



Education program for prevention of outdoor accidents in middle-high aged trekkers: Monitoring of change in blood pressure and heart rate during exercise

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ABSTRACT

This is an observational study to evaluate cardiovascular parameters during an educational trekking program. The number of alpine accidents involving elderly trekkers has been increasing in developed countries in recent years. Many middle-high aged trekkers have potential cardiovascular risks of which they are unaware. More than 77% of trekkers involved in alpine accidents in Japan were aged >40 years. The most common cardiovascular conditions were stroke or heart attack while trekking at altitude. An alpine club conducted an 8-month education program with participants aged >40 years in the setting of a mountain-side town. Blood pressure and heart rate during outdoor exercise were monitored, and any other adverse effects were recorded. As a result, the cardiovascular parameters evaluated during the first and final trek presented a physiological and similar behavior, however, lower heart rate values were registered at the highest point of the route in the final trek ($p < 0.05$). The trend of these parameters was similar in males and females, and there was little correlation between the cardiovascular parameters and age. In conclusion, the lower heart rate values may indicate the higher risk awareness of trekkers while self-pacing the physical activity outdoors, which may indicate the positive effect of the education program in increasing the safety of such unsupervised activities.

1. Introduction

Improvements in public health and the availability of medical services have increased life expectancy in many industrialized countries (<https://population.un.org/wpp/> (accessed on July 7, 2020)). Then, the proportion of the elderly population is increasing annually. Japan is the most aged society in the world, with more than 27% of the total population older than 65 years (<http://www.stat.go.jp/data/topics/pdf/topics97.pdf> (accessed on July 7, 2020)). As many middle-aged to elderly people enjoy moderate exercise in the outdoors, non-technical middle-altitude trekking has become increasingly popular in Japan (Saito et al., 2002). The “green exercise”, defined as physical activity in an outdoor environment such as forest and relatively low-altitude mountains, is widely recommended for middle-high aged citizens. Such activities are effective to maintain physical performance and prevent lifestyle-related diseases (Pretty et al., 2005; Park et al., 2010; Li et al., 2011). It is reported that green exercise can improve mental well-being and markers of physiological health. Blood pressure and endocrine parameters such

as noradrenaline, adrenaline, and cortisol can be improved by the physical activities (Bowler et al., 2010; Gladwell et al., 2013).

The increasing popularity of green exercise has had a significant impact on the frequency of accidents in mountains that are easily accessible from suburban areas. Data released by the Japanese National Police Agency shows that the number of outdoor accidents has increased markedly over the past 5 years (https://www.npa.go.jp/publications/statistics/safetylife/chiiki/R01sangakusounan_gaikyou.pdf). In 2019, 2937 trekkers were rescued by police agency, and 14.4% of them had some kind of diseases (https://www.npa.go.jp/publications/statistics/safetylife/chiiki/R01sangakusounan_gaikyou.pdf). Almost 80% of trekkers involved in accidents were aged > 40 years, and some suffered a stroke or heart attack while trekking at altitude (https://www.npa.go.jp/publications/statistics/safetylife/chiiki/R01sangakusounan_gaikyou.pdf). Because of oxygen partial pressure reduction at high altitude, mountain trekkers are vulnerable to hypoxic organ failure including ischemic heart attack (Erb and Auerbach, 2007, 2072–2090).

It is known that a large number of minor cardiovascular alterations,

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such as acute changes in blood pressure and heart rate, can be a precursor to major cardiovascular accidents. Creating strategies that can ensure individuals who exercise, often on their own, should be encouraged. The inclusion of an educational program can help to increase the safety of individuals, as well as to reduce the rate of complications regarding accidents. We believe that an educational program for middle-aged and elderly trekkers, with the objective of increasing cardiovascular health during outdoor exercises, is interesting and beneficial for the response of the circulatory system during physical activities and thus, increasing the safety of participants. This observational study analyzed cardiovascular parameters, blood pressure and heart rate, during an educational trekking program, in which importance of self-monitorization during outdoor and unsupervised physical activity were explained.

