






Injuries and somatic build of athletes practising competitive judo

Authors' Contribution:

-  **A** Study Design
-  **B** Data Collection
-  **C** Statistical Analysis
-  **D** Manuscript Preparation
-  **E** Funds Collection

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Abstract

Background and Study Aim:

Combat sports are characterised by a high dynamics of activities. One of the unwanted elements of the training process are injuries. The aim of this study was the knowledge about the body type of persons practising judo in accordance with Wanke's typology and to specify injuries that are characteristic of individual body types of athletes.

Material and Methods:

The study was conducted on a group of men being members of the Junior Polish National Team. They included 29 athletes aged 17-19 years, representing various weight categories at judo competitions. The minimum experience of the subjects was 5 years. Another qualifying criterion was a medal at the Polish Junior, Youth or Senior Championships. Anthropometric measurements were carried out for the purpose of determining the somatic build. In the course of research a typical set of anthropometric instruments was used and Martin's measuring technique was applied. The athletes examined were classified into particular somatic types using Wanke's typology.

Results:

Judo athletes in the 90-100 kg category were characterised by high values of pelvic width and chest depth. Athletes in the 81-90 kg category were characterised by wide shoulders. In the group examined there was a high percentage of knee, finger and toe injuries.

Conclusions:

With regard to somatotypes a general tendency was observed, consisting in the body type becoming stronger, as the weight categories go up, i.e. an increase in the "H" component and a definite decrease in the "I" component. The most frequent injuries suffered by the athletes examined were injuries of the knee, spine, fingers and toes, regardless of their body type. It may be concluded that it is the nature of sport combat that generates the prevalence of given injuries in judo.

Key words:

anthropometric • Martin's measuring technique • performance • Wanke's typology • weight category

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Technique – *noun* a way of performing an action [35].

Performance – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [35].

Physical activity – *noun* exercise and general movement that a person carries out as part of their day [35].

Periodisation – *noun* the act of planning a long-term training schedule for professional athletes, working around competitions [35].

INTRODUCTION

Combat sports are characterised by a high dynamics of activities. Judo is a sport discipline in which a high level of physical fitness creates opportunities for high-level performance. It is a discipline based on a large variety of movements, making use of exercises from many sport disciplines, such as rowing, swimming, cross-country skiing, walk-runs, etc. [1]. This large variety of movements that are used to exert an impact on a body in training makes it possible to classify judo as a whole-body training discipline.

In addition to the development of general fitness, coordination and technical potential, the importance of the ability to fall in a safe manner in various situations is also pointed out [2]. As the level of an athlete's performance progresses, more and more difficult tasks are assigned to him or her. Depending on the training period (periodisation), this involves changes in the training time or intensity. Efforts are made to make use of all possible reserves possessed by athletes. Such high demands placed on athletes may give rise to unwanted elements of the training process, i.e. injuries. This happens during periods of the most intense training [3]. Injuries may be a consequence of many different factors at work. Among these, authors who study this phenomenon mention resuming one's training too soon after an injury, badly executed warm-ups, bad work-rest proportions, etc. [4]. The literature available also points to the areas in which the injury is located [5]. The authors of this study have taken up the topic of the relationships that may exist between body types and injuries occurring in judo.

The aim of this study was the knowledge about the body type of persons practising judo in accordance with Wanke's typology and to specify injuries that are characteristic of individual body types of athletes.

MATERIAL AND METHODS

The study was conducted on a group of men being members of the Junior National Team of the Polish Judo Association. They included 29 athletes aged 17-19 years, representing various weight categories at judo competitions (Table 1). One of the selection criteria was the subject's experience – a minimum of 5 years. Another qualifying criterion was a medal at the Polish Junior, Youth or Senior Championships.

Table 1. Number of athletes in individual weight categories.

