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Prevalence of risk factors of cardiovascular diseases among practitioners of skiing - study on a sample of 632 subjects

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Abstract. The purpose of this study was to identify the prevalence and the relationship between cardiovascular risk factors (hypertension, sedentariness, obesity, stress, diabetes, dyslipidemia, and smoking) and cardiovascular diseases (hypertension - HTN, coronary artery disease, arrhythmias, and peripheral arterial disease) with practitioners of recreational skiing. *Material and Method.* The research was conducted on a group of 632 skiers aged between 18 and 68 practitioners of skiing in resorts in the Prahova Valley and Poiana Brasov, Romania. Questionnaires about risk factors and known cardiovascular disease, with or without treatment, were distributed. Subsequently, the data were summarized in tables and charts, and analysed. *Results.* Of all risk factors, hypertension (HTN) was reported in 31.64% of male skiers, aged 55, respectively 12.97% of female skiers over the age of 65; *sedentariness* in 38.29% of the subjects, dyslipidemia in 37.75%, stress in 31.06%, smoking in 26.56%, obesity in 21.36% and diabetes in 8.22%. Regarding cardiovascular diseases, 44.50% of the subjects with hypertension (31.64%) were under treatment, and 55.50% not. Also, heart rhythm disorders, described as palpitations (5.85%), angina pectoris described as chest pain on effort (2.05%), myocardial infarction with or without coronary revascularization (1.89%), and peripheral arteriopathy (1.42%) were recorded. Of the 632 subjects examined, 432 (68.35%) reported blood pressure values less than 140/90 mmHg, and 200 (31.64%) values of blood pressure over 140/90 mmHg. *Conclusions.* Hypertension is the most common cardiovascular disease among skiers, followed by coronary artery disease. Because of the association of several risk factors with subclinical or diagnosed and untreated cardiovascular disease, the subjects in the age group 46-55 are more exposed to the risk of worsening pre-existing conditions and to the occurrence of fatal and non-fatal cardiovascular events.

Key words: *hypertension, sedentariness, diabetes, dyslipidemia, coronary disease.*

Introduction

Recreational skiing in the Carpathians (Romania) has become a mass sport practiced by people of all ages, healthy or suffering from subclinical or diagnosed cardiovascular diseases. Ski practitioners are subjects with a medium state of physical training, who practice recreational skiing intermittently (1-2 days/week, 3-4 hours/day).

The cardiovascular risk factor is defined as the factor that through the nature, frequency and intensity that it occurs causes cardiovascular diseases (1). Cardiovascular risk factors can be classified as modifiable (hypertension, dyslipidemia, diabetes, smoking, obesity, sedentary lifestyle) and non-modifiable (age, family history of premature cardiovascular disease).

Cardiovascular risk factors are (according to the Guidelines of the European Society of Cardiology (ESC)) sex, age (men over 55, women over 65 years), smoking, dyslipidemia (total cholesterol > 5mmol/l, LDL-cholesterol > 3mmol/l, HDL – cholesterol < 1mmol/l in men and < 1.2mmol/l in women, TG > 1.7mmol/l), diabetes (glycemia ≥ 126mg at one or two repeated measurements), obesity (BMI > 30kg/m²), lack of exercise, systolic blood pressure >139mmHg and diastolic >89 mmHg (2).

Other factors that increase the risk of cardiovascular disease are stress and alcohol. The term cardiovascular disease designates a variety of diseases affecting the heart and blood vessels. Coronary artery disease is the disease affecting coronary arteries by reducing the flow of blood (1).

A person is not considered sedentary if they engage in moderate physical activity at least 30 minutes five days per week or in vigorous activity for 20 minutes three days a week (3).

The combination of moderate and intense physical activity is the ideal solution for preventing physical inactivity and implicitly diseases favored by it.

In Romania, studies of prevalence of risk factors for cardiovascular disease have focused on populations from different parts of the country (cities, villages and factories) (4-6). In the field of sports medicine there are numerous studies of physiology, physiopathology and prevalence of cardiovascular disease that focused on groups of athletes from different sports, but there is no research among practitioners of mountain sports, especially skiers and hikers (7, 8).