Methods

2. Study design

This is an observational study to evaluate cardiovascular parameters during an educational trekking program. The data sent to the authors' institute were retrospectively analyzed. An 8-month program promoting green exercise, including once-a-month educational lectures and short treks, was organized by the Gunma Division of the Japan Alpine Club (Maebashi, Japan). An author of this report was a member of the club. Following completion of the program, the obtained data were sent to Gunma University for analysis and evaluation. The authors obtained approval from the Human Ethics Committee of their institute and registered the study protocol at UMIN (# 000020659). Since the program was originally designed as a local community service by the alpine club, not as a scientific study, this study was classified as an observational and retrospective study analyzing preexisted non-invasive blood pressure and heart rate records.

2.1. Enrollment of participants

The program, called 'Educational Program for Healthy Trekking' in Japanese, took place in a prefecture with a population of 2 million people. The "prefecture" is a regional government subdivision in Japan, and Japan has 47 prefectures except for Tokyo, Osaka, Kyoto and Hokkaido region. It was promoted for one month by leaflets and on social media. The participants were recruited by receiving application form via regular mail or e-mail. Among the 199 applicants, the organizer used a free random-number-generating software to randomly select 60 participants who had no co-existing diseases other than controlled hypertension and diabetes. Applicants who are elder than 80, and younger than 20 were also excluded. All participants agreed to the secondary use of the obtained data which were not linked to personal identification, by written consent form.

2.2. Educational trekking

Participants were explained circulation system reaction during physical activities, and how to measure blood pressure and heart rate in outdoor settings. Following the brief talk regarding the physiological effects of trekking and health care in daily life (Table 1), the participants were asked to walk for at least 30 min every two days, ideally on an inclined out-door path or on treadmill machine having inclination of

Table 1
Health care tips lectured in the 'Educational Program for Healthy Trekking'.

- 1) Effects of exercise on circulation system.
- 2) Recommended respiration for better oxygenation at high altitude.
- 3) Thermoregulation in outdoor environment.
- 4) Hydration and nutrition during trekking.
- 5) Cautions to prevent musculoskeletal problems during descending.
- 6) Cause of delayed onset muscle soreness and its prevention method.

5%–15%. In addition, the participants were also asked to join in a short monthly treks five times during the 8-month period. The altitude distance in each trek was approximately 300–500 m, and the altitude range of these 5 treks were 800–1827 m above sea level. In the first and the last trek, participants walked an identical trekking route. During each trek, two staffs, one at the head of group, the other at the last, were watching the walking speed of participants, so as not to be excessive. However, those staff kept some distance from the participants, not to interfere the participants' comfortable pace. Weather conditions of the first and last trek were similar at a temperature around 10 °C and mostly sunny, although the season itself were different, spring and autumn. During the outdoor program, 3 doctors and 2 nurses attended with emergency medical gears including automated external defibrillator. Also, these medical staff asked the participants if they have any discomfort, such as chest pain, dyspnea or knee pain during the outdoor program.

2.3. Data acquisition

At each short trek, blood pressure and heart rate were measured by a wrist blood-pressure monitor (EW-BW10-W, Panasonic, Tokyo) at four time points in the trekking circuit: immediately prior to starting the trek, at the approximate mid-point of the outbound section, at the highest point, and immediately after finishing (at the start/finish point). Rate pressure product (systolic blood pressure × heart rate) was calculated after the completion of the trek. After arrival at each pre-set point (the mid-point, the highest point and the finishing point), the subjects sat on a bench seat and placed their arm on a pillow to elevate their wrist to the level of the mid sternum while the measurements were taken. This position was instructed by the manufacturer for proper measurement, and the sitting position was effective to stabilize the body of the participants during the measurement. Before and after each trek, the participants had brief instruction regarding healthcare during exercise. At the end of 8-month program, participants were asked with a form of questionnaire if the program had been effective for establishing the habit of regular exercise in their daily life (Table 2). By comparing the cardiovascular parameters, and by analyzing the answers to the questionnaire, the authors evaluated if the educational program had some beneficial effect on the participants' health and daily life.

