Papers on Anthropology XXVIII/2, 2019, pp. 89–102

SOMATOTYPES IN SKIING

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ABSTRACT

Although the available studies on body types in ski sports are relatively sparse and rather old, there are clear indications that, especially in alpine skiing, top athletes have become stronger and heavier in the last three decades [43, 24]. According to Bahr and Tone [5] as well as Mildner et al. [19], the anthropometric profile and the somatotype, in particular the extent of muscular development in the lower extremities, are to be regarded as significant intrinsic risk factors for alpine skiing trauma [20].

Especially among men, the downhill racers tend to have a more pyknomorph-hyperplastic constitution type or more mesomorph somatotype with longer trunk and shorter legs and higher BMI, while the slalom specialists tend to more leptomorphic values with longer legs and shorter trunk

Keywords: *sports anthropology; kinanthropometry; skiing; slalom; downhill racer; slalom somatotypes*

HISTORICAL SPORTS ANTHROPOLOGICAL STUDIES ON SKIERS' CONSTITUTION TYPES

For the first time, the body type of cross-country skiers was described by Kohlrausch in 1927 [16]; according to him, they share long legs with the other groups of runners in summer sports.

Above all, he emphasizes the relative length of the thighs. Otherwise the cross-country skier would be closer to the decathlon than to the running disciplines in terms of mass, muscle development, chest circumference and width of the support belt with regard to the sport-specific requirement profile.

https://doi.org/10.12697/poa.2019.28.2.08

In contrast to the relatively tall and slim type of the cross-country skier, Kohlrausch [16] characterizes the ski jumper as smaller (body height 166 cm) with broad shoulders and hips, short legs and chunky physique, "in order to cope with the force of the impact".

According to Janura et al. [15], a decisive factor for the increase in flight and jump distances was the reduction of the body mass index (BMI, see [21, 39]). Müller et al. [22] describe a decrease in BMI since 1970.

On the basis of a comprehensive study of 285 top athletes from different sports in the Netherlands, Maas [18] elaborated vividly descriptive, male sports types between 1965 and 1970. The cross-country skier (see Figure 1) is described as small and muscular with relatively broad shoulders and hips, large hands and long legs.

The special body features of the alpine skier were first described by Arnold [3, 4]. An extensive anthropometric investigation at Olympic Games, however, was first performed by Saller [30] on the occasion of the Games in Innsbruck in 1964.

Figure 1. Cross-country skier in sports typology after Maas [18], redrawn and modified according to Raschka [25].

SKIERS' BODY TYPES (SOMATOTYPES) IN THE SOMATOCHART

In addition to pure body composition, the body types (constitution types) often also play a relevant role for potential competition success in winter sports. The importance of these constitutional prerequisites for performance applies in some sports in childhood and adolescence already.

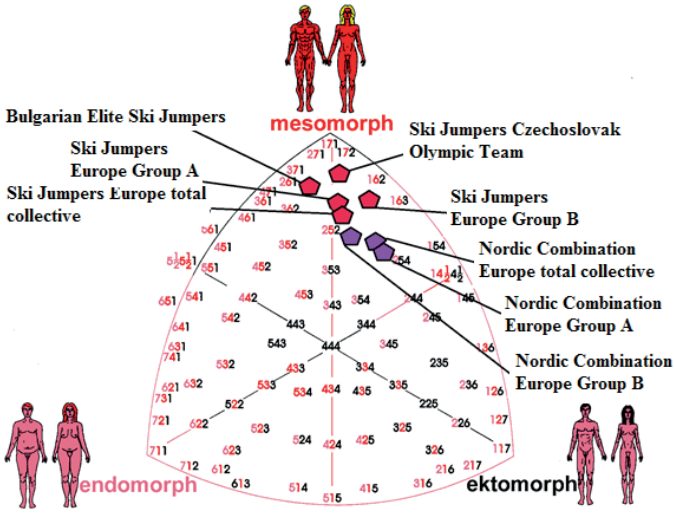

Figure 2. Somatochart of the average somatotypes of different ski-jumpers' groups, compiled according to the surveys of Toteva and Sumanov [42], Chovanová [7, 9], Štěpnička [35], Orvanová [23]

Most kinanthropometric average values for the ski-jumpers' somatotypes are found in the ectomesomorphic region (with relatively high mesomorphy ratings), with several athlete collectives arranging along the balanced-mesomorphic boundary and the Nordic combiners orienting themselves further into the centre of the ecto-mesomorphic area.

