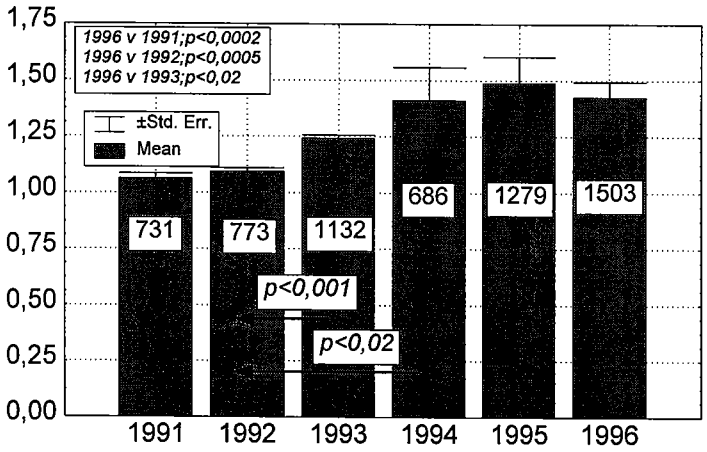

Fig. 6: The statistical significance of the increment of the mean A/E values in men.

Fig. 7 shows a distribution of A/E ratio in women. Similarly to men the mean values of A/E increased during the whole period from 0.93 in 1991 to 1.12 in 1996.

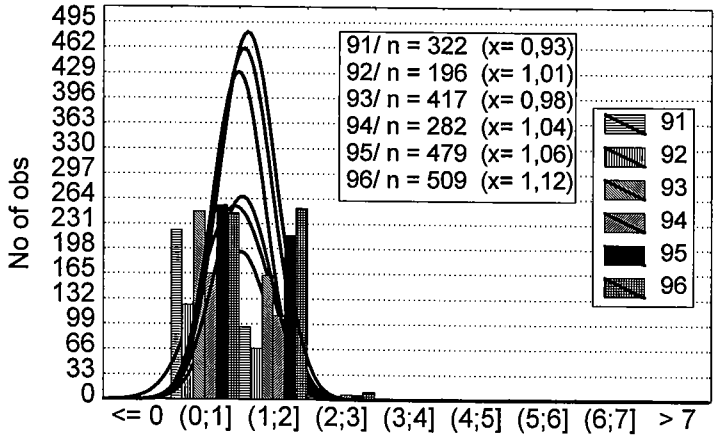

Fig. 7: Distribution of A/E ratio in women.

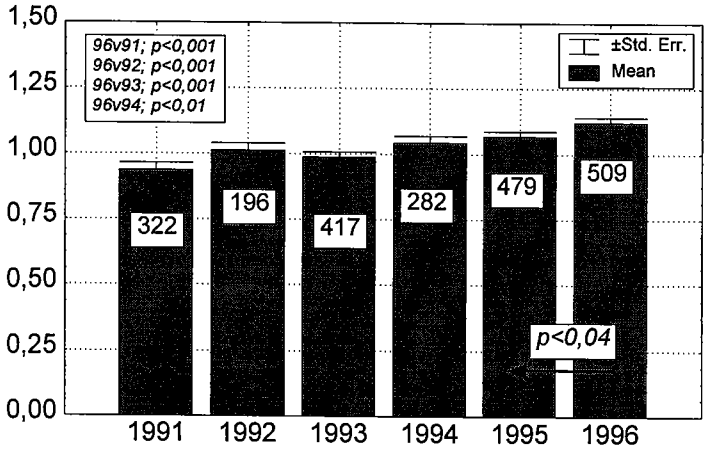

Fig. 8: Statistical significance of the fluctuations of the mean A/E values in women.

4. Discussion

Although it is generally accepted that T/E ratio of an individual is relatively stable at the level of about 1.5, it should be taken into account that many factors can modify the excretion of anabolic steroids to urine. Among them the age, sex, type and intensity of physical exercise, composition of every-day diet, race, physiological status of an individual, possible pathological changes in the organism and drug application would play a considerable role in the fluctuations of T/E and A/E values (Donike et al. 1993, de la Torre et al. 1996). Assuming, however, that these factors have not fundamental influence on steroid profile in professional sportsmen and that an individual value of T/E ratio has been stable for a long period, the T/E ratio was proposed to be a characteristic number describing anabolic-

androgenic status of an athlete (Donike 1993). The recent decision of IOC Medical Commission increasing T/E threshold for positive case seems to be more realistic by taking into account a significant individual differences of physiological levels of testosterone and epitestosterone as well as a possible fluctuations of these values in time.

The use of normal frequency distribution of T/E and A/E ratios in the present work was in agreement with the previous findings indicating that these ratios have a log-normal distribution with a median value around 1 and 1.5, respectively (de la Torre et al. 1996). On the other hand Catlin at. al. (1993) reported that T/E distribution is not gaussian . The authors presented also some evidence that T/E in males and females would be significantly different. Our results do not support these findings.

The present study do not allow to draw a definite conclusion. It can be speculate, however, that such factors as changes in nutrition habits related to the new economical situation in the country, influence of increased environmental pollution, greater total work volume performed during training as well as a tightening of doping control might partly explain the results. Perhaps an alternative method of detection of exogenous testosterone (by $^{13}C/^{12}C$ analysis with GC/C/IRMS) would give the possibility for deeper insight into mechanisms of fluctuations of T/E ratio in humans (Horning et al. 1997).

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