2.4. Statistics

Sample size for the blood pressure and heart rate measurements was determined by setting the expected standard deviation (SD) as 15, detectable difference as 15, P value as 0.05, and detection power as 80%, with reference to our preliminary study (Mieda et al., 2020). All data are expressed as the mean ± SD. Statistical comparisons of the measured values were assessed by paired *t*-test, chi-square test, and analysis of variance, and correlation between age and circulatory values were assessed with Pearson product-moment or Spearman's rank correlation coefficient, using statistical software (R 2.6–2 modified as EZR-ver.1.41 (Kanda, 2013); The R Foundation, Vienna, Austria; and Numbers, Apple Inc., California, USA). A P value < 0.05 was considered statistically significant.

Table 2
The contents of questionnaire prepared for the participants to evaluate the program.

- 1) Are you working on daily physical exercise?
- 2) Do you have any physical problem during exercise?
- 3) Please evaluate this program?
100% satisfactory, 80% satisfactory, 60% satisfactory, <50% satisfactory.
- 4) If this program is announced in the future, are you willing to apply again?
- 5) Which mountain range do you want to visit in the future?

This questionnaire was original for this 'Educational Program for Healthy Trekking'.

3. Results

3.1. Demographics of participants

Of the 199 applicants to the program (83 males and 111 females), 60 applicants were randomly selected. Of these, seven applicants did not join the program for personal reasons. Table 3 lists the demographics of the final participants. Mean age was 59.5 ± 8.3 years (range, 42–77 years), and mean age was younger in the female participants compared with the males. Body weight was lower in females than in males, as in the general population of Japan. (Table 3)

3.2. Comparison of circulatory parameters during the first and final trek

In the first short trek, systolic blood pressure measured prior to exercise and at the outbound mid-point (approximately 20 min after the start) was higher than that measured at the finish point. Systolic blood pressure was higher at the outbound mid-point than at the highest point (P < 0.01). Diastolic pressure was higher prior to exercise than at the highest point and at the finish point (P < 0.01). Mean heart rate ranged widely, from 79 to 113, in the first trek. Heart rate was lower prior to exercise than at the outbound mid-point, at the highest point, and at the finish point (P < 0.01); and was lower at the outbound mid-point than at the highest point. Heart rate was higher at the highest point than at the finish point (P < 0.01) (Table 4a).

In the final short trek, systolic blood pressure measured prior to exercise and at the outbound mid-point was higher than that measured at the finish point (P < 0.01), as in the first trek; and that at the outbound mid-point was not significantly higher than the value at the highest point. Diastolic pressure was higher prior to exercise than at the finish point (P < 0.01). Mean heart rate ranged from 79 to 104; and was lower prior to exercise than at the outbound mid-point, the highest point, and at the finish point (P < 0.01). Mean heart rate at the highest point was lower at the final short trek than at the first trek (P < 0.05).

3.3. Analysis of gender difference, age correlation, cardiovascular risk and program effect

The statistical analysis revealed only minor differences between males and females, and the general trends in blood pressure and heart rate were identical between the genders (Table 4a-c). In the first trek, systolic blood pressure at all four points was generally higher in males than in females (P < 0.01). Diastolic pressure prior to exercise at the first trek was higher in males than in females (P < 0.05). No correlation was found between heart rate and age (Table 4d). There was a minor correlation between age and systolic blood pressure prior to exercise in the last trek (P < 0.05: Table 4d).

Significantly larger number of participants had blood pressure higher than 160 mmHg (grade 2–3 level hypertension) prior to exercise and at the outbound mid-point, compared to the finish point (P < 0.05). This trend was similar between the first and last treks (Table 5). Rate pressure product higher than 22,500 was observed in three participants in the first trek, and in a single participant in the last trek (Fig. 1).

