

Patterns of Nutrient Intake among Male and Female High School-Aged Cross-Country Skiers and Speed Skaters

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Abstract

This study aimed to determine the appropriate nutritional intakes and dietary habits of high school-aged cross-country skiers and speed skaters. The subjects, all high school students from N Prefecture, included 18 male cross-country skiers, 5 male speed skaters, 10 female cross-country ski players and 4 female speed skaters. Physical measurements, food intake frequency survey results, bone mineral density and exercise stress test outcomes, and lactic acid measurements were evaluated. Female athletes in both sports had higher body fat percentages relative to the average range stated for female athletes. Male speed skaters had a significantly higher maximum oxygen intake than that male cross-country skiers did. By contrast, this parameter did not differ significantly among female athletes. A negative correlation was observed between the fat free mass and muscle mass, and a positive correlation was observed among the body fat percentage, fat percentage, and fat mass. Both male and female athletes had protein intake ratios within the reference ranges. All athletes except male speed skaters had lipid energy ratios that were higher than the upper limit of the reference value. Both male and female athletes also reported carbohydrate energy ratios within the reference ranges, but had cereal energy ratios below the reference values. Athletes should pay attention to the ingestion of various nutrients to ensure a sufficient energy intake. Accordingly, adolescent athletes should consume daily meals containing a good balance of staple foods, main dishes, side dishes, milk and other dairy products, and fruits.

Keywords

Nutrient Intake, High School, Cross-Country Skiers, Speed Skaters

1. Introduction

Athletes' eating and drinking habits are thought to affect sports conditioning, fatigue recovery, and performance [1]. The finding that junior athletes aim to emulate the dietary habits, particularly those pursuing highest levels of participation worldwide, serves as a testament to the high global level of awareness of diet [2]. Regarding high-level athletes [3], professional baseball players [4] are required to consume timely meals that accommodate daily and seasonal schedules. Although sports players are aware of the importance of diet [5], many experience problems with eating and drinking habits and a lack of sleep [6]. Previous reports have described the nutritional situations of groups of college and university athletes participating in karate, tennis, gymnastics, and soccer [7] [8] [9] [10]. Currently, however, official criteria for nutritional intakes are not publicly available to the Japanese population [11]. Although athletes may be aware that their intakes of some food groups may be lacking, they are also aware that they do not make efforts to consume these items [12]. Despite recognizing the need for proper nutrition, very few athletes work from a basis of correct knowledge and skills. High school athletes are expected to play a vital role in improving fitness and nutritional knowledge, health maintenance, conditioning, failure prevention, and athletic skills improvement, which will promote the nurturing of enriched and healthy humans [13]. This study aimed to examine the intakes of nutrients among high school students by examining the intakes and eating habits of skiers and speed skaters in this population.

2. Materials and Methods

The study included 18 male cross-country skiers, 5 speed skaters, 10 cross-country skaters, 10 ski-skaters, and four high-speed skaters who attended high school. This study received approval from the Matsumoto University of Science and Technology Committee. The height and weight of each athlete was measured. The body mass index (BMI) was then calculated from these measurements. The body composition parameters of body fat percentage, fat quantity, lean and fat body weights, and muscle mass were measured using a body fat meter (BC-11 E; Tanita, Tokyo, Japan). The stiffness index, a measure of bone density, was measured by using LUNAR, A-001, and A-1000LS (GE Medical Systems, Madison, WI, USA) (Table 1). The maximum oxygen intake amount was measured using an exhalation gas analyzer (AERO MONITOR AE 3000S). The athletes were subjected to multi-step exercise load tests, in which the loads were gradually increased. Blood lactate concentrations were measured as a simple lactic acid measurement from a fingertip blood sample using Lactate Pro II (Arkray Co.,

Table 1. Body composition data.