In countries with a tradition in mountain sports in Europe and not only, research in this area have developed progressively in relation to the increasing number of tourists and practitioners of mountain sports, so that monitoring the health and safety in the mountains has become a medical and economic priority. Studies with reference to the cardiovascular system of skiers are differentiated on topics of the physiology of effort (9-11) or physiopathology - targeting risk factors, prevalence and prevention (12-14).

The main objective of this research was to identify the main cardiovascular risk factors and cardiovascular diseases in a group of 632 practitioners of skiing, aged between 18 and 68. The secondary objective was establishing the correlation between risk factors and cardiovascular diseases in order to assess the risk of triggering or aggravating pre-existing cardiovascular diseases or fatal and non-fatal cardiovascular events, under conditions of effort in the mountains.

Material and method

A questionnaire was developed with questions formulated so as to be easily understood by respondents and include aspects of risk factors and cardiovascular diseases more common in skiers. The questionnaires followed the rules of medical ethics and deontology and the subjects gave their informed consent. The 942 forms were given for completion personally or with the help of volunteers, ski monitors, mountain rescuers, mountain guides.

The research was carried out during the skiing season from February 18 to March 8, 2011, from February 10 to March 4, 2012 and from January 25 to February 28, 2013. 520 forms were handed in Poiana Brasov and 422 in Predeal, Azuga and Sinaia. Of the 942 forms, 714 were returned, of which 632 were properly filled in with complete information to be analyzed and included in the study. The findings were summarized and included in tables and figures with risk factors and cardiovascular diseases among practitioners of skiing, distributed by age group (between 18 and over 65 years).

The subjects had an average physical training, skiing usually 1-2 days/week, 3-4 hours/day. The diagnosis of diabetes and dyslipidemia was recorded anamnestically and based on data recorded in the periodic medical examination form. The sample of 632 skiers consisted of subjects aged between 18 and 68 years. The wide age range imposed the division of subjects by age in order to facilitate an objective and dynamic analysis of risk factors and the associated cardiovascular diseases.

Statistical analysis. All the data provided by the study were stored in a Microsoft Excel database. The data processing program used was IBM SPSS (Statistical Package for Social Sciences), Version 20, for Windows.

Continuous variables have been expressed as mean±standard deviation (SD) and the discrete variables as numbers and proportion. Data on age and BMI were reported as mean with SD.

Results

The age group 18-25 was represented by 142 skiers (22.46%), the age group 26-35 by 168 (26.58%), the age group 36-45 by 154 (21.2%), the age group 46-55 years by106 (16.77%), the age group 56-65 by 58 (9.7%) and the age group over 65 (mean age 67.11 years ± 0.68) by 24 (3.70 %). Of the 632 subjects, 73.6% were men (mean age 43.66 ± 17.23 years) and 26.4% women (mean age 37.13 ± 12.26 years).

The average body mass index (BMI) was 27.87 kg/m²±4.06; 135 subjects (21.26%) had a BMI>30 kg/m², being obese (average BMI 32.56± 1.77kg/m²), 212 (33.54%) overweight (average BMI=27.59±1.32kg/m²), 285 (45.09%) subjects with normal weight (average BMI 23.46±1.63 kg/m²).

The non-modifiable risk factor (age over 55 years for men and over 65 for women) was represented as follows: 77 (12.18%) were men over 55 years old and 5 (0.79%) women over 65 years.

Among the biological and lifestyle risk factors, sedentariness or physical inactivity was recorded in 38.29% subjects and is the most common factor in all age groups with prevalence varying from under 40% until 45 years and more than 41.66% after 46 years (Table I, Figure 1); dyslipidemia (37.75%), increasing from 8.4% in the age group

18-25 to 66.66% in the age group over 65 years, with a value of 50.94% in the group 46-55 years; stress affected 31.96% of the subjects, being more frequent in the age group 46-55 years (41.50%); hypertension, manifested in 200 subjects (31.68%) - skiers said they had values of blood pressure over 140/90 mmHg, measured at one or more measurements or are treated at a family physician office - is increasing after 40 years (47.16%) to 75% over 65 years; smoking was reported in 159 subjects (26.5%), being more frequent between 26 and 45 years, and then decreases by age; obesity was recorded in 135 subjects (26.36%), with higher prevalence among the age group 46-55 (32.07%); type 2 diabetes was 5.85% and type 1 diabetes 1.26% in subjects over 40 years; moderate alcohol consumption was recorded in 6.96% of skiers (Figure 2).

