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Backcountry Skiing as Cardiovascular Prevention? An Analysis from the Swiss Alps

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Abstract

Background: More and more people in western countries suffer from a lack of physical activity and thus a predisposition for the development of metabolic and cardiovascular diseases. However, normally humans only exercise when they have to or when it`s fun. Backcountry skiing covers partly the fun aspect and potentially reveals protective effects on the metabolism and the cardiovascular system due to continuous physical stimulation.

Material & Methods: Eight recreational backcountry skiers with good basic endurance capacity and regular backcountry skiing activity absolved a tour in the central massive of the Alps (Gotthard region) from Realp to Rotondo and Gross Muttenhorn and Stotzig First. All participants were heart rate monitored during the whole ascent and descent of the tour.

Results: Time for all ascent part of the tour were 7 h 55 min and for all descent 1 h 20 min yielding to an ascent rate of 310 ± 16 m per hour and a descent rate of 1907 ± 504 m per hour. Average heart rate of ascent was 135 ± 6 beats per minute and for descent 119 ± 3 beats per minute. Total tour showed a mean heart rate of 128 ± 4 beats per minute.

Discussion: Measured heart rates are about 75 ± 3.3 percent of theoretical heart rate max for ascent and 66 ± 1.7 percent for descent and therefore in the range of optimal stimulation of cardiovascular system respectively fat metabolism.

Keywords: Skiing activity; Metabolic syndrome; Hypertension; Obesity; Osteoarthritis

Introduction

Backcountry skiing has become more and more popular and became from a niche sport mainly practiced in spring to a common form of mountaineering over the whole season. It´s likely that in the alps the number of tourists visiting altitudes of over 2000 Meter is higher than 40 Million per year [1,2]. Taken the assumption, that one out of 4 are backcountry skiers, the astonishing number of 10 Million backcountry skiers per year result. The majority are leisure sportsmen trying to relax in the mountains combined with physical activity. From a health point of view over the last two decades it became evident, that physical activity has a large influence on a number of chronic illnesses such as some cancers, diabetes type 2, dyslipidemia, metabolic syndrome, hypertension, obesity, osteoarthritis, rheumatoid arthritis, myositis, osteoporosis and fibromyalgia [3]. The range of these illnesses is huge whereby in all low-grade inflammation seem to be pathogenic relevant [4,5]. Evidence exists, that physical activity can protect from many illnesses and allow especially to minimize cardiovascular and metabolic risks [4,5]. The overwhelmingly evidence is straight forward and indicates that many if not most of the diseases for which physical inactivity is a major risk factor are considerably less prevalent in hunter- gatherers and many populations of subsistence farmers [6]. As an example, comprehensive medical evaluations of Kalahari Bushmen which are physical active from the 1960s and 1970s found no evidence for coronary heart disease, hypertension, diabetes or dyslipidemia [6,7]. From an evolutionary point of view this yields to the question why if physical activity is good for health are humans physical inactive? As Theodosius Dobzhansky famously wrote more than 40 years ago, "nothing in biology makes sense except in the light of evolution" [6,8]. Liebermann adds a nice corollary to Dobzhansky's famous sentence to state that "nothing in biology including the obesity and inactivity epidemics makes sense except in the light of evolution" [6,8]. Despite the above mentioned and the undoubtedly positive effects of physical activites of human are just adapted to be inactive whenever possible in order to save energy and to increase potential to survive and replicate [6]. It is natural and normal to be physically lazy [6]. No one has ever done the experiment, but It was predicted that hunter-gatherers in the Kalahari or the Amazon are just as likely as 21st century Americans to instinctually avoid unnecessary exertion [6]. Although a small percentage of people today exercise as a form of medicine, doing their prescribed dose, the vast majority of people today behave just as their ancestors by exercising only when it is fun (as a form of play) or when necessary [5]. Backcountry skiing covers the positive aspect of fun from different points of views such as riding down in powder snow or having the nice view of a beautiful landscape combined with fresh air and the social element to be in the nature with colleagues in a friendly atmosphere. Undoubtedly, physical activity through backcountry skiing can modulate organ systems by different mechanism e.g. stimulation of fat oxidation yielding to positive effects on cardiovascular and metabolic affections [1-5,9-14]. Furthermore positive effects on the organ system of skeletal muscle and aspects of central nervous system [e.g. coordination & equilibrium] can be expected. [11-16] From a functional point of view backcountry skiing is a combination of endurance sports and for descent a stimulation of coordination elements and force and especially the usage of eccentric muscle contraction [11-17]

