

Preliminary biometric characteristics of Border Collies and their dependence on sport activity

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SUMMARY

Biometric measurements were made on 20 female and 20 male Border Collies. Half of the population of each sex, i.e. 10 animals (active dogs), were either currently participating in disc dog competitions or had recently finished their sporting careers due to age. The other half of the population, i.e. 10 females and 10 males, were not active in sports (non-active dogs). Most of the dogs came from Polish kennels, but some were from other countries.

The following measurements were taken: diagonal body length, height at withers, chest girth, forelimb (metacarpal) girth, thigh length, shank length, foot length, and body weight. Statistical analysis of the results was performed, and the body length, massiveness, eurysonia and boniness indices were calculated.

Border Collies were shown to have some biometric traits similar to those of Polish hunting dogs and Polish hounds, and some were also similar to those of Polish sheepdog breeds and Polish greyhound. The biometric analysis showed only a few statistically significant differences between active and non-active groups of Border Collies, concerning height at the withers in females and the body weight of males. Consequently, the results did not confirm the research hypothesis that the traits and biometric parameters of Border Collies differ between jumping dogs and dogs that are not active in sport, in connection with their participation in various competitions. However, it can be assumed that for the needs of sport cynology, there will be a need to select dogs predisposed to athletic performance, and analysis of the biometric traits of dogs will be a useful tool in achieving this goal. The results of the measurements collected in this study and the indices calculated from them also contribute to the biometric database of Border Collies.

KEY WORDS: Border Collie, biometry, sport activity



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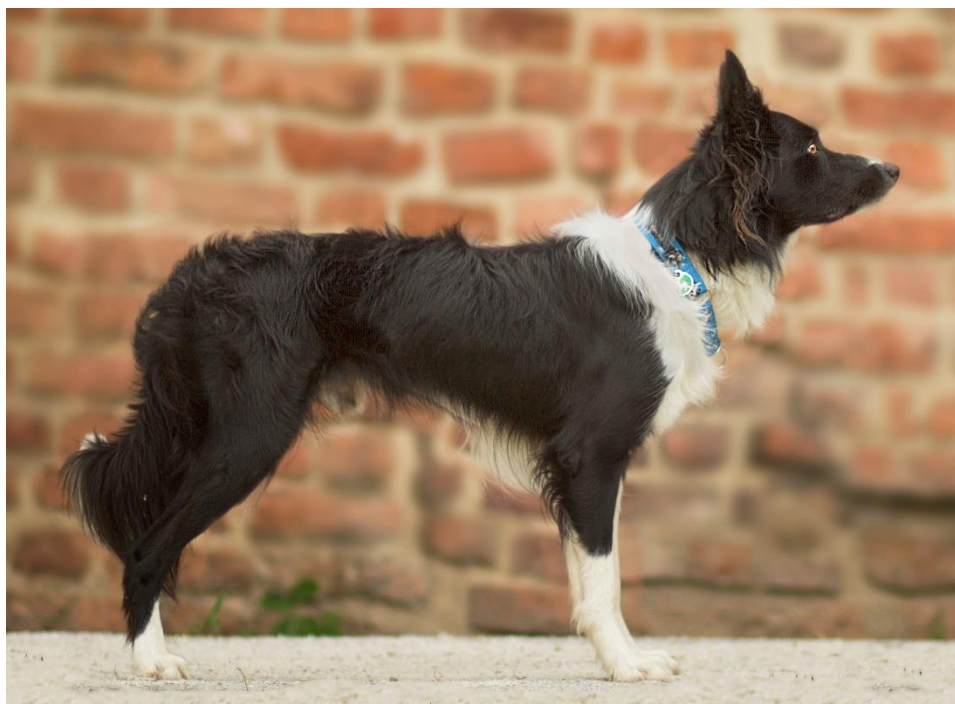
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INTRODUCTION

