Progress in Nutrition 2020; Vol. 22, Supplement 1: 206-216 DOI: 10.23751/pn.v22i1-S.9858

Original article

Cerebral laterality and body composition in judo athletes

Tevfik Cem Akalin
School of Physical Education and Sports, Bülent Ecevit University, Zonguldak, Turkey - E-mail: tc.akalin@hotmail.com

Abstract. *Study Objectives:* In this study, it was aimed to determine cerebral lateralization and functional asymmetry of the brain not only by adhering to hand preference, but also with the relation of the foot, eye, ear preferences, and somatotype. *Methods:* The sample was composed of 120 athletes (79 males and 41 females) who had participated in the Turkish Judo Championship. Their mean age and training experiences were 21.05 years (range 18–26) and 9.61 years (range 3-18) respectively. Hand preference was assessed using the Edinburgh Handedness Inventory. Some questions were asked to the subjects in the questionnaires in order to evaluate the range of preferences about a foot, eye, and ear. The hand grip strength measurements were made via the Jamar hydraulic hand dynamometer. Total body fat percentage was estimated by single-frequency, 8 electrodes bioelectric impedance analyzer system (BC-418, Tanita Corp, Tokyo, Japan). The components of somatotype were calculated according to the Heath-Carter technique. Data were collected, to SPSS program and Independent Samples T-test and Chi-Square test was used for the analysis of the obtained data. Analysis results were evaluated in the %95 confidence interval. *Results:* When the distribution of hand preference of the subjects (n = 120) was considered, 87.5% (n = 105) of the subjects preferred the right hand and 12.5% (n = 15) of the subjects preferred the left hand. Somatotype features of judo athletes were determined as the generally mesomorph. *Conclusion:* The results show that there was a difference between the dominant hand and the preferred foot, eye, and ear, and it is predicted that it can be reliable in all four preferences in determining the cerebral hemispheres. Despite that, according to the dominant hand preferences in judokas, there were no difference between BMI, body fat percentages, and somatotype features.

Key words: Cerebral laterality, Body composition, Hand preference, Somatotype, Grip Strength

Introduction

Judo is a sport with high-intensity actions and judo athletes' (judoka) performance may be determined by several physical abilities, in which muscle strength in upper and lower limbs is of major importance (1). Upper limb strength is an important aspect considered in judo performance, mainly during grip combat (Kumi-kata) to attack, defend, and maintain balance (2). During the fight, judokas spend a considerable amount of time grasping the Judogi of the adversary (using the Kumi-kata). The Kumi-kata is the first contact between two athletes in the fight and provides the basic support for the execution of other techniques. Therefore, the ability of maintain the grip force for long periods of time might be an important aspect of this technique (3).

During judo combat, strength and muscle power have been related to performance and judo throw efficiency (1). Considering the importance of bilaterally in judo, these strength factors should be equally exhibited by both sides of the body (4). Therefore, athletes with bilateral dominance and a high level of muscular strength and skills ought to have a tactical advantage over their opponents and increase their chances of success (5). The hand is a complex anatomical system comprising 27 bones and 15 joints with approximately 308 of rotational and translational freedom designed to grasp and apply force to objects of all shapes and sizes and to perform a combination of intricate finely controlled movements (6).

In hand-to-hand combat sports, such as wrestling, judo, jiu-jitsu, and mixed martial arts, maximum handgrip strength (HGS) is important when pushing, pulling, throwing, and controlling your opponent. Possessing a high level of HGS endurance is also believed to be important, if, and when the match/fight progresses into the later rounds (7-9). Therefore, it is recommended to include measures of maximum HGS and HGS endurance in the physical assessment battery of hand-to-hand combat sports (10).

The lateralization of brain and behavior in both humans and non-human animals is a topic that has fascinated neuroscientists since its initial discovery in the mid of the nineteenth century (11,12). The concept of handedness is a specific term, and typically refers to the hand preferentially used for a simple or complex motoric activity (13,14). Roughly 90% of people have a preference for using the right hand for complex manual tasks (15,16). A minority of roughly 10% prefer to use the left hand, and a smaller group of roughly 1% has no clear preference, the so-called 'ambidextrous' people (17).

