pleural effusion was drained and the intrathoracic pressure lowered. Blood examinations on the 30th hospital day showed a decrease in serum AVP concentration (1.5 pg/mL), increased serum osmolality (268 mOsm/L), decreased urine osmolality (339 mOsm/L), and normalization of serum sodium concentration (137 mmol/L). Many previous articles have reported that recurrence of Takotsubo cardiomyopathy is rare,[2,3] and this patient has not complained of chest pain and chest oppression since the initial episode.

DISCUSSION

Takotsubo cardiomyopathy has cardiac symptoms that are difficult to distinguish from acute STEMI and is observed especially in women aged 60 and older.[2] The patients diagnosed with Takotsubo cardiomyopathy complain of chest pain and chest oppression. ECG shows ST-segment elevation, and left ventriculography shows wall motion abnormalities, but CAG shows no evidence of obstructive atherosclerosis of the coronary arteries. Takotsubo cardiomyopathy is associated with several clinical events, such as subarachnoid hemorrhage,[4] pheochromocytoma,[5] Guillain-Barré syndrome,[6] and mental stress.[7] Although the pathophysiology and the reason for the strong elderly female predominance remain unknown, and accepted criteria for diagnosis have not been established, some hypotheses are suggested: catecholamine-mediated myocardial stunning, catecholamine-induced microcardiac artery spasm, and epicardial coronary artery spasm.[2]

AVP is a hormone produced in the cells located predominantly in the supraoptic and paraventricular hypothalamic nuclei, the axons of which terminate in the posterior lobe of the pituitary gland, and is well known as a antidiuretic hormone.[8] There are three subtypes of receptors for AVP: V1a, V1b, and V2. AVP also functions as a vasoconstrictor and myocardial contractor through V1a receptors, which are located on vascular smooth muscle cells and cardiomyocytes.[9] Because AVP causes peripheral vasoconstriction in the skin, skeletal muscles, gastrointestinal organs, fat tissue, renal arterioles, and coronary arteries, it is used as a vasoconstrictor to support blood pressure in refractory septic shock.[10] This case showed hypervasopressinemia (20 times as high as normal level) before she was diagnosed with Takotsubo cardiomyopathy. Her blood pressure was always normal (108/66 mmHg), but it went up to 142/82 mmHg when she complained of chest pain. AVP may have been one of the causes of high blood pressure, working as a strong vasoconstrictor. Because of these results, this case can suggest a new hypothesis in the pathophysiology of Takotsubo cardiomyopathy; AVP may have induced microcardiovascular spasm, causing left ventricular wall motion abnormalities "Takotsubo cardiomyopathy."

Although Takotsubo cardiomyopathy is becoming recognized as a common heart disease, especially in elderly women, acceptable criteria for diagnosis are not established, and the pathophysiology remains unknown. More cases and studies are needed to ascertain the pathophysiology and management of this syndrome. We first demonstrated a relation between Takotsubo cardiomyopathy and hypervasopressinemia. Hypervasopressinemia may be an important trigger of reversible left ventricular dysfunction "Takotsubo cardiomyopathy."

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THE EFFECT OF GLUCOSE TOLERANCE ON CENTRAL AND BRACHIAL PRESSURE IN ELDERLY PEOPLE

To the Editor: Central blood pressure (BP), brachial BP, and augmentation index decreased after an oral glucose tolerance test (OGTT); the magnitude of decrease in central BP

was higher than that in the brachial BP in elderly people. The magnitude of decrease in central systolic BP (SBP) and brachial SBP after an OGTT increased in a stepwise fashion across the brachial mean BP (MBP) before the OGTT.

Various kinds of daily orthostatic change, exercise, and eating affect the cardiovascular system.[1–3] Central hemodynamic variables are independently associated with organ damage and incident cardiovascular disease.[4,5] Central BP may be different from that measured on the arm. As for the BP decrease caused by standing up, the measurement of brachial BP suggests the possibility of a negligible decrease in brachial BP compared with that in the central BP.[2] Postprandial hypotension (PPH) is recognized as an important clinical problem in elderly people.[3] Although assessment of PPH in elderly people is important, changes in central BP after food consumption have not been studied. Thus, it was hypothesized that central BP changes are different from brachial BP changes. To clarify this, brachial and central BP before and after a 75-g OGTT in an elderly population were examined.

METHODS

In August 2006, 73 participants aged 75 and older not taking antihypertensive medication who used free health screening offered by healthcare center of Tosa town were recruited. Patients with a past history of coronary artery disease or heart failure were excluded. Right radial arterial pulse waves and left brachial BP were noninvasively measured using tonometry and oscillometry using a HEM-9000AI (Omron Healthcare Co., Ltd., Kyoto, Japan) before and 2 hours after an OGTT.[6,7] SBP2 and augmentation index (AI) were determined using pulse wave analysis.[6] Radial SBP2 was calculated using the following equations.

"Radial SBP2 =Radial AI × (brachial SBP − brachial DBP) + brachial DBP"

It has been shown that central SBP by direct measurement is closely associated with radial SBP2.[6] Therefore, radial SBP2 was used as the derived central aortic pressure. The paired *t*-test and analysis of variance were used for analysis

Table 1. Comparison of Changes in Blood Pressure Before and After an Oral Glucose Tolerance Test (OGTT) in an Analysis Stratified According to Quartiles of Brachial Mean Blood Pressure Before the OGTT