Border Collies (Phot. 1) come from the borderland between Scotland and England, where they were used by local shepherds as excellent assistants in herding sheep. These dogs are the best and most numerous herding breed in the world. The fact that they herd a third of the world's sheep population is confirmation of their unique advantages. They neither bark nor bite the sheep they herd, but enforce obedience by adopting a characteristic posture and looking at them in a specific manner. Border Collies can guide a herd of sheep through gates, drive them into an enclosure, separate lambs from their mothers, select mothers with twins, and divide the herd. Independence and outstanding intelligence are special features of these dogs (Monkiewicz and Wajdzik, 2003). The word 'border' in the name 'Border Collie' refers to the borderland between Scotland and England, while 'collie' is a Celtic word referring to all useful things. The Border Collie breed has been promoted during shepherding competitions organized since the late 19th century. These events developed from small local competitions into huge national events with auctions of sheep and trained dogs. In 1873, dogs from the borderland between Scotland and England were presented for the first time at the Sheepdog Trials, where they won the event. The first winner of this competition was Old Hemp, born in 1893, later the founder of the family from which modern Border Collies derive. Old Hemp was used as a model dog to develop the breed standard (Breed Standard FCI 297).



Phot. 1. Border Collie (photo by Kinga Tomczyk)

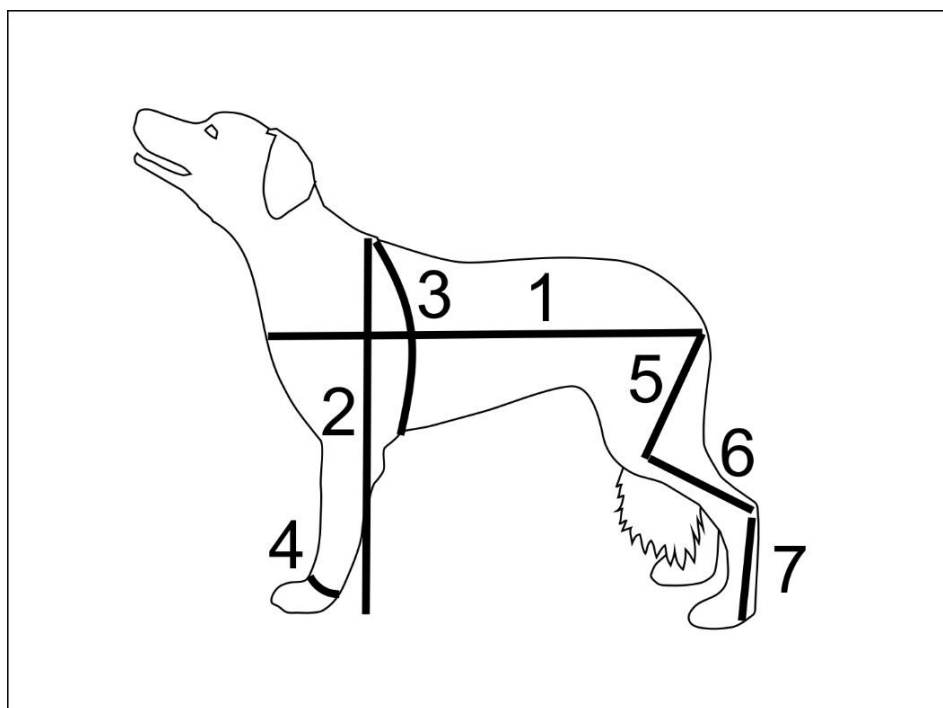
After World War II, Border Collies appeared in cities, where breeders discovered that they were the most suitable breed for obedience competitions. However, due to the lack of a registered breed standard, these dogs could not participate in competitions. After prolonged discussions, the authorities of the British Kennel Club and the International Sheep Dog Society reached an agreement, and in 1976 the Border Collie breed was registered. Thereafter, these versatile, agile, fast-learning dogs, cooperating perfectly with humans, were allowed to participate in various competitions (Coren, 1995). Border Collies proved to be unrivalled in various dog sports, such as disc dog, agility, obedience, and flyball. These dog sports (Strychalski et al., 2016) require animals to be capable of jumping. Protection (defence) training is the only dog sport in which Border Collies are not successful, as they lack an appropriate mental predisposition. Border Collies are increasingly used for rescue purposes. They are capable of searching for missing people in open areas as well as finding drugs and explosives (Hornsby, 1998; Larson, 1999).

The aim of the study was to analyse the results of selected measurements and biometric parameters of Border Collies, separately for male and female dogs and for sport competition participants (disc dog) and non-competing dogs of both sexes.