	Cross-country skiers		Speed skaters	
	Male	Female	Boys	Girls
	(n = 18)	(n = 10)	(n = 5)	(n = 4)
Age (years)	16.2 ± 1.4	15.8 ± 1.0	17.0 ± 1.0	16.0 ± 0.8
Body height (cm)	170.2 ± 6.9	159.0 ± 3.3 ^{ab}	170.8 ± 6.3	159.3 ± 8.3 ^{ab}
Body weight (kg)	60.3 ± 7.2	53.4 ± 5.1 ^{ab}	59.6 ± 7.9	56.8 ± 2.1 ^{ab}
Body mass index (kg/m ²)	20.8 ± 1.9	21.2 ± 1.7	20.3 ± 1.5	22.2 ± 2.0
Percent of body fat (%)	11.5 ± 4.1	25.1 ± 4.4 ^{ab}	8.9 ± 2.0	29.4 ± 4.5 ^{ab}
Body fat mass (kg)	7.1 ± 3.1	13.6 ± 3.5 ^{ab}	5.4 ± 1.7	16.7 ± 2.6 ^{ab}
Lean body mass (kg)	51.6 ± 10.4	40.0 ± 2.0 ^{ab}	54.2 ± 6.2	40.1 ± 2.8
Skeletal muscle mass (kg)	50.4 ± 5.1	37.6 ± 1.8 ^{ab}	51.4 ± 5.9	37.8 ± 2.5
Stiffness index	116.1 ± 14.3	116.9 ± 11.5	109.4 ± 21.6	119.0 ± 18.5 ^{ab}
Physical activity level	2.8 ± 0.6	2.6 ± 0.4	2.9 ± 0.1	2.8 ± 0.1

Values are shown as means ± standard deviations for individual groups. Total n = 37. ^a*p* < 0.05 vs. male cross-country skiers. ^b*p* < 0.05 vs. male speed skaters.

Ltd., Muntinlupa City, Philippines).

The meal survey was distributed on the same day as the physical measurements. All participants monitored their meal intakes for 1 or 2 months using the food intake frequency survey method developed by Takahashi *et al.* (FFQg) [14]. Each participant self-recorded the time spent in daily life activities to determine the physical activity level, and these data were used to estimate the required amount of energy. Nutrient intakes were compared with the Japanese dietary standard: 2.00 (1.90 to 2.20) [15].

The standard value at the time of the study was based on the Japanese meal intake standard (2010 version) with a physical activity level of 2.00 (1.90 - 2.20). The amount of consumed energy was compared with the estimated energy requirement for the standard Japanese diet: 2.00 (1.90 - 2.20) and the high energy requirement. A dispersion analysis, performed using the verification method, determined a difference of <5% (SPSS 11.0 J).

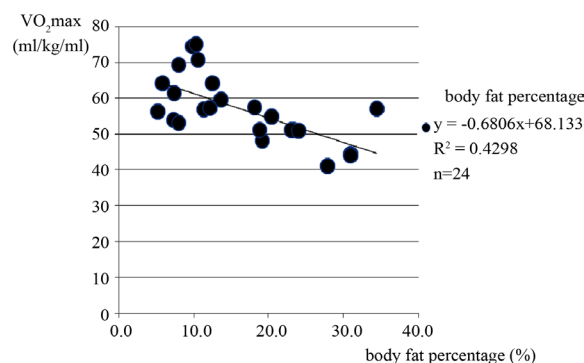
3. Results

3.1. Body Compositions of the Subjects

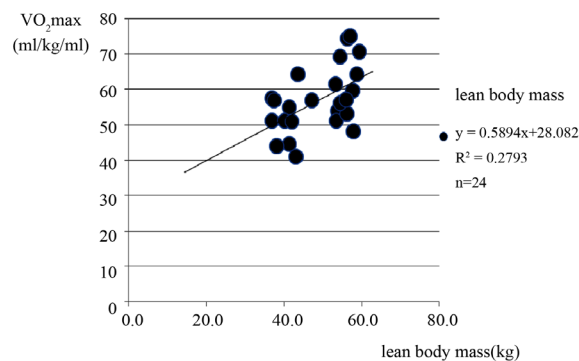
The average heights and weights of the subjects were compared to those from a national health and nutrition survey in 2012. The female speed skaters had a higher average weight relative to the 2012 national survey results. Significant sex-related differences were observed in body fat ratios. In addition, the physical activity level (PAL) of participants in the study exceeded the PAL of 2.0 for the body activity level in the Japanese Standards for Food Intake (2010 Edition). No significant differences were observed among participants or between sexes in terms of stiffness index values.