There was no accident in the program. Participants answered to the questionnaires prepared to evaluate the educational program as follows; 33% of the participants rated the program 100% satisfactory and 67%

Table 3
Demographics of the participants.

	number	age	height (cm)	body weight (kg)	BMI
male	26	63.0 ± 8.5	166.3 ± 4.7	64.1 ± 7.1	23.1 ± 2.0
female	27	55.7 ± 6.4	159.1 ± 4.5	54.2 ± 6.0	21.4 ± 2.1
total	53	59.5 ± 8.3	162.7 ± 5.8	59.2 ± 8.2	22.3 ± 2.2

mean ± SD.

Nine males and 2 females had hypertension, and 1 male had diabetes.

Table 4a

All participants.

	pre	middle	highest	post	P value#
Systolic BP (mmHg, means ± SD)					
First	148.6 ± 23.8	151.2 ± 23.6	138.7 ± 27.3	129.5 ± 19.2	≤0.0011,c, d,e
Last	152.2 ± 26.0	149.3 ± 20.0	139.2 ± 21.6	134.1 ± 19.9	≤0.0013,b, c,e
Diastolic BP (mmHg)					
First	89.5 ± 14.5	84.7 ± 13.6	81.3 ± 14.6	79.2 ± 13.1	≤0.0011,b, c
Last	92.9 ± 17.2	89.0 ± 15.5	85.6 ± 12.4	84.0 ± 14.1	0.0043,c
HR (min-1)					
First	78.8 ± 13.0	98.1 ± 19.8	113.0 ± 18.4	101.1 ± 17.2	≤0.0012,a, b,c,d,f
Last	78.9 ± 12.6	98.5 ± 13.0	103.7 ± 15.0	97.9 ± 17.5	≤0.0013,a, b,c

First; first trekking in the 8-month program.

Last; final trekking in the 8-month program.

Pre; prior to exercise.

Middle; at the outbound mid-point of the short trek.

Highest; at the highest point of the short trek.

Post; at the finish point of the short trek.

BP; blood pressure.

SD; standard deviation.

Table 4b

Males.

	pre	middle	summit	post	P value#
Systolic BP (mmHg, means ± SD)					
First	155.9 ± 20.5**j	160.7 ± 24.3*j	148.6 ± 27.7**j	136.8 ± 19.8*j	0.0022,c,e
Last	161.4 ± 18.3**k	152.6 ± 15.0	142.6 ± 20.2	137.2 ± 16.0	≤0.0012,b, c,e
Diastolic BP (mmHg)					
First	91.8 ± 13.5	86.7 ± 13.6	81.0 ± 11.7	79.6 ± 12.3	0.0032,b,c
Last	92.3 ± 11.1	88.8 ± 13.3	86.3 ± 13.2	81.6 ± 10.0	0.0222,c
HR (min-1)					
First	79.0 ± 13.6	95.5 ± 21.6	112.2 ± 20.4	98.5 ± 18.5	≤0.0012,a, b,c,d,f
Last	78.4 ± 12.6	96.3 ± 10.2	102.2 ± 14.8	96.0 ± 17.7	≤0.0012,a, b,c

a; significant difference between pre and middle.

b; significant difference between pre and summit.

c; significant difference between pre and post.

d; significant difference between middle and summit.

e; significant difference between middle and post.

f; significant difference between summit and post.

j; vs first systolic BP of female.

k; vs last systolic BP of female.

rated 80% satisfaction, 100% were willing to participate again in the future. Also, 89% of the participants were working on daily exercise throughout the program period, and 47% temporarily experienced pre-existed knee pain during exercise as it was before the participation.