Variable	Overall (N = 73)	1st Quartile (68.7–81.3)	2nd Quartile (81.3–88.0)	3rd Quartile (88.0–98.0)	4th Quartile (98.0–143.0)	*P*-Value
Age, mean ± SD	80.5 ± 4.7	81.3 ± 4.5	81.4 ± 5.5	80.5 ± 4.9	78.8 ± 3.6	
Sex female, %	65.7	65.0	41.2	72.3	83.3	
Body mass index, kg/m², mean ± SD	23.2 ± 3.0	21.5 ± 2.2†	22.8 ± 2.8	23.7 ± 3.1	24.9 ± 3.3†	<.001
Height, m, mean ± SD	1.48 ± 0.08	1.48 ± 0.08	1.50 ± 0.09	1.47 ± 0.08	1.49 ± 0.08	
Waist, cm, mean ± SD	82.0 ± 7.8	77.6 ± 8.8†	81.1 ± 7.9	83.8 ± 5.1	86.0 ± 6.5†	.005
Ankle brachial pressure index, mean ± SD	1.12 ± 0.07	1.11 ± 0.09	1.12 ± 0.08	1.13 ± 0.04	1.12 ± 0.05	
Brachial ankle pulse wave velocity, cm/s, mean ± SD	1,908 ± 360	1,795 ± 351	1,806 ± 372	1,995 ± 317	2,043 ± 358	
Cardio ankle vascular index, m/sec, mean ± SD	9.7 ± 0.2	9.5 ± 1.0	9.6 ± 1.6	10.1 ± 0.8	9.9 ± 0.9	
Obesity, %	28.7	5.0	23.5	38.9	50.0	
Dyslipidemia, %	34.2	35.3	20.0	57.1	50.0	
Normal glucose tolerance, %	60.2	75.0	76.4	38.9	50.0	
Impaired glucose tolerance and fasting glucose, %	27.3	15.0	23.5	38.9	33.3	
Diabetes mellitus, %	12.3	10.0	0.0	22.2	16.7	
Brachial PPH, %	16.4	0.0†	5.9	22.2†	38.9†	.006
Central PPH, %	21.9	0.0†	17.6	22.2†	50.0†	.003
Before OGTT, mean ± SD						
Brachial SBP, mmHg	132.1 ± 20.2*	114.1 ± 11.6†	123.8 ± 11.0	137.0 ± 10.5*	154.9 ± 18.1*†	<.001
Brachial DBP, mmHg	69.4 ± 12.0*	58.2 ± 4.2†	65.1 ± 5.1*	70.5 ± 5.5*	85.1 ± 10.9*†	<.001
Brachial PP, mmHg	62.6 ± 15.4	55.9 ± 13.4†	58.6 ± 15.5	66.5 ± 14.9	69.8 ± 14.7†	.01
Pulse rate, beats/min	67.9 ± 10.5	66.3 ± 10.9	64.5 ± 8.8	73.0 ± 12.0	67.9 ± 8.7	
SBP2, mmHg	125.2 ± 20.1*	107.1 ± 10.9	116.7 ± 8.5	129.9 ± 11.8*	148.8 ± 17.5*	<.001
AI, %	92.6 ± 11.6*	90.3 ± 10.2*†	92.9 ± 14.1	92.2 ± 12.0	95.4 ± 10.4*†	
After OGTT, mean ± SD						
Brachial SBP, mmHg	126.6 ± 18.6*	118.6 ± 15.0†	119.6 ± 20.0	129.5 ± 17.0*	139.0 ± 15.9*†	<.001
Brachial DBP, mmHg	65.5 ± 11.2*	61.4 ± 13.5†	60.6 ± 7.0*	65.8 ± 7.4*	74.2 ± 10.4*†	<.001
Brachial PP, mmHg	61.1 ± 17.3	55.9 ± 13.4	58.6 ± 15.5	66.5 ± 14.9	69.8 ± 14.7	
Pulse rate, beats/min	67.8 ± 9.4	66.7 ± 8.9	64.0 ± 7.1	70.9 ± 12.8	67.7 ± 7.7	
SBP2, mmHg	118.4 ± 18.6*	110.6 ± 16.3†	111.1 ± 17.2	121.2 ± 17.8*	131.2 ± 16.6*†	<.001
AI, %	89.2 ± 13.3*	87.1 ± 12.0*	90.6 ± 16.8	90.3 ± 16.1	88.9 ± 7.4*	

*Before versus after OGTT, $P<.05$.

†Quartile 1 versus Quartile 3 or Quartile 4, $P<.01$.

SD = standard deviation; PPH = postprandial hypotension; SBP = systolic blood pressure; DBP = diastolic blood pressure; PP = pulse pressure; AI = augmentation index.

using JMP statistical analysis software (SAS Institute, Inc., Cary, NC). $P<.05$ was considered statistically significant.

RESULTS

Subject's characteristics are listed in Table 1. Mean age was 80.5, and 65.7% were female. Brachial SBP and diastolic BP (DBP) after the OGTT were significantly lower than before the OGTT (brachial SBP: 132.1 ± 20.2 vs 126.6 ± 18.6 mmHg, $P<.01$; DBP 69.4 ± 12.0 vs 65.5 ± 11.2 mmHg, $P<.01$). SBP2 and AI after the OGTT were significantly lower than before the OGTT (SBP2 125.2 ± 20.1 vs 118.4 ± 18.6 mmHg, $P<.01$; AI 92.6 ± 11.6 vs 89.2 ± 13.3%, $P=.02$). No significant difference was observed between pulse pressure and pulse rate before and after the OGTT. The magnitude of decrease in SBP2 after the OGTT was significantly greater than in brachial SBP (− 6.8 ± 16.3 vs − 5.5 ± 15.9 mmHg, $P=.01$). The frequency of participants having only SBP2 decrease 20 mmHg or more after the OGTT was 8.2% (n = 6). Stepwise regression analysis revealed that brachial MBP before the OGTT was an independent determinant of brachial SBP and SBP2 changes before and after the OGTT. The participants were divided into four quartile groups according to brachial MBP before the OGTT. The magnitude of decrease in brachial SBP and SBP2 after the OGTT increased in a stepwise fashion across the brachial MBP before the OGTT ($P<.01$; Table 1).

DISCUSSION

This study found that central BP, brachial BP, and AI decreased after an OGTT. The magnitude of decrease in central BP was higher than of brachial BP. Radial AI is the ratio of the augmented pressure, which is generated by the reflection wave from the lower body, to the forward pressure.[8] Therefore, the magnitude of the decrease in the augmented pressure supports the theory that the predominant constituent of the pressure decrease after an OGTT was an induced reflection wave reduction from the lower body. The magnitude of decrease in central and brachial SBP after the OGTT increased in a stepwise fashion across brachial MBP before the OGTT. The decreased distensibility of the aorta and the excessive dilatation in the splanchnic artery may affect the impedance matching between the aorta and splanchnic artery.[9] A loss of the proximal reflecting site at the interface between the aorta and splanchnic arteries may explain why there is a reduction in central BP with a stepwise increase in brachial MBP before the OGTT.

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COMMUNITY-DWELLING ELDERLY JAPANESE PEOPLE WITH HOBBIES ARE HEALTHIER THAN THOSE LACKING HOBBIES

To the Editor: The concept of "active aging," which the World Health Organization has adopted, is now recognized as an important matter, following that of "successful aging." Common perceptions of active aging among elderly people include leisure and social activities.[1]

Previous longitudinal studies have suggested a protective effect of leisure activity against the development of dementia.[2] In addition, elderly people with hobbies showed better subjective quality of life (QOL).[3] The significance of hobbies and other enjoyable activities even in terminally ill older men has been reported.[4]

However, the relationship between hobbies and comprehensive geriatric functions in community-dwelling elderly people remains unclear. To explore this important matter in a cross-sectional study, activities of daily living (ADLs), depression, frequency of laughter, and subjective QOL of elderly people with hobbies were compared with those without in community settings in Japan.

Study participants consisted of 658 noninstitutionalized people (281 male, 377 female) aged 65 and older (mean age 76.4 ± 7.1) living in Tosa, Kochi Prefecture, Japan. To assess whether the participants had hobbies, each was asked, "Do you have any hobbies?" (yes or no), and "If you have hobbies, what types of hobbies are they?"

To assess basic ADLs, participants rated their independence, versus help required, in seven areas (walking, ascending and descending stairs, eating, dressing, using the toilet, bathing, and grooming), according to a scale from 3 to 0 (3 = completely independent, 2 = needing some assistance, 1 = needing a lot of assistance, 0 = completely dependent). The rated items were added to obtain a basic ADL score (0–21), on which low scores indicate disability.[5] To assess advanced ADLs, the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) rating scale of 0 to 13 was used.[6] The TMIG-IC scale includes scores for instrumental self-maintenance (0–5), intellectual activity (0–4), and social role (0–4).

The 15-item Geriatric Depression Scale (GDS-15) was used to assess depression; a score of 10 or higher was considered to indicate presence of depression.[7,8] To obtain a frequency-of-laughter score (0–9), the scores for the following three items—"I laugh a lot every day," "Sometimes, days go by without laughing at all,"* and "I hardly find anything funny in my daily life"* (*reverse scored item)—were summed, using a rating scale from 0 (strongly disagree) to 3 (strongly agree).

Five indicators of QOL (subjective health, relationship with family, relationship with friends, financial satisfaction, and subjective happiness) were rated on a 100-mm visual analogue scale (poorest = 0 to best = 100).[9]

The unpaired Student *t*-test was used for continuous variables, and the chi-square test was used for categorical variables. All data were analyzed using the SPSS statistical software package, version 15.0 for Windows (SPSS Inc., Chicago, IL).