3.2. Maximum Oxygen Intake, Heart Rate, and Blood Glucose Level

Table 2 presents the maximum oxygen intake, heart rate, and blood lactate values at the highest blood pressure achieved when using a treadmill. Among male study participants, speed skaters had a significantly higher average maximum oxygen intake per kg body weight, compared with cross-country skiers. By contrast, no significant difference was observed among female athletes. We established a clear relationship between the VO_{2max} , body fat percentage, fat quantity, fat amount, and muscle mass. The free fat mass correlated positively with the muscle mass, whereas the body fat percentage correlated negatively with the fat mass. As shown in **Figure 1**, a higher the body fat percentage, corresponded to a lower VO_{2max} , whereas a higher the fat free mass corresponded to a higher VO_{2max} . The maximum heart rate at the peak maximal oxygen uptake did not differ significantly among the groups of athletes. The highest lactic acid level indicates the extent to which the lactic acid mechanism is mobilized during the energy acquisition process of a muscle contraction. The energy during short-interval maximum exercise is thought to depend mainly on a glycolytic supply [16]. Accordingly, from the aspect of intermediate metabolism, the highest blood lactic acid value measured after the end of the exercise is used to estimate the anaerobic exercise ability index [17] and anaerobic energy expenditure [18]. In



(a)



(b)

Figure 1. Relationships of VO_{2max} with (a) the measured body fat percentage and (b) the measured lean body mass.

Table 2. Maximum oxygen uptake (VO₂max), maximum heart rate (HRmax), and lactate levels.

	Cross-country skiers		Speed skaters	
	Male	Female	Male	Female
	(n = 11)	(n = 8)	(n = 5)	(n = 4)
VO ₂ max (ml/kg/min)	56.2 ± 4.8	51.8 ± 4.9	70.8 ± 4.4 ^{abc}	48.2 ± 7.2
HRmax (bpm)	200.6 ± 10.9	186.4 ± 5.1	193.0 ± 6.9	194.0 ± 7.7
Lactate (mM)	10.8 ± 2.0	11.0 ± 3.2	14.9 ± 4.3	15.4 ± 3.2

Values are shown as means ± standard deviations for individual groups. Total n = 28. ^a*p* < 0.05 vs. male cross-country skiers. ^b*p* < 0.05 vs. male speed skaters. ^c*p* < 0.05 vs. female speed skaters.

this study, no significant inter-group differences were observed in the highest lactic acid intake levels.

3.3. Energy and Nutrient Intake

Tables 3-6 present the daily energy amounts and nutrient intakes of the subjects, while **Figure 2** presents the intake ratios by sex and sport type (In/St) with respect to the recommended dietary allowance (RDA), adequate intake (AI), and tentative dietary goal for preventing lifestyle-related diseases (DG) for each nutrient according to the Japanese dietary intake standard (2010 version). The intake of the three major nutrients was small in all groups. All groups reported a higher-than-baseline protein intake. The lipid intake amount met the DG in all groups except for male speed skaters. None of the groups met the standard carbohydrate intake value.

3.4. Nutrition Ratio

Table 7 lists the intake ratio of each nutrient and food. In all groups, the protein energy ratio was within the range. In all groups except speed skaters, the lipid energy ratio was equal to or exceeded the upper limit of the DG for fat energy. In all groups, the carbohydrate energy ratio was considered desirable, whereas the grain energy ratios were below the reference values.

3.5. Ratios of Amounts of Consumed Foods by Food Group to Standard Quantities

Tables 8-11 present the foods in each food group reported by the survey participants, and the amounts of consumed food by food group are used to determine whether the food composition satisfies the dietary intake criteria. All participant groups reported either an excess or deficiency in various food groups. Regarding sweets, preference drinks, and sugars, all groups had low total In/St values, and the intakes were considered to be lower than the reference values (**Tables 8-11**). As shown in **Tables 12-15**, however, the intakes of confectionery were larger than the reference value in all groups, with values of 1.72 - 3.71 times higher than those reported for similarly aged men and women.