MATERIALS AND METHODS

Biometric measurements were taken of 20 female and 20 male Border Collies. Half of the population of each sex, i.e. 10 animals (active dogs), were either currently participating in disc dog competitions or had recently finished their sporting careers due to age. The other half of the Border Collie population (10 females and males) were not active in sport (non-active dogs). Measurements were taken on animals with fully developed bones, i.e. from the age of 18 months, and the oldest dogs were 10 years old. The lower age limit of the dogs coincides with the age thresholds in the regulations of all disc dog competitions. The majority of dogs were from Polish kennels, but there were also Border Collies from the Czech Republic, Russia, Germany and the United States. All measurements were taken in standing dogs on their left side (Fig. 1):

- Diagonal body length
- Height at withers
- Chest girth
- Forelimb girth
- Thigh length
- Shank length
- Foot length
- Body weight



1 – Diagonal body length, 2 – Height at withers, 3 – Chest girth, 4 – Forelimb girth, 5 – Thigh length, 6 – Shank length, 7 – Foot length

Fig. 1. Graphical representation of the points where the measurements were made

All measurements were taken on a level, stable and firm surface. The height at the withers was measured from the highest point of the pelvic region, i.e. the withers, to the ground with a measuring stick. Chest girth was measured with a measuring tape, stretched between the withers and the sternal region (body of the sternum) just behind the shoulder blades. The remaining measurements were made with a zoometric compass. Diagonal body length was measured from the humeral tuberosity to the ischial tuberosity. The girth of the forelimb was measured below the carpal joint, i.e. in the metacarpal region. Three measurements were made of the length of the pelvic limb: from the ischium to the knee, from the knee to the calcaneal tuberosity, and from the calcaneal tuberosity to the ground. All dogs were weighed. The dogs were measured in the presence of their owners, which helped to keep them calm.

Measurements were taken during a disc dog competition:

- Dog Chow Disc Cup Wrocław 30-31.5.2015
- Dog Chow Disc Cup Poznań 27-28.6.2015
- Dog Games Sopot 31.7-2.8.2015
- Dog Chow Disc Cup Warsaw 5-6.9.2015
- Opolskie Dog Frisbee Show 10-11.10.2015

Statistical analysis of the measurement results was performed.

The following indices used in biometric research were calculated from the measurement results (Ściesiński, 2009; Horoszewicz et al., 2015):

- Body length index, i.e. diagonal body length in relation to height at withers

$$\text{Body length index} = \frac{\text{diagonal body length}}{\text{height at withers}} \times 100$$

- Boniness index, i.e. forelimb girth in relation to height at withers

$$\text{Boniness index} = \frac{\text{forelimb girth}}{\text{height at withers}} \times 100$$

$$\text{Massiveness index} = \frac{\text{chest girth}}{\text{height at withers}} \times 100$$

$$\text{Eurysomia index} = \frac{\text{chest girth}}{\text{diagonal body length}}$$

The measurement results were statistically analysed by Student's t-test, where $\alpha = 0,05$.

Research hypothesis: Border Collie traits and biometric parameters in jumping dogs differ from those of dogs that are not active in sport due to their participation in various competitions.

RESULTS AND DISCUSSION

Biometric analysis of the measurement results and the indices calculated from them provides an objective characterization of the animal's body build and proportions. FCI breed standards provide few metric criteria – usually only the height at the withers. Kobryńczuk and Borkowski (1999) emphasize the importance of biometrics in assessing the breed value of dogs. Biometric criteria have been successfully used in canine practice as an excellent tool for distinguishing the Polish Hound and Polish Hunting Dog breeds among the population of Polish hounds (Abramowska, 1973; Ściesiński and Kaleta, 1989; Ściesiński, 1997). Biometry is also used to monitor changes taking place within a given population (e.g. breed) over time (Abramowska, 1973; Ściesiński and Kaleta, 1989; Brzeski and Kulisa, 1993; Redlicki, 1996; Ściesiński, 1997, 2002; Cieśla et al., 2010; Firuta, 2019). Horoszewicz et al. (2015) used biometry to analyse the Siberian Husky population with regard to sex and age and observed statistically significant differences. Body proportions determined on the basis of biometric parameters have been used to distinguish utility types of Hucul ponies (Purzyc et al., 2007). In breeding practice, analysis of the proportions of certain parts of the animal body, e.g. limb segments, can be used to predict what purposes the animal is suited for, including sport competitions (Kaproń et al., 2000; Komosa et al., 2013). These applications of biometry inspired us to analyse selected biometric traits of Border Collies. The mean values of the measurements made in the research are shown in Tables 1 and 2.