Approximately 43% of this Japanese elderly population had no hobbies. Elderly people without hobbies were significantly older (77.3 vs 75.4) and tended to be male. Even after adjustment for the effect of age, elderly people without hobbies had significantly lower scores on each item of ADLs than did people with hobbies. Also, elderly people without hobbies exhibited significantly higher scores for depression, significantly lower scores for frequency of laughter, and significantly lower scores for subjective QOL (Table 1).

Table 1. Comparison of Activities of Daily Living (ADLs), Depression, and Subjective Quality of Life Between Community-Dwelling Elderly People with and without Hobbies

Characteristic	With Hobbies (n = 372)	Without Hobbies (n = 286)	*P*-Value
Age, mean ± SD	75.4 ± 7.2	77.3 ± 7.1	.001
Female, %	64.8	47.6	<.001
ADL score, mean ± SD			
Basic ADLs (0–21)	20.4 ± 2.1	19.0 ± 4.0	<.001*
Tokyo Metropolitan Institute of Gerontology Index of Competence (0–13)	11.5 ± 2.3	9.0 ± 4.0	<.001*
Self-maintenance (0–5)	4.7 ± 1.0	3.8 ± 1.8	<.001*
Intellectual activity (0–4)	3.4 ± 1.0	2.6 ± 1.3	<.001*
Social role (0–4)	3.5 ± 0.9	2.7 ± 1.4	<.001*
Depression			
GDS score, mean ± SD (0–15)	4.1 ± 3.3	6.0 ± 4.2	<.001
GDS score > 9, %	9.0	21.3	<.001
Frequency-of-laughter score, mean ± SD (0–9)	5.9 ± 1.8	4.8 ± 2.0	<.001
Quality of life score, mean ± SD (0–100)			
Subjective health	56.6 ± 21.2	49.0 ± 22.7	<.001
Relationship with family	78.8 ± 21.1	71.9 ± 23.0	<.001
Relationship with friends	78.4 ± 20.5	68.6 ± 24.0	<.001
Financial satisfaction	51.9 ± 23.0	46.3 ± 24.1	.004
Subjective happiness	62.8 ± 20.6	54.7 ± 23.7	<.001

Student *t*-test for continuous variables, chi-square test for categorical variables.
**P*-values after adjustment for the effect of age.
SD = standard deviation; GDS = Geriatric Depression Scale.

These findings suggest that having hobbies may play an important role in the maintenance of physical health, mental health, and active aging of elderly people.

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LETTERS TO THE EDITOR

CHANGES OVER TIME IN DISEASE STATE PERCEIVED BY ELDERLY ADULTS IN JAPAN TO BE LEAST WANTED LATE IN LIFE

To the Editor: Cancer, stroke, heart diseases, and dementia are leading underlying causes of death in elderly adults in Japan. In 1997, it was reported that the disease state that community-dwelling elderly people least wanted to die from was dementia, followed by cancer, stroke, and heart disease.[1] Since the long-term care insurance system was introduced in 2000, environments for caring for patients with chronic diseases in Japan have changed dramatically. In 2006, the same question was asked of people aged 65 and older living in three Japanese communities: 1,539 participants living in T town in Kochi prefecture (male:female = 733:806, mean age 75.6 ± 6.9), 2,647 participants living in O town in Mie prefecture (male:female = 1,098:1,549, mean age 75.3 ± 7.3), and 676 participants living in U town in Hokkaido prefecture (male:female = 289:387, mean age 75.0 ± 6.9). The three towns are located in different areas of Japan: T town in southwest Japan, O town in central south Japan, and U town in north Japan. Each participant was asked to select one of the following disease states as the one he or she least wanted to have late in life: dementia, cancer, stroke, and heart diseases. Table 1 shows a comparison between 1997 and 2006 of percentages of elderly participants in each community who chose each disease state. Percentages of elderly participants choosing dementia as the least-wanted disease state decreased from 60% to 69% in 1997 to 34% to 44% in 2006, whereas percentages choosing cancer as the least wanted increased from 20% to 22% in 1997 to 37% to 43% in 2006. Percentages of elderly people who chose heart diseases as the disease state least wanted were consistent between all communities and in both studies, at only 2%. Cultural factors such as the long-term care insurance system may influence the perception of disease state by older people. During the last 10 years, older people might have encountered some elderly patients with dementia that could be appropriately cared for with a suitable quality of life within Japan's healthcare system.

Table 1. Disease States that Elderly People in Japan Least Want Late in Life

	%			
Year and Town	Dementia	Cancer	Stroke	Heart Disease
1997				
K Town in Kochi (n = 1,513)	64	22	12	2
K Town in Kogoshima (n = 638)	69	20	8	2
2006				
T Town in Kochi (n = 1,539)	34	43	21	2
O Town in Mie (n = 2,647)	44	43	11	2
U Town in Hokkaido (n = 676)	44	37	17	2

There are three English terms that mean disease state connoting something somewhat conceptually different: disease, illness, and sickness. From the point of view of field medicine, each has a slightly different meaning, as outlined here. Disease connotes a concept of the causative agent or of the scientific mechanism of cause and effect. Illness refers to effects of the agent on a person's health and how a person experiences a disease state and is mingled with cultural overtones and social norms.[2] The third word, sickness, connotes a social concept that means something wrong, not normal, abnormal, or anything unusual. A disease state perceived and selected by each community-dwelling elderly adult might be mingled with multidimensional, including scientific, subjective, and sociocultural, factors.

Through medical field work in Asian countries, including traditional local cultures in West Papua[3] and current populations in Japan,[1,4,5] understanding of the broad variations in cultural interpretation of disease states and differences in how quality of life is defined has been deepened. Patients whose disease had been treated but who never felt that their illness had been cured were sometimes encountered. In contrast, patients with dementia could not be completely cured, but their subjective illness could be. Patients might request a cure for disease, healing for illness, and rehabilitation for sickness.

In conclusion, more attention should be paid to multidimensional subjective views of illness or sickness as perceived by elderly individuals, as well as scientific concepts of disease.

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ORIGINAL ARTICLE

Comprehensive geriatric assessment of elderly highlanders in Qinghai, China I: activities of daily living, quality of life and metabolic syndrome

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Aim: To reveal the comparison of comprehensive geriatric functions of elderly highlanders in Qinghai Plateau in China among three different ethnic groups.

Methods: Activities of daily living (ADL), screening-based depression, quality of life (QOL) and checking-up of metabolic syndrome including community-based oral glucose tolerance test were assessed in 393 community-dwelling elderly subjects aged 60 years or more (247 Han elderly subjects, 49 Mongolian ones and 97 Tibetan ones).

Results: Tibetan elderly highlanders were more disabled in ADL, but had higher QOL than Han elderly ones in Qinghai Plateau. Blood pressure measurements, rate of hypertension and hemoglobin concentrations in Tibetan elderly highlanders were lower than Han ones. Rates of diabetes and impaired glucose tolerance in elderly highlanders were relatively lower than other Asian elderly lowlanders.

Conclusion: Prevalence of metabolic syndrome in elderly highlanders in Qinghai was still not high, however, we should pay attention to its tendency related with socialglobalism in the near future. Further investigation on physiological adaptability to hypoxic environment and human ageing phenomena in a global context may open a new research frontier for ageing science.

Keywords: activities of daily living, elderly highlanders, metabolic syndrome, Qinghai Plateau in China, quality of life.