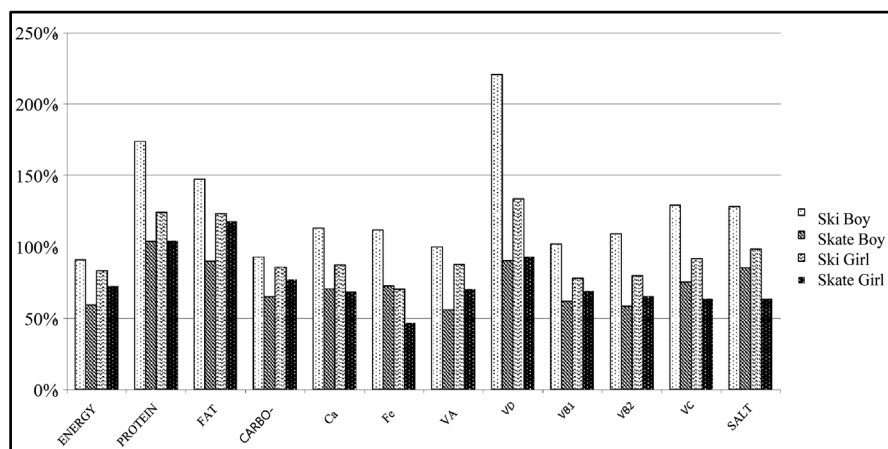


Figure 2. Nutritional intake ratios. Japanese food intake standard (2010); Physical activity level: 3.

Table 3. Nutritional intakes of male cross-country skiers.

Nutrients	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				15 - 17- year-olds	Survey results
Energy (kcal)	2735 ± 533	88	3100	2504	109
Protein (g)	100.8 ± 25.3	168	60	86.1	195
Lipid (g)	98.3 ± 24.4	143 ^{*5}	68.9 - 103.3	81.2	121
Carbohydrate (g)	349.5 ± 71.2	90 ^{*6}	387.5 - 542.5	344.3	102
Calcium (mg)	870.4 ± 408	109	800	550	158
Fe (mg)	10.2 ± 2.9	107	9.5	8.2	124
Retinol (µg)	854 ± 295	95	900	597	143
Vitamin D (µg)	9.6 ± 5.3	213	4.5	6.8	141
Vitamin B ₁ (mg)	1.5 ± 0.5	100	1.5	1.15	130
Vitamin B ₂ (mg)	1.82 ± 0.6	107	1.7	1.37	133
Vitamin C (mg)	120 ± 66	120	100	86	140
Total amount of dietary fiber (g)	15.1 ± 4.7	-	-	14.1	107
Salt (g)	11.2 ± 2.8	124	9.0	11.0	102

n = 18. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Japanese food intake standard (2010); Physical activity level: 3. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to peers who responded to the National Health and Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*5}The ratio of the lipid intake quantity to the target quantity when the energy ratio is 20%. ^{*6}The ratio of the carbohydrate intake quantity to the target quantity when the energy ratio is 50%.

3.6. Awareness of Food Habits

The results of the questionnaire survey are shown in **Table 16**. In response to the question “Do you know your proper weight?”, >60% of subjects (excepting

Table 4. Nutritional intakes of male speed skaters.

Nutrients	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				15 - 17-year-olds	Survey results
Energy (kcal)	1852 ± 371	60	3100	2504	74
Protein (g)	62.1 ± 19.8	104	60	86.1	72
Lipid (g)	61.9 ± 19.2	90* ⁵	68.9 - 103.3	81.2	76
Carbohydrate (g)	253.2 ± 38.9	65* ⁶	387.5 - 542.5	344.3	74
Calcium (mg)	565 ± 276	71	800	550	103
Fe (mg)	6.9 ± 3.4	73	9.5	8.2	84
Retinol (µg)	504 ± 230	56	900	597	84
Vitamin D (µg)	4.1 ± 1.9	91	4.5	6.8	60
Vitamin B ₁ (mg)	0.92 ± 0.3	61	1.5	1.15	80
Vitamin B ₂ (mg)	0.99 ± 0.3	58	1.7	1.37	72
Vitamin C (mg)	75 ± 44	75	100	86	87
Total amount of dietary fiber (g)	9.9 ± 4.6	-	-	14.1	70
Salt (g)	7.4 ± 2.6	82	9.0	11.0	67

n = 5. *¹In/St: Intake quantity/Standard value. *²Japanese food intake standard (2010); Physical activity level: 3. *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to peers who responded to the National Health and Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁵The ratio of the lipid intake quantity to the target quantity when the energy ratio is 20%. *⁶The ratio of the carbohydrate intake quantity to the target quantity when the energy ratio is 50%.

Table 5. Nutritional intakes of female cross-country skiers.

