北華大學

The effect of Forest Environment on Human Health care in Changbai Mountain area

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CONTENTS

1.Overview of the Project

Forest health: It is an emerging industry that uses forest environment to achieve the functions of treatment, rehabilitation and health care after clarifying the impact of forest environment on human physiological function, then establishes a new health concept and improves human health level.

•A series of studies by Japanese scholars

- **Increasing NK cell number and activity**
- **Deceasing the level of corticosteroids**
- **Decreasing the activity of sympathetic nervous system**
- **Decreasing the level of blood sugar**

Forest environment plays a positive role in improving human health.

1.Overview of the Project

- **Since the establishment of the international society of nature and forest medicine from 2011, forest rehabilitation has been highly recognized and valued by the international community.**

- **At present, Japan, South Korea, Europe (mainly Germany) have had remarkable achievements in the prevention and treatment of chronic diseases, geriatric diseases, depression, cancer and other diseases through forest rehabilitation.**

- **Since the implementation of forest rehabilitation in Germany, it has not only effectively improved the national health index, but also reduced the national medical expenditure by 10%.**

1.Overview of the Project

- The research on forest rehabilitation in China has just started. The research methods, content, level and achievements in this field are in the early stage of development.

- The relationship of the world-famous Changbai Mountain forest environment and human health research is still blank, forest health system has not been established in Jilin province. Therefore, we will select the most representative Pinus koraiensis broad-leaved forest in Changbai Mountain (it is the area with the widest area and the richest biological species, suitable for health care at altitude, and was rated as one of the top ten most beautiful forests in China in 2005) to carry out the research, so as to clarify the factors of forest environment which affect human health, and provide scientific basis for vigorously carrying out forest health care.

2.Investigation of the Health Care Environment

Tab 1 Basic information of survey plots

Ribbon	Forest type	Longitude	Latitude	Altitude	Slope	canopy density (%)	Plot area	disturbance intensity
Luisure area	**Mixed wood of larch and birch**	128° 10'58.63"	42° 16'53.10"	949	8°	60	400m²	**Severity**
Forest**B**ackground area	**Mixed wood of larch, amur linden, korean pine, spruce-fir**	128° 10'58.29"	42° 16'58.20"	984	15°	80	400m²	Light
Road, rest area and **boardwalk**	**Mixed wood of amur linden and korean pine**	128° 10'45.29"	42° 16'53.77"	964	6°	70	400m²	**intermediate**

In order to figure out the vegetation, 3 ribbons were selected for forest community, 1 survey area was set up in each ribbon.

2.Investigation of the Health Care Environment

Heping Town in Changbai Mountain is rich in forest resources, rich in valuable ornamental and edible tree species in Northeast China. From July to August every year, the forest is lush and vigorous, which is the best season for health care. The common tree species in this area are:

Tab2 Sampling survey of forest vegetation -plant list

Number	Species	Type	Value
1	*Betula platyphylla*	tree	ornamental
2	*Syringa reticulata var. mandshurica*	tree	ornamental
3	*Acer ginnala*	tree	ornamental
4	*Euonymus macropterus*	shrub	ornamental
5	*Prunus padus*	tree	Ornamental, fruit for edible
6	*Abies nephrolepis*	tree	ornamental
7	*Acanthopanax senticosus*	shrub	ornamental, leaf and fruit for edible
8	*Aegopodium alpestre*	herb	edible
9	*Betula costata*	tree	ornamental
10	*Picea koraiensis*	tree	ornamental
11	*Pinus koraiensis*	tree	Ornamental, fruit for edible
12	*Athyrium multidentatum*	herb	Ornamental and edible