Table 1

Mean values of biometric features of male Border Collies – non-active, active in sport, and total male population (cm)

Trait/Measurement	Non-active males		Active males		Total males	
	N=10		N=10		N=20	
	\bar{x}	S	\bar{x}	S	\bar{x}	S
Height at withers	54,90	2,31	53,30	2,33	54,10	2,45
Diagonal body length	62,7	3,59	61,05	3,97	61,87	3,87
Chest girth	66,05	3,13	64,10	3,78	65,07	3,60
Forelimb girth	11,05	0,85	10,80	0,68	10,92	0,78
Thigh length	19,90	2,41	19,60	1,81	19,8	2,14
Shank length	23,70	2,15	23,70	1,50	23,75	1,85
Foot length	17,20	1,45	16,15	1,34	16,67	1,49
Body weight	20,95	2,00	18,50	2,77	19,72	2,71

Table 2

Mean values of biometric features of female Border Collies – non-active, active in sport, and total female population (cm)

Trait/Measurement	Non-active females		Active females		Total females	
	N=10		N=10		N=20	
	\bar{x}	S	\bar{x}	S	\bar{x}	S
Height at withers	51,70	2,78	49,12	1,76	50,41	2,66
Diagonal body length	60,70	5,51	56,95	2,69	58,82	4,72
Chest girth	62,50	3,45	59,85	1,82	61,75	3,06
Forelimb girth	10,30	0,60	9,90	0,65	10,12	0,65
Thigh length	19,10	1,53	18,8	1,82	18,95	1,68
Shank length	21,90	2,05	21,8	1,6	21,85	1,84
Foot length	15,25	1,10	14,75	0,56	15,00	0,91
Body weight	16,85	2,19	15,10	1,81	15,97	2,19

In the entire population of Border Collies included in the study, the average height at the withers, which is a commonly used biometric trait of animals, was 54,10 cm in the males and 50,41 cm in the females. The height at the withers of males not competing in sports, males competing in sports, females not competing in sports, and females competing in sports was 54,90 cm, 53,30 cm, 51,70 cm and 49,12 cm, respectively. The differences were not statistically significant. According to FCI Standard 297 for this breed, the height at the withers should be 53 cm in males and slightly less in females. The height at the withers in the group of Border Collies was similar to the breed standard. Comparison of the average height at the withers in Polish dog breeds and Greysters showed identical

values in female Border Collies and Polish Hunting Dogs. However, this similarity was not observed in the males of these breeds (Table 3).

Table 3

Mean values of some biometric indices for all Border Collies in the study (20 females and 20 males) and for Greysters and native Polish dog breeds according to various authors (cm)

Breed/type	Sex	Height at withers	Diagonal body length	Chest girth	Metacarpal girth
Border Collie – total (own research)	male	54,10	61,87	65,00	10,92
	female	50,41	61,75	58,82	10,12
Greyster (Frąckowiak et al. 2021)	male	69,92	68,57	77,50	-
	female	64,85	63,57	72,36	-
Polish Greyhound (Firuta 2019)	male	75,57	75,97	83,83	11,40
	female	69,79	71,71	78,59	10,65
Polish Hound (Ściesiński 1997)	male	61,86	62,30	75,90	11,00
	female	59,30	61,90	73,50	10,95
Polish Hunting Dog (Ściesiński 1997)	male	57,60	57,20	69,60	11,20
	female	50,40	55,50	65,60	9,70
Podhale Shepherd Dog (Ściesiński 2007)	male	71,13	84,00	89,87	17,12
	female	65,87	78,19	78,37	14,75
Polish Lowland Sheepdog (Krystek 1984, Ściesiński 2009)	male	47,50	49,33	64,07	11,5769
	female	44,10	46,20	61,77	10,625

The measurements of oblique body length showed that the mean values were similar for the males (61,87 cm) and females (61,75 cm). The body length of non-competing males, competing males, non-competing females, and competing oblique females was 62,70 cm; 61,05 cm; 60,70 cm and 56,95 cm, respectively. The differences were not statistically significant. Ściesiński (1997) noted similar mean oblique body lengths in Polish Hounds, i.e. 62,30 cm in males and 61,90 cm in females.