Cerebral lateralization is defined as the morphological and functional differences between two brain hemispheres (18). Cerebral laterality is defined as anatomical and functional differentiation between the right and left hemispheres of the brain. Examination of hand, foot, eye, and ear preferences is important for the evaluation of this anatomical and functional differentiation (19,20). Control of mixed and successive movements and the control of left hemisphere and holistic-spatial functions, right hemisphere are lateralized for humans (21). Left brain hemisphere audits the right part of the body, right brain hemisphere, the left part of the body (22). Brain hemispheres provide left-right symmetry of the body (23). Although the left and right human cerebral hemispheres differ both functionally and anatomically, little is known about the environmental or genetic factors that govern central nervous system asymmetry. Nevertheless, cerebral asymmetry is strongly correlated with handedness, and handedness does have a significant genetic component (24). Handedness is the most obvious manifestation of hemispheric asymmetries (25).

Laterality in sports is typically determined by validated and verified tests or self-reported use of hand, foot, eye, ear preference and/or surveys, such as the Edinburgh Handedness Inventory. (26), for manual dexterity and bimanual coordination, etc. Research on the regional anatomy of the human cerebellum has revealed topographically defined functional distinctions and asymmetries (27). Traditionally considered a component of the motor system (28), emerging evidence links functions of individual cerebellar lobules to higher-order cognitive functions (29), such as language (30,31), visuospatial attention (32), working memory (33,34) and performance monitoring (35).

Unfortunately, in the current literature, there is little research on comparing variables between hand dominance in judo athletes. Besides body laterality, another relationship of interest is the one between muscle strength and body composition (5). In this regard, a positive correlation has been reported between these two variables (36), e.g. muscle strength increases according to the heavier category.

Successful competition in sports has been associated with specific anthropometric characteristics, body composition, and somatotype (37,38). Understanding and quantifying human body composition has formed a central part of medical research for the best part of a century (39). Because body composition is an important health and performance variable. The measurement of body composition occurs in many areas of biology and medicine when the outcome is a better understanding of nutrition and growth status assessment in disease states and their treatment in populations (40). Body mass index (BMI) is the cornerstone of the current classification system for obesity and its advantages are widely exploited across disciplines ranging from international surveillance to individual patient assessment. However, like all anthropometric measurements, it is only a surrogate measure of body fatness (41).

A better understanding of the integrative role of the central nervous system in energy homeostasis becomes increasingly important as the prevalence of obesity and obesity-related diseases are rising worldwide (42,43). From experimental studies in animals, it has long been established that certain brain areas are critical for the regulation of caloric intake, notably the prefrontal cortex, the limbic and paralimbic regions, the hypothalamus, and the brain stem. To unravel the neuroanatomical correlates of eating behavior in humans, two different neuroimaging techniques are increasingly explored (44).

As obesity is a complicated issue, differences in brain function is likely to be important (45). The anatomical asymmetries of the human brain have been documented for over a century and are still widely investigated for their functional, physiological, and behavioral implications (46). However, similarly, in the case of hand dominance, there are no reports investigating this relationship with other strength parameters such as explosive force and muscular endurance in the upper and lower extremities (47).

In this context, the aim of this study was to determine whether there was a difference between the hand grip strength, body fat percentage, and somatotypes and dominant hand preferences of male and female judokas and to determine whether there was a difference between the dominant hand preferences and foot, eye and ear preferences determined.

Material and method

Participants

The sample was composed of 120 athletes (79 males and 41 females) who had participated in the Turkish Judo Championship. Their mean age and training experiences were 21.05 years (range 18–26) and 9.61 years (range 3-18) respectively. All athletes were instructed to maintain a normal diet prior to the day of the test. The participants were informed about the purposes and methods of the study before signing a consent form. The participants were informed that they would be free to withdraw from the study at any time.