Note: sampling area 400m^2×3

2.Investigation of the Health Care Environment

Number	Species	Type	Value
13	*Juglans mandshurica*	tree	Ornamental, fruit for edible
14	*Acer ukurunduense*	tree	ornamental
15	*Maackia amurensis*	tree	ornamental
16	*Phellodendron amurense*	tree	Ornamental and medicinal
17	*Tilia mandshurica*	tree	Ornamental, leaf for edible
18	*Carex siderosticta*	herb	ornamental
19	*Lonicera edulis*	shrub	Ornamental, fruit for edible
20	*Ulmus laciniata*	tree	Ornamental, fruit for edible
21	*Larix gmelini*	tree	Ornamental
22	*Corylus mandshurica*	shrub	Ornamental, fruit for edible
23	*Hippochaete hyemale*	herb	ornamental
24	*orilis japonica*	herb	ornamental
25	*Acer tegmentosum*	tree	ornamental
26	*Acer mono*	tree	ornamental
27	*Rosa davurica*	shrub	Ornamental, flower and fruit for edible
28	*Brachybotrys paridiformis*	herb	Ornamental, edible
29	*Populus davidiana*	tree	ornamental
30	*Carex remotiuscula*	herb	ornamental

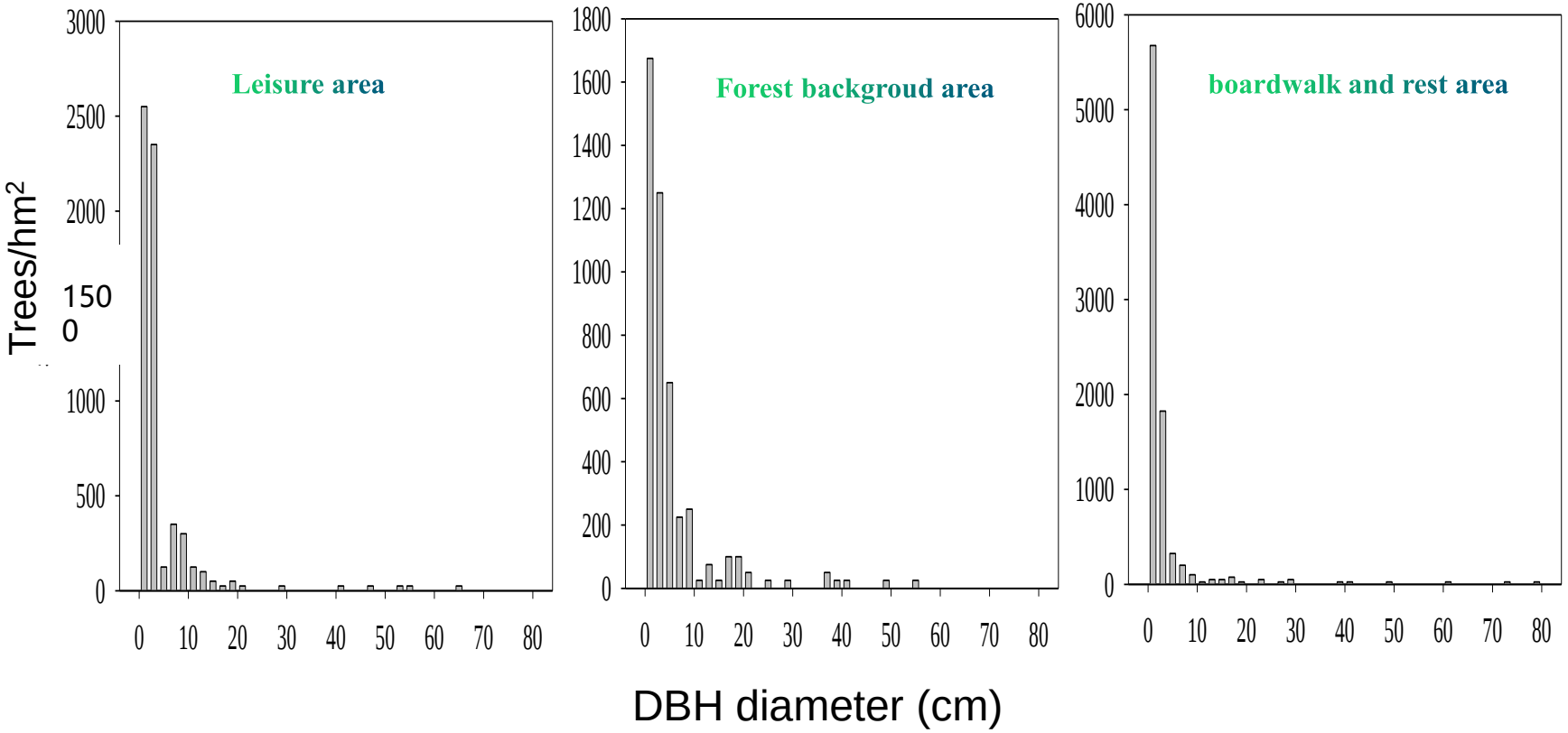
Note: sampling area 400m^2×3

2.Investigation of the Health Care Environment

Number	Species	Type	Value
31	*Abies holophylla*	tree	ornamental
32	*Rumex acetosa*	herb	Ornamental, edible
33	*Ostericum grosseserratum*	herb	ornamental
34	*Euonymus alatus*	shrub	ornamental
35	*Meehania urticifolia*	herb	ornamental
36	*Ribes komarovii*	shrub	Ornamental, fruit for edible
37	*Sorbaria sorbifolia*	shrub	ornamental
38	*Serratula cupuliformis*	herb	ornamental
39	*Acer barbinerve*	tree	ornamental
40	*Tilia amurensis*	tree	ornamental
41	*Acer pseudo-sieboldianum*	tree	ornamental

Note: sampling area 400m^2×3

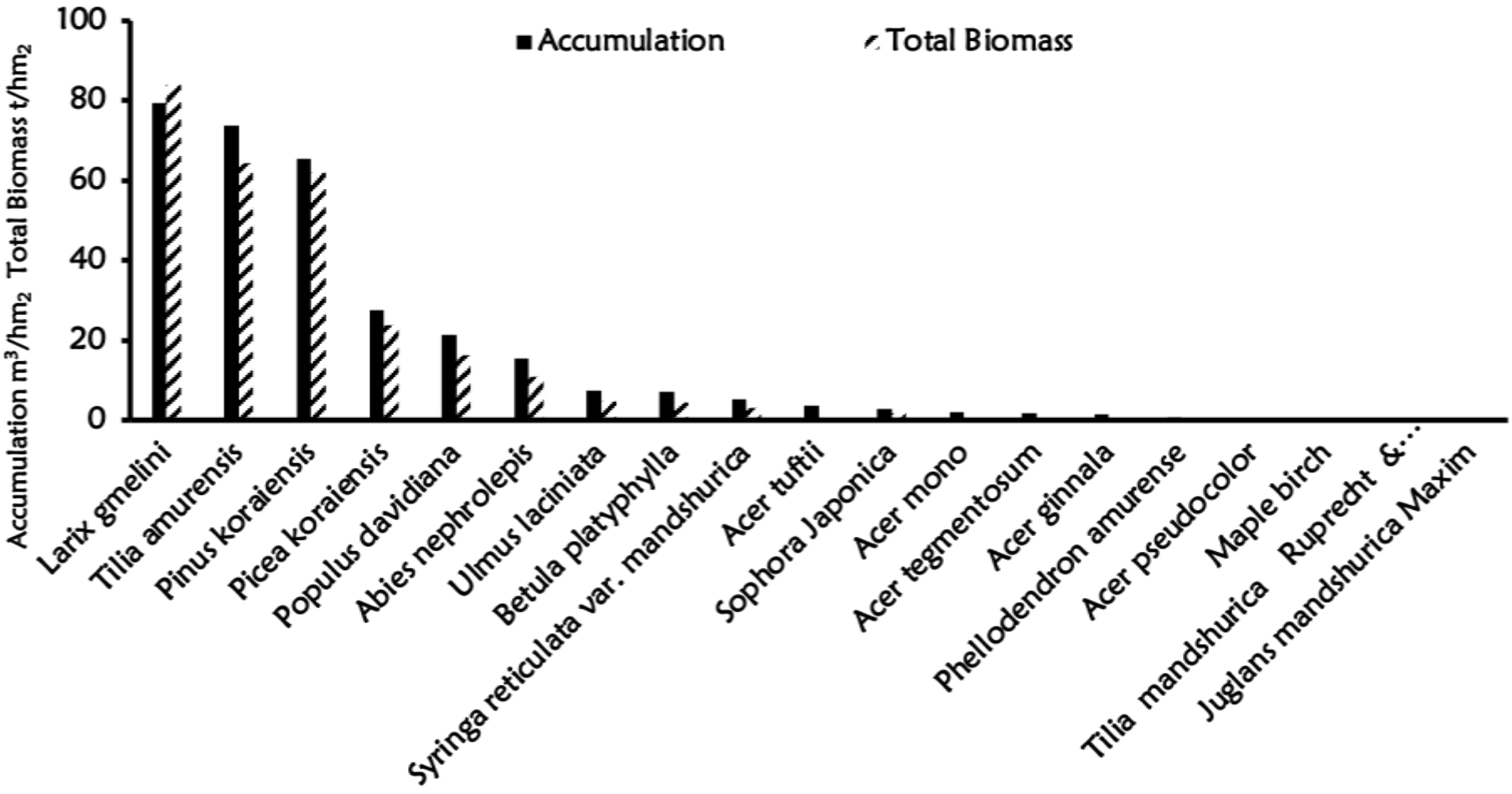
2.Investigation of the Health Care Environment



