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Comparison of anthropometric, physiologic and physical properties of Iran's elite cross-country and alpine skiers

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Abstract

Sport performances and executions improve day by day, in ways that kinds of performances of elite athletes of previous decades, considered as regular and ordinary performances for nowadays athletes. Hence, new records are registered in sport fields every day. One of the most important factors in magnificent and remarkable progresses of athletes is well-timed and scientific knowledge of sport talents. Therefore, the present study was designed and executed with the purpose of comparison anthropometric, physiologic and physical properties of Iran's elite cross-country and alpine skiers. Statistical society of the present study consisted whole Iran's elite sprint and endurance skiers which were practicing in Iran national teams during 2010; including 12 elite sprint skiers with averages age of 25.42±3.95 years old, 80.22±7.67 kg weight and 178.57±3.23 cm height and 12 endurance ones with averages age of 26.71±6.15 years old, 69.08±5.61 kg weight and 179.57±3.86 cm height which selected purposefully. Anthropometric variables (like body fat percentage, muscular mass, BMI, height, weight, sitting height and length of hands), physiologic variables (as maximal oxygen consuming and lactate threshold) and physical variables (like speed, endurance, power, agility, flexibility and reaction duration) were gauged from the subjects. After classification, the outcome data were analyzed by using descriptive and perceptive statistical methods (T test). Weights and muscular masses of sprint skiers were significantly more (P=0.009 and P=0.004, respectively) and body fat percentages and Body Mass Index (BMI) were significantly less (P=0.034 and P=0.007, respectively) than endurance ones. Also, speed running records of sprint skiers were less, indeed better, than endurance ones (P=0.012) which means sprint skiers have rather agilities than endurance ones (P=0.019). In addition, maximal oxygen consumptions and lactate thresholds of endurance skiers were more than sprint ones (P=0.007 and P=.005, respectively). Sprint skiers are heavier than endurance ones, and because of gravity effect, this matter is an advantage for them, who compete in downhill. So, their speed and agility records are superior. Body fat percentages and Body Mass Index (BMI) of endurance skiers and muscular masses of sprint skiers are further than the others, which their probable reasons refer to feeding situations and kinds of sport metabolism. Also, maximal oxygen consumptions (VO2max) and lactate thresholds of sprint skiers were more than endurance ones, which concern different characteristics of the two branches. However, with regard to information shortage and some incongruous founds, further researches are required.

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Introduction

To succeed in international sport fields, various factors including physical abilities (fitting anthropometric, physiologic and physical readiness properties), skill abilities (suiting individual and team techniques and tactics) and psychological abilities (self-confidence, motivation and mental concentration) are effective (Asfarjani., 2000). Therefore, physical abilities contain an extensive part of sport trainings schedules. Sport performances and executions improve day by day, in manners that, performance qualities of last decades elite athletes considered as regular and ordinary performances for nowadays athletes. So, newer records are registered in sport fields, every day. One of the most important and effective factors of athletes' remarkable and dazzling progresses is well-timed and scientific knowledge of sport talents (Mohsenin., 1990).

Successful participation of each society in international fields indicates economic, politic, cultural development of that society. Nowadays, almost the whole countries design remarkable fundamental plans to acquire gold, silver and bronze medals in continental, world and Olympic competitions. In the sight of sport scientists, talents exploration is an intellectual, short and thrifty way for athletes' successful participation in international fields. In championship world, talents sport discovery, especially in individual and basic fields, is very important to acquire success in sport competitions. Lack of knowledge about individual differences and effective physiologic parameters in education and preparation of professional and amateur athletes, might make difficult preparation of athletes for successful participating in championship fields and competitions, and could cause extensive times and costs (Shahin Tab'e., 1998). In aspects of anthropometric, physiologic and physical properties of sprint and endurance skiers, preparation is seemed vital.