Weight category		Number of persons
from to (kg)	in Tables	
–66	66 kg	7
+66 –73	73 kg	8
+73 –81	81 kg	8
+81 –90	90 kg	4
+90 –100	100 kg	2
Total		29

Anthropometric measurements were carried out for the purpose of determining the somatic build. In the course of research a typical set of anthropometric instruments was used and Martin's measuring technique was applied [6]. The values of 8 somatic features were measured, which enabled the calculation of the anthropometric indicators necessary to characterise body types, as the absolute values alone obtained by means of anthropological measurements do not make it possible to evaluate shapes or proportions. The features examined, necessary for calculating the indicators, were supplemented by the reach of the upper limbs. The authors set out to determine the value of this indicator in the group examined (see Table 2).

In order to determine the somatic types of individual athletes, Wanke's typology was used [7-10]. This typology removes the subjectivity of a typologist by relying on specific calculations that make use of the following five indicators: torso, shoulders, pelvis, chest and Rohrer's Index. On their basis four body types may be distinguished, named after letters of the alphabet: "I", "A", "V" and "H". The use of these letters is not accidental, as they show similarity to a given type. Type "I" is characterised by a weak build, a long torso, narrow shoulders, a medium wide pelvis, a flat chest and a low weight in relation to the height. Type "A" has a long torso, narrow shoulders, a wide pelvis, a barrel chest and a medium body weight in relation to the height. Type "V" is characterised by a short torso, wide shoulders, a narrow pelvis, a flat chest and a high body weight in relation to the height. Type "H" is defined by a short trunk, wide shoulders, a wide pelvis, a barrel chest and a medium body weight in relation to the height.

Table 2. Somatic features measured and their symbols together with units of measurement [6].

Feature examined	Anthropometric indicators symbol	Unit of measurement
Body mass	c	kg
Body height	B-v	cm
Torso length	sst-sy	cm
Reach of upper limbs	dalll-dalll	cm
Shoulder width	a-a	cm
Hip width	ic-ic	cm
Chest width	thl-thl	cm
Chest depth	xi-ths	cm

Since individuals with a 100% match of particular features are rare, the author of this typology considers a person who has 68% or more of one of the above-mentioned elements as a pure type. In the absence of such prevalence, he or she is a mixture of two types, e.g. "IV", "VI", "AV", "HA", etc. Information on sport injuries was obtained on the basis of a questionnaire and by asking the subjects directly. All the athletes agreed to be examined.

Statistical analysis

The results obtained from the measurement of somatic features and the results of an analysis of anthropometric indicators were subjected to basic statistical calculations. Individual athletes' characteristics were normalised into the common mean and standard deviation (SD) for both the whole material and individual weight categories [11].

RESULTS

The higher the weight category, the higher the value of all the absolute features (except for the torso length), which is an obvious phenomenon. When analysing the values of absolute features in individual weight categories, one should omit the body weight and height, which, due to the differences resulting from weight categories, will differ significantly. As regards the other features, the largest value discrepancies were recorded for the reach of the upper limbs and the smallest ones for the chest depth and shoulder width (Table 3).

The largest deviation from the mean is exhibited by the features of lower and high category athletes, while the smallest deviation from the mean is exhibited by those of medium category athletes. Athletes representing the 73-81 kg category have the most average profile with respect to all the features. Athletes in the 90-100 kg category are

Table 3. Mean values and SD of absolute features for the whole group examined and individual weight categories.

Feature	All judo athletes (n = 29)		Weight category				
	Mean	SD	66 kg (n = 7)	73 kg (n = 8)	81 kg (n = 8)	90 kg (n = 4)	100 kg (n = 2)
c (kg)	74.31	8.86	63.43	69.75	77.50	84.75	97.00
B-v (cm)	1,709.83	59.97	1,678.58	1,693.75	1,703.12	1,742.50	1,845.00
sst-sy (cm)	503.10	17.88	503.57	493.12	505.62	516.25	505.00
dalll-1dalll (cm)	1,747.59	78.99	1,697.86	1,728.75	1,747.50	1,768.25	1,920.00
a-a (cm)	377.76	14.89	362.86	377.50	382.50	393.75	380.00
ic-ic (cm)	265.86	18.90	254.28	269.37	258.75	277.50	297.50
thl-thl (cm)	289.48	22.83	266.43	288.12	301.25	311.25	285.00
xi-ths	205.00	16.19	188.57	196.25	213.75	223.75	225.00

Table 4. Mean values of absolute features in individual weight categories of judo athletes expressed in the standard deviation for the whole group (n =29).