In Central Europe e.g. should perhaps read in Switzerland, given the current climatic conditions makes it possible for an extended period during which back country tours can be undertaken between November and April. Despite the potential positive aspects, the physiological requirements of recreational backcountry skiing in detail are only partly elucidated [1,2,11-14,18-20]. Although addressing partly other aspects, these study allow to assume that through backcountry skiing protective effects on metabolic and cardiovascular system are partly unveiled [1,2,11-14,18-20]. Besides the mentioned positive aspects of physical activity the counterpart, physical inactivity is to keep in mind when judging a sport concerning its benefits. Principally recommendations imply, that human need at least 30 min on 5-7 days per week with moderate intensity in order to have protective effects [21]. Given this background physical activity has a central meaning for protecting from cardiovascular and metabolic

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diseases, whereby individual measures of prevention lead to short increases of activity with unfortunately often only short duration [22]. Especially backcountry skiing due to the mentioned positive social and nature aspects the risk of a stop seems to be smaller. From an evolutionary point of view as Humans were selected to be endurance athletes the kind of activity is accustomed to the need of the body [6]. Modern hunter-gatherers of similar body mass to H. erectus and who inhabit similar arid, tropical African environments walk an average of 9 to 15 km (5 to 10 miles) per day to forage for enough food, which helps explain the evidence that the genus Homo, especially H. erectus, has many novel adaptations for long- distance trekking such as long legs, a more modern pelvis, and relatively large joints [6,23-25]. In addition, hunter-gatherers have to carry food and babies across long distances, they occasionally have to throw projectiles and climb trees, and tropical hunter gatherers typically spend 2 to 3 h a day using sticks to dig up tubers [6,25]. As one can easily follow that many movements are very similar in backcountry skiing to those of our ancestors yielding to the central aim of the study, What are the requirements on cardiovascular and metabolic system for the human body while backcountry skiing? What are the cardiac intensities confronted and what preventive potentials result from such activity? In order for potential falsification it is stated, that physical activity is not sufficient during the days of a backcountry tour [26].

Material and Methods

Participants

8 male backcountry skiers (38.7 ± 13.5/177 ± 3 cm/71.2 kg ± 3.4 kg) with good leisure sports level while absolving a backcountry tour. Participants were advised to be rested and on standard diet without consuming alcohol at least 24 h before. The study was approved by the ethic committee of north-western and central Switzerland.

Field measurements

All backcountry skiers were wearing heart rate gear during the whole tour. Starting point was Realp (1538 altitude) to Rotondo cottage (2570 altitude) the first day and the second day via Leckipass (2892 altitude) to Gross Muttenhorn (3098 altitude) and Stotzig First (2759 altitude) with descent back to Realp (Figure 1). To consider when interpreting data, that there were some technical parts in the last part before the peak of Gross Muttenhorn. Furthermore, all rests and changes of material such as skin or clothes changes as well as the short eating rests are included in the calculated numbers. Furthermore, the whole tour was absolved together, so stronger participants were always waiting for colleagues during all ascents and descents (Figure 2).

Figure 1: from left to right – Rotondo cottage (2570 altitude)/view from Leckipass (2892 altitude) to direction west to Stotzig Muttenhorn [3062 altitude] between Cantone Wallis and Uri / view from Gross Muttenhorn (3098 altitude).

Equipment

All participants were wearing A300 of Polar (Zug / Switzerland), which allowed via Software (FlowSync) an analyze of the time/heart rate relationship.

Statistical Analyses

Average rates of ascent and descent were calculated as arithmetic mean. Concerning heart rate averages and standard deviations for participants of all ascents and descents were calculated. Theoretical maximum heart rate was calculated with formula 220 minus age [27]. All single samples were tested with Shapiro-Wilks Test on normal distribution, whereby hypothesis of alpha = 0.1 Level could not be rejected for all subpanels [28,29]. Differences of heart frequency from ascent (average of all) and descent (average of all) were tested concerning significant differences with two sided, paired heteroscedastic t-Test [28,29]. Analyses were made with Graph Pad Prism 5.0 and Microsoft Excel.

Results

Heart rates of ascents versus descents were individually pairwise matched and revealed a p-value of 0.015 for n = 8 participants implying higher heart rates while ascent versus descent. Keep in mind when interpreting, that the sample had an average age of 39 years yielding to a theoretical heart rate max of 181 beats per minute. For ascent an exertion of about 75 ± 3.3 percent of theoretical (135 ± 6 out of 181) heart rate max and for descent 66 ± 1.7 percent of heart rate max (119 ± 3 out of 181) and for the whole tour 70.7 ± 2.2 percent of heart rate max (128 ± 4) resulted. The average altitude absolved was 310 ± 16 meters for ascent and 1907 ± 504 for descent. As a rule of thumb concerning estimated calories used for the whole tour depending on age, size and weight (keep in mind the always large interindividual differences) for the first day with 3 h 10 min of ascent of around 2,000 kcal respectively 8,000 kJ and for the second day with 4 h 45 min of ascent and 1 h 20 min of descent around 3,500 kcal respectively 14,000 kJ are probably affordable (the energy of nearly ten standard chocolate tables 100 gram) [27].