Nutrients	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				15 - 17-year-olds	Survey results
Energy (kcal)	2081 ± 371	83	2500	1828	114
Protein (g)	68.4 ± 19.8	124	55	66.5	103
Lipid (g)	68.7 ± 19.2	124* ⁵	55.6 - 83.3	62.3	110
Carbohydrate (g)	267.2 ± 38.9	86* ⁶	312.5 - 437.5	242.8	110
Calcium (mg)	568 ± 276	87	650	456	125
Fe (mg)	7.4 ± 3.4	70	10.5	6.7	110
Retinol (µg)	570 ± 230	88	650	491	116
Vitamin D (µg)	6.0 ± 1.9	133	4.5	6.0	100
Vitamin B ₁ (mg)	0.9 ± 0.3	75	1.2	0.87	115
Vitamin B ₂ (mg)	1.1 ± 0.3	79	1.4	1.1	100
Vitamin C (mg)	91.0 ± 44	91	100	78	117
Total amount of dietary fiber (g)	12.4 ± 4.6	-	-	12.3	100
Salt (g)	7.4 ± 2.6	99	7.5	9.0	82

n = 10. *¹In/St: Intake quantity/Standard value. *²Japanese food intake standard (2010); Physical activity level: 3. *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to peers who responded to the National Health and Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁵The ratio of the lipid intake quantity to the target quantity when the energy ratio is 20%. *⁶The ratio of the carbohydrate intake quantity to the target quantity when the energy ratio is 50%.

Table 6. Nutritional intakes of female speed skaters.

Nutrients	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				15 - 17-year-olds	Survey results
Energy (kcal)	1816 ± 360	73	2500	1828	99
Protein (g)	57.3 ± 15.0	104	55	66.5	86
Lipid (g)	65.5 ± 24.4	118* ⁵	55.6 - 83.3	62.3	105
Carbohydrate (g)	240.1 ± 42.4	77* ⁶	312.5 - 437.5	242.8	99
Calcium (mg)	444 ± 188	68	650	456	97
Fe (mg)	4.9 ± 1.4	47	10.5	6.7	73
Retinol (µg)	457 ± 164	70	650	491	93
Vitamin D (µg)	4.2 ± 1.7	93	4.5	6.0	70
Vitamin B ₁ (mg)	0.8 ± 0.3	69	1.2	0.87	95
Vitamin B ₂ (mg)	0.9 ± 0.3	66	1.4	1.1	84
Vitamin C (mg)	64 ± 21	64	100	78	82
Total amount of dietary fiber (g)	8.0 ± 2.4	-	-	12.3	65
Salt (g)	4.8 ± 1.1	64	7.5	9.0	53

n = 4. *¹In/St: Intake quantity/Standard value. *²Japanese food intake standard (2010); Physical activity level: 3. *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to peers who responded to the National Health and Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁵The ratio of the lipid intake quantity to the target quantity when the energy ratio is 20%. *⁶The ratio of the carbohydrate intake quantity to the target quantity when the energy ratio is 50%.

Table 7. Nutrition and food intake ratios.

	Intake situation				Standard value
	Cross-country skiers		Speed skaters		
	Male	Female	Male	Female	
Protein energy ratio	14.8 ± 2.0	13.8 ± 1.9	13.2 ± 2.5	12.6 ± 2.3	10% < 20%
Lipid energy ratio	32.7 ± 4.1	32.1 ± 3.8	29.6 ± 3.8	31.6 ± 7.9	20% < 30%
Carbohydrate energy ratio	52.5 ± 5.4	54.1 ± 4.9	57.1 ± 6.1	55.8 ± 9.4	50% < 70%
Cereal energy ratio	31.7 ± 7.6	34.0 ± 5.4	39.5 ± 7.9	41.9 ± 12.5	50% - 60%* ²
Animal protein energy ratio	61.7 ± 9.2	54.9 ± 6.2	52.1 ± 11.9	61.2 ± 10.5	40% - 50%* ²

Values are shown as means ± standard deviations. *¹Japanese food intake standard (2010) *²Standard values recommended in Excel Nutrition.

male cross-country skiers) answered “I know”. More than 80% of all target groups responded that “meal time has been determined” to a question regarding food attitudes. Also, in response to the question “Do you eat meals?” Everyone responds that they do not do anything. Regarding whether the amount of snacking was adequate, >40% of the respondents answered, “Don’t you know?”

Table 8. Food intakes of male cross-country skiers.

