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Relationship between Lifestyle Habits and Vascular Aging in Female University Students

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Abstract

Blood vessels age due to lifestyle disturbances and stress in the living environment, in addition to aging. The lower the elasticity of the blood vessels, the higher the vascular age. The purpose of this study was to clarify the factors related to vascular aging by measuring the elasticity of blood vessels and administering questionnaires on lifestyle and stress to female university students. In this study, 113 female university students (aged 18 - 29) had their vascular elasticity measured using a body checker. Lifestyle habits, such as exercise, smoking, and alcohol consumption, were also investigated using a questionnaire. Stress was scored by asking the participants to select a number of stressors that they felt in their daily lives and to choose the ones that they applied. The effects of lifestyle and stress on vascular aging were also analyzed. Significant results were found for mental stress and stress-coping skills, and high daily stress was associated with vascular aging. Many causes of stress exist in daily life and are considered to be difficult to resolve in daily life. Failure to relieve stress may lead to chronic blood contamination, and consequently, stress may have a negative impact on vascular aging.

Keywords

Vascular Elasticity, Vascular Aging, Stress, Lifestyle Habits

1. Introduction

Vascular aging refers to a state in which the flexibility and elasticity of the blood vessels are lost, causing the blood vessels as a whole to become stiff and the lumen to narrow. It is believed that one of the reasons why high blood pressure is common in the elderly is that the elasticity of blood vessels decreases due to aging,

resulting in a poor blood flow [1]. Hypertension in the elderly is an important factor determining the patient's prognosis, activity of daily living (ADL), and quality of life (QOL). In recent years, the importance of systolic hypertension as a risk factor for cardiovascular complications and cardiovascular events in the elderly with hypertension has been recognized. Hypertension in the elderly also causes a decrease in vascular compliance with the progression of arteriosclerosis, a decrease in organ blood flow, impaired self-regulation, and age-related changes in humoral and neurological blood pressure regulators [2].

However, in modern times, it has been reported that the rate of aging of blood vessels is accelerating due to irregular lifestyle habits and stress in the living environment, leading to an increase in the number of people with a vascular age that is higher than their actual age [3]. The causes of vascular aging include binge eating, excessive drinking, mental stress, imbalance of autonomic nerves, lack of exercise, and smoking. Another cause is a decrease in the function of the autonomic nervous system, which makes it difficult for blood vessels to contract and expand [4].

From the above, in order to delay vascular aging, it is important to improve irregular lifestyles and relieve stress in the living environment at a young age, thereby suppressing vascular aging that may occur due to aging as much as possible. In particular, it is of great significance to have regular lifestyle habits, because having regular lifestyle habits at a young age can be expected to delay vascular aging due to aging. The health of young women is considered to be susceptible to lifestyle factors, and this study focused on female university students [5].

In this study, we investigated vascular elasticity, lifestyle history, and stress environments in female university students, in order to clarify the factors deeply related to vascular aging.

2. Methods

2.1. Subjects

The subjects consisted of 113 female university students, aged 18 to 29, from one university in Japan. The survey was conducted between October 2018 and March 2019. The present study was approved by the Ethics Committee of Epidemiological Studies at Yamagata Prefectural Yonezawa University of Nutrition Sciences.

2.2. Measurement Items

Vascular elasticity ranked from 1 (low) to 3 (high) was determined by measuring the fingertip plethysmography of the left index finger and analyzing the hemodynamics of the peripheral fine artery using a body checker (Tokyo Iken Co., Ltd.). The heart rate was also measured. Height, weight, body mass index (BMI), and body fat percentage were measured using standard height and weight scales.

In addition, lifestyle habits such as exercise, snacking, smoking, and drinking were investigated using a self-administered questionnaire [6]. Similarly, using the questionnaire that we developed, stress scores, physical stress, mental stress, and stress-coping skills were also measured [7] [8]. Regarding autonomic dysregula-

tion and orthostatic dysregulation, participants were asked to list 36 things they could feel in their daily lives and choose those that applied to them.

Based on these results, we analyzed how lifestyle habits affected vascular aging.

2.3. Statistical Processing

Microsoft Excel was used to tabulate and analyze the survey results, with one-way analysis of variance used to analyze differences by the vascular aging degree group for each survey item.