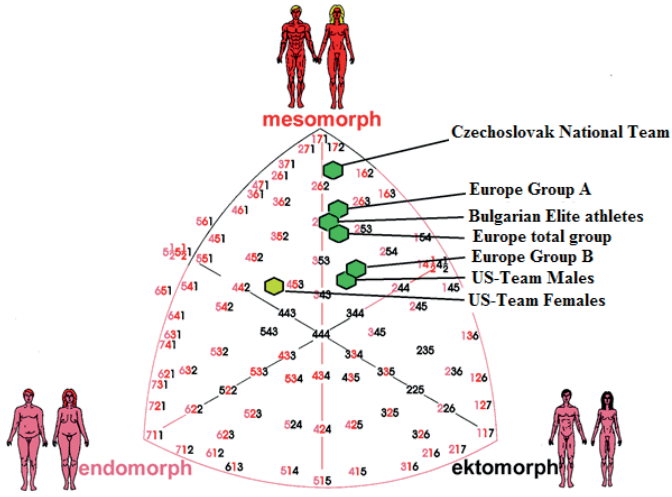

Figure 3. Somatochart of the average somatotypes of different cross-country skiers' groups, compilation according to the surveys of Toteva and Sumanov [42], Chovanová [7, 9,], Sinning et al. [33], Orvanová [23]

The somatotype mean scores of the male cross-country skiers are all ectomesomorphic along the balanced-mesomorphic line, whereas the cross-country skiers are endomesomorphically located near the mesomorph-endomorphic boundary.

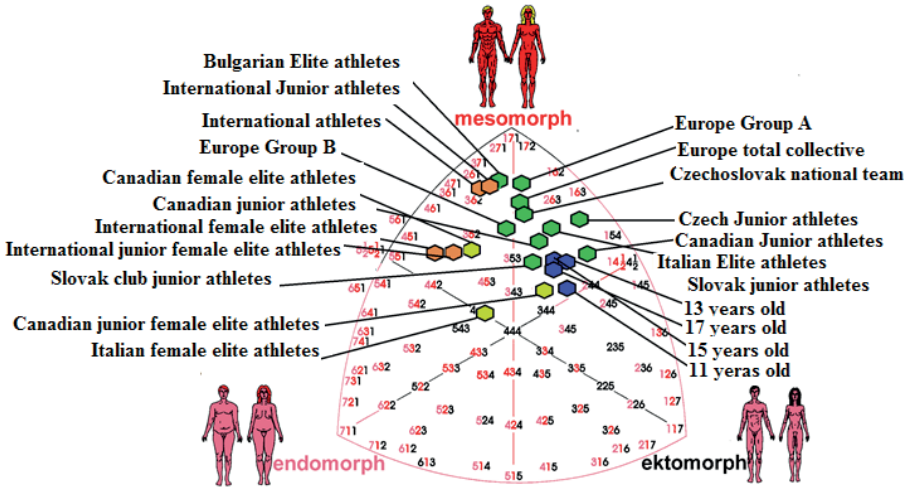

Figure 4. Somatochart of the average somatotypes of different alpine skier collectives, compilation according to the surveys of Toteva and Sumanov [42], Chovanová [7, 9, 10], Štěpnička [35, 36], Štěpnička and Broda [38], Ross et al. [29], Ross and Day [28], Song [34], Znášik [44], Orvanová [23], Gualdi-Russo and Graziani [13], Taeymans et al. {40]

For alpine skiers, a wide spread of somatotypes throughout the mesomorphic-somatochart-third manifests. One recognizes a more tendentious placement of the male top athletes along the balanced mesomorphic line, the up-and-coming athletes above the mesomorph-ectomorphic axis above the ectomorphic third, and the female elite athletes above the mesomorphic-endomorphic line above the endomorphic third. For many alpine skier groups, the endomorphism rating thus appears slightly higher than for cross-country skiers and ski jumpers.