Feature	Weight category				
	66 kg (n = 7)	73 kg (n = 8)	81 kg (n = 8)	90 kg (n = 4)	100 kg (n = 2)
c	-1.22	-0.51	0.36	1.17	2.56
B-v	-0.52	-0.26	-0.11	0.54	2.25
sst-sy	-0.02	-0.55	0.14	0.73	0.10
dalll-dalll	-0.62	-0.23	0	0.48	2.18
a-a	-1.00	-0.01	0.31	1.07	0.15
ic-ic	-0.61	-0.18	0.37	0.61	1.67
thl-thl	-1.00	-0.05	0.51	0.95	-0.19
xi-ths	-1.01	-0.54	0.54	1.15	1.23

characterised by a large value of pelvic width and chest depth, those in the 81-90 kg category – by a large value of shoulder width, and those in the category of up to 66 kg – by a low value of shoulder width. As regards the length features, athletes in the 90-100 kg category exhibit higher values than those from the other weight categories (Table 4).

Regardless of the weight category, judokas are characterised by: a short torso, medium wide shoulders, a narrow pelvis, a moderately arched chest, a Rohrer's Index indicating a very strong build and long upper limbs in relation to the torso length. The differences in proportions are small in individual weight categories. Athletes in the category of up to 66 kg are characterised by a medium long torso, medium wide shoulders, a narrow pelvis and a moderately arched chest. They represent an athletic type with a long reach of the upper limbs. Athletes in the category of up to 73 kg are characterised by

a short torso, shoulder values close to wide, pelvic values close to medium wide and a flat chest. They represent an athletic type with a long reach of the upper limbs. Athletes weighing up to 81 kg have: a medium long torso, medium wide shoulders and a narrow pelvis. They represent a type with a very strong build and long arms. Athletes weighing up to 90 kg have a medium long torso, shoulder values close to wide, a narrow pelvis and a moderately arched chest. They represent a type with a strong build and long arms. Athletes weighing up to 100 kg are characterised by a short trunk, medium wide shoulders and an arched chest. They represent a type with a strong build and long arms. One may notice quite clear tendencies consisting in the torso becoming relatively shorter and the reach of the upper limbs becoming relatively larger as the weight category goes up. Such tendencies are not clearly visible in the other proportions analysed (Table 5).

Table 5. Mean values of indicators for all weight categories of the group examined.

Indicator	All judo athletes (n = 29)		Weight category				
	Mean	SD	66 kg (n = 7)	73 kg (n = 8)	81 kg (n = 8)	90 kg (n = 4)	100 kg (n = 2)
Torso	29.44	1.21	30.01	29.13	29.69	29.62	27.37
Shoulders	75.17	3.98	72.13	76.59	75.80	76.35	75.31
Pelvis	70.42	4.90	70.21	71.34	67.70	70.44	78.28
Chest	70.84	5.86	71.32	68.25	71.10	70.59	78.94
Rohrer's Index	1.48	0.15	1.34	1.44	1.56	1.59	1.55
Reach of upper limbs	102.33	2.78	101.14	102.53	102.54	102.54	104.04

The largest variation is exhibited by the values of the chest and pelvis indicators and the smallest one – by the torso and Rohrer's Index values. Athletes in the 73-, 81- and 90 kg categories are closest to the mean values of these proportions. Athletes in the weight category of up to 66 kg are slightly more diverse, being characterised by the longest torso, the narrowest shoulders, a low Rohrer's Index and a low reach of the upper limbs. Those in the 100 kg category have the overwhelmingly shortest torso, the widest pelvis, the most arched chest and the longest reach of the upper limbs. The majority of the judokas in the group examined (58.6%) were athletes with somatotypes characterised by a prevalence of the "VI", "V" and "IV" components (calculated according to Wanke's typology). The rest of the subjects (41.4%) exhibit a prevalence of the "A", "H" and "I" components (Table 6).