Table I. Prevalence of cardiovascular risk factors by age

Age (years)		**18-25**	**26-35**	**36-45**	**46-55**	**56-65**	**> 65**	Total
Number of subjects		142 (22,46%)	168 (26,58%)	134 (21,20%)	106 (16,77%)	58 (9,70%)	24 (3,79%)	632
Cardiovascular risk factors	Arterial hypertension	7.0%	17.9%	45.5%	47.2%	53.4%	75.0%	31.64%
	Sedentarism	33.8%	35.7%	37.3%	43.4%	44.8%	41.7%	38.29%
	Stress	29.6%	31.0%	32.1%	41.5%	27.6%	25.0%	31.96%
	Obesity	5.6%	21.4%	26.9%	32.1%	27.6%	20.8%	21.36%
	Smoking	23.9%	28.6%	28.4%	24.5%	17.2%	12.5%	26.50%
	Diabetes type II	0.0%	0.0%	3.7%	14.2%	15.5%	33.3%	5.85%
	Diabetes type I	0.7%	1.2%	2.2%	1.9%	0.0%	0.0%	1.26%
	Dyslipidemia	8.5%	20.8%	41.8%	50.9%	58.6%	66.7%	37.75%
	Alcohol (moderate consumption)	1.4%	2.4%	12.7%	14.2%	6.9%	8.3%	6.96%

Table II. Prevalence of cardiovascular diseases by age

Age (years)		**18-25**	**26-35**	**36-45**	**46-55**	**56-65**	**>65**	Total
Number of subjects		142 (22,46%)	168 (26,58%)	134 (21,20%)	106 (16,77%)	58 (9,70%)	24 (3,79%)	632
Cardiovascular diseases	Treated hypertension	1.4%	5.4%	14.9%	22.6%	34.5%	58.3%	14.1%
	Untreated hypertension	5.6%	12.5%	30.6%	24.5%	19.0%	16.7%	17.6%
	Arrhythmias (palpitations)	1.4%	3.0%	6.0%	6.6%	15.5%	25.0%	5.85%
	Angina pectoris (precordial pains)	0.0%	0.0%	1.5%	2.8%	6.9%	16.7%	2.05%
	Myocardial infarction without revascularization	0.0%	0.0%	0.0%	1.9%	5.2%	8.3%	1.1%
	Myocardial infarction with revascularization	0.0%	0.0%	0.0%	2.8%	5.9%	8.3%	0,79%
	Peripheral arteriopathy	0.0%	0.0%	0.0%	2.8%	6.9%	8.3%	1.42%

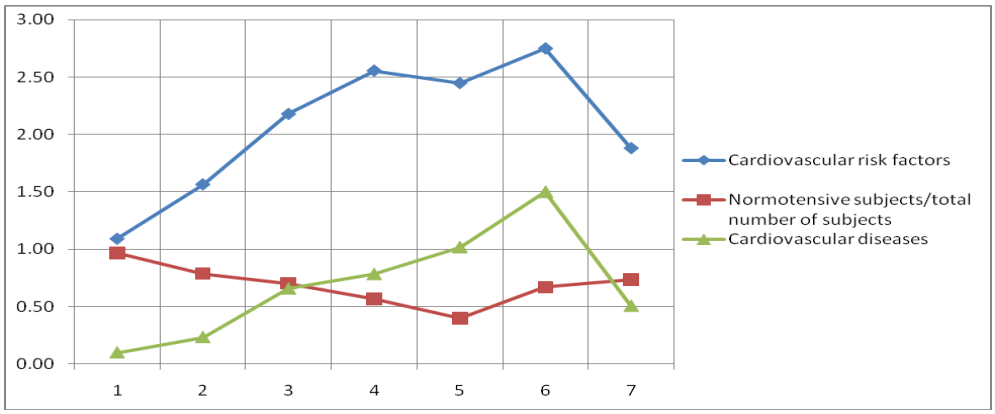

Figure 1. Risk factors in relation to normotensive subjects and cardiovascular diseases

