

Effect of weekly hiking on cardiovascular risk factors in the elderly

Introduction

It is well established that regular physical activity provides numerous health benefits, including reducing the risk for a variety of diseases (e.g. coronary heart disease, stroke, cancer, diabetes) and improvements in functional ability [14]. Nowadays, scientific literature recommends regular (≥ 3 days/week) moderate- to vigorous-intensity physical activity, with a total volume of ≥ 150 min/week for healthy adults, the elderly and even for different patient groups [1, 4, 14]. However, due to time constraints, some individuals may choose to compress their weekly exercise into a single prolonged session. Studies addressing such a practice are scarce and outcomes are ambiguous [14]. It seems that performing just one long-lasting weekly session of moderate-intensity exercise does not reduce mortality among elderly persons already having at least one cardiovascular risk factor [9]. Conversely, men without any major risk factors may profit from such a practice in terms of reduced mortality [9] and possibly by achieving endurance gains comparable to those achieved with regular training (five sessions per week) [10].

In Alpine regions and the many areas with low mountain ranges, hiking is a very popular activity among the elderly population (>60 years) [3]. Regular hiking performed three times per week was shown to have positive effects on all key markers of metabolic syndrome [7, 15]. However, due to the time (several hours) that is usual-

ly associated with such an activity, as well as the travel sometimes required to reach the mountain or upland regions, hiking is often only undertaken at the weekend. As mentioned above, evidence for the health benefits of this practice is lacking [14]. Particularly in light of the fact that more than 6 million elderlies (>60 years) undertake mountain activities in the Alps every year [3], as well as the finding that the elderly hiker has a cardiovascular disease prevalence of $>35\%$ [6] and is at higher risk of sudden cardiac death during hiking [5], additional information on this population group could be valuable in order to adequately prescribe physical activity patterns. Therefore, the present investigation aims to study the effects of a single weekly hiking session on major cardiovascular risk factors in the elderly (age >60 years) over a period of several months. We hypothesized that the single weekly hiking session would improve cardiovascular risk profile in the elderly.

Materials and methods

Participants

Participants were recruited via a call for participants published in various local media. Inclusion criteria for the study were age >60 years and the capability to undertake easy hiking (i.e., according to their habits, participants estimated their capability to achieve a 500-m altitude increase within 3 h). Exclusion criteria were: inability to perform the hike within the

given timeframe; New York Heart Association (NYHA) class 2–4; myocardial infarction or stroke occurring within the 6 months preceding the start of the study; instable angina pectoris; multivessel coronary disease; hypertension treated with more than two medications; major surgery performed within the 6 months prior to the start of the study; all forms of cancer except prostate cancer; chronic obstructive pulmonary disease (COPD) with functional lung capacity <2 l and/or forced expiratory volume in the first second of <1 l; resting oxygen saturation $<90\%$; alcohol abuse (>100 g/d) and smoking.

The call for participation was followed by 27 elderly males and 25 elderly females. Of these, 14 males (age 65.6 ± 2.7 years; weight 78.7 ± 11.2 kg; height 177.1 ± 7.5 cm; body mass index, BMI 25.0 ± 2.2 kg/m²) and 10 females (age 66.2 ± 4.4 years; weight 60.4 ± 5.3 kg; height 163.0 ± 4.2 cm; BMI 22.8 ± 1.9 kg/m²) were eligible and completed the entire study protocol. At the start of the study, 23 participants reported undertaking hiking on a regular basis, whereas one participant hiked only occasionally. Regarding medication, seven males and seven females were receiving drug therapy comprising medication targeting either the cardiovascular risk profile—males ($n=4$): two angiotensin converting enzyme (ACE) inhibitors, calcium antagonist, diuretics; females ($n=3$): ACE inhibitor, β -blocker, cholesterol-lowering drug—or other drugs, e.g., non-steroidal antirheumatics (NSARs), thyroid, asthma and osteoporosis medica-

Tab. 1 Changes in measured parameters over the 9-month period for the entire group and in terms of gender