A recent study by Aerenhouts et al. [1] compares the somatotypes of international top skiers from different countries with different downhill disciplines:

Table 1. Comparison of internationally successful alpine skiers of different nations (n = 25 women, n = 58 men), modified according to Aerenhouts et al. [1]

Alpine Skiing	**Women**		**Men**	
Discipline	Slalom	Downhill	Slalom	Downhill
Number (n)	11	9	17	26
Ages (years)	21.3±2.8***	25.6±2.5***	22.5±3.2*	25.8±4.2*
Height (cm)	167.7±5.2	168.8±5.2	178.8±5.1	181.0±4.8
Weight (kg)	65.8±3.9	69.2±5.6	80.8±7.2*	87.0±5.5*
% body fat	24.4±3.0	26.7±2.8	12.9±3.1	14.5±2.7
BMI (kg/m^2)	23.4±1.6	24.3±1.1	25.3±1.6*	26.6±1.6*
Endomorphy	3.8±0.8	4.4±0.7	2.7±0.9	3.0±0.6
Mesomorphy	4.7±1.2	4.5±0.5	5.8±0.9*	6.3±0.8*
Ektomorphy	1.9±0.8	1.6±0.4	1.8±0.6	1.4±0.6

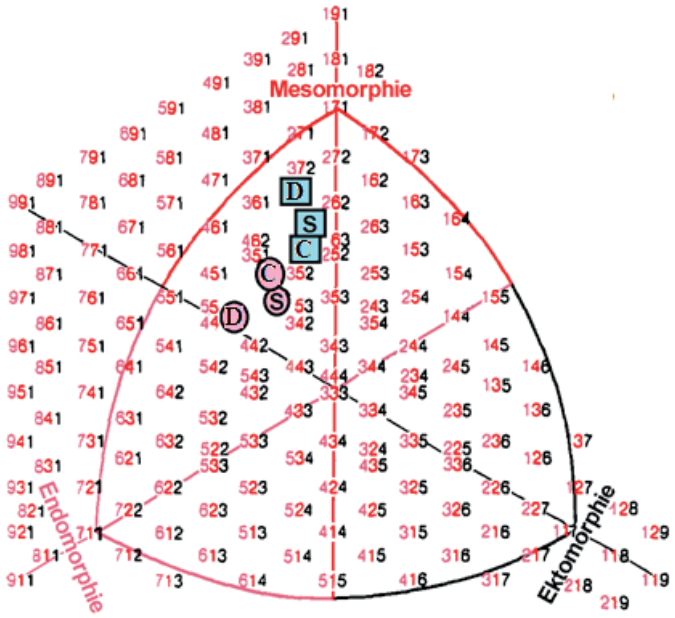

Figure 5. Mean values of the somatotypes of international top alpine skiers, outlined by Aerenhouts et al. [1], D = downhill S = slalom, C = combination, women (pink, circles), men (blue, squares)

SKIERS' BODY TYPES IN CONRAD'S CHECKERBOARD PATTERN GRAPHIC

The most extensive survey with this type system of alpine ski racers was carried out in the winter of 1974/1975 by Amman [2], who subjected the entire world elite to an anthropological investigation. A total of 87 World Cup riders from 14 countries were examined, among them the Swede Ingemar Stenmark as well as the Austrian Franz Klammer and Anton Steiner, the Swiss Bernhard Russi and Roland Collombin as well as the Germans Sepp Ferstl and Michael Veith.

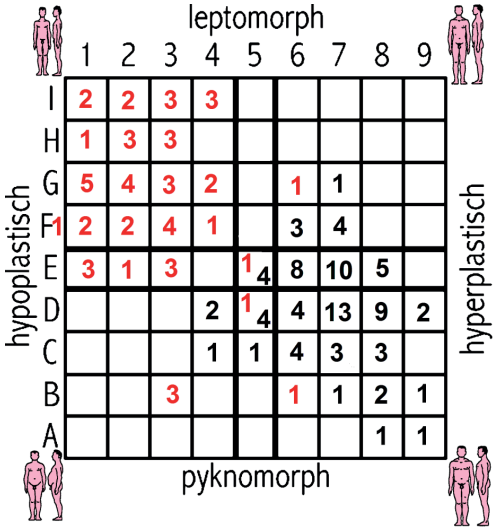

Figure 6. Position of the total collective (black numerals) of alpine ski racers (n = 87) compared to ultra-long-distance runners (red numerals) in the checkerboard pattern graphic after Conrad [12]

As can be seen from the checkerboard graphic, most skiers focus in the lower right, pyknomorph-hyperplastic quadrant. If one adds the skiers from the adjacent, metroplastic and metromorphic fields, which delimit the lower, right square, then 76 of the 87 alpine ski racers have a constitutional type characterized by strong muscle development and relatively large body mass.