4. Discussion

4.1. Popularity of green exercise

Numerous recent studies have recommended the benefits of green

Table 4c

Females.

	pre	middle	summit	post	P value#
Systolic BP (mmHg, means ± SD)					
First	141.5 ± 24.9	142.1 ± 19.3	129.1 ± 23.7	122.3 ± 16.1	≤0.0011,c,d,e
Last	143.5 ± 29.5	146.2 ± 23.8	136.0 ± 22.7	131.1 ± 23.1	0.125
Diastolic BP (mmHg)					
First	87.3 ± 15.3	82.8 ± 13.6	81.5 ± 17.1	78.9 ± 14.1	0.0131,c
Last	93.0 ± 21.8	89.2 ± 17.7	84.8 ± 11.7	86.4 ± 17.2	0.161
HR (min-1)					
First	78.7 ± 12.6	100.6 ± 18.0	113.7 ± 16.7	103.5 ± 15.7	≤0.0012,a,b,c,d,f
Last	79.4 ± 12.8	100.6 ± 15.1	105.2 ± 15.4	99.9 ± 17.6	≤0.0012,a,b,c

1; Kruskal-Wallis one way analysis of variance (ANOVA) on ranks followed by Tukey test

2; One way ANOVA followed by Holm-Sidak method

3; One way ANOVA followed by Dunn's method

Table 4d

Correlation coefficient between age and blood pressure or heart rate.

First trek	prior to exercise	at the highest point	at the final point
Systolic pressure	0.11 (0.45)	0.11 (0.47)	0.17 (0.24)
Diastolic pressure	-0.05 (0.75)	0.12 (0.44)	0.09 (0.56)
Heart rate	-0.06 (0.67)	-0.18 (0.22)	0.17 (0.24)
Last trek			
Systolic pressure	0.31 (0.04) [§]	-0.03 (0.83)	0.06 (0.69)
Diastolic pressure	-0.10 (0.53)	-0.08 (0.60)	-0.003 (0.98)
Heart rate	-0.25 (0.12)	-0.18 (0.26)	-0.18 (0.26)

*; p <0.05 with t-test

**; p <0.05 with Mann-Whitney rank sum test

#; p value <0.05 indicates a statistically significant difference over the groups

§; p<0.05 with Pearson product-moment or Spearman's rank correlation coefficient

exercise (Pretty et al., 2005; Park et al., 2010; Li et al., 2011). In our previous study, we identified the current preference of middle-aged and elderly Japanese trekkers to take solo day-trips to nearby mid-altitude mountains, whereas younger trekkers tend to favor distant and more famous mountains (Bowler et al., 2010; Li et al., 2011; Park et al., 2010; Pretty et al., 2005; Saito et al., 2002; Gladwell et al., 2013; https://www.npa.go.jp/publications/statistics/safetylife/chiiki/R01sangaku-souan_gaikyou.pdf; Kimura et al., 2012; Mieda et al., 2020). Reflecting these social trends, 199 people applied for the 60 available places in the present program. The number of females was larger than that of males, among the applicants. In this program, individuals with adequately controlled diabetes mellitus and hypertension were not excluded, since nation-wide government data demonstrated a high prevalence of these diseases (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryuu/kenkou/eiyuu/r1-houkoku_00002.html (accessed on January 4, 2021)).

Table 5

Comparison of the percentage of hypertensive participants at the beginning and at the end of the program.

	First trekking				Last trekking			
	pre	middle	summit	post	pre	middle	summit	post
≥160 mmHg (unit: %)	26.4	30.1	18.9	7.5	38.8	25.7	18.4	6.3

*; significantly larger than the post exercise value (P < 0.05).