3. Results

The results of the physical characteristics of the subjects were shown in Table 1 with mean values and standard deviations. As shown in Table 1, both the mean value and standard deviation were similar to those of Japanese adult women. The results of the lifestyle habits and stress of the subjects were shown in Table 2 and Table 3 with mean values and standard deviation, respectively.

Table 1. Mean value and standard deviation of physical characteristics of the subjects.

Item	Numeric value
Age (years)	21.2 ± 2.1
Height (cm)	157.6 ± 5.4
Weight (kg)	51.6 ± 7.4
BMI (kg/m^2)	20.8 ± 2.8
Body fat percentage (%)	27.6 ± 5.0
Average heart rate	77.2 ± 17.4
Vascular elasticity (rank)	2.3 ± 0.7

Table 2. Average values and standard deviations of lifestyle habits of the subjects.

Item	Numeric value
Exercise time in elementary school (hours/month)	5.7 ± 5.9
Exercise time in junior high school (hours/month)	12.9 ± 10.8
Exercise time in high school (hours/month)	8.2 ± 10.6
Exercise time in university (hours/month)	2.4 ± 4.8
University commuting time (minutes)	14.4 ± 16.1
Drinking (days/month)	2.1 ± 2.6
Snacks (days/week)	1.2 ± 0.8
Sleep time (hours/day)	7.5 ± 1.0
Smoking (cigarettes/day)	0.01 ± 0.1

Table 3. Average and standard deviation of subject's stress.

Item	Numeric value
Autonomic dysregulation (how many episodes)	1.6 ± 1.7
Orthostatic dysregulation (how many episodes)	2.0 ± 1.8
Stress score (points)	18.2 ± 31.9
Physical stress	1.4 ± 0.7
Mental stress	1.6 ± 0.8
Stress management ability	2.8 ± 1.0

Table 4 shows the results of examining the relationship between vascular elasticity and six physical characteristics considered related to the degree of vascular aging.

There were no significant differences in height, body fat percentage, or average heart rate, between vascular elasticity (rank) groups. On the other hand, there were significant differences in age, weight, and BMI, between vascular elasticity (rank) groups.

Table 4. Relationship between vascular elasticity rank and physical characteristics.

	Vascular elasticity rank			Significant difference
Rank number (n)	**1** (18)	**2** (46)	**3** (49)	
Age	22.4 ± 0.7	21.2 ± 0.4	20.8 ± 0.5	1 vs 2, 1 vs 3, both $p < 0.05$
Height (cm)	158.4 ± 1.0	158.7 ± 1.3	157.0 ± 1.0	N.S.
Weight (kg)	48.5 ± 1.4	56.9 ± 2.9	47.6 ± 1.1	1 vs 2, 2 vs 3, both $p < 0.05$
BMI	19.2 ± 0.5	22.6 ± 1.2	19.4 ± 0.5	1 vs 2, 2 vs 3, both $p < 0.05$
Body fat (%)	25.7 ± 1.2	30.2 ± 2.2	27.7 ± 1.2	N.S.
Heart rate	83.8 ± 2.5	72.4 ± 2.3	86.9 ± 6.6	N.S.

The relationship between vascular elasticity and lifestyle is shown in Table 5. No significant differences were observed in exercise time between elementary school, junior high school, high school, and university by vascular elasticity (rank) group. While no significant differences were observed in the university commuting time and sleep time by vascular elasticity (rank) group, there was a significant difference in snacking ($p < 0.01$). In terms of alcohol consumption, the results were not satisfactory because the participants did not drink alcohol frequently, averaging only two days a month (data not shown). In terms of smoking as well, although a survey was conducted, sufficient results were not obtained as all but one of the subjects had no habit of smoking (data not shown).

Table 5. Relationship between vascular elasticity rank and lifestyle habits.

	Vascular elasticity rank			Significant difference
Rank number (n)	**1** (18)	**2** (46)	**3** (49)	
elementary school exercise time (hours/month)	4.7 ± 1.2	7.7 ± 2.0	4.7 ± 1.6	N.S.
junior high school exercise time (hours/month)	11.0 ± 2.5	19.0 ± 2.8	12.7 ± 2.5	N.S.
high school exercise time (hours/month)	7.5 ± 2.3	11.5 ± 2.8	12.8 ± 3.5	N.S.
university exercise time (hours/month)	0.8 ± 0.5	2.3 ± 0.6	2.2 ± 0.6	N.S.
university commuting time (minutes/day)	12.9 ± 3.1	24.2 ± 6.9	10.5 ± 1.2	N.S.
Snacks (days/week)	1.8 ± 0.2	1.0 ± 0.1	0.9 ± 0.2	1 vs 2, 1 vs 3, both $p < 0.01$
Sleep time (hours/day)	7.7 ± 0.2	7.7 ± 0.2	7.3 ± 0.2	N.S.