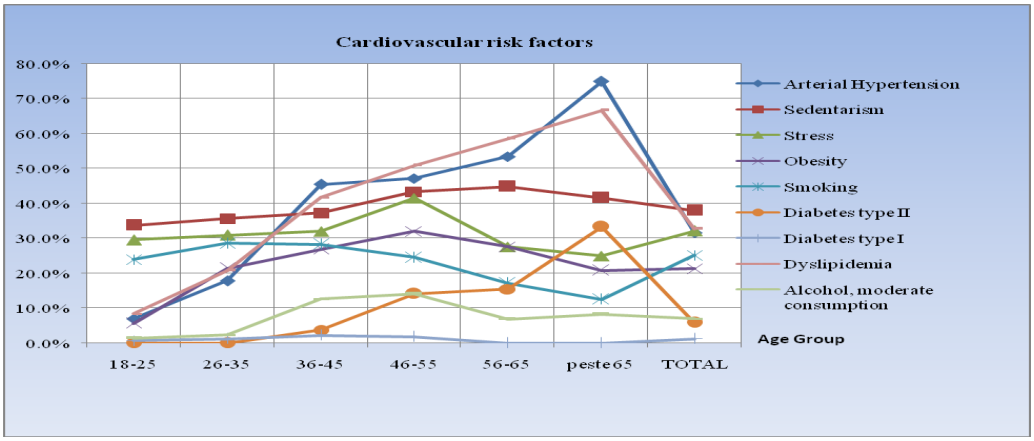

Figure 2. Cardiovascular risk factors distributed by age

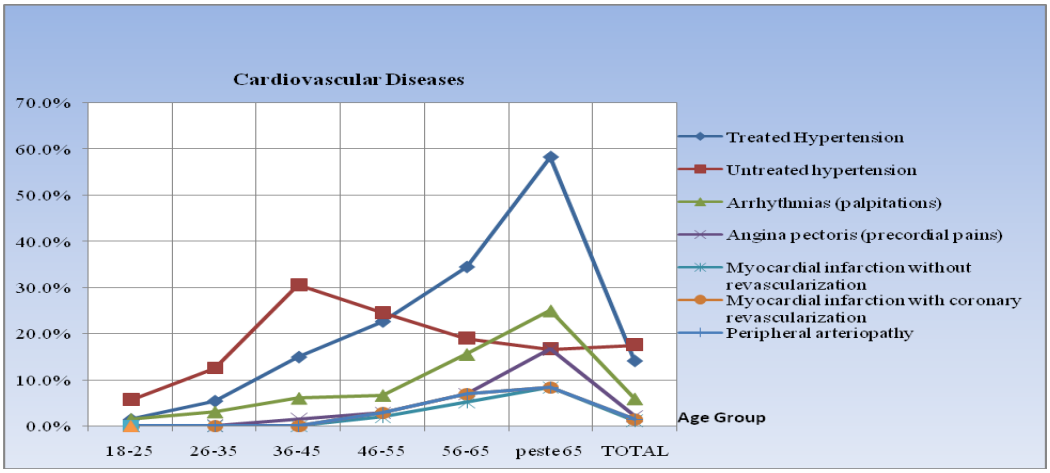

Figure 3. Cardiovascular diseases distributed by age

Among cardiovascular diseases (Table II), hypertension was the most commonly recorded among practitioners of skiing.
Of 632 subjects, 432 (68.32%) said they were normotensive and 200 (31.68%) with hypertension. Of these, 89 (44.50%) were under permanent medical treatment, and 111 (55.5%) were not or considered that there is no need to follow a certain treatment.
Among coronary artery disease, myocardial infarction was recorded in 7 skiers (1.10%), and myocardial infarction with coronary revascularization in 5 (0.79%).
Angina pectoris, described as chest pain on effort, or history of angina was recorded in 13 subjects (2.05%), not being reported by those with prior myocardial infarction.
Arrhythmias, described as spontaneous palpitations on effort (without recorded ECG), were recorded in 5.80% of cases (37 subjects).
Peripheral arteriopathy, described as intermittent claudication pain in the calf muscle at different levels of effort, was reported by 1.42% of the participants (Figure 3).