Tree diameter structure of forest communities in different functional areas

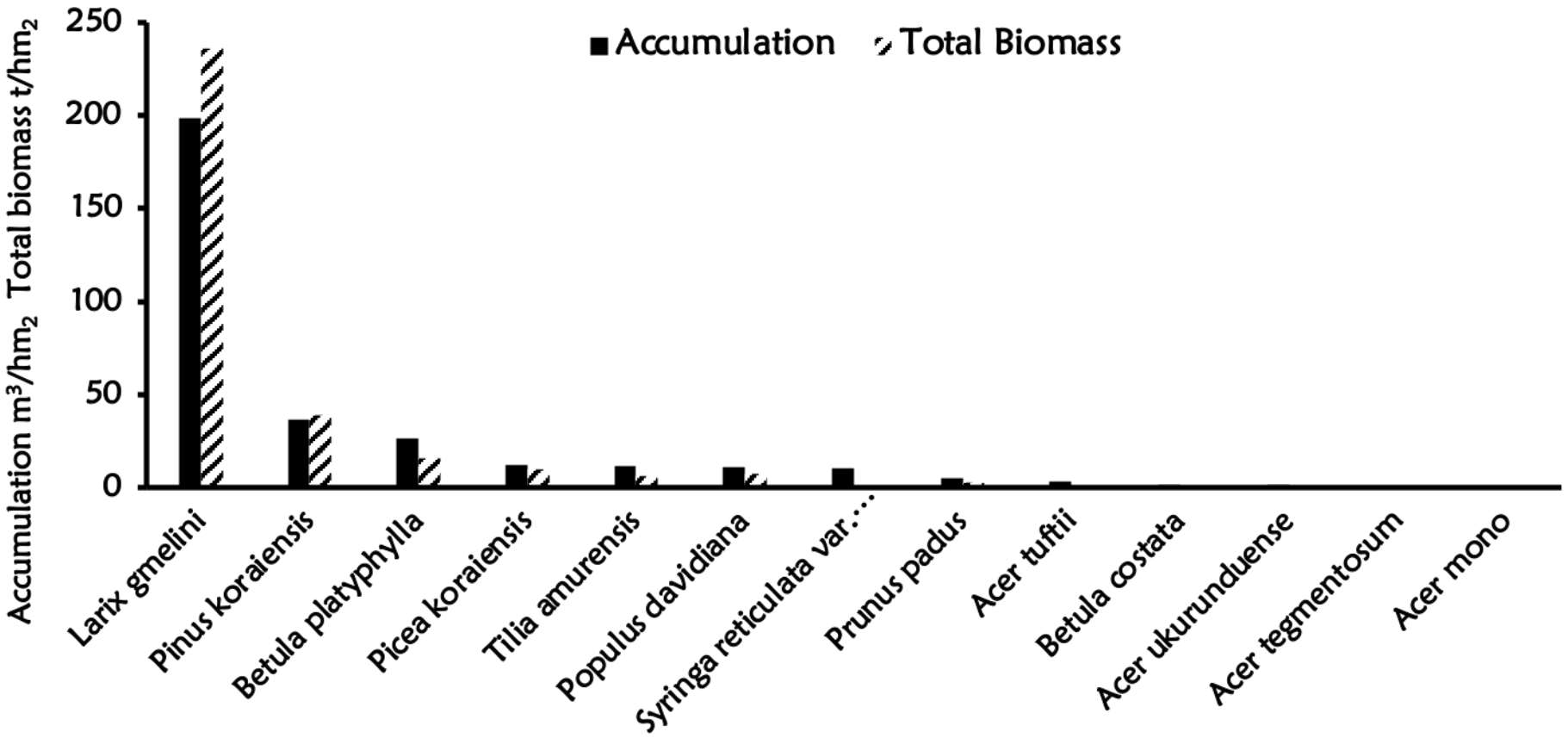
According to the diameter structure of the three types of forest stands, the forest communities in the three functional areas are inverted "J" distribution, and the community renewal is good, but there is a certain degree of diameter missing, which is closely related to the regional interference.