They differ significantly from the physique of the hypoplastic-leptomorphic ultra-long-distance runners, which appear mainly in the upper left area.

Unlike the downhill racers, the slalom specialists are slimmer, more delicate, and graceful, i.e. more hypoplastic and more leptomorph. According to Amman [2], the giant slalom riders are very similar to the slalom riders in many physical traits. The greater body height of the downhill specialists is mainly due to the greater length of the trunk and not to lengthening of the legs.

This results in the picture of the somewhat more leptomorph, long-legged and slender slalom and giant slalom rider compared to the rather pyknic and more massive downhill specialist.

The body type differences are very vividly exemplified by the long-time dominance of the slalom / giant slalom racer and a successful downhill rider, a World Cup winner in downhill skiing, in the checkerboard pattern graphic after Conrad.

While the slalom driver (Sl) is in the mesomorphic range, i.e. in the centre of the coordinate system, one can see the downhill specialist (Do) in the lower right corner of the pyknomorph-hyperplastic quadrant (Fig. 7).

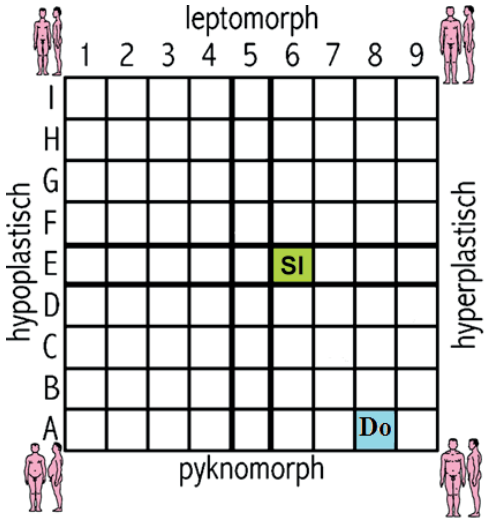

Figure 7. Position of a successful downhill rider (World Cup winner downhill = Do) and an outstanding dominator of the slalom / giant slalom race (Sl) in the checkerboard pattern after Conrad [12]

The proportions of both athletes are again determined by means of proportion figures (Fig. 8). Clearly recognizable are the larger, relative leg length but shorter trunk length of the slalom rider (Fig. 10) as well as the large trunk length but relatively shorter legs of the downhill racer (Fig. 9).

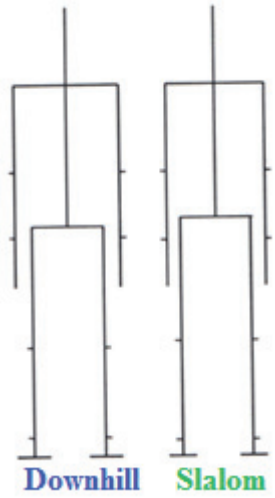

Figure 8. Proportion figures of a successful downhill skier (World Cup winner in the downhill race) and a long-time dominator of the slalom / giant slalom race after Ammann [2]

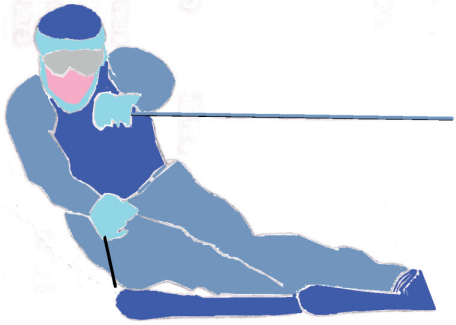

Figure 9. Successful downhill rider (World Cup winner in downhill skiing)

Figure 10. Long-time dominator of the slalom / giant slalom race

Even if the listed constitutional biological surveys are already somewhat old, one recognizes the two basic constitutional types also in the comparison of the German male and female champions of the last decade, if one analyses only weight, body height and BMI.