Discussions

The research aimed to determine the prevalence of cardiovascular risk factors and cardiovascular disease in a group of 632 practitioners of recreational skiing in mountainous areas with an altitude of less than 2000 m. The study included subjects aged between 18 and 68.
The type and number of risk factors vary by age and the total number of factors of the whole group was 1315; so, 88.22% of the subjects showed one or more risk factors, distributed as follows: 77 (12 97%) were non-modifiable factors (sex and age over 55 years for men and 65 years for women) and the remainder were determinants. 31.64% of the subjects had hypertension, and 43, 61% other factors. The number of risk factors increases progressively by age as follows: from 1.09 at age group 18-25 to 2.56 associated factors on a subject aged 46-55 and up to 2.75 associated factors in subjects over 65 years (Figure 1).
The association of risk factors is differentiated by age; hypertension is the predominant factor for two age groups: 44.50% between 18 and 45 years and 65.5% over 45 years (Figure 2). The association of blood pressure with 1-2 risk factors increases the total additional risk from low risk to very high risk in relation to blood pressure (2), and the association of three or more risk factors, with metabolic syndrome and subclinical organic injuries increases the additional risk from moderate to high and very high. Low moderate, high and very high risk refers to fatal or non-fatal cardiovascular events within a period of 10 years. The additional term indicates that the risk is greater than average in all categories. In the subjects aged 18 to 45, hypertension is followed by sedentariness (35.50%), then stress (30.63%), smoking (27.62%), dyslipidemia (23.19%) and obesity (15.76%). Over the age of 45, dyslipidemia is the dominant factor (55.30%), followed by sedentariness (43.60%), stress (35.10%), obesity (29.2%), smoking (20.74%) and diabetes 9 (6.96%).
Alcohol consumption is a modifiable, debatable risk factor, which should be discussed when combined with other risk factors and cardiovascular diseases in the context of practicing a sport of intense effort, in a mountainous climate and under conditions requiring attention and precise coordination of activities.
Research carried out in the last 30 years claims that consumption of alcoholic beverages daily, equivalent to 2.5 -15 g pure alcohol, can have a protective effect, reducing by 25% the risk
of cardiovascular disease by increasing HDL cholesterol, lowering fibrinogen, reducing the coronary spasm, lowering blood pressure and producing vasodilatation, including of coronary artery (15).
Excessive consumption on the other hand affects the cardiovascular system, being a risk factor for hypertension, cerebral vascular accidents, heart failure. Alcohol consumption in skiing and in sport in general decreases performance, attention and thus leads to various accidents.
Practitioners of skiing over 65 years, who had skied from their youth and live in or around mountain resorts, know their limits in terms of effort and mountain environment and treat their diseases. In fact, in their case it is a process of self-selection: skiing or other sports are practiced by those who are better trained, with a good health condition that allows effort, reducing the risk of stroke.
Among cardiovascular diseases, untreated hypertension was recorded in 111 subjects (55.5%), more frequently in age groups under 45. Between 46-55 years the number of untreated hypertensive patients (24.5%) is substantially equal to those under hypertensive treatment

(22.6%), and after 55 years, 60.36% are under permanent treatment and only 30.63% without treatment (Table II). Subjects with hypertension under treatment associate 2-3 risk factors, so that multiple treatment is used.

Untreated high blood pressure is due to several factors; the subjects considered that blood pressure values are not so high as to affect their health, or they are not monitored by a doctor, while others avoid drug therapy, practice a particular sport and follow a certain diet. Under conditions of effort untreated subjects can make hypertensive jumps with a high risk of cardiovascular events. Subjects with hypertension under medication are less prone to hypertensive jumps and hence to the risk of worsening pre-existing conditions or to fatal or non-fatal cardiovascular events (2).

