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Characteristics of Changes in Body Composition Measurements Among Japanese Alpine Skiers

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ABSTRACT

This study aimed to clarify changes in body composition among young Japanese alpine skiers. The subjects are 11 skiers (7 males and 4 females). Their ages are 15 to 18 years old. No studies have measured the same skiers over the long term and described their characteristics. Therefore, in this study, body composition measurements were conducted three times, June 2024, November 2024, and July 2025. Measurements were taken using a multi-frequency measuring instrument (MC-780A-N, TANITA corporation, Japan). The data items of this measurement included weight, body fat percentage, fat mass, lean mass, muscle mass, and estimated bone mass. The average of fat mass was highest for both males and females in the measurements taken in November 2024. Consequently, the average of body fat percentage also peaked in November 2024. The average of muscle mass increased with each measurement for both males and females. A male skier was found to have gained 6.3 kg of muscle mass over the course of about one year. In addition, it was found that female skiers experience a fluctuation of 1–2 kg in body fat over the course of a year. Understanding the skier's body can be considered beneficial not only for maximizing performance but also for preventing injuries. The subjects of this study were a very small number of Japanese alpine skiers. Therefore, it is necessary to expand the sample size. I will examine the developmental characteristics of Japanese skiers while conducting international comparisons in the future.

Keywords: Skier, Health, Training, Physical growth and development

INTRODUCTION

Alpine skiing is a sport involving high-speed descents down mountain slopes. It is also one of the Winter Olympic disciplines. Alpine ski racing is an action-packed sport that mixes speed, agility, balance, and coordination (U.S. Ski & Snowboard). Thus, alpine skiers must possess a wide range of physical skills and stamina. They must engage in both on-snow and on-land training to achieve this. Furthermore, it is necessary to strive to maintain and improve these skills throughout the season.

However, training that ignores the physical growth and development of skiers may also harm their health. Adolescence (ages 13–18 years) is a period of significant growth and physical development that includes changes in body composition, metabolic and hormonal fluctuations, maturation of organ systems, and establishment of nutrient deposits, which all may affect

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future health (Desbrow, 2021). Thus, it is important to consider the physical development of young skiers when designing their training programs.

One indicator for understanding their physical characteristics is body composition measurement. This body composition measurement provides information on weight, muscle mass, fat mass, lean mass, estimated bone mass, and more. Several studies on body composition measurements for alpine skiers have been published. However, no studies have measured the same skiers over the long term and described their characteristics.

Therefore, this study aimed to clarify changes in body composition among young Japanese alpine skiers. This study visualizes the physical development of skiers. As a result, it helps skiers gain a deeper understanding of their bodies. Furthermore, coaches and supporters may be able to provide training tailored to the skiers' physical development.

METHODS

Subjects

The subjects are 11 skiers (7 males and 4 females). Their ages are 15 to 18 years old. They are active in competitions within Japan. One of the subjects was not a Japanese national. However, this skier lives in Japan and competes in Japanese competitions. The data of this skier was treated as a reference value in this study.

Survey Period and Location

Body composition measurements were conducted three times, June 2024, November 2024, and July 2025. Their training and racing season runs from around late November to early May. The measurements must be conducted on a date when everyone is available. That is why the measurement was held on the dates mentioned earlier. The measurement location was a facility within the school to which they belong.

The measurements were taken early in the morning. The reason for this is that it is generally considered best to take measurements immediately upon waking and before eating. The subjects wore short-sleeved shirts and shorts for all measurements. The weight of clothing was standardized at 0.5 kg. Then, this was entered into the computer.

Ethical Procedures

Research subjects had been informed in advance, both verbally and in writing, about the content of this research and the method of providing feedback. Then, they signed the consent form if they were able to cooperate with this study. This research had been approved by the Research Ethics Committee of the university where the principal investigator was affiliated.

Body Composition Measurement

Measurements were taken using a multi-frequency measuring instrument (MC-780A-N, TANITA corporation, Japan). The frequencies of this measuring instrument were 5 kHz, 50 kHz, and 250 kHz. Furthermore,

the measured current was 90μA or less, complying with Japanese Industrial Standards 0601-1. The same analyser was used for each measurement. The measured data was saved in dedicated software (Get In Shape-N, NV-191. TANITA corporation, Japan).

The preliminary data required for measurement were the skier's height, date of birth, and gender. After entering these, the measurement was performed. The data items of this measurement included weight, body fat percentage, fat mass, lean mass, muscle mass, and estimated bone mass.

Statistical Analyses

All statistical analyses were performed using Excel statistical software (BellCurve, SSRI Co., Ltd., Japan). It calculated the average values separately for males and females.

RESULTS

Measurement Values for Each Item

The body composition measurements for each skier are shown in Table 1. It has been found that young Japanese skiers showed significant differences in physique even among those of the same age. The muscle mass of males increased each time it was measured. Some cases showed a decrease in muscle mass during the November 2024 measurement compared to the June 2024 measurement among male skiers. However, the July 2025 measurement revealed an increase in muscle mass for all skiers. A male skier (M-2) was found to have gained 6.3 kg of muscle mass over the course of about one year. Female skiers were found to experience fluctuations over a period of approximately one year. The lean mass and estimated bone mass increased with each measurement for male.