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Discussion

The aim of the study was to explore the cardiac intensities and preventive potentials resulting from backcountry skiing for cardiac and metabolic diseases. For this purpose, eight recreational backcountry skiers absolved a tour in the central massive of the Alps (Gotthard region) in Switzerland. Undoubted the analyzed sample underlies a positive selection bias concerning endurance capacity when compared to average population in Switzerland. However, populations in civilized countries gain more and more weight predisposing cardiac and metabolic affections with a need for either reduction of energy intake or increase of physical activity or both [3,6,10,27-31]. The analyzed sample reached an average of 70.7 % ± 2.2 % of heart rate max respectively 128 ± 4 beats what equates a typical endurance activity 27. (Figure 3). From an energetic point of view it's to mention, that during some parts of the tour intensity was low allowing to save glycogen reserves while using especially fat oxidation with respective positive effects on obesity and cardiovascular diseases [9,10,15,27]. Furthermore, 70.7% of heart rate max is about 60 - 65% of VO_2 max, whereby studies revealed that exertion in the range of 65–75% VO2 max uses the most fat, a value that is achieved when only looking at ascent with 75 percent of Heart rate max [9,32-35]. To order in, relative share of fat for energy consumption seems to be constant in the range of 55–75% VO_2 max with about 50.9% With 65% VO_2 max with 0.5 to 0.6 gram fat per minute the highest fat burning rate is achieved – a value close to the measured one of 66 for descent of the backcountry tour - although large individual differences have to be considered [32-36]. To sum up, ascent has to be taxed based on measured heart rates of the sample as good cardiovascular training with 75% of Heart rate max and descent for stimulation of fat metabolism with 66 percent of Heart rate max. (Figure 4) Especially the aspect that based on newer studies untrained athletes have highest fat oxidation rate with 65% VO_2 max respectively around 70 Heart rate max the area is very close to the one detected in the analyzed sample predisposing backcountry skiing as preventive mean [37,38]. Concerning an analysis of total energy consumption, the whole tour revealed an estimated additional energy consumption besides basal metabolic rate of around 2,500 kcal a day considering the weight of the sample an average of about 4,300 kcal a day results. To compare, average total energy expenditures of hunter-gatherers are approximately 2,600 to 3,000 kcal a day for males and 2,000 to 2,600 kcal a day for females [6]. Coming back to the initially stated hypothesis that physical activity is not sufficient during the days of a backcountry tour this can be principally rejected. However, when comparing calories amount that despite the long tours during the two days total amount does not exceed amounts of our ancestors by large extent implying the huge amount of physical activity necessary when willing to reach levels of our ancestors. This seems to be unrealistic when confronted with real requirements in civilized countries, but pinpoints that backcountry tours from energetic aspects are easily tolerated by human bodies. In principal, there is no minimum dose of exercise, no optimal dose, and no dose without risks or negative consequences [6]. For example, while exercise has many benefits for cardiovascular function, it does not prevent some forms of heart diseases and may actually be harmful in certain doses due to specific adaptions [6,39]. Put differently, an evolutionary perspective predicts that while an absence of physical inactivity almost certainly increases the chances of morbidity and mortality, exercise is not a guarantee of good health and inevitably involves trade-offs [6]. For example, people who exercise to lose weight have to cope with increased hunger and metabolic shifts, presumably because these reactions are adaptations to regain energy balance [6,40]. However, it has been proven that capacity to fat oxidation is dependent from physical activity [10,41]. Continuous endurance training yields to adaptions in skeletal muscle [10]. Most important are an increase of density of mitochondria up to 50% [42] and an increase of intramuscular triglycerides (IMCL)[43] as well as an increase of oxidative capacity of muscle fiber [44]. To sum up, based on the above-mentioned backcountry skiing seems to be a reasonable way for stimulating cardiovascular and metabolic mechanism and can have protective potentials. When encouraging humans for backcountry skiing e.g. by General practioners doing the sport with friends (e.g. in a SAC-Group) is probably best suited also for security reasons for a continuous and avid activity.

