

## THE EFFECT OF PHYSICAL TRAINING ON BONE DEVELOPMENT OF JUDOISTS AND CYCLISTS

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*Abstract: Bone development (width of the epicondylus of femur and humerus) as well as other anthropometric parameters of judoists and cyclists at the age of 14 to 26 years were measured to determine the development of the muscular and the skeletal system of sports with different physical loads. The sample (n=79) was divided into 3 age groups.*

*According to the different physical load of the upper body the humoral width of judoists is significantly wider ( $p=0.2$ ) than the one of the cyclists within the age group number 3 (21 to 26 year old athletes). There was no significant difference for the younger age groups. BMI as well as the mesomorphy (Heath & Carter) show a significant difference for the age group number 2 (16 to 21 year old athletes) and 3.*

*Key words: Bone development; BMI. Mesomorphy; Judoists; Cyclists.*

### Introduction

The increase in the width of bones carries on for life. Continuously apposition and deposition are determined by the function of the bones. Appropriate to the forces of compression, rotation, shearing force and traction bones get their characteristics and shape. In the course of time the shape of bones changes to the actual optimum. This is reached when the bone has developed a structural and functional balance. The functional stimulation for the increase in width is given either by the physical load or by the traction of the active locomotor system.

Training represents a high load for muscles, tendons, ligaments and bones. The muscular system is highly adaptable to work load. A strong muscular system results in a high traction to the bones. The consequence is an increase in width.

### Subjects and Methods

The study was carried out with athletes of the Austrian national cadre (n=79, thereof 26 judoists and 53 cyclists) and young athletes from the Federal Sports Centre in Südstadt (n=13, thereof 7 judoists and 6 cyclists). At this centre talented young athletes are trained and coached. The athletes are omitted to the entrance examination at the age of 13 to 15 years and stay in the sports centre for 5 years at least. During this period the athletes are checked medically, motorically and anthropometrically in regular intervals. In this way the development of the athletes can be followed.

The purpose of the study was the examination if specific training has an influence on bone development, the extend of this influence and the age at which the development starts. According to the connection of muscular load and development of bones, it can be concluded that sports which include high forces show a more pronounced muscular and skeletal system than types of sport with low force elements. We tested judoists and cyclists.

Judo is characterized by high force, power endurance and muscular endurance elements, whereas cycling primarily requires a high level of endurance and muscular endurance. The weight of the cyclist is supported by the bike and the muscular load is concentrated to the lower extremities.

With respect to the different physical loads of judo and cycling, it can be asserted, that there is a difference in the development of the muscular and the skeletal system. The difference gains importance with the increase of specific training and it is marked stronger at the arms than at the legs.

If the stimulation of the skeletal system is too high during the adolescent period and there is not enough time for forming an adequate structure of bones, the skeletal system will not be able to sustain the load. The danger of bone damage becomes higher.

*Realisation of the study:* The study was carried out between 1992 and 1995. The following anthropometric parameters were measured: body weight, body height, diameter of the humeral condyles and diameter of the femoral condyles. For the mesomorphy after Heath/Carter the following parameters were determined: circumference of the upper arm, circumference of the calf and skinfolds at the triceps and the calf. The mesomorphy is part of the determination of the constitution at the body and represents the muscular and skeletal development.

## Results and Discussion

*Comparison of anthropometric parameter from judoists and cyclists belonging to the national team:*

In order to measure the influence of specific training to the development of the skeletal and muscular system the Austrian athletes were divided into three groups: G 1: 13.0 to 15.99 years (comprises 12 judoists and 22 cyclists); G 2: 16.0 to 20.99 years (comprises 8 judoists and 24 cyclists); G 3: 21.0 to 25.99 years (comprises 6 judoists and 7 cyclists).

Figure 1 shows the comparison of humeral and femoral diameter as well as the mesomorphy and the body-mass-index of judoists and cyclists of the three groups. It can be recognised that the average diameter of the humerus of judoists and cyclists in the first age group is the same. In both types of sport the diameter increases from one group to the next, but the diameter of the judoists increases more than that of the cyclists.

In the first age group the diameter of the femur of the cyclists is bigger than that of the judoists. Whereas the femoral width of the judoists is growing continually, that of the cyclists stagnates. In the last age group it is even thinner than it is in the second one. The reason of the stagnation in growth may be the early adaptation of the bones to the extensive amount of training of cyclists which has been performed in the early stages of the training process.

While judoists show a constant increase of the mesomorphy, the level of mesomorphy of the cyclists decreases a little bit from one age group to the next one. It can be supposed, that this fact is connected with the rather small number of athletes in this group as well as in general.

The first level of the body mass index is the same for both types of sport. The index increases from one age group to the other, but in judo the progress of the index is higher. That means that judoists are heavier per centimetre of their body height than cyclists.