The overall somatotype of athletes in individual weight categories clearly shifts from the "weakest" build in lightweight categories to the "very

strong" build in heavyweight categories. It is evident from the percentage data that the amount of the "I" component in the overall somatotype of the athletes gradually decreases beginning from the lightest category to the heaviest one, where its value is 7.23%. The opposite is true for the percentage share of the "H" component. One can observe its increase depending on the weight category. In the somatotype of the lightest weight category its value is 10.75% and in the heaviest weight category 70.44%. One may see here a general tendency for the body build of athletes practising competitive judo to become stronger as the weight category goes up (Table 7).

There is a high percentage of knee, hand, toe and spine injuries in the group examined of judo athletes, which is due to the specific nature of the discipline – elements of the technique, such as grappling, throwing or holding, which are a considerable burden on the above-mentioned joints (Table 8).

Table 6. Mean values of indicators for all weight categories expressed in the standard deviation after their normalisation to the common x and s.

Indicator	Weight category				
	66 kg (n = 7)	73 kg (n = 8)	81 kg (n = 8)	90 kg (n = 4)	100 kg (n = 2)
Torso	0.47	-0.25	0.20	0.14	-1.70
Shoulders	-0.76	0.35	0.15	0.18	0.03
Pelvis	-0.04	0.18	-0.15	0.00	1.60
Chest	0.48	-0.44	0.04	-0.04	1.38
Rohrer's Index	-0.93	0.26	0.53	0.73	0.46
Reach of upper limbs	-0.42	0.07	0.10	0.21	0.61

Table 7. Percentage share of individual components and overall somatotypes for weight categories.

Weight category	Component of somatotype (%)				Dominant somatotype
	"I"	"A"	"V"	"H"	
66 kg (n = 7)	35.09	14.74	34.40	10.75	"IV"
73 kg (n = 8)	25.30	10.10	48.38	16.20	"VI"
81 kg (n = 8)	24.50	19.46	38.85	17.16	"VI"
90 kg (n = 4)	24.01	13.40	31.32	31.24	"VH"
100 kg (n = 2)	7.23	16.59	5.72	70.44	"H"

Table 8. Individual body parts injured for the entire group examined.

Body parts	Number of injuries	Group examined (%)
Knee (pain)	12	41.4
Knee (injury)	7	24.1
Fingers	11	37.9
Spine	11	37.9
Ankle	6	20.7
Toes	6	20.7
Shoulder	4	13.8
Hip	3	10.3
Clavicle	2	6.9
Elbow	2	6.9
Metacarpus	2	6.9
Wrist	2	6.9
Forearm	1	3.4

In the group of athletes with the characterised by somatotypes “V”, “VI” and “IV” there is a prevalence of ailments related to the knee, spine and fingers (Table 9).

The results of the other somatotypes are specified in Table 10. It shows the percentage of injuries and ailments related to individual body parts

Table 9. Frequency of occurrence of injuries related to individual body parts of athletes with somatotypes “V”, “VI” and “IV”.

Body parts	Number of injuries	Frequency of occurrence (%)
Spine (pain)	8	47.05
Knee (pain)	7	41.17
Knee (injury)	2	11.76
Fingers	6	32.29
Ankle	3	17.64
Hip	2	11.76
Toes	2	11.76
Wrist	2	11.76
Clavicle	1	5.88
Elbow	1	5.88
Metacarpus	1	5.88
Forearm	0	0
Shoulder	0	0

for athletes characterised by a conglomerate of the “I”, “A” and “H” components. There is a prevalence of ailments associated with the knee, spine, fingers, ankle and toes in this group (Table 10).