2.Investigation of the Health Care Environment



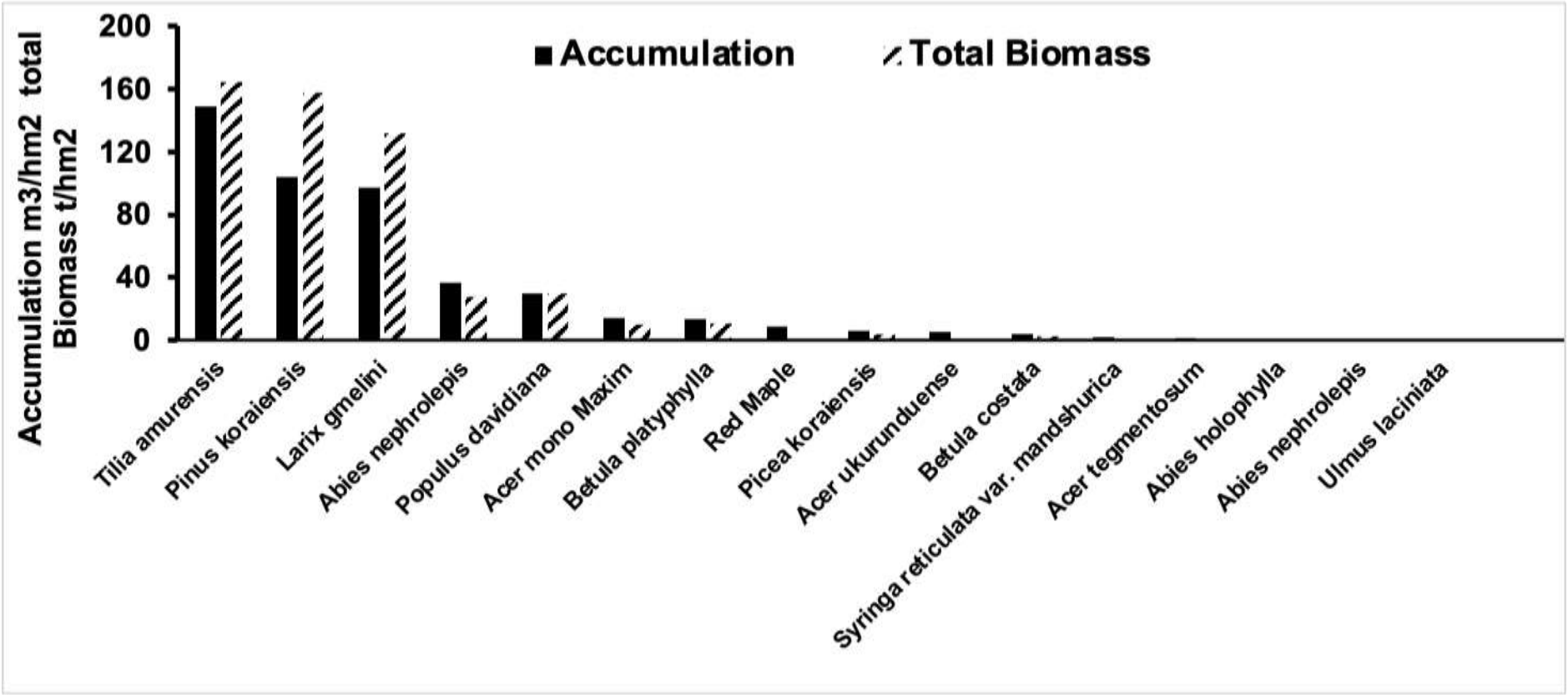
Community composition, accumulation and biomass characteristics of forest backgroud area