4.2. Blood pressure measurement at the wrist

In this program, a commercially available oscillometric blood pressure monitor was used and worn on the wrist to measure blood pressure. Although blood pressure at the wrist has been considered less reliable than that measured at the upper arm, reliability is high for modern devices that are used properly. (Casiglia et al., 2016) With this method, the accuracy of measurement depends largely on the difference in height between the wrist and the heart because of the confounding effect of hydrostatic pressure caused by the limb blood column. In the present program, medical staffs gave repeated instructions regarding the correct site and the proper way to take the measurements. In the outdoor setting, wrist measurement has advantages over other assessment methods because it is quick and can easily be obtained at multiple time points. In addition, organizers were able to demonstrate that blood pressure measurement can be easily performed in the outdoors using an affordable and commercially available personal device. The authors consider that this approach raised public awareness of cardiovascular care during exercise.

4.3. Blood pressure and heart rate during short treks

Blood pressure shows wide variation among those aged > 40 years and increases markedly during exercise in this age group. A previous study in the field of health and sports science reported that blood pressure increases during the early phase of exercise in both field sports and indoor sports (http://www.yowakai.org/healthsupport/pdf/healthsupport_kotsuryo, 2020). Otsuki reported that blood pressure in city walkers was higher at the 1 km mark compared with that measured at 2 and at 3 km (Otsuki and Ishii, 2017). They suggested that pronounced elevation of systolic blood pressure during exercise is a risk factor for immediate ischemic heart events and future cardiovascular

rate pressure product of each participant

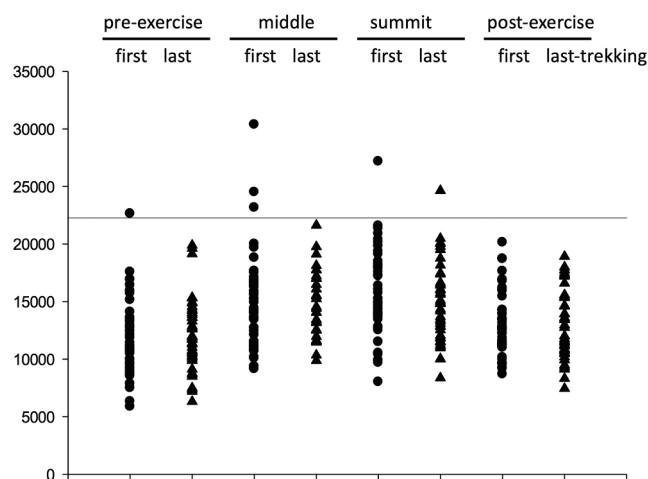


Fig. 1. Rate pressure products of each participant at the beginning and at the end of the program. The products of 22,500 is the value reported by Nelson RR (26) during dynamic hard exercise.

disease (Schultz et al., 2013). In the present program, which was conducted at moderately high altitude, blood pressure was higher prior to exercise and at the outbound mid-point of the short trek than at the highest point and at the finish point. These observations imply that the risk of a cardiovascular event is highest at the beginning of physical exercise.

Hypertension during exercise (defined as systolic blood pressure \geq 210 mm Hg in men, \geq 190 mm Hg in women; and diastolic blood pressure \geq 110 mm Hg in men and women) is considered to be a manifestation of multiple factors that include large artery stiffness, increased peripheral resistance, and neural and metabolic irregularities (Rowell and O'Leary, 1990; Mancia et al., 1997; Schultz and Sharman, 2014). Caselli et al. reported that hypertension during exercise can be 'masked' hypertension that is associated with the future incidence of hypertension and adverse left ventricular structure. It may predict future cardiovascular events and mortality. A hypertensive response to exercise, especially at a low-to-moderate exercise workload, is strongly associated with an increased likelihood of adverse cardiovascular outcomes (Caselli et al., 2019; Kim and Ha, 2016).