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Author contributions: K. M., K. O., R. S., M. K. and all the Chinese authors conducted community-based geriatric examinations in Haiyan in Qinghai in 2008. All of the authors contributed to the interpretation of the data, helped with revisions of the manuscript, and read and approved the manuscript. K. O. supervised the progress of the project and K. M. approved the final manuscript.

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Introduction

Mountains make up one-fifth of the world's landscape and approximately 10% of the total population in the world are living in mountainous regions, with at least more than 2% living at high altitude over 2500 m a.s.l.[1] Highland people have commonly developed to physiologically adapt to hypoxic environments. However, it is known that indigenous highlanders living in the Andean Altiplano in South America, in the Tibetan Plateau in Asia and at the highest elevations of the Ethiopian Highlands in east Africa have evolved three distinctly different biological adaptations for surviving in the oxygen-thin air.[2] Several physiological and clinical studies on human adaptation to hypoxia including human fertility, growth, development and nutrition were reported,[3] however, there have been few investigations on human ageing of highlanders.

We have carried out a comprehensive geriatric survey in Qinghai Province in China in 2008 as one research in the chain of the project of research Institute of Humanity and Nature (Kyoto) entitled "Human Life, Aging, and Disease in High-Altitude Environments: Physiomedical, Ecological and Cultural Adaptation in "Highland Civilization."

As one of a consecutive series of geriatric surveys for highlanders in Qinghai, we would like to report activities of daily living (ADL), subjective quality of life (QOL) and actual features of metabolic syndrome of community-dwelling elderly highlanders.

Methods

Subjects

The study population consisted of 393 community-dwelling elderly subjects aged 60 years or more (male : female, 185:208; mean age, 66.2 years old) living in Haiyan County in Qinghai in China, which was 19.4% of 2027 eligible subjects aged 60 years and more in the county. Haiyan County located at 3000–3300 m a.s.l. and 30 km northwest of Xining, which is the capital of Qinghai Province (Fig. 1). These subjects were elderly volunteers who hoped to be examined in response to our announcement of geriatric examination.

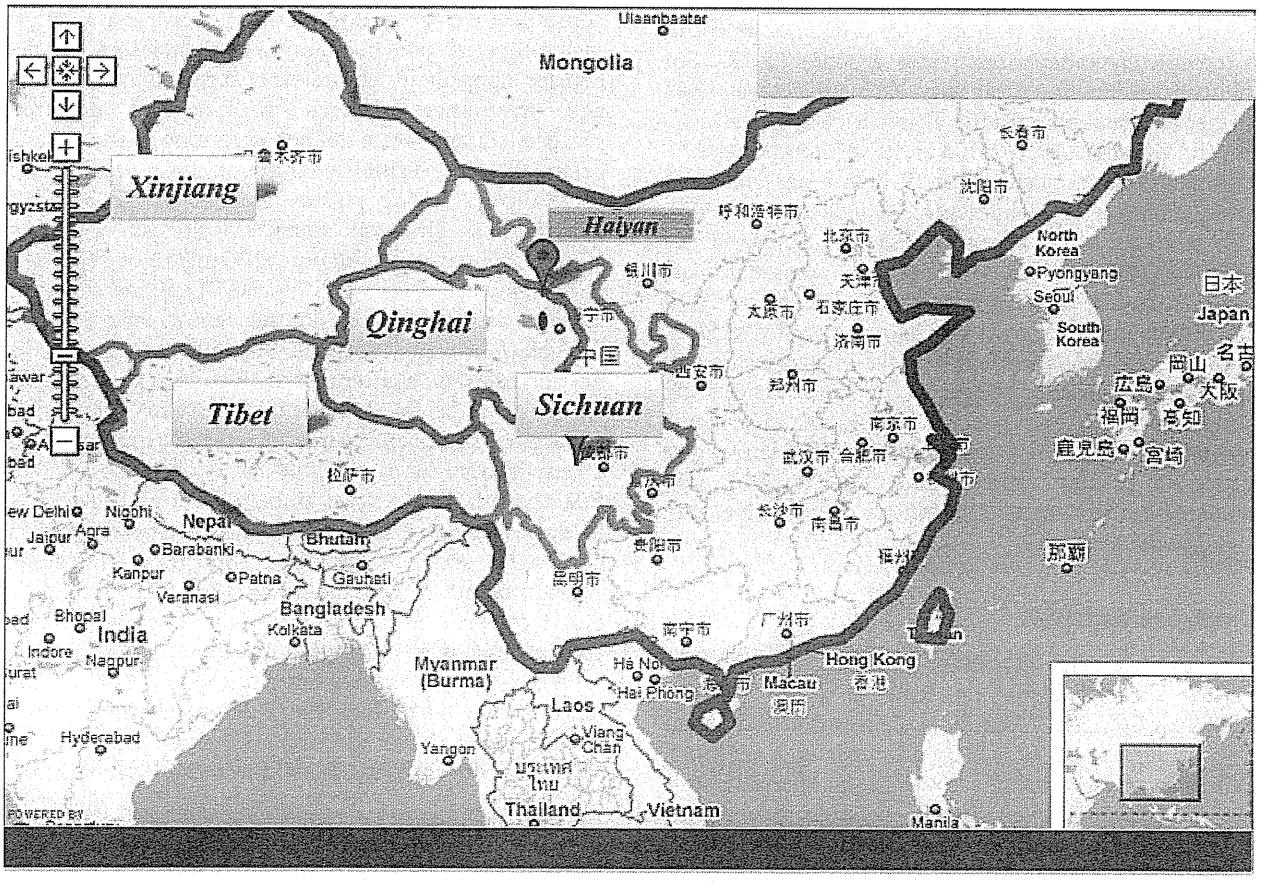

Figure 1 Map of Haiyan, Qinghai, China from Google.

The geriatric survey for community-dwelling elderly living in Haiyan County in Qinghai Province was carried out in August in 2008.

Items of comprehensive geriatric assessment

Items of comprehensive geriatric assessment included ADL, assessment of depression and quantitative assessment of QOL as well as medical and anthropometric indicators. Taking medical history and medico-social status was carried out by direct interview and medical indicators were assessed by geriatric examination.

ADL

For basic ADL assessment, each subject was rated by interviewing his/her independence in seven items (walking, ascending and descending stairs, feeding, dressing, using the toilet, bathing, grooming) as to the help needed, and was rated from 3 to 0 as follows: 3, completely independent; 2, need some help; 1, need help much; and 0, completely dependent. The items were added to give scores ranging 0–21, with low scores indicating disability.[4–8] Information-related function was defined as scores we summed for four items of function (visual acuity, hearing acuity, conversation, memory in one day) using a rating scale from 0 (cannot at all) to 3 (completely independent) into a score (0–12). For higher-level functional capacity, each subject was rated his/her independence on the Tokyo Metropolitan Institute of Gerontology (TMIG) index of competence.[9,10] This assessment consists of a 13-item index including three sublevels of competence: (i) instrumental ADL (five items rated on a yes/no basis: the ability to use public transport, buy daily necessities, prepare a meal, pay bills, handle banking matters); (ii) intellectual ADL (four items rated on a yes/no basis: the ability to fill in forms, read newspapers, read books or magazines and interest in television programs or news articles on health-related matters); and (iii) social role (four items rated on a yes/no basis: the ability to visit friends, give advice to relatives and friends who confide, visit someone at the hospital and initiate conversation with younger people).