2.Investigation of the Health Care Environment



Community composition, accumulation and biomass characteristics of leisure area

2.Investigation of the Health Care Environment



Community composition, accumulation and biomass characteristics of boardwalk and rest area

The volume and biomass composition characteristics of the three communities were obtained by statistical conversion. Both the volume and biomass are the indicators of stand composition, and also the background values used to analyze and explain the forest environment.

2.Investigation of the Health Care Environment

According to the air pollution standard classification standards for ambient air quality standards (GB3095-2012) PM2.5 and PM10 and the National Forest Park Master Plan Specification (LY/T2005-2012) air anion level classification standard issued by the People's Republic of China, the area has excellent environmental quality and is suitable for forest rehabilitation .

Environmental information of monitored area

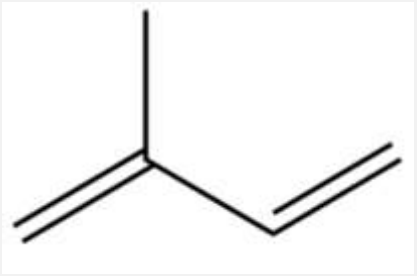
Temperature（℃）	Humidity （%）	PM2.5（ug/m3）	PM10（ug/m3）	Bacterial content（CFU/m3	Fungal content（CFU/m3）
23.8 18-24	61.2 45-6F5	2.1 First level <35	53.6 First level <50	4.2 First level <200	5.5

Environmental information of monitored area

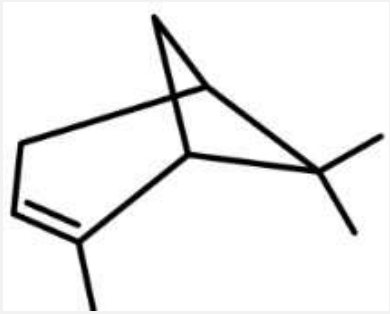
Air anion（Ions/cm3）	Air cation（Ions/cm3）	q=n+/n-	CI=q=(n-/1000)/*(1/q)
8183.75	7327.01	0.89	9.1
>1500Fresh air	Comfortable	q<1	CI-air cleanliness level: AThe cleanest

2.Investigation of the Health Care Environment

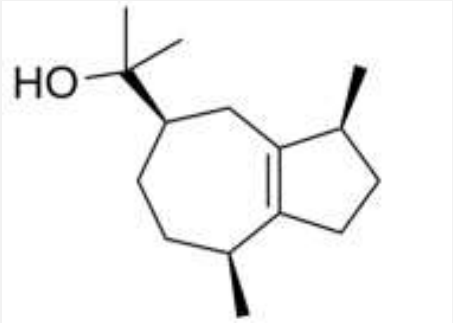
Forest volatiles—— The volatile organic compounds (BVOCs) with relative molecular weight of 100-200, synthesized by forest plants through secondary metabolic pathway. Among them, the components beneficial to human body are called pythoncidere, phytobactericide, forest essence and plant essence.



2-methyl-1,3-butadiene,
(isoprene C5H8)
Sesquiterpenes



α - pinene C10H16
Monoterpene



Guaiacol C15H26O
sesquiterpene alcohols

Pythoncidere has the function of sterilization and bacteriostasis. It has therapeutic effects on many diseases, such as cough, asthma, chronic bronchitis, pulmonary tuberculosis, neurosis, arrhythmia, coronary heart disease, hypertension, edema, etc., especially for respiratory diseases.