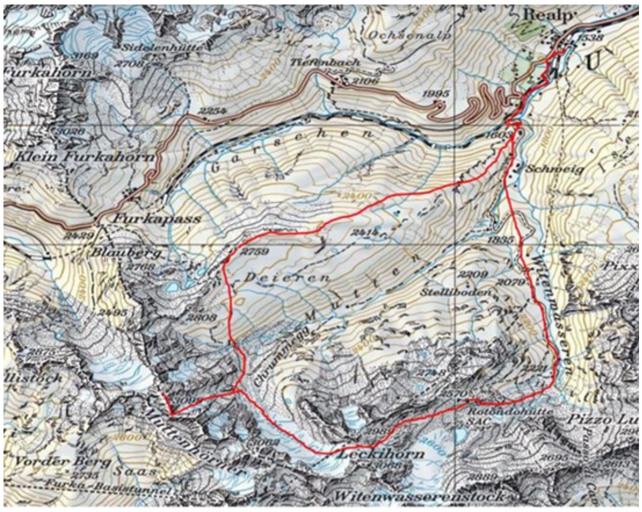

Figure 2: the red ascent line from Realp (1538 altitude) to Rotondo cottage (2570 altitude) and Leckipass (2892 altitude) to Gross Muttenhorn (3098 altitude) and Stotzig First (2759 altitude) with descent back to Realp in Cantone Uri border to Wallis, Switzerland.

Practical implications

Populations in western or civilized countries gain more and more weight-But still people today behave just as their ancestors by exercising only when it is FUN (e.g. as a form of play) or when necessary [6,40].

Backcountry skiing seems therefore to be a reasonable possibility as activity due to exercising in a nice landscape with friends and the fun factor of downhill skiing after reaching the peak.

In principal for all exercise activity, there is no minimum dose, no optimal dose, and no dose without risks or negative consequences, but the measured requirements respectively cardiac stimulation while Backcountry Skiing reaches with around 70 percent of heart rate max an optimal range for stimulation of different organ systems [3,6,27,40].

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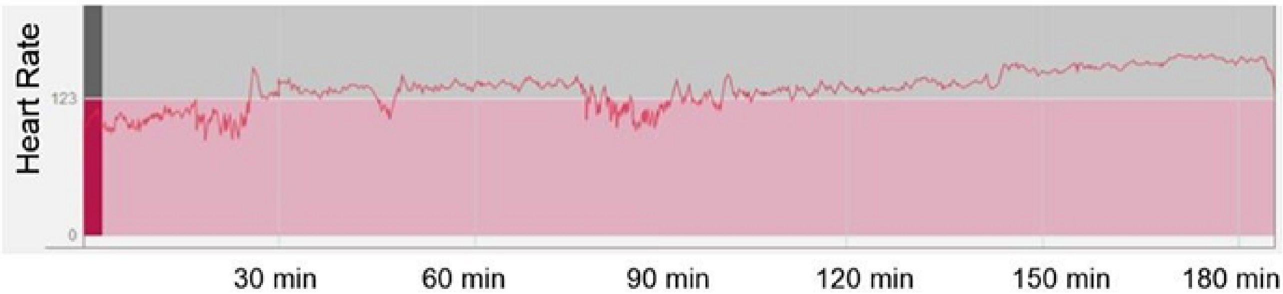

Figure 3: A typical relatively steady pattern of a backcountry skier while ascent from Realp to Rotondo Cottage with a continuous increase of Heart Rate. Heart Rate was between 78 to 162 beats per minute yielding to a mean of 131 beats per minute for the whole part. Grey (75% of total time) and pink (25%) of total time indicating the approximate range of optimal stimulation of cardiovascular respectively fat metabolism

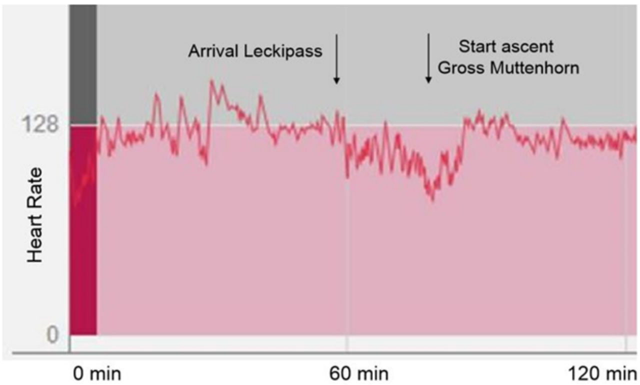

Figure 4: The first two hours of the second day from Rotondo Cottage to Leckipass and down to Chrummegg. Clearly indicating the expected decrease during descent.

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