Table 1: Body composition measurement data for each skier.

Males

ID	M-Y	Age	Height (cm)	Weight (kg)	Body Fat (%)	Fat Mass (kg)	Lean Mass (kg)	Muscle Muss (kg)	Estimated Bone Mass (kg)
M-1	Jun-24	16	170.0	58.8	11.1	6.5	52.3	49.6	2.7
	Nov-24	17	170.0	61.9	13.2	8.2	53.7	50.9	2.8
	Jul-25	17	172.0	63.7	12.2	7.8	55.9	53.0	2.9
M-2	Jun-24	17	172.0	69.5	14.0	9.7	59.8	56.7	3.1
	Nov-24	17	173.0	73.8	16.2	12.0	61.8	58.6	3.2
	Jul-25	18	172.0	78.0	14.9	11.6	66.4	63.0	3.4
M-3	Jun-24	17	172.0	61.4	11.3	6.9	54.5	51.7	2.8
	Nov-24	17	172.0	61.8	12.2	7.5	54.3	51.5	2.8
	Jul-25	18	173.0	60.8	7.8	4.7	56.1	53.2	2.9
M-4	Jun-24	17	170.0	60.4	11.9	7.2	53.2	50.4	2.8
	Nov-24	17	170.0	64.4	15.7	10.1	54.3	51.5	2.8

(Continued)

Table 1: Continued.

ID	M-Y	Age	Height (cm)	Weight (kg)	Body Fat (%)	Fat Mass (kg)	Lean Mass (kg)	Muscle Muss (kg)	Estimated Bone Mass (kg)
	Jul-25	18	170.0	65.1	13.7	8.9	56.2	53.3	2.9
M-5	Jun-24	15	170.0	64.8	17.7	11.5	53.3	50.4	2.9
	Nov-24	15	171.0	63.3	16.3	10.3	53.0	50.1	2.9
	Jul-25	16	171.0	65.5	15.8	10.3	55.2	52.3	2.9
M-6	Jun-24	16	170.0	58.1	15.2	8.8	49.3	46.7	2.6
	Nov-24	16	170.0	61.2	16.4	10.0	51.2	48.5	2.7
	Jul-25	17	170.0	63.0	17.5	11.0	52.0	49.3	2.7
M-7	Jun-24	15	161.0	47.9	8.1	3.9	44.0	41.7	2.3
	Nov-24	16	161.0	48.8	8.6	4.2	44.6	42.3	2.3
	Jul-25	16	160.0	51.2	9.4	4.8	46.4	44.0	2.4

Females

ID	M-Y	Age	Height (cm)	Weight (kg)	Body Fat (%)	Fat Mass (kg)	Lean Mass (kg)	Muscle Muss (kg)	Estimated Bone mass (kg)
F-1	Jun-24	16	169.0	66.7	28.0	18.7	48.0	45.0	3.0
	Nov-24	16	169.0	68.8	29.4	20.2	48.6	45.5	3.1
	Jul-25	17	169.0	70.0	30.8	21.6	48.4	45.3	3.1
F-2	Jun-24	16	167.0	59.1	23.7	14.0	45.1	42.3	2.8
	Nov-24	16	167.0	57.7	24.0	13.8	43.9	41.2	2.7
	Jul-25	17	168.0	59.3	22.2	13.2	46.1	43.2	2.9
F-3	Jun-24	16	158.0	55.6	25.3	14.1	41.5	39.0	2.5
	Nov-24	16	158.5	57.5	28.7	16.5	41.0	38.6	2.4
	Jul-25	17	159.0	59.3	26.0	15.4	43.9	41.2	2.7
F-4	Jun-24	16	153.0	50.8	25.3	12.9	37.9	35.7	2.2
	Nov-24	17	153.0	53.4	28.0	15.0	38.4	36.2	2.2
	Jul-25	17	153.0	51.4	24.0	12.3	39.1	36.8	2.3

* The nationality of F-2 was not Japanese. Therefore, it was presented as a reference value in this study.

The Average and Standard Deviation of Each Item

The average and standard deviation for each measurement item were as shown in Table 2. The average of fat mass was highest for both males and females in the measurements taken in November 2024. Consequently, the average of body fat percentage also peaked in November 2024. The average of muscle mass increased with each measurement for both males and females.

Table 2: The average and standard deviation for each item.