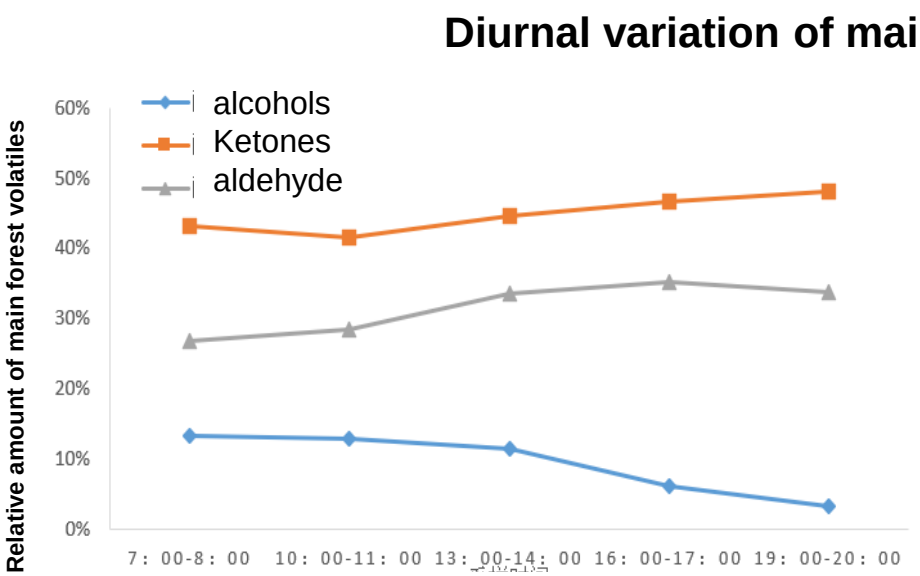
2.Investigation of the Health Care Environment

Main species of forest volatiles in Heping Town of Changbai Mountain in August

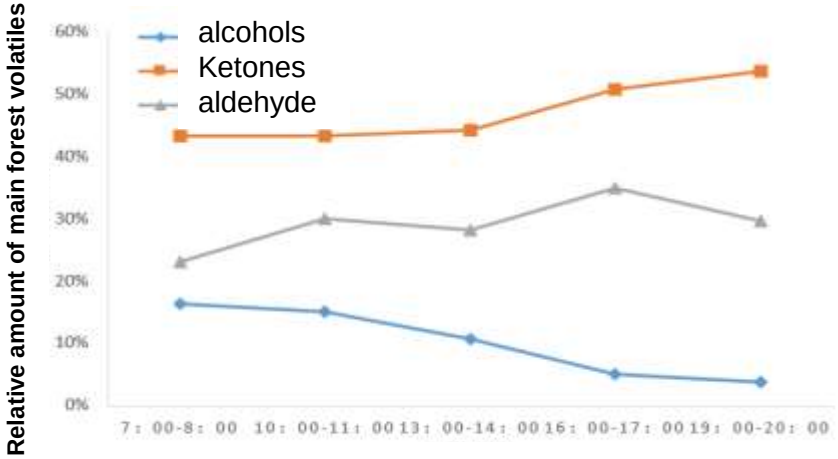
保留时间RT	英文名称	分子式
3.35	3-methyl-3-Pentanol	$C_6H_{14}O$
3.389	Hexanal	$C_6H_{14}O$
3.619	Toluene	C_7H_8
3.731	6-Methyl-3,4-dihydro-2H-pyran	$C_6H_{10}O$
3.764	5-Hexen-2-one	$C_6H_{10}O$
3.922	3-Hexanone	$C_6H_{12}O$
4.007	2-Hexanone	$C_6H_{12}O$
4.106	3-Hexanol	$C_6H_{14}O$
4.198	2-Hexanol	$C_6H_{14}O$
5.132	3-methyl-Cyclopentanol	$C_6H_{12}O$
5.263	4-methyl-Cyclopentanone	$C_6H_{10}O$
5.631	Xylene	C_8H_{10}
5.835	Xylene	C_8H_{10}
6.46	Xylene	C_8H_{10}
7.387	3-ethyl-3-methyl-Pentane	$C_7H_{14}O$
7.525	2,5-Hexadione	$C_6H_{10}O_2$
8.044	3,4-epoxy-2-Hexanone	
8.34	2-Nitrohexane	$C_6H_{13}NO_2$
8.419	Methacrylamide	C_7H_6O
8.814	2-Pentanone	$C_5H_{10}O$
9.452	1,4-Pentadien-3-ol	C_5H_8O
9.537	2,3,3-Trimethyl-1-butene	C_7H_{14}
9.774	4,4-Dimethyl-trans-2-pentene	C_7H_{14}
10.694	Benzyl Alcohol	C_7H_8O
11.082	6-Hydroxy-2-hexanone	$C_6H_{12}O_2$
17.756	Eugenol methyl ether	$C_{11}H_{14}O_2$
18.072	Methyl azelaaldehydate	$C_{24}H_{38}O_4$