	Males			Females			All		
	No. participants	Pretrial	Posttrial	No. participants	Pretrial	Posttrial	No. participants	Pretrial	Posttrial
Body mass (kg)	14	78.7±11.2	79.0±12.0	10	60.4±5.3 ^a	60.7±5.1 ^a	24	71.1±12.9	71.4±13.3
BMI (kg/m ²)	14	25.0±2.2	25.0±2.5	10	22.8±1.9 ^a	22.8±1.9 ^a	24	24.1±2.3	24.1±2.5
HR _{rest} (beats/min)	12	60±7	64±8	8	59±6	60±9	20	59±7	62±9
BP _{sys} (mmHg)	14	126.9±14.3	125.6±10.0	10	122.5±13.9	122.4±12.4	24	125.1±14.0	124.2±10.9
BP _{dia} (mmHg)	14	78.0±10.1	76.6±7.6	10	76.9±6.8	75.5±4.9	24	77.6±8.7	76.1±6.5
HbA _{1c} (%)	9	5.4±0.5	5.6±0.4	7	5.5±0.4	5.5±0.3	16	5.5±0.5	5.5±0.3
HDL cholesterol (mg/dl)	14	62.3±19.5	61.9±16.3	10	74.9±16.2	70.3±23.0	24	67.5±18.9	65.4±19.4
LDL cholesterol (mg/dl)	12	135.7±27.5	126.3±33.1	10	149.9±41.2	144.2±41.2	22	142.1±34.3	134.4±37.2

BMI body mass index, HR_{rest} resting heart rate, BP_{sys} systolic blood pressure, BP_{dia} diastolic blood pressure, HbA_{1c} glycated hemoglobin, HDL high density lipoprotein, LDL low density lipoprotein^aIndicates gender-specific differences.

tion: males (n=6); females (n=6). All participants were informed about the study goals and provided their written informed consent. The study was carried out in accordance with the ethical standards laid down in the declaration of Helsinki and the study protocol was approved by the local ethics committee (approval nr: SB-GLand/UNI/24/04/2006).

Procedure

Before commencing the 9-month hiking program, a routine medical examination was performed to establish major cardiovascular risk factors. The examination included measurement of weight, a resting electrocardiogram (ECG) recording (to guarantee safety during the hiking session, an exercise ECG was performed in some participants where indicated), blood pressure and HbA_{1c}, high-density (HDL) and low-density lipoprotein (LDL) level determination. All laboratory testing was performed in accredited laboratories. The hiking program consisted of completing a 500-m altitude increase within 3 h, once a week. According to the age-predicted peak oxygen uptake [16], the corresponding work intensity was approximately 50%. This intensity can be sustained for several hours [3] and should be adequate and safe for this study population. The downhill walk back to the starting point was not included in the 3-h timeframe. Performing a 1000-m altitude increase within 6 h every 2 weeks was also allowed. Resting periods lasting longer than 2 weeks were not permitted and during the 9 months

(approximately 37 weeks), exercise was required to be performed during at least 31 weeks. Participants were not supervised during the study period, but had to complete a hiking protocol. Additionally, participants were regularly questioned regarding lifestyle modifications supplementary to those intended by the study. Every second day, participants were required to perform morning blood pressure measurements. A qualified person demonstrated and trained participants in the correct handling of the automatic blood pressure measurement device (Boso medistar S, Bosch, Jungingen, Germany) before the start of the study. For the final analyses, the mean blood pressure values over the first and the ninth months were taken. Energy expenditure for the 500-m altitude increase hike was calculated based on the formula by Burtcher [3], i.e., $VO_{2rel} = (0.133Dh + 2.0Dv)/t + 3.5$, where VO_{2rel} = relative oxygen consumption (ml/min/kg), Dh = horizontal distance (m), Dv = vertical distance (m), t = time (min). Hiking equipment weighing 3 kg and an optimal gradient of 15% for mountain paths was assumed [3, 11]. After the 9-month hiking period, the same measurements were performed as before the program.

Statistical analysis

Data are presented as means ± standard deviation (SD). Due to missing values, sample size differs slightly (■ Tab. 1). Data analyses were performed with the SPSS statistical software package (PASW Statis-

tics for Windows version 18.0, SPSS Inc., Chicago, IL, USA). In the case of normally distributed data (Kolmogorov–Smirnov test) and a sample size (n) >10, parametric statistics were used; otherwise non-parametric statistics were applied. As a result, unpaired student t-tests were applied to investigate gender differences and paired student t-tests or Wilcoxon tests (n<10) were applied to identify changes over the 9-month period. To obtain information on whether or not outcomes of such a hiking program vary between participants with different cardiovascular risk profiles, two groups were identified. One group included participants with normal values and the second group included participants with borderline or pathological values (blood pressure >140/90 mmHg, LDL >130 mg/dl, HDL <40 mg/dl [1]) at the start of the study. The Mann–Whitney U test was used to investigate whether or not there was a significant difference over time (calculated as posttrial minus pretrial values) between these groups. Significance level was set at p<0.05.