		Jun-24	Nov-24	Jul-25
Height (cm)	M	169.29 ± 3.77	169.57 ± 3.95	169.71 ± 4.42
	F	160.00 ± 8.19	160.17 ± 8.13	160.33 ± 8.08
Weight (kg)	M	60.13 ± 6.67	62.17 ± 7.32	63.90 ± 7.90
	F	57.70 ± 8.16	59.90 ± 7.98	60.23 ± 9.34
Body fat (%)	M	12.76 ± 3.14	14.09 ± 2.94	13.04 ± 3.48
	F	26.20 ± 1.56	28.70 ± 0.70	26.93 ± 3.49
Fat mass (kg)	M	7.79 ± 2.46	8.90 ± 2.54	8.44 ± 2.82
	F	15.23 ± 3.06	17.23 ± 2.68	16.43 ± 4.74
Lean mass (kg)	M	52.34 ± 4.84	53.27 ± 5.08	55.46 ± 5.99
	F	42.47 ± 5.12	42.67 ± 5.30	43.80 ± 4.65
Muscle muss (kg)	M	49.60 ± 4.60	50.49 ± 4.82	52.59 ± 5.69
	F	39.90 ± 4.71	40.10 ± 4.83	41.10 ± 4.25
Estimated bone mass (kg)	M	2.74 ± 0.25	2.79 ± 0.27	2.87 ± 0.30
	F	2.57 ± 0.40	2.57 ± 0.47	2.70 ± 0.40

*The calculation was performed excluding the data for F-2.

Characteristics of Increased Fat Mass in Females

Comparing the average fat mass among females revealed variations of 1-2 kg. Therefore, this study investigated fat mass by body region (Table 3). The amount of fat in the trunk showed the greatest variation. However, it was found that one skier (F-1) had increased fat mass in all body regions. No distinctive findings regarding changes in fat mass were observed in other body regions.

Table 3: Changes in fat mass in female skiers.

Females

ID	M-Y	Age	Right Leg	Left Leg	Right Arm	Left Arm	Trunk
F-1	Jun-24	16	4.1	4.2	0.8	0.8	8.8
	Nov-24	16	4.4	4.5	0.9	0.9	9.5
	Jul-25	17	4.7	4.7	1.0	1.1	10.1
F-2	Jun-24	16	3.5	3.5	0.6	0.6	5.8
	Nov-24	16	3.5	3.5	0.5	0.5	5.8
	Jul-25	17	3.6	3.6	0.5	0.5	5.0
F-3	Jun-24	16	3.1	3.3	0.6	0.6	6.5
	Nov-24	16	3.5	3.6	0.6	0.6	8.2
	Jul-25	17	3.4	3.5	0.7	0.7	7.1
F-4	Jun-24	16	3.0	3.0	0.5	0.5	5.9
	Nov-24	17	3.3	3.2	0.6	0.6	7.3
	Jul-25	17	2.8	2.8	0.5	0.5	5.7

* The nationality of F-2 was not Japanese. Therefore, it was presented as a reference value in this study

DISCUSSION

Comparison With Alpine Skiers From Other Countries

The study compared the body composition measurements of alpine skiers from other countries based on the results of these Japanese skiers. The study of Högström GM, et al., (2012) indicated that Swedish alpine skiers (males) of the same age group had an average weight of 72.35 kg and an average height of 177.7 cm. Their average body fat percentage was 17.6%. Also, Swedish alpine skiers (females) of the same age group had an average weight of 62.75 kg and an average height of 168.2 cm. Their average body fat percentage was 24.8%. Additionally, a study of internationally competitive Polish alpine skiers found that the body fat percentage for males was 19.9% and for females was 25.7% (Sievänen H. et al., 2015). This indicates that Japanese alpine skiers (male) tend to have lower body fat percentages and less fat mass than skiers from other countries. Therefore, it is considered important for males to maintain 15-20% body fat to perform effectively in cold environments. An increase in both muscle mass and fat mass could pose a challenge for Japanese skiers.

Fluctuations in Female's Fat Mass

The results of this study showed that the fat mass measured in females just before the start of the season was higher than the values measured during the off-season. A study measuring the body fat mass of Japanese female university students found that the values measured in December were higher than those measured in June. This study speculated that the decrease in activity levels during winter and the increase in body fat may have been adaptations to protect against the cold (Yumigeta et al., 2015). However, alpine skiers were training in November before the season. Therefore, it is unlikely that their activity levels decreased. This study did not examine the training pattern or content. It is unclear why fat mass increased before the season.

A study of elite female track and field athletes in Japan found that fat mass and fat percentage significantly increased after one year. These changes were found to be associated with performance (Tsukahara et al., 2020). However, female athletes do not simply gain fat mass as they age. In the case of the world's top class female wrestlers, a significant increase in back muscle strength was observed after the late puberty (Arakawa et al., 2020).

Maintaining fat mass may be necessary for alpine skiers. It is necessary to clarify the characteristics of body composition measurements for female alpine skiers by comparing them with the body composition of athletes in other sports.

Limitations of the Study

The subjects of this study were a very small number of Japanese alpine skiers. Therefore, it is necessary to expand the sample size. Furthermore, detailed research will be necessary to understand the reasons for the high body fat percentage among alpine skiers.

CONCLUSION

This study has considered the body composition characteristics of Japanese alpine skiers. This study found an increase in muscle mass among males and fluctuations in fat mass among females. One skier saw an increase of 6.3 kg in muscle mass over the course of a year. Thus, skiers and coaches must first fully understand that physical development occurs. It will also be necessary to consider training and nutritional intake appropriate to the stage of development. Understanding the skier's body can be considered beneficial not only for maximizing performance but also for preventing injuries. I will examine the developmental characteristics of Japanese skiers while conducting international comparisons in the future.

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