Whereas, numerous researches have investigated anthropometric, physiologic and physical properties in other sport fields, but unfortunately could hardly find a study that has investigated these properties in ski. Niinimaa *et al.,* (1979) found a positive correlation between body fat percentage and ski playing in endurance skiers of classic field, whereas thin body mass didn't concern to ski playing. Ross and Day (1972) and Song (1982) reported in their studies that alpine skiers tend to ecto-mesomorph type. Bergh (1987) and Bergh and Forsberg (1992) declared muscular skiers have advantage in endurance ski, especially in flat fields. Neumayr *et al.,* (2003) stated in their research that applied experience of success in professional alpine ski doesn't relate to unit physiologic variables, though two major parameters are high level of aerobic power and vital muscle strength. Larsson and Henriksson-Larse'n (2008) carried out their study in the purpose of investigating combination of body and execution in endurance ski and stated: it appears large amounts of fat-free muscles masses, especially in arms, are rather important in endurance ski execution. Also, Alvarez-San and Gonzalez-Badilla (2010) performed their investigations with the purpose of determining somatotype (physical type) of youngster boys and girls skiers of Spain's national class in creating maximal non-aerobic strength and power of their feet and experimentation of relation between these variants and their national rankings. They concluded mesomorph type is more common among boys, although endo-mesomorph type is rather common among girls. Sport rankings significantly correlated among boys with muscular mass and also jumping ability, non-aerobic power, mean power and maximal dynamic strength in Scott test. But, no correlation was seen among girls. None of variables of Wingate test, except mean power and only among boys, correlated with sport rankings, Sto"ggle *et al.,* (2010) declared strength and speed are the major determining factors of endurance ski in sprint ski field.

Therefore, the present study was designed and executed with the purpose of investigating comparison of anthropometric, physiologic and physical properties of Iran's elite cross-country and alpine skiers.

Material and methods

Subjects

Statistical society of this study involves the whole Iran's elite sprint and endurance skiers who were training in Iran national teams during 2010. By performed accordance with center of examination and development of physical abilities of Iran's Olympic national academy, 24 elite sprint and endurance skiers were selected purposefully after receiving approvals. It should be mentioned, test situations were the same for the whole subjects. They're 12 Iran's elite alpine skiers with averages age of 25.42±3.95 years old, weight of 80.22±7.67 kg and height of 178.57±3.23 cm and also 12 Iran's elite cross-country skiers with averages age of 26.71±6.15 years old, weight of69.08±5.61 kg and height of 179.57±3.86 cm.

Information Collecting

Anthropometric variables (like body fat percentage, muscular mass, Body Mass Index (BMI), height, weight, sitting height and length of hands), physiologic variants (as maxima oxygen consuming and lactate threshold) and physical variables (like speed, muscular endurance, power, agility, flexibility and reaction time) of the subjects were measured. In order to collect information and data, plastic band meter (with accuracy of 1 mm to measure lengths and circumferences of various limbs), caliper (with accuracy of 0.05 mm to measure widths of various limbs), Height-Measuring device (made in Iran Satrap Co. with accuracy of 1 mm to measure heights), Weight-Measuring device (made in Germany with accuracy of 0.5 kg to measure bodies weights), Instantaneous Speed Measurement device (made in Iran Satrap Co. for 40 yards running), DH Time device (made in Iran satrap Co. to measure reaction time), treadmill (to gauge maximal oxygen consuming and lactate threshold, equipped by maximal test system, Yunt900 model, made in Italy Techno gym Co.), Body Composition Analyzer device (made in Korea Biospace Co.), Illinois device (made in Iran Satrap Co. to measure agility), Ergo-Jump device (made in Iran Satrap Co. to measure explosive power according to Dr. Bosco's protocol), Sit and Reach device (made in Iran Satrap Co. to gauge flexibilities of fore and rear muscles) and Arm Stan device (to measure hands length) were utilized.

Statistical method

In order to analyze data, descriptive statistical methods (average and standard deviations) and perceptive ones (independent T test) were used. All of statistical tests were carried out using SPSS v.16 and to plat statistical charts Excel 2007 was used.

Results

Statistical description of measured variables of the present study, have represented in Table 1.