Hand, foot, eye and ear preferences measurements

Hand preference was assessed using the Edinburgh Handedness Inventory, and the Geschwind Scores (20) were calculated. The participants were asked 10 questions regarding their hand preferences for writing, drawing, throwing, using various implements like scissors, toothbrush, a knife without fork, spoon, striking matches, and jar opening. They were asked to put "+" in the column associated with the hand they used to carry out the activity. They were asked to put "++" in the associated column if their preference for one hand was very strong, and to put a "+" in both columns if they were using both hands equally. A "++" in the right column was assigned 10 points, a "+" in the right column 5 points, whereas a "++" in the left column −10 points and a "+" in the left column −5 points. The sum of these points was used to determine the Geschwind Score (GS), as an indicator of the direction and degree of hand preference. Hand preference was evaluated in 5 groups depending on the value of GS, consistent right-handers: $+80 < GS < +100$, weak right-handers: $+20 < GS < +75$, ambidexterity: $-15 < GS < +15$, weak left-handers: $-75 < GS < -20$, and strong left-handers: $-100 < GS < -80$ (20.47).

Foot preference was assessed by three items (kicking a ball, picking up a pebble, stepping onto a chair), eye preference was assessed by three items (looking through a keyhole, looking into a bottle, and looking through a telescope), and ear preference was also assessed by three items (listening at a door, listening to a heartbeat, and using an earphone). Items were scored on a three-point scale of left, mixed, and right, scored as -1, 0 and +1 (48).

Hand grip strength measurements

The hand grip strength measurements were made via the Jamar hydraulic hand dynamometer (Sammons Preston, USA). The dominant side was given priority. The measurement was made when a subject was in a sitting position while the forearm was in a 90 − degree flex (without support from the body). During the measurements, the wrist was regarded to be in a neutral position. The measurement was made in three successive replications and the mean value was used as data. Values were recorded in kilograms (49).

Anthropometric assessment and body composition measurements

Body height was measured using a digital stadiometer (SECA 213, Hamburg, Germany) and body weight were measured using a digital scale (SECA 813, Hamburg, Germany).

The three components of somatotype - endomorphy, mesomorphy, and ectomorphy were calculated according to the Heath-Carter technique (37). The measurements were taken during the peak of the competition season, just before the national competition. An anthropometric method was used for obtaining the judokas' somatotype. Anthropometry included 10 following variables: body height (in cm), body weight (in kg), four skinfolds (over triceps, subscapular, suprailiac, medial-calf; in mm), biceps girth (flexed 90° and tensed; in cm), standing calf girth (in cm), bicondylar humerus and femur breadth (in cm).

Total body fat percentage (BF %) was estimated by using a commercially available single-frequency, 8 electrodes bioelectric impedance analyzer system (BC-418, Tanita Corp, Tokyo, Japan). The reliability and validity of this system in measuring BF% has been previously verified in multiple ethnicities (50,51). All measurements were taken during morning hours (08:30–12:00) and the subjects didn't have any vigorous activity during the preceding 12 hours of the measurement.

Statistical analysis

Data were analyzed with the SPSS for Windows 21.0 packet program. Descriptive statistics were given as "mean ± standard deviation". Independent Samples t-test and Chi-Square test was used for the analysis of the obtained data. If the expected values in chi-square analysis were above 5%, Pearson Chi-Square values were used for p value and Fisher's Exact Test values were used if less than 5%. Analysis results were evaluated in the 95% confidence interval and the significance level was set at $p < .05$.

Results

With varying ages of subjects between 18 and 26 in the study, the athlete's mean ages, heights, and weights were identified as 21.05 ± 1.99, 171.13 ± 9.07, and 76.59 ± 19.46, respectively. Of the 120 judo athletes, 82 were identified to be at national athletes and 38 were licensed. The subjects were determined to play sports for 2.10 ± 0.51 hours in a day, 4.16 ± 2.08 days in a week, and 9.63 ± 3.55 years in their lifetime.