Coronary artery disease, sequelae of myocardial infarction and chest pain with a history of angina represent 3.94% of cases (Table II and Figure 3).

It is prudent to consider arrhythmias (present in 5.83% of the subjects over 40 years, described as palpitations and associated with hypertension and other risk factors) heart rhythm disorders in the context of coronary damage; similarly for the assessment of precordial chest pain of angina pectoris.

Patients with sequelae of myocardial infarction practice skiing as a recreational sport; they know their limits in terms of effort, they monitor their blood pressure, electrocardiogram and lipid profile and follow a treatment. The risk of a fatal or non-fatal cardiovascular event is not higher than in other sports that require effort of the same intensity (13).

In practicing skiing, and other sports, the subjects self-evaluate and self-select based on their health condition and tolerance to effort.

In a similar study (between 2011 and 2013 in the Bucegi Mountains, on the route from Busteni - 850m to Omu Peak - 2505 m), which I made on a group of 236 subjects, aged between 18 and over 65, practitioners of trekking, the prevalence of risk factors and cardiovascular disease was: hypertension 29.3%; sedentariness 36.4%, increasing from 21.4% in the age group 18-25 to 45 8% in the age group 46-55 and 57.1% in those over 65 years; obesity 13.1%, with values of 20.8% in age group 46-55; stress 30.9%, higher in age groups 25 -36 (34.8%) and 36-45 (37%); diabetes - 4.2%, dyslipidemia - 15.3%, with values between 31.3% and 42.9% in age group 56 and over 65; smoking - 20.3%, higher with age groups 25-36 (34.8%) and 36-45 (37%). As for cardiovascular diseases, from the 236 subjects, 161 (68%) said they were normotensive and 32% with high blood pressure.

Treated hypertension was recorded in 35.5% of subjects and untreated hypertension in 64.5%. Arrhythmias, described as palpitations, represented 3.1%; retrosternal pain with a history of angina 1.9%; myocardial infarction 1.2% and peripheral arteritis 2.1%.

The comparative study of prevalence and risk factors of cardiovascular disease recorded for practitioners of hiking and skiing shows that: the percentage of the sedentary, obese, smoking hikers suffering from dyslipidemia, diabetes, and hypertension is 20.80%, while that of skiers 28%. The difference shows that practitioners of hiking are apparently healthier and practice a physical activity or sport with high calorie consumption on a regular basis.

Vascular diseases with peripheral vascular and coronary affection (sequelae of myocardial infarction, angina pectoris, arrhythmias, arteritis obliterans) were 7.3% among hikers and 11.24% among skiers.

The effort of hikers to climb and descent is smaller and covers a longer period of time (10-12 hours for better adaptation of the cardiovascular system) while the skiers begin the descent quickly and from a certain altitude. So, in association with higher risk factors and cardiovascular disease, skiers may be more exposed to cardiovascular events.

The results of research conducted on a sample population who practice a sport activity can be related to other prevalence studies of cardiovascular risk factors and cardiovascular diseases conducted on larger populations in urban, rural areas or enterprises in Romania.

In the study

SEPHAR "Proiecte româneşti de cercetare a factorilor de risc cardiovascular"/"[Romanian Research Projects on cardiovascular risk factors]" (4), conducted on a sample of 2017 subjects aged over 18, hypertension was recorded in 40.1% of subjects, obesity in 24%, smoking in 29%, diabetes in 5%, dyslipidemia in 24%.