Nutrition	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value (g) ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				Intake quantity	Ratio (%) ^{*4}
Cereals	515 ± 118	69	750	650	79
Corns	44 ± 29	49	90	58	76
Brightly colored vegetables	101 ± 57	67	150	84	120
Other vegetables and mushrooms ^{*5}	126 ± 83	39	320	181	70
Seaweed	7 ± 4	35	20	9	78
Beans	64 ± 44	64	100	50	128
Seafood	87 ± 54	73	120	55	158
Meat	184 ± 62	153	120	167	110
Eggs	43 ± 24	54	80	50	86
Milk	385 ± 261	154	250	179	215
Fruits	116 ± 169	53	220	93	125
Confectionary, Taste Beverage, Sugar ^{*5}	286 ± 134	51	557	496	58
Oils, Seeds ^{*5}	28 ± 35	140	20	18	156
Seasonings, Spices	41 ± 14	70	90	90	46

n = 18. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012. ^{*5}Classified as a similar nutrient food group; the intake amount was set as the total value.

Table 9. Food intakes of male speed skaters.

Nutrition	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value (g) ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				Intake quantity	ratio (%) ^{*4}
Cereals	420 ± 53	56	750	650	65
Corns	19 ± 21	21	90	58	33
Brightly colored vegetables	65 ± 47	43	150	84	77
Other vegetables and mushrooms ^{*5}	58 ± 42	18	320	181	32
Seaweed	5 ± 5	25	20	9	56
Beans	72 ± 81	72	100	50	84
Seafood	37 ± 28	22	120	55	67
Meat	98 ± 44	82	120	167	58
Eggs	13 ± 6	16	80	50	26
Milk	164 ± 88	66	250	179	92
Fruits	90 ± 84	41	220	93	97
Confectionary, Taste Beverage, Sugar ^{*5}	159 ± 113	29	557	496	32
Oils, Seeds ^{*5}	13 ± 6	65	20	18	72
Seasonings, Spices	34 ± 27	38	90	90	38

n = 5. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012. ^{*5}Classified as a similar nutrient food group; the intake amount was set as the total value.

Table 10. Food intakes of female cross-country skiers.

Nutrition	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value (g)* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				Intake quantity	Ratio (%)* ⁴
Cereals	405 ± 37	65	620	410	99
Corns	24 ± 9	30	80	52	46
Brightly colored vegetables	88 ± 52	63	140	78	113
Other vegetables and mushrooms* ⁵	193 ± 92	69	280	174	111
Seaweed	4 ± 3	27	15	8	50
Beans	69 ± 26	77	90	39	177
Seafood	43 ± 40	39	110	49	88
Meat	115 ± 37	115	100	119	67
Eggs	37 ± 19	62	60	43	88
Milk	155 ± 58	70	220	141	110
Fruits	71 ± 49	36	200	83	86
Confectionary, Taste Beverage, Sugar* ⁵	257 ± 138	52	492	390	66
Oils, Seeds* ⁵	24 ± 11	141	17	12	200
Seasonings, Spices	22 ± 10	28	80	75	29

n = 10. *¹In/St: Intake quantity/Standard value. *²Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012. *⁵Classified as a similar nutrient food group; the intake amount was set as the total value.

Table 11. Food intakes of female speed skaters.

Nutrition	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value (g)* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				Intake quantity	Ratio (%)* ⁴
Cereals	429 ± 36	69	620	410	105
Corns	9 ± 14	8	80	52	17
Brightly colored vegetables	63 ± 28	45	140	78	81
Other vegetables and mushrooms* ⁵	93 ± 70	33	280	174	53
Seaweed	1 ± 1	7	15	8	13
Beans	20 ± 14	22	90	39	51
Seafood	38 ± 14	35	110	49	78
Meat	114 ± 69	114	100	119	96
Eggs	18 ± 8	30	60	43	42
Milk	158 ± 104	72	220	141	112
Fruits	62 ± 32	31	200	83	75
Confectionary, Taste Beverage, Sugar* ⁵	107 ± 77	22	492	390	27
Oils, Seeds* ⁵	15 ± 8	88	17	12	125
Seasonings, Spices	13 ± 7	16	80	75	17

n = 4. *¹In/St: Intake quantity/Standard value. *²Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012. *⁵Classified as a similar nutrient food group; the intake amount was set as the total value.

Table 12. Confectionery, preference drink, and sugar intakes of male cross-country skiers.

Nutrition	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value (g) ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				Intake quantity	Ratio (%) ^{*4}
Confectionary	128 ± 76	256	50	34.4	371
Taste Beverage	152 ± 94	34	450	454.9	33
Sugar	9 ± 6	129	7	6.8	132

n = 18. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012.

Table 13. Confectionery, preference drink, and sugar intakes of male speed skaters.