Concerning results to T test about comparison of anthropometric variables (body fat percentage, muscular mass, Body Mass Index (BMI), height, weight, sitting height and hands length) of two groups of Iran's elite sprint and endurance skiers have been shown in Table 2. Also, relating results to T test about comparing physiologic variants (VO_2max, and lactate threshold) of two groups have been shown in Table 3. Eventually, concerning results to T test about comparison of physical variables (speed, muscular endurance, power, agility, flexibility, reaction time, muscles endurance of belly and paw strength) of two group have been shown in Table 4.

As seen, significant difference in body fat percentage observed between two groups of sprint and endurance skiers (P=0.034). Indeed, body fat percentages of endurance skiers are significantly less than sprint ones. Significant differences in muscular masses between 2 groups (P=0.004). Actually, muscular masses of sprint skiers were significantly more than endurance ones. Also, significant differences in Body Mass Indices (BMIs) were seen between 2 groups (P=0.007). Indeed, Body Mass Indices (BMIs) of endurance skiers were significantly less than sprint ones. There wasn't any significant difference between heights of sprint skiers and endurance ones (P=0.653). Also, significant differences in weights of 2

groups were observed (P=0.009). Actually, weights of speed skiers were significantly more than endurance ones. There wasn't any significant difference in sitting heights of 2 groups (P=1). Also, there wasn't any significant difference in hands lengths between elite sprint and endurance skiers (P=0.653).

Table 1. Statistical description of measured variants of the present study.

Variables	Cross-Country Ski	Alpine Ski
Age (years old)	26.71±6.15	25.42±3.95
Weight (kg)	69.08±5.61	80.22±7.67
Height (cm)	179.57±3.86	178.57±3.23
Body Fat Percentage (%)	11.58±2.85	14.85±2.23
Muscular Mass (kg)	47.55±11.76	64.64±5.36
Body Mass Index (kg/m²)	21.41±1.44	25.20±2.74
Sitting Height (cm)	89.71±2.42	89.71±4.27
Hands Length (cm)	184.57±3.86	183.57±4.23
Maximal Oxygen Consuming (ml/kg/min)	68.85±3.28	57.85±8.25
Lactate Threshold (beat/min)	174.76±3.48	163.71±7.78
Speed Record (sec)	5.26±0.19	4.99±0.14
Muscular Endurance (movement times)	26.85±7.08	24.71±7.20
Power (ergo/jump test score)	39.85±6.49	40.42±2.93
Agility (sec)	16.14±0.45	15.40±0.56
Flexibility (cm)	37.57±6.47	32.85±3.38
Reaction Time (hundredth of sec)	414.29±60.05	384.43±70.14
Paw Strength (kg)	63.85±7.17	73.85±11.86
Muscles Endurance of Belly (movement times)	60.00±8.20	66.28±8.84

Table 2. T test results to compare anthropometric properties of two groups of sprint and endurance skiers.

Indices / Variables	Differences of Averages	df	T	P-value
Body Fat Percentage	3.27	22	2.389	0.034*
Muscular Mass	17.09	22	2.389	0.004*
BMI	3.79	22	3.230	0.007*
Height	11.14	22	0.461	0.653
Weight	1	22	3.1	0.009*
Sitting Height	0	22	0.000	1
Hands Length	1	22	0.461	0.653

Table 3. Results of T test to compare physiologic properties of 2 groups of sprint and endurance skiers.

Indices / Variables	Differences of Averages	df	T	P-value
VO_2max	11	22	3.275	0.007*
Lactate Threshold	11.15	22	3.475	0.005*

As seen, significant differences in VO_2max were observed between 2 groups of elite sprint and endurance skiers (P=0.007). Indeed, maximal oxygen consuming of endurance skiers was significantly rather than sprint ones. Also, significant differences in lactate thresholds of 2 groups were seen (P=0.005). Actually, lactate percentages of endurance skiers were significantly more than sprint ones.

Table4. Result of T test to compare physical properties of 2 groups of sprint and endurance skiers.