Table 2. Overview of the German champions of the last decade in alpine skiing, differentiated according to the disciplines pairing slalom / giant slalom and downhill / super G with weight and height, as available on Wikipedia (accessed on 24.9.2017), with calculated BMI values

German Champions	Discipline	Weight (kg)	Height (cm)	BMI (kg/m²)
Felix Neureuther	(Giant)Slalom	87	184	25.7
Dominik Stehle	(Giant)Slalom	83	176	26.8
Fritz Dopfer	(Giant)Slalom	85	188	24.0
Stefan Kogler	(Giant)Slalom	96	193	25.8
Dominik Schwaiger	(Giant)Slalom	82	180	25.3
Linus Straßer	(Giant)Slalom	75	183	22.4
Alexander Schmid	(Giant)Slalom	70	178	22.1
Stephan Keppler	Downhill/Super G	93	183	27.8
Hannes Wagner	Downhill/Super G	97	190	26.9
Felix Neureuther	Downhill/Super G	87	184	25.7
Philipp Zepnik	Downhill/Super G	92	185	26.9
Andreas Sander	Downhill/Super G	91	178	28.7
Klaus Brandner	Downhill/Super G	85	177	27.1
Thomas Dreßen	Downhill/Super G	97	188	27.4
Josef Ferstl	Downhill/Super G	85	179	26.5

The average weight of the German downhill / super G group with 90.9 ± 4.9 kg is significantly higher than that of the (giant) slalom racers with 82.6 ± 8.4 kg ($p< 0.05$). The BMI differences are even very significant (27.1 ± 0.9 kg/m² vs. 24.6 ± 1.8 kg/m²). However, the average body height does not differ (each 183 cm).

By contrast, the results on the ladies are less obvious.

Table 3. Overview of the German female champions of the last decade in alpine skiing, differentiated according to the disciplines pairing slalom / giant slalom and downhill / super G with weight and height, as available on Wikipedia (accessed on 24.9.2017), with calculated BMI values

German Champions	Discipline	Weight (kg)	Height(cm)	BMI (kg/m^2)
Monika Bergmann	(Giant)Slalom	74	176	23.9
Veronika Staber	(Giant)Slalom	64	167	22.9
Viktoria Rebensburg	(Giant)Slalom	67	170	23.2
Kathrin Hölzl	(Giant)Slalom	59	163	22.2
Fanny Chmelar	(Giant)Slalom	83	187	23.7
Susanne Riesch	(Giant)Slalom	79	181	24.1
Nina Perner	(Giant)Slalom	60	164	22.3
Veronika Staber	(Giant)Slalom	64	167	22.9
Christina Geiger	(Giant)Slalom	67	170	23.2
Simona Hösl	(Giant)Slalom	56	165	20.6
Veronique Hronek	(Giant)Slalom	62	157	25.2
Barbara Wirth	(Giant)Slalom	67	170	23.2
Marlene Schmotz	(Giant)Slalom	62	163	23.3
Lena Dürr	(Giant)Slalom	64	173	21.4
Susanne Weinbuchner	(Giant)Slalom	64	167	22.9
Maria Höfl-Riesch	Downhill/Super G	78	182	23.5
Hilde Gerg	Downhill/Super G	70	171	23.9
Gina Stechert	Downhill/Super G	75	172	25.4
Viktoria Rebensburg	Downhill/Super G	67	170	23.2
Lena Dürr	Downhill/Super G	64	173	21.4
Fanny Chmelar	Downhill/Super G	83	187	23.7
Isabelle Stiepel	Downhill/Super G	71	178	22.4
Veronique Hronek	Downhill/Super G	62	157	25.2
Michaela Wenig	Downhill/Super G	77	176	24.9
Marina Wallner	Downhill/Super G	75	170	26.0
Kira Weidle	Downhill/Super G	68	172	23.0
Susanne Weinbuchner	Downhill/Super G	64	167	22.9

For women, however, there are no significant differences between downhill / super G and (giant) slalom groups in terms of weight, body height and BMI of the German champions (71.2 ± 6.5 vs. 66.1 ± 7.4 kg, 172 ± 7.5 vs. 169.3 ± 7.6 cm, 23.8 ± 1.4 vs. 23.0 ± 1.1 kg / m^2).

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