Results

There were no gender-specific differences in the established parameters, except for the anthropometric parameters (in that males were heavier and taller than females). Therefore, the net (without basal) energy expenditure for the 500-m altitude increase was higher for males than females (574±79 kcal vs. 446±38 kcal, p<0.001). Medication remained unchanged and lifestyle changes, others than those pre-

scribed by the study protocol, were not reported during the intervention period. No changes over the 9-month period were found in any investigated parameter, either for the entire group or for either of the gender groups (■ Tab. 1). When analyzing the participants who had pathological or borderline values at the beginning of the study, only systolic blood pressure tended to improve (from 145.6 ± 7.0 to 137.0 ± 9.3 mmHg, $p=0.068$; $n=4$). Changes over time differed between the two groups (-8.7 ± 9.1 vs. 0.7 ± 6.8 mmHg, $p=0.023$).

Discussion

To our knowledge, this is the first study reporting data on cardiovascular risk factors in older subjects performing regular, but only once weekly moderate-intensity mountain hiking sessions. The main findings of the present investigation were that, in contrast to our hypothesis, such a practice does not improve classical cardiovascular risk factors in elderly persons not suffering from major cardiovascular diseases. However, in elderly persons who suffer from systemic hypertension, once weekly hiking sessions might lower blood pressure.

With respect to the unaffected risk factors, the present results support the findings of Lee et al. [9], who showed that being active only at the weekends does not reduce mortality among elderly persons already suffering from at least one cardiovascular risk factor. Nonetheless, a potential positive effect on the present population cannot be excluded, as risk factors did not worsen and even improved in hypertensive participants. Besides these measured risk factors, a high fitness level is important in view of the findings that low cardiovascular fitness represents an important risk factor for cardiovascular diseases and is associated with increased mortality [2, 12]. Kohl et al. [8] showed that persons who are active at a moderate intensity only 1–2 days per week are more likely to be classified as having low fitness compared to persons who exercised three or more times each week at the same intensity. Additionally, Burtscher et al. [4] found that more than two exercise sessions are necessary to improve exercise capacity. Unfortunately, exercise capacity

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Abstract

Background. Hiking is one of the most popular activities among the elderly in Alpine regions. Due to the long-lasting, moderately intensive nature of this form of physical activity, hiking is generally considered to be beneficial to health. However, it is currently unclear whether once-weekly hiking—as commonly practiced at weekends—really does yield such positive effects in elderly persons aged 60 years and over.

Objectives. This study investigated the effect of a single weekly mountain hiking session on cardiovascular risk factors.

Materials and methods. A 9-month mountain hiking program was completed by 14 male (age 65.6 ± 2.7 years) and 10 female (age 66.2 ± 4.4 years) elderly participants. The program consisted of a single weekly hiking session with the goal of achieving a 500-m altitude increase within 3 h. Before and after the 9-month program, an electrocardiogram (ECG) was performed and blood pressure, glycated hemoglobin (HbA1c), high-density

(HDL) and low-density lipoprotein (LDL) measurements were made.

Results. The elderly participants showed a normal cardiovascular risk profile at the start of the investigation. The estimated net energy expenditure for one hiking session was approximately 521 ± 91 kcal. Over the 9-month period, no changes were found in any of the investigated parameters for the entire group. However, participants with untreated hypertension showed a reduced systolic blood pressure.

Conclusion. The present investigation showed that moderate-intensity activity only at weekends does not improve cardiovascular risk factors in elderly persons with a relatively normal cardiovascular risk profile. Conversely, elderly persons suffering from hypertension might profit from such a practice.

Keywords

Hypertension · Exercise · Cardiovascular disease · Blood pressure · Electrocardiogram

Auswirkungen wöchentlicher Bergwanderungen auf kardiovaskuläre Risikofaktoren bei älteren Menschen

Zusammenfassung

Hintergrund. Im alpinen Raum zählt Wandern bei älteren Menschen zu den beliebtesten Aktivitäten. Aufgrund der länger andauernden, körperlichen Aktivität mit moderater Intensität werden dem Wandern positive gesundheitliche Effekte zugeschrieben. Jedoch ist unklar, ob 1-mal Wandern pro Woche, wie es häufig an den Wochenenden praktiziert wird, diese positiven Effekte hervorruft.