Depression and QOL

We screened for depressive symptoms using the 15-item Geriatric Depression Scale (GDS-15).[11,12] translated into Chinese. We defined screening-based suspicion of depression as a GDS-15 score of 6 or more. QOL was assessed using a 100-mm visual analog scale (worst QOL on the left end of the scale, best on the right) in the following five items: (i) subjective sense of health; (ii) relationship with family; (iii) relationship with friends; (iv) financial status; and (v) subjective happiness.[13,14] For assessment of sense of value, each participant was asked to choose one item as the most important among economy, health, family, friend, religion and others.

Neruobehavioral functional assessment

We assessed neurobehavioral function using two items of tests including Up & Go test[15] and functional reach.[16]

Medical examination and community-based oral glucose tolerance test

Living condition, lifestyle (e.g. current habit of exercise, drinking alcohol, smoking) and medical histories (histories of stroke, heart diseases, bone fractures, osteoarthropathies and falls, as well as taking antihypertensive drugs) were also assessed. Two blood pressure measurements in the sitting position by autosphygmomanometer (HEM 757; Omron, Kyoto, Japan) were averaged into the blood pressure level of the subjects. Hypertension was defined as 140 mmHg or higher in systolic pressure, 90 mmHg or higher in diastolic or taking antihypertensive medication. Seventy-five-gram oral glucose tolerance test (OGTT; taking blood sample at fasting and 2 h after 75-g glucose tolerance) was carried out in each participant who accepted informed consent as well as fasting blood chemical examination including total protein, albumin, total cholesterol, high-density lipoprotein cholesterol, blood urea nitrogen and creatinine. Diabetes mellitus and impaired glucose tolerance were defined according to the criteria of the World Health Organization (WHO): diabetes (≤126 mg/dL fasting plasma glucose or ≤200 mg/dL 2-h plasma glucose); impaired glucose tolerance (110 ≤ fasting plasma glucose < 126 mg/dL or 140 ≤ 2-h plasma glucose <200 mg/dL by OGTT). Blood chemical analysis was carried out in the central laboratory of Qinghai University Hospital. Metabolic syndrome was defined based on a criteria of the Examination Committee of Criteria for Metabolic Syndrome (Japan);[17,18] adding to the cut-off points of waist circumference of 80 cm or more for men and 90 cm or more for women, fulfilling at least two items among: (i) serum triglyceride levels of 150 mg or more and/or low-density lipoprotein cholesterol levels of less than 40 mg/dL; (ii) systolic blood pressure of 130 mmHg or more and/or diastolic blood pressure of 85 mmHg or more; or (iii) fasting plasma glucose of 110 mg/dL or more.

These surveys were approved by the Ethical Committee of the Research Institute of Humanity and Nature and Medical Institute of Qinghai University, and written informed consent was obtained from each participant.

Statistical analysis

Statistical analysis was performed using StatView ver. 5 for Macintosh. ANOVA was used for continuous

variables among three groups and χ^2-test was used for categorical variables. *P*-values less than 0.05 were used to indicate statistical significance.

Results

The elderly participants were divided into three ethnic groups; 247 Han elderly subjects, 49 Mongolian and 97 Tibetan. Table 1 shows comparison of baseline characteristics among three ethnic elderly highlanders in Haiyan County in Qinghai Province. There were no significant differences in mean age, sex ratio, marital state, exercise habits, drinking or smoking and past medical histories among the three groups. However, lifestyles were different; most Han people were retired public servants and/or farmers, Mongolian people were engaged in farming and pasturage mixed, and Tibetan people were engaged in pasturage. Table 2 shows the comparison of scores in ADL among three ethnic elderly groups. Scores in ADL including scores in basic ADL and ones in each item of ADL; information-related functions and higher ADL except social role were lower in Tibetan elderly than those in Han elderly people.

Table 3 shows the comparison of scores in GDS-15 and percentage of screening-based depression and quantitative subjective QOL among three ethnic groups. There were no significant differences in mean scores in GDS-15 and in percentage of subjects with GDS scores of 6 or more. In contrast with ADL, mean scores in subjective QOL such as economic satisfaction and subjective happiness were higher in Tibetan elderly than those in Mongolian or Han elderly people. Figure 2 shows comparison of values among Han, Mongolian and Tibetan elderly highlanders. Tibetan elderly people thought religion as well as health and family were more important issues than economy, while Han elderly thought economy as well as health and family were more important than religion. Mongolian elderly thought family was the most important issue followed by health.

Table 4 shows the comparison of anthropometrical indicators among three ethnic elderly groups by sex. Although only body mass index (BMI) was higher in Tibetan elderly women than in Han people, there were few differences in anthropometrical measurements among the three ethnic groups both in men and women. In neurobehavioral functions, scores in Up & Go test assessing walking speed and postural function was lowest in Tibetan men.

Table 5 shows the comparison of blood pressures and blood chemical examination including OGTT among the three ethnic groups. Both systolic and diastolic blood pressures were lower in Tibetan elderly subjects than in Han. Although there was no significant difference in SPO2 among the three ethnic groups, hemoglobin concentration and hematocrit were lower in Tibetan and Mongolian elderly subjects than in Han. There were no significant differences in fasting blood sugar levels, plasma glucose levels at 2 h after 75-g oral glucose taking of elderly subjects with diabetes or impaired glucose tolerance and prevalence of metabolic syndrome among the three ethnic groups.

Table 1 Comparison of baseline characteristics among Tibetan, Mongolian and Han elderly

	Tibetan ($n = 97$)	Mongolian ($n = 49$)	Han ($n = 247$)	*P*-value
Age	66.7 ± 5.1	67.4 ± 5.8	65.9 ± 5.3	NS
Sex (M/F)	46/51	28/21	111/136	NS
Marital status				
Spouse alive (%)	70	65	72	NS
Widowed (%)	28	35	28	NS
Life habits				
Living alone (%)	5	6	2	NS
Work or exercise every day (%)	46	63	61	NS
Drinking alcohol (%)	16	24	22	NS
Smoking (%)	25	43	25	NS
Medical history				
Taking antihypertensive medication (%)	24	23	28	NS
History of stroke (%)	14	11	15	NS
History of heart disease (%)	70	71	53	NS
History of bone fracture (%)	21	17	19	NS
History of osteoarthropathy (%)	83	74	76	NS
History of fall (%)	24	20	35	NS

P-values were calculated by ANOVA or χ^2-test. NS, not significant.

Table 2 Comparison of activities of daily living among Tibetan, Mongolian and Han elderly

	Tibetan	Mongolian	Han	*P*-value
ADL				
Scores in basic ADL (0–21)	19.0 ± 3.6†	20.1 ± 2.5	20.1 ± 2.4	0.0147
Independence rate of all basic ADL (%)	61	80	78	0.0212
Independence rate of each basic ADL item (%)				
Walking	79†	91	92	0.0529
Ascending and descending stairs	67†	86	86	0.0104
Feeding	91†	97	98	0.0534
Dressing	91	97	97	NS
Toileting	89	97	97	NS
Bathing	80	89	90	NS
Grooming	83†	91	93	0.0913
Scores in information-related function (0–12)	9.6 ± 2.0†	10.2 ± 1.6	10.2 ± 1.5	0.0191
Scores in total TMIG (0–13)	7.2 ± 3.1†	8.3 ± 2.6	8.5 ± 2.9	0.0084
Scores in instrumental ADL (0–5)	3.4 ± 1.4†	3.6 ± 1.2	3.9 ± 1.4	0.0301
Scores in intellectual ADL (0–4)	1.0 ± 1.3†	1.5 ± 1.4	1.6 ± 1.4	0.0029
Scores in social role (0–4)	2.8 ± 1.3	3.2 ± 1.0	2.9 ± 1.1	NS

†Statistically significant between Tibetan and Han. *P*-values were calculated using ANOVA or χ^2-test. ADL, activities of daily living; NS, not significant; TMIG, Tokyo Metropolitan Institute of Gerontology index of competence.