When the distribution of hand preference of the subjects (n = 120) was considered 87.5% (n = 105) of the subjects preferred the right hand, 12.5% (n = 15) of subjects preferred the left hand (Table 1).

When the distribution of foot preference of the judo athletes was analyzed, 79.2% were observed to prefer the right foot and 20.8% the left foot. Similarly, when the distribution of the eye preference of the subjects was analyzed, 80.8% were observed to prefer the right eye and 19.2% left eye. However, when the distribution of ear preference of the subjects was analyzed, 83.3% were observed to prefer the right ear and 16.7% the left ear (Table 2).

Table 2. Distribution of the dominant foot, eye and, ear preferences of the subjects.

Variables		n	%
Foot Preference	Right Foot	95	79.2
	Left Foot	25	20.8
Eye Preference	Right Eye	97	80.8
	Left Eye	23	19.2
Ear Preference	Right Ear	100	83.3
	Left Ear	20	16.7

Table 1. Distribution of the hand preference groups based on the results of the lateralization survey.

Variables		Lateralization Survey Scoring	Score	Distribution of hand preference	n	%	Total n	Total %
Hand Preference	Right-handed	Between +80 and+100	85	Strong right-handed	73	69.5	**105**	**87.5**
		Between +20 and +75	60	Weak right-handed	32	30.5		
	Left-handed	Between -20 and -75	-70	Weak left-handed	9	60	**15**	**12.5**
		Between -80 and -100	-90	Strong left-handed	6	40		

According to the dominant hand preferences of male and female judokas, there were no difference between hand grip strength, BMI, body fat percentages, and somatotypes (Table 3).

When the preferred foot, eye, and ear and somatotypes of judokas were compared according to the dominant hand preferences, it was found that there was a difference between the foot, eye, and ear preferences, but there was no difference in their somatotypes. These results showed that right-hand dominant judokas generally prefer right foot, eyes, and ears. Despite that, while left hand dominant judokas generally preferred left foot and left eye but 53.3% of left hand dominant judokas preferred their right ears (Table 4).

Table 3. Comparison of the dominant hand preference results of male and female athletes.

Variable		Male (n = 79)					Female (n = 41)				
		Right-handed (n = 71, 89.9%)		Left-handed (n = 8, 10.1%)			Right-handed (n = 34, 82.9%)		Left-handed (n = 7, 17.1%)		
		$\bar{X}$	sd	$\bar{X}$	sd	p	$\bar{X}$	sd	$\bar{X}$	sd	p
Height (cm)		174.7	7.9	176.3	10	.612	164.7	5.5	160	7.5	.057
Weight (kg)		82.6	20.3	82.8	13.1	.981	66	13	59.7	11.3	.243
Grip Strength	*Right hand*	52.7	9.2	50.7	4.8	.548	32.4	5.3	31	3.1	.533
	Left hand	52.1	7.9	52.4	7.3	.929	31.6	5	31.3	4.6	.893
BMI		23.8	1.9	24	1.6	.716	22.8	2.8	22.7	2.1	.910
Fat mass (%)		13.2	7	12.9	7.6	.901	18.8	7.4	18.6	7.8	.958
Fat free mass (%)		70.5	11.6	71.9	11.7	.754	52.9	6.6	47.9	4.6	.069
Somatotype	*Endomorph*	3.2	1.2	2.7	1	.186	3.8	.7	4.1	.6	.202
	Mesomorph	5.5	.2	5.6	.3	.665	5.3	.3	5.1	.2	.478
	Ectomorph	1.6	1.5	1.1	.9	.212	1.8	1.1	1.9	1.3	.312

$p < 0.05$

Table 4. Comparison of the preferred foot, eye, ear, and somatotypes of judokas according to dominant hand preferences

Variable		Right-handed (n = 105, 87.5%)		Left-handed (n = 15, 12.5%)		X^2	p
		n	%	n	%		
Foot Preference	Right foot	95	90.5	-	-	65.143	.001*
	Left foot	10	9.5	15	100		
Eye Preference	Right eye	97	92.4	-	-	72.298	.001*
	Left eye	8	7.6	15	100		
Ear Preference	Right ear	92	87.6	8	53.3	11.109	.004*
	Left ear	13	12.4	7	46.7		
Somatotype	Endomorph	4	3.8	1	6.7	3.969	.137
	Mesomorph	98	93.3	12	80.0		
	Ectomorph	3	2.9	2	13.3		