Indices / Variables	Differences of Averages	df	T	P-value
Speed	0.27	22	2.945	0.012*
Muscular Endurance	2.14	22	0.561	0.585
Power	0.57	22	0.212	0.836
Agility	0.74	22	2.704	0.019*
Flexibility	4.72	22	1.706	0.114
Reaction Time	29.86	22	0.855	0.409
Muscles Endurance of Belly	6.28	22	1.378	0.193
Paw Strength	10	22	1.908	0.081

As seen, significant differences in speeds of 2 groups of sprint and endurance skiers were observed (P=0.012). Indeed, speeds of sprint skiers were significantly more than endurance ones. There wasn't any significant difference in muscular endurance of 2 groups of sprint and enduring skiers (P=0.585). There wasn't any significant difference in powers of 2 groups, too (P=0.836). Also, significant differences in agilities of elite sprint and endurance skiers were seen (P=0.019). Actually, agilities of sprint skiers were significantly rather than endurance ones. There wasn't any significant difference in reaction times of sprint and endurance skiers (P=0.409). There wasn't any significant difference in muscles endurance of belly of 2 groups, too (P=0.193). Also, there wasn't any significant difference in paw strengths of sprint and endurance skiers (P=0.081).

Discussion

According to the founds of the present study, there were significant differences in body fat percentages of Iran's elite sprint and endurance skiers and body fat percentages of endurance skiers were less than sprint ones, which coincides with understandings of Nikolopoulos *et al.,* (2009). But, they didn't coincide with founds of Osgnach *et al.,* (2009) which reported body fat percentages of Austria's national alpine skiers as 15.9±3.7 percent, from 1997 to 2000. It's clear that Austria alpine national team is one of the best alpine national teams of world, or maybe the best one in this field. In comparison with founds of the present study, perhaps feeding situation is a reason of inconsistency in understandings. It was reported, body fat percentages of young skiers were less than national average, though they're rather they're rather than reported values of international high level endurance athletes (Niinimaa *et al.,* 1978). Maybe, age conditions of subjects in various researches is another reason of difference between previous and present founds, whereas ipsilateral understandings with founds of the present study are also observed in literature which have been pointed to them.

According to the founds of the present study, muscular masses of sprint skiers are significantly more than endurance ones, which have been confirmed by understandings of Neumayr *et al.,* (2003) and Alvarez-San and Gonzalez-Badillo (2010), though haven't been confirmed by founds of Sto"ggl *et al.,* (2010), that could mention it's inconsistency reason as elite levels of subjects. Also, based on the understandings of the present research, Body Mass Indices (BMIs) of endurance skiers were significantly less than sprint ones. Results of this part have been confirmed by founds of Osgnach *et al.,* (2009) and Sto"ggl *et al.,* (2010). In contrast, according to understandings of the present study, significant differences in weights of sprint and endurance skiers were observed. Indeed, sprint skiers are significantly heavier than endurance ones. Results of this part have been confirmed by founds of Nikolopous *et al.,* (2009) and Osgnach *et al.,* (2009). Hence, it should be declared, although many variables role in successfulness of a skier, by the way among the whole variables, importance of weight of body incisively becomes apparent, especially in high speeds (like downhill) (Osgnach *et al.,* 2009). Heavier persons have advantage in downhill. Based on understandings of the present study, maximal oxygen consuming

(VO_2max) of endurance skiers was significantly rather than sprint ones. Researches show elite male and female Nordic skiers usually have levels of VO_2max as 55-75 (ml/kg/min) and 65-95 (ml/kg/min) for women and men, respectively (Larsson and Henriksson-Larse´n 2008). Most of Nordic competitors have levels of VO_2max in ranges of 80 (ml/kg/min) or upper 70 (ml/kg/min). It was reported about Nordic men skiers, that VO_2max of under 38 (ml/kg/min) is low, 39-43 (ml/kg/min) is lower-intermediate, 44-51 (ml/kg/min) is intermediate, 52-56 (ml/kg/min) is suitable, 57-62 (ml/kg/min) is high, 63-69 is in sport level and upper 70 (ml/kg/min) is in Olympic class (LaRoche., 2007). As seen, VO_2max of Iran's cross-country national team skiers is 68.85±3.28 (ml/kg/min), so it is stated in sport range and has a distance from Olympic class, which is upper than 70 (ml/kg/min). Although, mere attention to VO_2max for successfulness in endurance sports is a mistake and other parameters should be noted, but the lack of attention to VO_2max is a greater mistake. Today, no researcher or sport physiologist could deny influence of VO_2max on endurance performance.