Table 10. Frequency of occurrence of injuries related to individual body parts of athletes with somatotypes “I”, “A” and “H”.

Body parts	Number of injuries	Frequency of occurrence (%)
Fingers	5	41.60
Knee (injury)	5	41.60
Knee (pain)	5	41.60
Shoulder	4	33.30
Toes	4	33.30
Ankle	3	25.00
Spine (pain)	3	25.00
Clavicle	1	8.33
Elbow	1	8.30
Forearm	1	8.30
Hip	1	8.30
Metacarpus	1	8.30
Wrist	0	0

DISCUSSION

Authors of numerous publications have addressed issues related to the somatic build of athletes practising various sport disciplines, including judo. In their research they made use of various typologies [12]. The original and unique Perkal’s method was used by Jagiełto et al. [13, 14] in the combat sports athletes in the study. The same has been done with respect to injuries [3-5]. The present study demonstrates that athletes from the lightest and the heaviest categories present a fairly diverse picture, especially with regard to length features and chest dimensions (in particular the chest depth). The most common body type is one with a prevalence of the “V” element. It occurs as a “clean” type or a “mixed” type with an addition of the “I” component. Another noteworthy aspect is the percentage share of the “H” component, which increases depending on the weight category. In the somatotype of the lightest weight category its value is 10.75%, while in the heaviest weight category it is 70.44%. One may see here a general tendency for the body build of athletes practising competitive judo to become stronger as the weight categories go up. A similar conclusion was presented in

a study by Ziemińska [15], while Burdukiewicz et al. [12] noticed, using a different typology, that the body type of athletes also changes as their experience progresses and corresponds to the meso-endomorph type. Injuries are an unwanted side of sport. They can often ruin an athlete's career or, in less drastic cases, make it difficult or even impossible for him or her to win a medal or perform at a desired level. It is, therefore, necessary to engage in continuous research aimed at analysing the phenomenon of injuries in sport. This is particularly important in the era of new emerging technologies, modernisation of training methods and the use of modern training equipment.

The results presented demonstrate that the specific nature of the discipline gives rise to particular injuries. These include knee, spine, finger and toe injuries. Knee injuries in this discipline are also pointed out by Rukasz and Sterkowicz [15-19]. Similar conclusions have been drawn by authors comparing various disciplines, including judo [20-34].

In this study we looked at the possibility of relationships between the body type and injuries. As shown by the results, a somatic build has no impact on the type of injuries suffered. An injury appears to be a consequence of the nature of judo and the involvement of particular body parts in training or combat. Due to the small size of groups examined, as a result of the restricted access to high-class athletes, it is not possible to formulate far-reaching conclusions. The results

obtained may, however, help coaches design the training process and cause them to pay attention to the safety of athletes.

CONCLUSIONS

The judokas examined, regardless of their weight category, are characterised by a short torso, medium wide shoulders, a narrow pelvis, a moderately arched chest and Rohrer's Index indicating a strong build. One may notice that, as the weight categories go up, the torso becomes relatively shorter and the reach of the upper limbs becomes relatively larger.

The most homogeneous group in terms of body proportions are athletes from the weight categories of 66-73 kg and 73-81 kg. The most common body type in the group examined is one with a prevalence of the "V" component – as a pure type or a mixed type with an addition of the "I" element.

With regard to somatotypes a general tendency was observed, consisting in the body type becoming stronger, as the weight categories go up, i.e. an increase in the "H" component and a definite decrease in the "I" component. The most frequent injuries suffered by the athletes examined were injuries of the knee, spine, fingers and toes, regardless of their body type. It may be concluded that it is the nature of sport combat that generates the prevalence of given injuries in judo.

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