* $p < 0.05$

Discussion and conclusion

Cerebral lateralization is a concept that includes all organically significant factors and mechanisms involved in the acquisition of a number of specific neurological functions of the cerebral hemisphere. Lateralization means that a hemisphere is predominantly responsible for particular procedure. Many behavioral asymmetries have emerged as a result of hemispheric asymmetry. The most obvious of these is hand preference. In order for the relationship between hand preference and hemisphere functions to become more evident, hand dominance must first be defined (22). In this study, it was aimed to determine cerebral lateralization and functional asymmetry of the brain not only by adhering to hand preference, but also with the relation of the foot, eye, ear preferences and hand grip strength and it was investigated the differences between body composition and somatotype with the dominant preferences.

According to the Edinburgh Handedness Inventory determining the hand preferences of elite judo athletes; 105 judokas (87.5%) were identified as right-handed, 15 judokas (12.5%) were left-handed were found.

The incidence of left-handedness in the general population is about 13% during the teenage years and declines gradually with age, reaching about 6% in the seventh and eighth decades of life (52,53). About 90 percent of people are right-handed, says Corballis. The remaining 10 percent are either left-handed or some degree of ambidextrous, though people with "true" ambidexterity i.e., no dominant hand at all only make up about 1 percent of the population (54). In a study conducted by Tarman, (2007), the relationship between hand dominance and cerebral lateralization in musicians was investigated. Three-hundred and thirteen music graduate students from four different universities participated in the study. The Oldfield survey was used to determine the hand dominance and 88% of the musicians were identified as right-handed, 5% ambidexter, and 7% left-handed. In conclusion, the vast majority of the subjects who participated in the study were right-handed and their left hemisphere was dominant (55). Also, recent noninvasive imaging studies demonstrate that approximately 95% of normal right-handed subjects have left-hemispheric dominance for language (56). In a research performed on the student-athletes of the Yaşar Doğu Physical Education and Sports School of the Ondokuz Mayıs University, 39.27% of the students were reported to be strong right-handed, 52.81% weak right-handed, 2.97% ambidexter, 3.30% weak left-handed and 1.65% strong left-handed (57). Among the athletes of national weightlifting, gymnastics, taekwondo and wrestler sports participated in their researches, Gümüş and Akalın, (2016) determined the ratio of right-handedness, strong right-handedness, left-handedness, and strong left-handedness as 84.1%, 42.9%, 12.7%, and 3.2%, respectively (58).

Many authors have focused on the over-representation of left-handers in certain sports such as tennis, fencing, judo, wrestling, and boxing compared to the general population (59,60). Wood and Aggleton (1989) reported that left-handers (or left-footers) appear to be more common in what are called fast ball sports (19.5%, n = 322). Left-handers' (or left-footers') overrepresentation also prevails in non-interactive sports like golf (61) and in interactive or confrontational sports (62). The existence of a higher percentage of left-handers in certain sports has been generally attributed to a greater chance of success (6,63). World- and Olympic-level male judokas usually had lower than 10% body fat (64). Although the studies in the literature are similar to the present study, the percentage of athletes who use left hands in the present study group has found high. Judo sport is thought to be due to the need to use raid in both hands due to the game features.

While one of the hemispheres to be more dominant than the other is considered as the anatomic lateralization, the hand preference is considered as the functional cerebral lateralization. Similar to the hand use preference, the eye, ear, and foot dominances are also used to determine cerebral lateralization (65). When the foot preference distributions of judo athletes participating in this study were examined; 79.2% were observed to prefer the right foot and 20.8 the left foot. Similarly, when the distribution of the eye preference of the subjects was analyzed, 80.8% were observed to prefer the right eye, 19.2% left eye, and 83.3% were observed to prefer the right ear and 16.7% the left ear.