Table 3 Comparison of mood and subjective quality of life among Tibetan, Mongolian and Han elderly

	Tibetan	Mongolian	Han	*P*-value
Mood				
GDS (0–15)	5.1 ± 2.5	5.2 ± 2.7	5.6 ± 2.8	NS
% of GDS > 5	41	37	45	NS
Subjective QOL				
Subjective sense of health	58.6 ± 27.2	51.4 ± 25.4	52.1 ± 29.2	NS
Family relationship	89.5 ± 20.4	87.1 ± 25.2	86.2 ± 20.9	NS
Friendship	91.5 ± 16.6†	86.5 ± 22.2	84.9 ± 21.2	0.0663
Economic satisfaction	66.5 ± 25.1†	59.3 ± 25.6	45.9 ± 28.8	<0.0001
Subjective happiness	83.0 ± 22.1†	76.6 ± 28.8	72.2 ± 27.0	0.0139

†Statistically significant between Tibetan and Han. *P*-values were calculated using ANOVA or χ^2-test. GDS, Geriatric Depression Scale; QOL, quality of life.

Discussion

Although a substantial portion of the world's population lives at high altitude, there has been little information on the effects of altitude on ageing phenomena of humans residing permanently at altitudes ranging 2500–5000 m a.s.l. Altitude, through its effect on factors such as diminished atmospheric pressure, weather conditions, isolation, changes in the proportion of radiations of different wave length in the sun's rays and the related unique livelihoods of highlanders could affect human ageing phenomena. Highlanders have maintained their traditional livelihoods exerting their ingenuity with limited environmental resources and adapting their bodies to hypoxic environments. However, recent economic and social globalizations (e.g. monetary economy and marketism, acceleration of information delivery, rapid development of transportation and growing ageing society) are mounting even to high altitude areas including Qinghai and Tibet in China, for example, through full opening of highland railways from Shanghai to Lhasa in Tibet through Xining in Qinghai. The objective of this series of articles was to describe actual geriatric features of community-dwelling elderly highlanders living in Qinghai Plateau. Highland populations living in Qinghai were grossly classified into the main three ethnic groups and others, Han people, Mongolian and Tibetan, each of which has had a somewhat different history in reaching high altitude, lifestyle and culture.

This article described the comparison of the comprehensive geriatric functions of community-dwelling

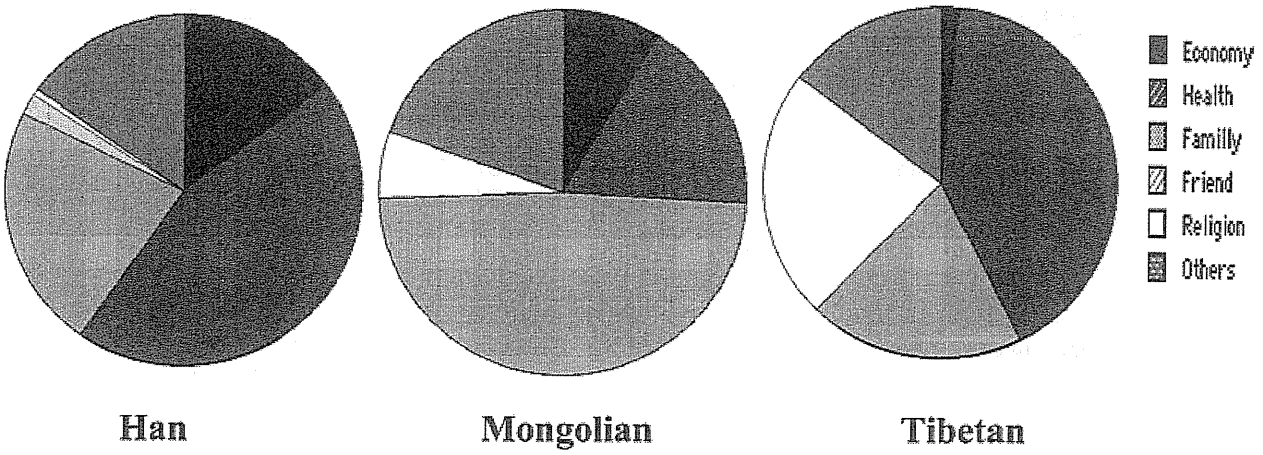

Figure 2 Comparison of the most important issues among three different ethnic groups of elderly highlanders.

Table 4 Comparison of anthropometrical indicators among three ethnic groups of elderly highlanders in Qinghai in China

	Tibetan	Mongolian	Han	*P*-value
Anthropometrical (male)				
Height (cm)	162 ± 10	161 ± 9	160 ± 9	NS
Bodyweight (kg)	64 ± 13	64 ± 11	62 ± 11	NS
BMI	24.7 ± 4.4	24.3 ± 3.5	23.6 ± 3.8	NS
% BMI ≥ 25	37%	48%	31%	NS
Abdominal circumference	86 ± 14	89 ± 10	84 ± 12	NS
Hip circumference	96 ± 10	99 ± 7	95 ± 10	NS
Neurobehavioral functions				
Up & Go	20.4 ± 14.8†	17.5 ± 13.1	14.0 ± 5.3	0.0003
Functional reach	28 ± 10	33 ± 19	28 ± 10	NS
Anthropometrical (female)				
Height (cm)	156 ± 8	160 ± 4	154 ± 6	NS
Bodyweight (kg)	62 ± 8†	54 ± 8	55 ± 10	0.0179
Body mass index	24.7 ± 4.3†	21.5 ± 2.9	22.8 ± 4.0	0.026
% BMI ≥ 25	42%	17%	30%	NS
Abdominal circumference	86 ± 9	80 ± 15	83 ± 12	NS
Hip circumference	99 ± 6	95 ± 10	95 ± 9	NS
Neurobehavioral functions				
Up & Go	15.1 ± 3.0	13.8 ± 1.9	14.7 ± 4.2	NS
Functional reach	30 ± 8†	20 ± 7	23 ± 10	0.0121

†Statistically significant between Tibetan and Han. *P*-values were calculated using ANOVA or χ^2-test. BMI, body mass index.

elderly subjects among three different ethnic groups living in Haiyan County in Qinghai Province in China. In general, scores in ADL of community-dwelling elderly were lower in Asian developing countries than those in developed ones. Scores in basic ADL of Tibetan elderly highlanders in Qinghai were lower than those in Han or Mongolian highlanders. Also, the mean score in basic ADL of Tibetan elderly highlanders was lowest among those of community-dwelling elderly in villages in eight Asian countries (Singapore,[19] Korea,[20] Japan,[20] Vietnam,[21] Laos,[22] Indonesia,[23] Myanmar,[24] Thailand[25]), while that of Han or Mongolian elderly highlanders was slightly higher than those of elderly lowlander subjects in Myanmar[24] or Vietnam.[21] In general, scores in ADL in elderly highlanders including Tibetan and Han were lower than those in other elderly lowlanders in Asian countries, supposing that highland environment itself including hypoxia and limited environmental resources might promote human ageing phenomena. The lower ADL and lower abilities of