Nutrition	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value (g) ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				Intake quantity	Ratio (%) ^{*4}
Confectionary	68 ± 40	136	50	34.4	198
Taste Beverage	89 ± 77	20	450	454.9	20
Sugar	2 ± 2	29	7	6.8	29

n = 5. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012.

Table 14. Confectionery, preference drink, and sugar intakes of female cross-country skiers.

Nutrition	Intake quantity (mean ± SD)	In/St (%) ^{*1}	Standard value (g) ^{*2}	National Health Survey and Nutrition Examination Survey ^{*3}	
				15 - 19-year-olds	
				Intake quantity	Ratio (%) ^{*4}
Confectionary	75 ± 36	214	35	34.8	216
Taste Beverage	171 ± 111	33	450	382.5	45
Sugar	4 ± 4	57	7	6.6	61

n = 10. ^{*1}In/St: Intake quantity/Standard value. ^{*2}Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5. ^{*3}Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. ^{*4}Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012.

Asked about the question of whether or not to eat food or cereals, everyone answered, When asked “Are you eating enough?”, all of the subjects except female cross-country skiers responded affirmatively. Also, more than 50% of participants in all groups answered that tried to consume milk. More than 75% and 65% of all respondents respectively answered the questions “Are you trying to

Table 15. Confectionery, preference drink, and sugar intakes of female speed skaters.

Nutrition	Intake quantity (mean ± SD)	In/St (%)* ¹	Standard value (g)* ²	National Health Survey and Nutrition Examination Survey* ³	
				15 - 19-year-olds	
				Intake quantity	Ratio (%)* ⁴
Confectionary	60 ± 60	171	35	34.8	172
Taste Beverage	46 ± 70	10	450	382.5	12
Sugar	2 ± 1	29	7	6.6	30

n = 4. *¹In/St: Intake quantity/Standard value *²Excel Nutrition Food Frequency Survey; Standard Value by FFQ Ver. 3.5 *³Overview of the National Health Nutrition Survey of the Ministry of Health, Labor, and Welfare in 2012. *⁴Intake ratio of subjects to 15 - 19-year-old participants in the National Health and Nutrition Survey result from the Ministry of Health, Labor, and Welfare in 2012.

Table 16. Consciousness of eating habits.

(%)	Cross-country skiers		Speed skaters	
	Male	Female	Male	Female
	n = 18	n = 10	n = 5	n = 4
Appropriate body weight				
Known	39	60	80	75
Unknown	61	40	20	25
Think about nutrition				
Think carefully	22	30	80	75
Sometimes think	50	50	20	
Do not think	28	20		25
Main dish, side dish combination				
Habitually	28			
Often	39	70	20	25
Sometimes	22	20	80	50
Almost never	11	10		25
So that there is no bias in the cooking method				
Habitually	28	20		25
Often	39	40	60	25
Sometimes	17	40	20	50
Almost never	17		20	
Meal time				
Is confirmed	89	90	80	100
Not determined	11	10	20	
Absence of meals				
Not at all	100	100	100	100
Hardly				

Continued

Eat until full				
Yes	44	60	60	50
No	55	40	40	50
Appropriate amount of snack				
Reasonable amount	50	40	60	50
More	6	10		
Unknown	44	50	40	50
Quality of eating habits				
Very good		10		25
Good	11	30	20	25
Acceptable	50	60	80	50
Slightly problematic	39			
Eat rice regularly				
Have enough to eat	100	90	100	100
Have not eaten		10		
Drinking milk				
I remember to do this	50	50		75
Sometimes I remember	28	40	100	25
Not much	22	10		
Eating beans				
I remember to do this	22	40	40	25
Sometimes I remember	56	30	60	50
Not much	22	30		25
Eating vegetables				
I remember to do this	39	100		75
Sometimes I remember	39		100	25
Not much	22			
Eating fruits				
I remember to do this	39	10	20	50
Sometimes I remember	28	70	80	25
Not much	28	20		25
Not at all	5			

eat vegetables?” and “Are you trying to eat fruits?” “We try to remember to eat them.”