The oblique body length and the height at the withers are used to calculate the body length index. The standard value for the Border Collie is 1,14 for males and 1,17 for females. The values of this index in the group under study were 1,14 in both groups of males, 1,17 in non-competing females, and 1,16 in the competing females (Table 4). The values of the body length index of the Tatra Shepherd Dog were the closest to those calculated for the Border Collies, i.e. 1,18 for males and 1,19 for females (Table 5). The values of the body length index of Border Collies indicate that their body shape can be inscribed in a rectangle.

Table 4

Indices of female (N=20) and male (N=20) Border Collies depending on their sporting activity

Group of dogs	Body length index	Massiveness index	Eurysomia index	Boniness index
Male non-active N=10	1,142	1,203	1,053	0,201
Male active N=10	1,145	1,202	1,049	0,202
Male total N=20	1,14	1,20	1,05	0,2019
Female non-active N=10	1,174	1,208	1,029	0,199
Female active N=10	1,159	1,218	1,050	0,202
Female total N=20	1,17	1,15	0,98	0,2008

According to FCI standard No. 45 for the Bernese Mountain Dog, the ratio of height at the withers to body length should be 9:10. The value of this ratio in the population of the Border Collies in our study was 8,24:10.

In the entire population of Border Collies in the study, the chest girth was 65,0 cm in males and 58,82 cm in females. The following values were noted in individual groups: non-competing males – 66,05 cm; competing males – 64,10 cm; non-competing females – 62,50 cm and competing females – 59,85 cm. The chest girth of the Border Collies was the closest to its values in Polish Lowland Sheepdogs and female Polish Hunting Dogs. The chest girth and height at the withers were used to calculate the massiveness index. In the entire population of Border Collies under study it was 1,20 in the males and 1,15 in the females. The following values were noted in individual groups: competing and non-competing males – 1,20; non-competing females – 1,208 and competing females – 1,218. The value of the massiveness index in the Border Collies was the closest to its values in male Polish Hunting Dogs, female Polish Tatra Shepherd Dogs and Polish Hounds of both sexes (Table 5).

The chest girth and oblique body length are the components necessary to calculate the eurysomia index. Its mean values for the Border Collie were 1,05 for males and 0,98 for females. The mean values of the eurysomia index for the males and females in both groups (active and non-active) were identical to the values calculated for the entire population (Table 4). The value of the Border Collie eurysomia index was the closest to its values in the Polish Greyhound and the Tatra Shepherd Dog (Table 5).

Table 5

Indices of Border Collies (our own research, whole population), Greysters, and native Polish dog breeds (according to various authors), by sex

Breed/type	Sex	Body length index	Massiveness index	Eurysomia index	Boniness index
Border Collie (own research)	male	1,14	1,20	1,05	0,2019
	female	1,17	1,15	0,98	0,2008
Greyster (Frąckowiak et al. 2021)	male	0,98	1,10	1,10	-
	female	0,98	1,11	1,11	-
Polish Greyhound (Putko 1985 cited by Ściesiński 2009)	male	1,01	1,10	1,08	0,1431
	female	1,03	1,07	1,03	0,1416
Polish hound (Kołucki 82-83 cited by Ściesiński 1997)	male	1,00	1,23	1,18	0,17
	female	1,04	1,24	1,19	0,18
Polish Hunting Dog (Kołucki 82-83 cited by Ściesiński 1997)	male	0,98	1,20	1,22	0,18
	female	1,10	1,30	1,18	0,19
Podhale Shepherd Dog (Kucharska-Żądło cited by Ściesiński 2009)	male	1,18	1,26	1,07	0,24
	female	1,19	1,19	1,00	0,22
Polish Lowland Sheepdog (Krystek 1984 cited by Ściesiński 2009)	male	1,0381	1,3490	1,2995	0,2437
	female	1,0476	1,4008	1,3371	0,2409