The relationship between vascular elasticity and stress is shown in Table 6. Sig-

nificant differences were observed in autonomic dysregulation between vascular elasticity (rank) groups ($p < 0.05$). No significant difference was observed in orthostatic dysregulation. Significant differences were observed in the stress scores for each vascular elasticity (rank) group. ($p < 0.01$). Although no significant difference in mental stress was observed, there was a significant difference in mental stress and stress coping ability (both $p < 0.01$).

Table 6. Relationship between vascular elasticity rank and stress.

	Vascular elasticity rank			Significant difference
Rank number (n)	**1** (18)	**2** (46)	**3** (49)	
Autonomic dysfunction (how many episodes)	2.1 ± 0.5	2.0 ± 0.3	1.1 ± 0.3	1 vs 3, 2 vs 3, both $p < 0.05$
Orthostatic dysregulation (how many episodes)	2.1 ± 0.6	2.5 ± 0.4	1.5 ± 0.2	N.S.
Stress score (points)	44.3 ± 5.1	28.2 ± 5.5	28.3 ± 2.7	1 vs 2, 1 vs 3, both $p < 0.05$
Physical stress	1.6 ± 0.2	1.4 ± 0.2	1.4 ± 0.1	N.S.
Mental stress	2.2 ± 0.2	1.6 ± 0.2	1.6 ± 0.2	1 vs 2, 1 vs 3, both $p < 0.05$
Stress management ability	2.2 ± 0.3	3.1 ± 0.3	3.1 ± 0.2	1 vs 2, 1 vs 3, both $p < 0.05$

4. Discussion

A significant relationship between age and vascular elasticity was observed. As we age, our blood vessels lose elasticity, blood flow deteriorates, and systolic blood pressure increases, especially as the heart contracts to deliver blood [9]. In recent years, it has also come to be said that blood pressure increases as blood vessels become thicker through the hormone angiotensin II, which is involved in blood pressure regulation [10]. Therefore, it is believed that even without irregular lifestyle habits such as excessive sodium intake and drinking, vascular elasticity is lost with age and blood pressure is likely to rise [11].

We observed a significant relationship between body weight, BMI, and vascular elasticity. Obese individuals are said to be 2 to 3 times more likely to develop high blood pressure than non-obese individuals [12]. There are two types of obesity: "subcutaneous fat obesity" and "visceral fat obesity". Visceral fat obesity is said to be related to hypertension. Regarding visceral fat obesity, when visceral fat accumulates, adipocytes enlarge and proliferate, leading to abnormal (elevated) secretion of adipocytokines. One adipocytokine is angiotensinogen, which enhances the secretion of angiotensin. This promotes arteriosclerosis and causes the onset and worsening of diabetes, high blood pressure, and dyslipidemia [13].

No significant relationship was found between body fat percentage and vascular elasticity. The subjects of this study were female university students. The subjects who were found to be obese based on their body fat percentage were not considered "visceral fat type obese", but rather "subcutaneous fat type obese", which is more common in women, potentially explaining why no correlation was found [14]. Another limitation of this study was that fat distribution was not measured.

No significant relationship between the mean heart rate and vascular elasticity

was found. The average heart rate of the subjects was 77.2, which was within the standard range of 60 to 90. Therefore, it is believed that there was no significant relationship between vascular elasticity and the average heart rate [15].

From the results, only snacking exhibited a significant relationship with vascular elasticity, with no significant relationship observed with other factors. Because we examined the exercise time over a period of one month, from elementary school to university, it is likely that the long-term exercise habits were not reflected as a factor. According to the "Physical Activity Standards for Health Promotion 2013" of the Ministry of Health, Labour and Welfare, it is recommended that people aged 18 to 64 do at least one hour of moderate-intensity physical activity per day, including one hour of sweat-inducing activity per week [16] In particular, the average monthly exercise time of female university students in this study was 2.4 hours, indicating that the exercise time was considerably less than the recommended time. While some people may exercise every day, we speculated that many people are so busy with studying or part-time work that they do not have time to exercise.