4. Discussion

The relationship between cross-country skiing and speed-skating ability and

stamina is very strong. Additionally, the correlation between athletic performance and the maximum oxygen intake is very strong, as competitiveness is highly dependent on oxygen uptake [19]. Among male participants in this study, the speed skaters were significantly higher than that of cross-country skiers. By contrast, no significant difference was observed between the female athletes. Furthermore, a definite relationship was established among an individual's $VO_2\text{max}$, body fat percentage, fat quantity, fat amount, and muscle mass. Reports describe body fat percentages of 11% - 13% among male athletes and 22% - 24% among female athletes. Speed skaters in the present study had slightly higher body fat percentages. Buskirk and Taylor [20] also focused on the relationship between the $VO_2\text{max}$ and fat. Relative to a slimmer person, an obese person has a higher the $VO_2\text{max}$; however, the $VO_2\text{max}$ per body weight is higher in the obese person than in the slimmer person, and the value of the $VO_2\text{max}$ is almost equal to the value of the leaner. Furthermore, among study subjects whose body fat ratios differed from the body fat, the body weight was lower as the body weight is heavier. The results observed for female cross-country skiers and speed skaters in our study are similar to those from earlier studies, suggesting that an increase in fat weight loss is needed to improve the $VO_2\text{max}$. However, we did not observe a similar relationship between weight and body fat among male cross-country skiers and speed skaters [21]. In this study, we did not observe significant differences in the maximum lactic acid levels at the highest oxygen intakes, suggesting that cross-country skiers and speed skaters do not differ in terms of oxygen levels.

A diet survey was conducted to determine the PALs and nutritional statuses of high school-level female speed skaters and female golfers. As a result, the standards exceeded the PAL level of 2.00 (1.90 to 2.20) in all categories of Japanese meal intake standards in 2010. Saito *et al.* [22] measured overall daily consumption of Sports and PAL in the dual-marker Water Act and reported PALs ranging from 1.7 - 2.5, as well as PALs exceeding 2.5. This suggests that the survey results may have resulted from the results of the survey as a result of the study of the survey results in the survey of food intake frequency, and the number of players with high training results differs from that of many athletes with higher levels of training. By contrast, the average energy intake reported in the food intake frequency survey was below the normal range in all groups.

In 2009 statement, the American Society for Sports Medicine recommended that the protein intakes of endurance athletes should be based on data from a study of nitrogen balance [23]. The average intake of protein in the present study exceeded the Japanese dietary standard of 2.00 (1.90 - 2.20) in 2010. In 2012, however, less protein was consumed by the same age skater than in the same period of protein intake in the National Health and Nutrition Survey. In a previous study, Lemon [24] reported the risk of vitamin and mineral deficiencies at a protein intake level of <12%. The study found that the protein ratio in the target population was below 12%. However, it is difficult to determine the amount of

protein required by athletes. During aerobic training, it is reported that the disappearance of the amino acid in the exercise of the amino acid during exercise is restrained compared with the initial training of the trained person [25].

Sports players must consume sufficient amounts of sugar to replenish the energy needed for training and competition. Current recommendations suggest that they should consume >5.5 grams of sugar per kg of body weight [26]. In this study, the standard intake was lower than the standard Japanese dietary intake (1.90 to 2.20) and higher than the standard of the Japanese diet (1.90 to 2.20). When I looked at the amount of weight per kilogram, I found myself in less than a cross country skiing man. In this study, although the carbohydrate energy ratios were within the range of reference values, the grain energy ratios of all target groups were less than the reference values. Glucose can be used as energy sources. All groups in this study consumed particularly large amounts of glucose, or 1.72 - 3.71 times the levels of other peers of both sexes. The tendency to supplement energy shortages using energy derived from grains was identified as a preference for confectionery.

Although the grain energy ratio data suggested an insufficient carbohydrate intake, all subjects responded that “Are you eating enough food and cereals” except for Cross-Country Ski Championships? In a survey regarding sweets, half of the respondents reported that their consumption levels were adequate. Even an individual who is conscious of the amount of grain consumed might not understand the amount of food that should be consumed each day or a loss of appetite due to fatigue. Snacks should be selected to satisfy energy and provide nutrients that cannot be consumed in only three meals. First, grains (e.g., corn) should be consumed during meals. Reports suggest that dietary carbohydrate intake and subsequent absorption are essential to full fatigue recovery [26]. While the meal is growing, the problems of eating and eating are increasing, and the problems of eating alone are reported [27].

5. Conclusion

Nutrition guidance should be provided based on athletes' livelihoods. The study participants were able to eat meals without eating meals. Additionally, many people reported that they thought about nutrition. The survey revealed that the dietary consciousness and efforts of the researchers, as well as the nutritional intakes of the study subjects, were biased.

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