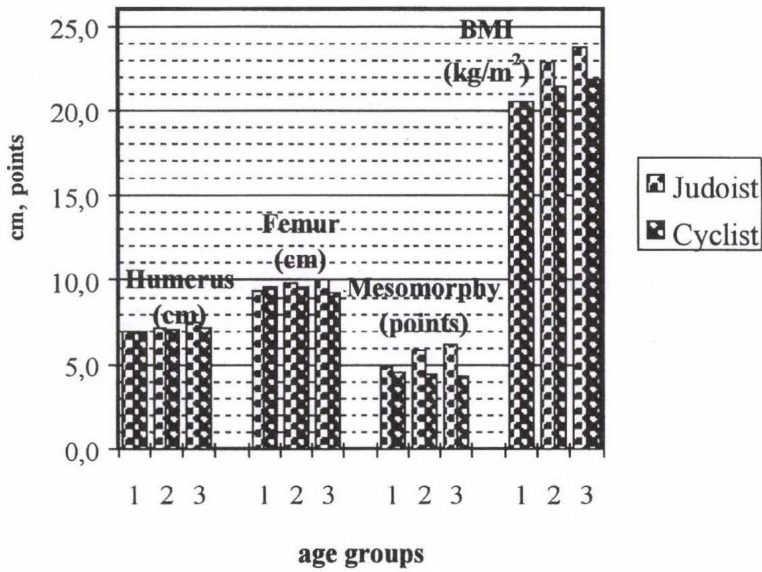


Fig. 1: Comparison of Humoral and Femoral Width, Mesomorphy and Body-Mass-Index of Judoists and Cyclists

The statistical test of the anthropometric parameters was carried out by a T-test for unpaired, random samples (Table 1). In the age group of the 13 to 16 year old athletes none of the parameters differs significantly. In the group of the 16 to 21 year old athletes the difference of the mesomorphy is highly significant ( $p=.00$ ). That means that the judoists have a clearly better developed skeletal and muscular system. The comparison of the third age groups shows a high significant difference of the mesomorphy ( $p=.00$ ) as well as a significant difference of the humoral diameter ( $p=.02$ ) and the body mass index ( $p=.01$ ). Judoists have a wider humerus condylus and they are heavier in relation to their height as their cycling colleagues.

Table 1: Results of the T-test for unpaired random samples of different anthropometric parameters.

Age group	Sport	Weight (kg)	Height (cm)	BMI (kg/m <sup>2</sup> )	Hum.width (cm)	Fem.width (cm)	Meso-morphy
1	Judo	59.4	169.3	20.6	6.9	9.4	4.8
	Cycling	60.5	171.2	20.6	6.9	9.6	4.5
<i>p</i>		.89	.42	.44	.52	.95	.06
2	Judo	69.4	173.9	22.9	7.2	9.8	5.8
	Cycling	67.8	178.1	21.4	7.1	9.6	4.4
<i>p</i>		.50	.06	.02	.16	.49	.00
3	Judo	75.7	178.2	23.8	7.5	10.0	6.2
	Cycling	70.4	179.2	21.9	7.2	9.4	4.3
<i>p</i>		.12	.67	.01	.02	.19	.00

### *Conclusion:*

With respect to the higher part of force in judo the mesomorphy is more developed in comparison with cycling.

According to the different physical load of the upper body, the humeral width of judoists is better developed than the one of the cyclists. The difference of the lower body between judoists and cyclists is less than that of the upper one.

The differences between judoists and cyclists becomes more evident with the increase of the specific training. This fact can be seen especially at the mesomorphy.

### *Comparison of the development of young judoists and cyclists:*

The first assessment of the anthropometric parameters shows that weight and height as well as humeral and femoral diameter of judoists and cyclists have nearly the same extension. The difference of mesomorphy is 0.3 points but is not significant.

After 1.6 years the judoist have been tested again after 1.8 years the cyclists. During this period the increase of the femur was equal for both types of sport. The diameter of the humerus of judoists grew 0.3 cm that of cyclists 0.2 cm. The augmentation of the mesomorphy of judoists is 0.7, that of cyclists 0.3. It can be supposed that the differentiation of bone development will occur at a later period.

The difference between the mesomorphy of judoists and cyclists increased since the first study and is now 0.8 points. There is no significant difference neither for the mesomorphy nor for other parameters.

### *Conclusion of the athletes from the federal sports institute:*

The skeletal system of both types of sport is equal at the entrance examination as well as at the second study. According to the general training at the federal sport centre the bone development of judoists and cyclists is proceeds parallel.

A remarkable - but not significant difference - can be seen for the muscular growth. The muscular development is in advance of the skeletal growth. It can be admitted that this process occurs at the selected age groups and that the augmented development of the skeletal system will happen in the following years. Changes will be examined at further investigations.

Although the skeletal development lags timely behind (that means a higher risk for overload bone damage) no overload damage is known at the Federal Sport Institut. The training load complies with the morphological development of the athletes.

### *Notes:*

The author is aware of the fact that the number of measured athletes is too small to do a statistically well founded declaration. Therefore a bigger sample as well as a longitudinal study would be necessary. In that sense this study could be noted as a first approach to the problem. A continuation of the study is planned.

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