Table 5 Comparison of blood pressure and blood chemical examination among three ethnic groups of elderly highlanders in Qinghai in China

	Tibetan	Mongolian	Han	*P*-value
Physiological				
Systolic blood pressure (mmHg)	130 ± 26†	137 ± 22	141 ± 25	0.0025
Diastolic blood pressure (mmHg)	79 ± 15†	84 ± 12	86 ± 14	0.0007
Pulse rate	76 ± 12	73 ± 18	77 ± 15	NS
% of hypertension	36†	48	58	0.0017
SPO_2 (%)	90 ± 3	90 ± 4	89 ± 5	NS
Hematological				
Hemoglobin level (g/dL)	15.9 ± 2.5†	16.1 ± 2.2	16.6 ± 2.8	0.045
Hematocrit (%)	44.8 ± 6.5†	44.8 ± 6.4	47.8 ± 8.0	0.0008
Results of oral glucose tolerance test				
Fasting plasma glucose (mg/dL)	91.0 ± 30.9	84.4 ± 17.6	87.1 ± 33.4	NS
2-h plasma glucose (mg/dL)	114.9 ± 64.0	109.7 ± 66.5	118.0 ± 68.8	NS
% of diabetes	6.6%	9.40%	7.9%	NS
% of impaired glucose tolerance	10.5%	0.0%	11.8%	NS
Triglyceride (mg/dL)	53 ± 29†	54 ± 28	65 ± 41	<0.0001
Total cholesterol (mg/dL)	225 ± 58†	227 ± 47	195 ± 45	0.012
HDL cholesterol (mg/dL)	54 ± 15	59 ± 21	54 ± 20	NS
% of metabolic syndrome	8	6	9	NS

†Statistically significant between Tibetan and Han. *P*-values were calculated using ANOVA or χ^2-test. HDL, high-density lipoprotein; NS, not significant.

walking, ascending and descending stairs of Tibetan people may be due to high prevalence of severe osteoarthropathy. Hard exercise in nomadic lifestyle throughout life in Tibetan people might bring about severe arthropathy in some elderly persons in their later life.

However, it is noteworthy that in contrast with ADL, scores in subjective QOL of Tibetan elderly highlanders, especially scores in friendship, economic satisfaction and subjective happiness, were significantly higher than those of Han or Mongolian elderly highlanders. Discrepancy between ADL and QOL was sometimes revealed in religiously pious people.[26] Higher scores in subjective QOL in Tibetan elderly people might be due to, at least in part, their pious beliefs in Buddhism and to sense of social freedom from communistically organized labor system since 1982. This view was coincided with differences in sense of value among the three ethnic groups. Tibetan elderly people thought religion was an important issue as well as health and family, which were common concerns for the elderly in the world, while Han elderly people thought economy was important following health and family.

Of particular note was that hemoglobin concentrations and hematocrit levels in Tibetan and Mongolian highlanders were significantly lower than those in Han highlanders, indicating that Tibetan and Mongolian peoples were differently adaptive to hypoxic environments than Han people,[27] as we have discussed in another article in this series.[28] On metabolic syndrome in elderly highlanders, blood pressure levels both in systolic and diastolic and rate of hypertension in Tibetan elderly were significantly lower than those in Han or Mongolian elderly subjects. There was no significant difference in rate of subjects with diabetes or subjects with impaired glucose tolerance among the three ethnic groups. In general, rates of diabetes and impaired glucose tolerance in elderly highlanders in Qinghai were lower than those in other lowland Asian areas.[29–32] Controversies exist in the definition of metabolic syndrome among Western and Asian countries. However, based on a criteria of the Examination Committee of Criteria for Metabolic Syndrome (Japan),[17,18] prevalence of metabolic syndrome as well as diabetes was relatively lower in highlanders in Qinghai than Asian lowlanders, at least until now. Lower prevalence of diabetes in Qinghai highlanders in our findings coincided with a few studies showing lower impaired glucose tolerance in highlanders than lowlanders.[33] However, as social globalism including prolongation of lifespan is reaching highland areas and lifestyle at high altitudes are changing from traditional to modern, we should pay more attention to tendency of metabolic syndrome in the elderly highlander as we also described in another paper of this series.[34] Future study may be needed on the relationship between genetically different adaptability to oxidative stress,[35] hypoxia and human ageing phenomena including metabolic syndrome.

In conclusion, Tibetan elderly highlanders were more disabled in ADL, but had higher QOL than Han elderly in Qinghai Plateau. Prevalence of metabolic syndrome in elderly highlanders in Qinghai was not still high, however, we should pay attention to its progress related to social globalism in the near future. Further investigation on physiological adaptability to a hypoxic environment and human ageing phenomena in a global context may open a new research frontier for ageing science.

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ORIGINAL ARTICLE

Comprehensive Geriatric Assessment of elderly highlanders in Qinghai, China II: The association of polycythemia with lifestyle-related diseases among the three ethnicities

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Aim: The objective of this study is to disclose the association of polycythemia with lifestyle-related diseases (hypertension, obesity and glucose intolerance) among the three ethnicities in Qinghai, China.

Methods: The subjects were 393 elderly people (247 Han, 97 Tibetan and 49 Mongolian) aged 60 years and more living in Qinghai (3000 m a.s.l.) in China. The associated factors with polycythemia were analyzed in the subjects. Excessive polycythemia was defined as hemoglobin concentration over 20 mg/dL.

Results: Polycythemia was associated with men, hypoxemia, obesity and high diastolic blood pressure (DBP) in the elderly in Qinghai. Male sex was associated with polycythemia in all ethnicities. Obesity was associated with Han and Tibetan men. Glucose intolerance and activities of daily living were not directly associated with polycythemia after adjustment for sex. There were 7.9% with excessive polycythemia. Independently-associated factors for excessive polycythemia were male sex, body mass index of 25 or more, SpO_2 of less than 85%, DBP of 85 mmHg or more and Han ethnicity (vs Tibetan) by multiple logistic regression.

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Conclusion: There was a close association of polycythemia with diastolic hypertension and obesity in lifestyle-related diseases in high-altitude elderly people. Han people had a higher hemoglobin concentration after adjustment of lifestyle-related diseases compared with Tibetan people. The difference of hemoglobin concentration may be due to Tibetans undergoing a much longer period of adaptation than Han people. Further study is needed to disclose the association between the difference of hypoxic adaptation, lifestyle-related diseases and chronic mountain sickness for their prevention.

Keywords: chronic mountain sickness, elderly highlanders, polycythemia, Qinghai Plateau in China.

Introduction

High-altitude peoples have become well-adapted to severe hypoxic environments. Evolutionary strategies include an increased amount of hemoglobin, increased blood flow in pulmonary circulation, increased capacity of pulmonary ventilation and the preservation of high oxygen saturation of hemoglobin.[1,2] There is even a morbid state, commonly called "chronic mountain sickness" (CMS) caused by the failure of adaptation mechanisms.[3–8] Persons with CMS have extremely high hemoglobin levels; this may be regarded as an exaggeration, rather than insufficiency, of the normal adaptation mechanism.[9] Not only CMS but also high-altitude pulmonary hypertension (HAPH) are the serious chronic conditions in highlanders caused by hypoxia, as there may be 5–10% of highlanders or immigrants who are at risk of suffering from the two diseases.[8,10] Definition of those diseases was shown in a consensus statement.[8] CMS has the condition of excessive erythrocytosis and HAPH has predominant pulmonary hypertension and those conditions may appear in the same individuals. The risk factors of CMS were reported and they were male sex, aging, obesity and lower respiratory tract disease. The risk factors of HAPH were reported and they were male sex, Han ethnicity and children. It remains unknown how the lifestyle-related diseases of not only obesity but also hypertension and glucose intolerance are related to suffering from CMS. A longitudinal study of disclosing the risk factors for the onset of CMS has not yet been carried out.[8,10]

Polycythemia is the most important basic pathophysiological condition for the development of CMS in highlanders. The purpose of this study is to disclose the association between polycythemia and lifestyle-related diseases such as obesity, hypertension, glucose intolerance, and differences among the three ethnicities of Han, Mongolian and Tibetan elderly highlanders.