In "Studiul Urziceni – Studiu populațional prospectiv de depistare a factorilor de risc pentru bolile cardiovasculare şi intervenție în populație, depistarea precoce a bolilor cardiovasculare"/"

[Urziceni Study – a screening population prospective study of risk factors for cardiovascular disease and response in the population, early detection of cardiovascular disease]" (5) in subjects aged over 16, hypertension was recorded in 41%, obesity in 24%, smoking in 21.8%, diabetes in 5% and cholesterol in 24%.
In the study CARDIO-ZONE (6), the risk factors were present as follows: hypertension 39.1%, obesity 26.3%, smoking 21.7%, hypercholesterolemia 31.4%, diabetes 11.8% and of cardiovascular diseases: 14.2% stable angina pectoris, 2.4% myocardial infarction without revascularization, 0.6% coronary revascularization after myocardial infarction, and 3.6% peripheral arteritis.
Compared to these studies on larger population groups, my own study of the risk factors and cardiovascular diseases differs through the higher percentage of hypertensive subjects (40.1% in the SEPHAR study and 39.1% in the CARDIOZONE one). The prevalence of other risk factors is substantially equal to that determined in skiers, but increased by 9.5% compared to hikers. Cardiovascular diseases recorded by the study CARDIOZONE (angina pectoris, history of myocardial infarction, arteritis obliterans) is 20.8%.
The comparatively large percentage is due to the higher percentage of subjects with a history of angina (14.2%).
The research in mountain medicine, carried out in the French and Swiss Alps, which addresses this issue cover various aspects: a survey in the ski resorts in the Swiss and Austrian Alps and on a sample of 1043 skiers shows that 11.2% of skiers have at least one cardiovascular disease (14); another study of 934 skiers show that 5.8% of skiers have at least one cardiovascular disease and hypertension is the most common cardiovascular disease among practitioners of skiing and hiking. All persons with coronary artery disease, with or without myocardial infarction, and 79% of subjects with cardiovascular diseases are men over 40 years (16); another research shows that the prevalence of cardiovascular disease increases with age and hypertension is the most common cardiovascular disease, but with a lower frequency in practitioners of trekking (17); Burtscher's retrospective study (13) of subjects who suffered from a fatal cardiovascular event (sudden death) showed that they had a history of myocardial infarction (41%), hypertension (50%), coronary artery disease without previous myocardial infarction (9%) and did not practice a sport on a regular basis.
This research shows that the prevalence of coronary disease with skiers and hikers in the Alps is between 5.8 and 12.7%, compared with my studies where the prevalence of coronary and peripheral arterites was 7.3% for hikers and 11.24% for skiers.

Conclusions

Mountain sports and especially recreational skiing are practiced by an increasing number of people with good health condition and of different age. The particularity of this study was to determine the prevalence of risk factors and cardiovascular disease among practitioners of a sport (skiing). The study aimed to contribute to the expansion of this field of research due to the need to assess the cardiovascular risk in these practitioners.
Though my research broadly answered these goals, it did not clarify many of the issues raised in relation to the topic of cardiovascular disease and risk factors.
Thus, due to the limited information offered by a questionnaire on prevalence, I did not have sufficient data about the dynamic values of some parameters (blood glucose, HDL and LDL cholesterol) or the blood pressure limits in order to be able to determine the total fatal or non-fatal cardiovascular risk, based on the SCORE diagram (18), or to stage the hypertension in relation to risk factors according to the ESC guidelines for the management of blood pressure.
Also, I have not established a relationship between BMI, physical activity and loss of weight, with a beneficial effect on health in general and on the cardiovascular system in particular.
However, this research set the context for a further study, in progress, which addresses these issues (Cardiovascular events with practitioners of hiking and skiing, variations of systolic, diastolic heart tension, heart rate and electrocardiogram - study on a group of 164 skiers and 164 hikers).
The study was conducted in the external mountain environment, being sometimes difficult to address skiers and capture their interest in this research. The research has practical value by developing recommendations for healthy behavior in skiing and the prevention of risk factors and cardiovascular disease.

Thus, one can conclude that skiing requires prior training by practicing other sports throughout the year; overweight people are advised to practice systematically physical activities of moderate intensity and to lose weight as a cardiovascular protective factor. It is also recommended to give up habits with increased risk factors (smoking, excessive alcohol consumption, unhealthy diet).
For the prevention of cardiovascular diseases in people with high cardiovascular risk (documented cardiovascular disease, type II diabetes, type I diabetes with target organ damage) the European guidelines for the prevention of cardiovascular disease in 2012 (1) recommends a change in lifestyle, with or without lipid-lowering treatment, depending on the level of LDL cholesterol.

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