Ziel. Ziel dieser Studie war es, die Auswirkungen einer Wandereinheit pro Woche auf kardiovaskuläre Risikofaktoren zu untersuchen.

Material und Methoden. An dem Wanderprogramm, das sich über einen Zeitraum von 9 Monaten erstreckte, nahmen 10 weibliche (Alter: $66,2 \pm 4,4$ Jahre) und 14 männliche (Alter: $65,6 \pm 2,7$ Jahre) ältere Menschen teil. Das wöchentliche Wanderprogramm beinhaltete einen Aufstieg von 500 Höhenmetern 1-mal pro Woche innerhalb von 3 Stunden. Vor und nach den 9 Monaten wurden ein EKG aufgezeichnet, der Blutdruck gemessen und HbA1c-, HDL- und LDL-Werte bestimmt.

Ergebnisse. Zu Beginn der Untersuchung lag das kardiovaskuläre Risikoprofil der Teilnehmer durchweg im Normalbereich. Der Energieverbrauch während der Wandereinheit betrug durchschnittlich 521 ± 91 kcal. In der Gesamtgruppe konnten keine Veränderungen der erhobenen Risikoparameter gefunden werden. Jedoch zeigte sich, dass Teilnehmer mit unbehandeltem Bluthochdruck eine Reduktion des systolischen Blutdrucks erfuhren.

Schlussfolgerung. Bei älteren Personen mit einem relativ normalen kardiovaskulären Risikoprofil dürfte Bergwandern, an einem Tag in der Woche, keinen Effekt auf kardiovaskuläre Risikofaktoren haben. Andererseits zeigte sich, dass ältere Personen mit Bluthochdruck von den wöchentlichen Wandereinheiten profitieren können.

Schlüsselwörter

Hypertonie · Bewegung · Kardiovaskuläre Erkrankungen · Blutdruck · Elektrokardiogramm

was not assessed in the present investigation, but on the basis of the findings from Kohl et al. [8] and Burtcher et al. [4], increases in exercise capacity are unlikely to have occurred. It has to be mentioned that participants of the present investigation expended only approximately 521±91 kcal for every 500-m altitude increase during the hike. This amount does not meet the recommendation of accumulating at least 1,000 kcal expended per week with physical activity in order to achieve health benefits [1]. Nonetheless, participants performed moderate-intensity activity lasting ≥150 min/week and even small increases in the volume of physical activity might provide important health gains according to the “some activity is better than none” maxim [1, 13, 14]. However, the presented practice did not improve cardiovascular risk factors, except in four hypertensive participants, who showed a greater improvement in systolic blood pressure when compared to those with normal blood pressure. This indicates that such exercise frequencies and/or intensities are too low to achieve health/fitness benefits in elderly persons with a normal risk profile [1], but might improve measurements in persons with inadequately treated risk factors [14]. Naturally, the study has some limitations which should be mentioned. The call for participation throughout the local press possibly led to a selection bias. Most participants answering the call reported to have already been regularly active before the study and were thus adequately medically adjusted. Therefore, their cardiovascular risk profile was largely normal at the start of the study, which might have been the reason why the implemented hiking program had no additional effect. Furthermore, it cannot be excluded that some participants over- or underperformed in the hiking exercise without recording this. We do not think that these limitations greatly impacted the outcome of the study or the overall approach to test a moderate-intensity hiking program in the elderly, since our study protocol came close to what would be feasible for a hiking program in this age group.

Conclusion

In conclusion, the present investigation shows that being active at a moderate intensity only at the weekend does not improve classical cardiovascular risk factors in elderly persons not suffering from major cardiovascular diseases. However, elderly persons suffering from hypertension might benefit from such a practice.

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Compliance with ethical guidelines

Conflict of interest. H. Gatterer, C. Raab, S. Pramsohler, M. Faulhaber, M. Burtcher and N. Netzer state that there are no conflicts of interest.

All studies on humans described in the present manuscript were carried out with the approval of the responsible ethics committee and in accordance with national law and the Helsinki Declaration of 1975 (in its current, revised form). Informed consent was obtained from all patients included in studies.

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