Regarding the university commuting time, because students use a variety of means, including walking, cycling, driving, and motorcycling, conditions were not the same, even if it took the same amount of time to commute. Additionally, since some university students live alone near the school, it is thought that the number of students who do not take much time to go to school is increasing as a factor.

Regarding alcohol consumption, the average number of days drinking per month was 2.1 days, which indicates no excessive drinking habits. Moderate alcohol intake is said to have a protective effect against the development of myocardial infarction and cerebral infarction, reducing the risk of peripheral vascular obstruction [17]. On the other hand, excessive drinking increases cardiovascular disease-related deaths, which is a risk factor for all diseases [18].

Regarding sleep time, the average daily sleep time was 7.5 hours, indicating that that a relatively sufficient amount of sleep was a factor in why vascular elasticity was not affected. A study comparing the blood pressure in healthy people who slept 7 to 8 hours, with those who were sleep deprived (sleeping only 3.6 hours) [19] found that it affected blood pressure increases, not only at night but also during the day. It is known that not only "time" but also "quality" is important for sleep. Because this study only investigated duration of sleep, it may have been necessary to add questions regarding sleep quality, such as whether or not participants took naps and how easily they fell asleep [20].

Regarding snacking, consuming food amounts that exceed the daily required energy amount is thought to be a factor in the significant relationship that was observed with vascular elasticity. Excessive energy intake can increase the likelihood of becoming obese, in addition to also potentially leading to the secretion of adipocytokines from accumulated visceral fat, which can increase the likelihood of blood clot formation and promote arteriosclerosis. However, because this study only examined the frequency of snacking, in order to conduct more in-depth re-

search, the content, quantity, total energy intake, and nutritional quality of snacks should also have been investigated.

Autonomic dysregulation, mental stress, and stress coping ability were significantly associated with vascular elasticity. Although no significant difference was observed in orthostatic dysregulation, stress score, and physical stress, there was a tendency for higher vascular elasticity (rank) to yield lower scores.

Both autonomic dysregulation and orthostatic dysregulation are related to an imbalance in the autonomic nervous system and are thought to involve a complex intertwining of various factors, including poor lifestyle habits, excessive stress, changes in the environment, and the influence of female hormones [21]. In this study, because participants were only asked to fill out a questionnaire about items that they felt applicable in their daily lives, it is not possible to determine with certainty that they suffered from autonomic dysregulation and orthostatic dysregulation. Therefore, it is believed that it was not possible to determine whether autonomic dysregulation and orthostatic dysregulation were associated with vascular elasticity.

Physical stress includes physiological desires, fatigue, and pain, while psychological stress includes anxiety, anger, hatred, and feelings of inferiority. University students have a variety of lifestyles, including change in the environment due to starting to live alone and taking on part-time jobs and participating in club activities. Additionally, the burden of interpersonal relationships varies, not only with friends and lovers, but also with acquaintances such as teachers, part-time supervisors, and colleagues. Therefore, there are many opportunities for psychological stress, such as conflicts with others, feelings of inferiority, mental fatigue, and consideration. In addition, psychological stress has been reported to increase the function of the sympathetic nervous system, increase the production of corticosteroids, and strain blood vessels [22]. Based on the above, it is believed that there was a significant relationship in psychological stress among university students who were the subjects of this study.

The ability to cope with stress is the ability to recognize and release stress when it accumulates. As mentioned above, stress is known to cause blood vessels to age, and if stress is not relieved and continues to build up, it is more likely to lead to arteriosclerosis [23]. This suggests that there was a significant relationship between increased stress coping ability and increased vascular elasticity. However, the study's reliance on self-reported data may have affected the results of this study, and since this study had a cross-sectional study design, the results may have been clearer in a longitudinal intervention study design had been used instead.

5. Conclusions

While it is generally believed that being obese leads to vascular aging, this study found no relationship between vascular elasticity and body weight, BMI, or body fat percentage. In addition, a relationship was observed between older age and lower vascular elasticity.

In terms of lifestyle habits, only snacking had a significant negative relationship with vascular elasticity, while exercise time, commuting time, drinking alcohol, and sleep time did not exhibit any significant relationship.

In terms of stress versus vascular elasticity, while a significant relationship was observed with autonomic dysregulation, mental stress, and stress coping ability, there was no significant relationship with orthostatic dysregulation, physical stress, and stress score.

This study suggests that the presence or absence of stress affects vascular aging, so reducing stress may lead to the prevention of vascular aging.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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