As mentioned earlier, the authors determined in the present program that blood pressure was high during the early phase of exercise, and that the value decreased during the later phase of exercise. At numerous times, the medical staffs advised the participants about this phenomenon of blood pressure, and told them that a moderate workload during the early phase has beneficial effects for their well-being. In fact, knowledge of this characteristic of blood pressure might enable aged trekkers to moderate their workload during the early phase of exercise. Warm-up exercise prior to the main physical activity is recommended in all types of sports. Since trekking is an outdoor activity, where environmental factors have additional effects on human body, importance of warm-up should be emphasized. The reduction in heart rate variation observed during the last trek of the present 8-month program might have resulted from participants' new knowledge about cardiovascular risk during exercise. Even though there was not a significant decrease in blood pressure, the lower heart rate suppressed the rate pressure product, which is known to be related to the risk of cardiovascular events and ischemic heart attack (Robinson, 1967; NELSON et al., 1974; Fletcher et al., 1979).

4.4. Effects of the 8-month program

Based on current blood pressure and heart rate trends, we accept that physiological and morphological changes in the heart and blood vessels could not be obtained in a period of 8 months. However, over the course of the program, the participants appear to have developed a careful attitude toward maintaining a safe physical workload during exercise in the mountains, and avoided strenuous exertion when ascending.

Although there was no significant change in mean blood pressure between the first and last treks, fewer participants showed extremely high blood pressure and rate pressure product during exercise by the end of the 8-month program. It is obvious that there was a Hawthorne effect, meaning participants behaved nicely in the health promoting program, however, we expect that this outcome might contribute to decreasing the risk of accidents in the mountains that are caused by health problems, and to promoting life-long wellness in potentially hypertensive individuals.

In the questionnaire that was completed at the end of the program, 33% of the participants rated 100% satisfaction and 67% rated 80% satisfaction. Also, 100% were willing to participate again in the future. These values suggested that the program had been effective for establishing the habit of regular exercise in their daily life. They also stated that they were willing to continue exercising in the future to enhance their longevity. We expect that exposure to the guidelines regarding healthy diet and routine physical exercise near their place of residence may have had some educational value for the participants, and encouraged them to maintain a healthy lifestyle after the end of the

program. Although we could not confirm if they are maintaining the habitual exercise and trekking following the program, such follow-up and numerical comparison of cardiovascular data before and after the program to evaluate the long-term effects seems to be effective promote public wellness.

This observational study did not compare the effect of program with a control group. It would be interesting to include a control group, which did not receive the guidelines of the educational program. A comparison between the groups at the end of the period, would be valuable to assess the magnitude of the impact of the educational program.

4.5. Recommended outdoor exercise for middle-high aged

The present program was performed in a mountainous area near Tokyo. Therefore, the results may not fully reflect general trends in other countries, but some of the data are probably applicable to aging societies worldwide.

It is possible that green exercise with intermittent on-site blood pressure monitoring can prevent mountain accidents in aged trekkers. Also, recently developed wearable cardiovascular monitors, which are more and more accessible for public, have been reported to be effective to evaluate health condition of users in real-time manner, and to prevent adverse events (Singhal and Cowie, 2020; Schubert et al., 2020; Vorweg et al., 2020). We plan to release the results of this study to elderly trekkers via public media, with the aim of encouraging them to examine their circulatory condition routinely during exercise. Demonstrable figure or advertisement orienting the correct way of self-monitoring of cardiovascular parameters during exercise seems to be effective for public announcement. We hope such activity will contribute to a decrease in cardiovascular-related accidents in the alpine environment and promote general wellness in middle-high aged citizens who enjoy being active in their later years.

5. Conclusions

Many middle-high aged people in Japan have some interest in non-technical middle-altitude trekking for their wellness. However, these trekkers have the risk of a cardiovascular event, especially at the beginning of physical exercise. Educational program explaining physical effects of green exercise is considered to be effective to develop a careful attitude toward maintaining a safe physical workload during exercise in the mountains, and to avoid strenuous exertion when ascending.

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CRediT authorship contribution statement

Rie Mieda: Investigation. **Yusuke Matsui**: Investigation. **Masaru Tobe**: Investigation. **Masafumi Kanamoto**: Investigation. **Takashi Suto**: Investigation. **Shigeru Saito**: Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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