Tran and Voracek (2016) utilizing latent class analysis and structural equation modeling, they investigated in a series of studies (total n > 15300) associations of handedness and footedness with self-reported sporting performance and motor abilities in the general population. The present series of studies obtained replicable evidence of footedness being a more relevant predictor of sporting performance and motor abilities than handedness. Specifically mixed- and left-footedness showed positive effects in various interactive and non-interactive sports, suggesting better bodily coordination and speed, but also strategic advantages that are consistent with frequency-dependent effects (66). However, about 10% of the population prefer to use their left hand and about 30% prefer to use their left eye in such situations (67). In a study conducted the degree of genetic and environmental influence on hand and other lateral preferences were estimated from the covariance between hand, foot, and ear preferences (68).

Handedness is further divided into measures of preference and performance. Hand preference identifies the preferred hand for completing a task, whereas performance differentiates between the abilities of the left and right hand on a particular task (69). A relationship is commonly observed between these two constructs, such that performance abilities (i.e., skill) increases with the preferred hand (70). In recent studies related to hemispheric asymmetry, determination of the performance of individual's hand, foot, and eye was aimed in order to be able to form a study basis on cerebral lateralization by Barut et. al. based on this study's results, performances of hand, foot, and eye preferences were determined to play an important role in the evaluation of brain lateralization (71). In order to determine the functional asymmetry of the brain, a lot of research has been done in which the hand preference and the dominant eye are examined together, the relationship between the hand preference and the dominant eye has not been fully clarified. According to the results of the current study, parallel results were achieved in the choice of foot, eye, and ear with the dominant hand preference. These results show that the dominant hand is generally similar to the laterally preferred foot, eye, and ear and it is predicted that it can be reliable in all 4 preferences in determining the cerebral hemispheres.

It appears that tasks requiring precision aiming result in larger performance differences between the hands than less complex tasks (72). Corey et al. (2001), the results of their studies show that hand preference is a multi-dimensional feature; therefore, many components of hand preference and performance should be considered during the evaluation (73). Usually, the evaluation of the handgrip strength (HGS) is utilized in the clinic and occupational practice, performing an important role in the determination of the clinical effects of surgeries, in the control of the rehabilitation process (74), providing practical information regarding the muscles, nerves, articular (75) and cardiac diseases (76), being also utilized in the study of the ergonomics of hand held tools (77), in admission tests of various types of work (78) and in the sports field (79,80).

In this study, dominant hand grip strength of male judokas was found 52.7 ± 9.2 for right-handed, 52.1 ± 97.9 for left-handed, these values for non-dominant hands were 50.7 ± 4.8, 52.4 ± 7.3, respectively and female dominant hand 32 ± 36.1 for right-handed and 32.4 ± 5.3 for left-handed, these values for non-dominant hands were 31 ± 3.1 and 31.3 ± 4.6 respectively. The differences in HGS between elite and sub-elite female combat sports athletes were more pronounced than those in their male counterparts. A pooled analysis revealed very large HGS differences between elite and sub-elite junior female wrestlers and judokas (9,81). The accentuated HGS differences between elite and sub-elite combat sports athletes within the female population may be in part attributed to the differences in age, overall strength, and training experience (81). Similar to our study, there is a similar difference between male and female athletes in the mentioned study. But this is an expected result and it does not affect present study. In the findings of the current study were consistent with the relevant literature within the scope of hand preference and right- and left-hand grip strengths. In the studies of Koley and Singh (2010), dominant hands and non-dominant hands of 151 male university students were compared from the aspect of grip strength force for both right and left-handed and found no statistically meaningful difference was available (82).

The rate of dominant hand grip strength to non-dominant hand grip strength is higher than the other hand in all studies. In general, HGS seems to be an attribute of elite athletes and a covariate of overall upper- and lower-body strength, impulsive ability (i.e., sprinting and jumping), body mass, lean muscle mass, age, and training experience (i.e., training age) (10).