About 95-100% efficiency of cross-country skiers depends to their aerobic power. Maximal oxygen consuming vitally determines capacity of aerobic endurance and usually used to recognize execution capacities in cross-country skiers (Niinimaa *et al.,* 1979). Also, according to understandings of the present study, lactate thresholds of endurance skiers were significantly more than sprint ones. Lactate threshold of endurance skiers was 174.86±3.48 (beat/min) and lactate threshold of sprint ones was 163.7±7.78 (beat/min). The researchers couldn't find a study which investigated lactate thresholds of skiers. Hence, founds of the present study couldn't be compared with other understandings. However, higher lactate thresholds of cross-country to alpine ones, indicates rather endurance of cross-country skiers.

Alpine skier has shown he/she has further developed glycolytic capacity. Blood lactate accumulation of this group has shown that alpine ski produces a high level of blood lactate, which correlates with non-aerobic power, endurance and glycolytic capacity. Blood lactate accumulation indicates engagements of short and intermediate non-aerobic systems in alpine ski (Heikkinen., 2003).

Based on other founds of the present study, 40 yards sprint running records of sprint skiers were significantly less than endurance ones, which means sprint skiers have better speed than endurance ones. Another understanding of the present study indicates that muscular endurances of sprint and endurance skiers haven't any significant difference with each other. Whether, egregious differences with Olympic class skiers were existed, this contrary perhaps concerns to differences in expertise levels between the subjects of the present study and Olympic class skiers. According to understanding of the present study, sprint skiers significantly finished agility test in shorter times than endurance ones. Results of this part have been confirmed by research of Anderson *et al.,* (1990). It seems, agility is an important parameter in alpine ski. It's expectable, agility record of an alpine skier is significantly better than cross-country one. Character essence and similarity that confirm winding sprint test (the test which used for agility measurement in this study) with alpine ski competition (alpine ski consists a downhill winding motive path) could be a good reason for this significant difference.

There wasn't any significant difference in flexibility of sprint and endurance skiers in founds of the present study. In contrast, it's declared there're high levels of flexibility in competitors of alpine ski (Heikkinen., 2003). Perhaps, this difference concerns to expertise level, although rather investigations are required.

Conclusion

Eventually, it should be stated that ski match is a sport which depends to some parameters for

successfulness. Anthropometric, physiologic and physical test don't consist the whole parameters, but psychological skill, person's competitions experiences and other parameters are also vital in sport. Equipment broadcast, psychological preparation and many other parameters, role in result of a ski competition. These parameters couldn't be measured only by anthropometric, physiologic and physical tests. It should be noticed that each of these factors could play in results of a ski match and even have a greater part. Although, anthropometric, physiologic and physical tests might show agility of athlete to contrive difficulty of match in physical aspect, but anthropometric, physiologic and physical preparations aren't reliable to succeed, lonely. High physiologic capacities, desirable physical preparations and availing appropriate anthropometric properties don't make a complete certainty that an athlete will have experiences and skills and will turn to a successful ski competitor. A fine athlete with few competitions experiences perhaps is very good in these tests and has high physiologic capacities, desirable physical preparations and appropriate anthropometric properties, but he/she is still a ski competitor without high levels of expertise and experiences. There dire needs of other parameters here, which are important in ski sport, like technical and psychological properties. Also, participations in competitions and earning experiences are very important that should investigate other aspects of successfulness in ski sport in further researches.

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