We have carried out comprehensive assessments of the medical functions of community-dwelling elderly and provided efficient education to promote healthy lifestyles in the elderly in Japan compared with Asian countries.[11–18] As a result, diseases and frailty in community-dwelling elderly people are found to be influenced by such ecological differences as the natural environment, historical background, lifestyle, personal habits, religion and health promotion policies in the area. Because the process of human aging may be accelerated in high-altitude environments,[19,20] it is of great significance to study the relationship of human aging and disease in high-altitude environments. That is why we analyzed the association between functional ability and polycythemia in elderly highlanders.

Our colleagues, Matsubayashi *et al.*, showed the comparison of O_2 saturation (SpO_2), body mass index (BMI), blood pressure, glucose intolerance, smoking habit, history of stroke or heart disease, and basic and higher functional abilities in the same subjects of elderly Han, Mongolian and Tibetan people in Qinghai.[21] Han people had better basic activities of daily living (ADL) and higher functional abilities. We analyzed the associations of those factors with hemoglobin concentration and polycythemia in this study.

Methods

Subjects

The subjects were 393 elderly people (male : female = 185/208; mean age: 66.2 years), consisting of 247 Han people (male : female = 111/136; mean age: 65.9 years), 97 Tibetans (male : female = 46/51; mean age: 66.7 years), and 49 Mongolian people (male : female = 28/21; mean age: 67.4 years), aged 60 years and more living in two towns and four villages in Haiyan County in Haixi Mongolian and Tibetan Autonomous Prefecture, Qinghai Province, China. The survey was carried out in Haiyan Town (3000 m a.s.l.) in 2008 and 393 elderly people, which was 19.4% of 2027 eligible people aged 60 and more, could be examined.[22] The population of Haiyan County was 38 000.[23] The associated factors with polycythemia were analyzed among the three ethnicities.

Medical examinations

Examination of hemoglobin concentration (Hb) and 75 g oral glucose tolerance test (OGTT) were carried out in each participant who provided informed consent.

Excessive polycythemia (Hb ≥20 g/dL) was defined as over 20 mg/dL of Hb for men and women. Mild polycythemia was defined as 20 > Hb ≥ 18 g/dL in men and 20 > Hb ≥ 16 g/dL in women. Anemia was defined as Hb of less than 13 g/dL in men and Hb less than 12 g/dL in women.

Diabetes mellitus and impaired glucose tolerance were defined according to the criteria of the World Health Organization (WHO): diabetes (126 mg/dL or less fasting plasma glucose or 200 mg/dL or less 2-h plasma glucose), impaired glucose tolerance (110 mg/dL ≤ fasting plasma glucose < 126 mg/dL or 140 mg/dL ≤ 2-h plasma glucose < 200 mg/dL) by OGTT.[24] Blood chemical analysis was carried out in the central laboratory of Qinghai University Hospital. O_2 saturation (SpO_2) was examined by pulse oximeter (Epoch 30; Ubix Corporation, Tokyo, Japan) percutaneously.

Two blood pressure measurements in the sitting position by auto-sphygmomanometer (HEM 757; Omron health Care Co., Ltd. Kyoto, Japan) were averaged into the blood pressure level of the subjects. Hypertension was defined as 140 mmHg or higher in systolic blood pressure (SBP), 90 mmHg or higher in diastolic blood pressure (DBP) or taking antihypertensive medication.

Items of Comprehensive Geriatric Assessment (CGA) included basic ADL and higher-level functional capacity. For basic ADL assessment, each subject was rated by direct interview of his/her independence in regard to seven items (walking, ascending and descending stairs, feeding, dressing, making his/her toilet, bathing, grooming) as to the help needed. The items were rated from 3 to 0: 3, completely independent; 2, need some help; 1, need a lot of help; 0, completely dependent). The items were added to give scores ranging 0–21, with low scores indicating disability.[18] For higher-level functional capacity, each subject was rated by direct interview of his/her independence in the Tokyo Metropolitan Institute of Gerontology (TMIG) index of competence.[25,26] This assessment consists of a 13-item index including three sublevels of competence: (i) instrumental ADL (five items: the ability to use public transport, buy daily necessities, prepare a meal, pay bills and handle banking matters, rated on a yes/no basis); (ii) intellectual activities (four items: the ability to complete forms, read newspapers, read books or magazines and take interest in television programs or news articles on health-related matters, rated on a yes/no basis); and (iii) social role (four items: the ability to visit friends, give advice to relatives and friends who confide, visit someone at the hospital and initiate conversation with younger people, rated on a yes/no basis).

History of stroke, history of heart disease, habit of current and past smoking were established by interviewing the subjects.

This survey was approved by the Ethical Committee of Research Institute for Humanity and Nature and Medical Institute of Qinghai University, and we got the written informed consent from each participant.

Statistical analysis

Statistical analysis was performed using StatView ver. 5 for Macintosh. ANOVA was used for continuous variables among three groups and the χ^2-test was used for categorical variables. Associated factors for excessive polycythemia was analyzed by logistic regression analysis. *P*-values less than 0.05 were used to indicate statistical significance.

Results

Table 1 shows the comparison of hematological status, SpO_2, BMI, blood pressure, glucose intolerance, smoking habit, history of stroke or heart disease, and basic ADL and higher functional abilities in Han and Mongolian elderly people compared with Tibetan people in Qinghai. There was no difference in age, sex, SpO_2 and prevalence of glucose intolerance among the three ethnicities. The Han people had higher hematocrit, hemoglobin concentration, lower average BMI, higher average SBP and DBP, and higher prevalence of hypertension compared with Tibetan people. There was more prevalence of polycythemia in Hans compared with Tibetans but no difference in the prevalence of anemia between them.

Table 2 shows the comparison of Hb in Han and Mongolian elderly people compared with Tibetan people in Qinghai, respectively, in men and women. The Han people had higher Hb concentration and much higher prevalence of polycythemia than Tibetan people in men, but not significantly in women.

As there were much higher Hb levels in men than women in all ethnicities, separate analyses by sex were carried out for the comparison of average Hb in the differences of DBP, BMI and glucose intolerance in each ethnicity (Table 3). In the analysis of the whole subjects, there were the associations of higher Hb with lower SpO_2 in both sexes, higher DBP in men, and higher BMI in men. Han people with low SpO_2 had higher Hb in men and women but there was no association in Tibetan people. Tibetan female elderly with higher DBP had higher Hb. The elderly with glucose intolerance had higher Hb for all of the subjects in Qinghai, but there were no differences in the separated analyses of men and women, respectively. People with current or past smoking had higher Hb concentration but there were no differences in the separate analysis by sex. People with high scores in instrumental ADL and intellectual activities had higher Hb, but there were no differences in the separate analysis by sex. There was no association of history of stroke or heart disease with Hb.