In elite judo competitor's physique is an important factor affecting performance, exhibits the greatest similarity in morphological traits and motor abilities (83). Most authors have come to one, the most prominent somatotype model of judokas: endomesomorphic (with mesomorphy being more dominant and endomorphy less) (84,85). Several investigations evaluated the relevance of anthropometric variables in judo performance. The body structure is related to accomplish the elite level in judo and it may influence the type of techniques applied during a match (86). The somatotype analysis of Serbian judokas proved of the endomesomorphic type (3.29-5.23-2.88), which is generally the predominant type in other countries as well (87). The studies by Lewandowska et al. on Polish judo players indicated that the values of mesomorphic somatotype components influenced muscle torque and power output (88). Judoists have higher mesomorphic component values and lower endomorphic and ectomorphic component values in the somatotype than the non-athlete comparison group (89). A study which examined the somatotype of top athletes of a variety of sports, among which were judokas at that time the future contestants in the 2000 Olympics in Athens, placed them into the group of athletes with the highest values of the mesomorphic component and the significantly lower values of the ectomorphic one (2.84-5.72-1.51) (90). Similar to hand preference, eye, ear, and foot dominance are also used in determining cerebral lateralization.

When the results of the body composition of the athletes participating in this study; results of men; dominant hand BMI (right hand 23.8 ± 1.9, left hand 24 ± 1.6), fat mass (13.3 ± .7, 12.9 ± 7.6) and fat free mass (70.5 ± 11.6, 71.9 ± 11.7), women; dominant hand BMI (right hand 22.8 ± 2.8, left hand 22.7 ± 2.1), fat mass (18.8 ± 7.4, 18.6 ± 7.8) and fat free mass (52.9 ± 6.6, 47.9 ± 4.63). Monterrosa Quintero et.al. (2019) examined the body composition and somatotypes of 50 Colombian judo athletes and compared them with studies conducted in 7 different countries. Studies presented a wide range of values, and several methods of measurement were reported. According to the results female body fat (%) (17.3 ± 4.94 and endomorph (4.94 ± 1.8), male (15.2 ± 5.8 and endomorph 3.5 ± 1.3) (91). One of the most important factors affecting performance is body composition. Therefore, the fat and lean body mass of athletes has been the focus of scientific studies. Successful judo athletes have very low levels of body fat – both male and female – with the exception of heavyweight athletes. Mesomorphy is the most predominant somatotype component in male athletes, while females have similar components of mesomorphy and endomorphy (92). Previous studies give the body fat percentage values of different judo players as follows: Male; Franchini et al. (Brazilian team) (13.7%), (Jayasudha and Itagi (12.6%), Hungarian team (14.0%), US (10.8%), Canadians (14.6%), Polish (13.7%), Female; Polish team (20.9%), Canadians (15.2%), US (15.8%), Brazilian Olympic team (22.0%) (92). When the data obtained from the body composition measurement results in the present study were compared with similar studies in the literature, a similarity was observed between the data.

Although one hemisphere is heavier than the other is anatomical lateralization, hand preference is accepted as functional cerebral lateralization. Similar to hand preference, eye, ear, and foot dominance are also used in determining cerebral lateralization.

As a result, it was determined in the current study that Judo athletes were mostly right-handed in all their preferences regardless of gender and that the athletes used their left hemispheres dominantly. These results show that the dominant hand is generally similar to the laterally preferred foot, eye, and ear and it is predicted that it can be reliable in all 4 preferences in determining the cerebral hemispheres. However, in elite judo athletes, there was no significant difference between the dominant and non-dominant hands in terms of grip strength, suggesting that the effect of hand preference, which is determined as multi-factor, on the grip strength is low. Also according to the dominant hand preferences in judokas, there were no difference between BMI, body fat percentages, and somatotype features.

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Correspondence:
Tevfik Cem Akalin
School of Physical Education and Sports, Zonguldak Bülent Ecevit University, Zonguldak, Turkey
E-mail: tc.akalin@hotmail.com
Mobile phone: +90532341425