The mean circumference of the thoracic limb, i.e. the metacarpus, in the entire population of Border Collies in our study was 10,92 cm for the males and 10,12 cm for the females. The following values were noted in individual groups: non-competing males – 11,05 cm; competing males – 10,80 cm; non-competing females – 10,30 cm and competing females – 9,90 cm. The average value of the boniness index in individual groups as well as in the entire population was about 0,20. Horoszewicz et al. (2015) noted similar values for the boniness index in the Siberian Husky. The mean boniness index of the Border Collie was lower than for native breeds of Polish Shepherd Dogs, i.e. the Tatra Shepherd Dog and the Polish Lowland Sheepdog, but much higher than in the Polish Greyhound (Table 5).

The total length of the pelvic limb in the entire Border Collie population, calculated as the sum of the lengths of the thigh, shank, and foot, was 60,22 cm in the males and 55,50 cm in the females. The length of the pelvic limb of the non-competing males was 60,85 cm. It was slightly greater than the mean value in the entire male population, while the length of the pelvic limb of the competing males was slightly smaller, i.e. 59,45 cm. Similarly, the total length of the pelvic limb of the non-competing females was slightly greater than the mean for the entire female population, whereas the total length of the pelvic limb of the competing females was slightly lower.

The shank was the longest segment of the pelvic limb in all the Border Collies, accounting for about 39% of the total length of the pelvic limb. The shank accounted for 39,43% of the total length of the pelvic limb in the entire population of male dogs and 39,15% in the total female population.

The thigh length of all the male and female Border Collies ranged from about 33% to nearly 34% of the total length of the pelvic limb (Table 6). The thigh length was almost identical in the two groups of females and constituted almost 34% of the total length of the pelvic limb. The foot was the shortest segment, accounting for about 27% of the total length of the pelvic limb. Its average proportion in the population of male dogs was greater than in females, at 27,68%. The mean percentage share of the foot in the total length of the pelvic limb was identical in the groups of males and females.

Table 6

Mean length of each segment of the Border Collie pelvic limb and its percentage of the total limb length in each group and in the entire Border Collie study population

Group	Thigh		Shank		Foot		Total	
	cm	%	cm	%	cm	%	cm	%
Male non-active	19,90	32,74	23,75	39,86	17,20	27,10	60,85	100
Male active	19,60	33,54	23,70	39,86	16,15	27,10	59,45	100
Male total	19,80	32,87	23,75	39,43	16,67	27,68	60,22	100
Female non-active	19,10	33,95	21,90	38,94	15,25	27,11	56,25	100
Female active	18,80	33,96	21,80	39,38	14,75	27,10	55,35	100
Female total	18,95	33,96	21,80	39,15	14,75	26,88	55,50	100

Comparison of the length proportions of individual segments of the pelvic limb of Border Collies and Greysters (Frąckowiak et al., 2021) showed that the shank of the Border Collies was proportionally longer than that of the Greysters, which are fast runners; its share in the total length of the limb exceeded 39%. Komosa et al. (2013) found that horses had a proportionately longer shank, which predisposes them to jumping. Assuming that this connection is universal, this biometric trait might be used to assess whether a Border Collie is predisposed to jumping.

Body weight, which is the least stable biometric trait, was also taken into account in our study. As predicted, competing males and females both had lower body weights than their non-competing counterparts (Tables 1 and 2). There were statistically significant differences between the groups of males.

To sum up, there were some similarities in biometric traits between Border Collies and Polish Hunting Dogs, Polish Hounds and Tatra Shepherd Dogs. The eurysonia index of Border Collies was the closest to that of Polish Greyhounds, whereas their boniness index was the closest to those of both breeds of Polish sheepdogs. The biometric analysis showed few statistically significant differences between the groups of Border Collies; these were noted for the height at the withers of the females and the body weight of the males. In consequence, the research hypothesis was not confirmed. However, it can be assumed that as the discipline of canine sport science develops, it will be necessary to select dogs which could compete in sports. Analysis of the biometric traits of dogs will be a useful tool in achieving this goal. In addition, the measurements made in this study and the indices calculated from them contribute to the biometric database of Border Collies.

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