In August, 39 species of forest volatiles were isolated and identified, including 9 ketones, 7 alcohols, 6 esters, and olefins, alkanes and aromatics. Among them, 28 species were in leisure activity area, 19 in forest Yoga area, and 17 in forest background area.

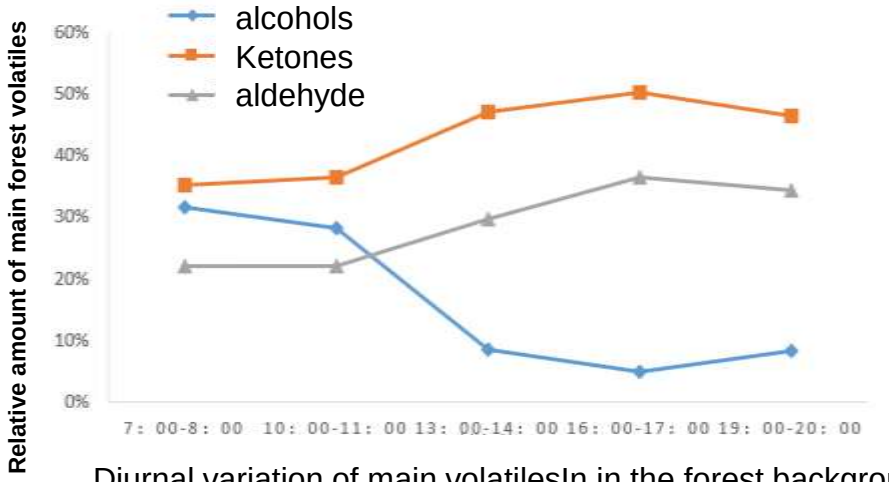
2.Investigation of the Health Care Environment



Diurnal variation of main volatiles in leisure area



Diurnal variation of main volatiles in the yoga area

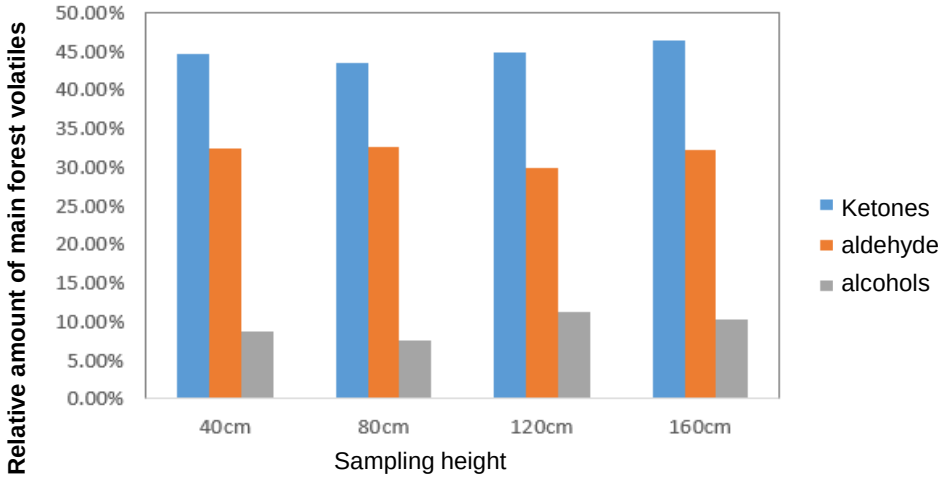


Diurnal variation of main volatilesIn in the forest background

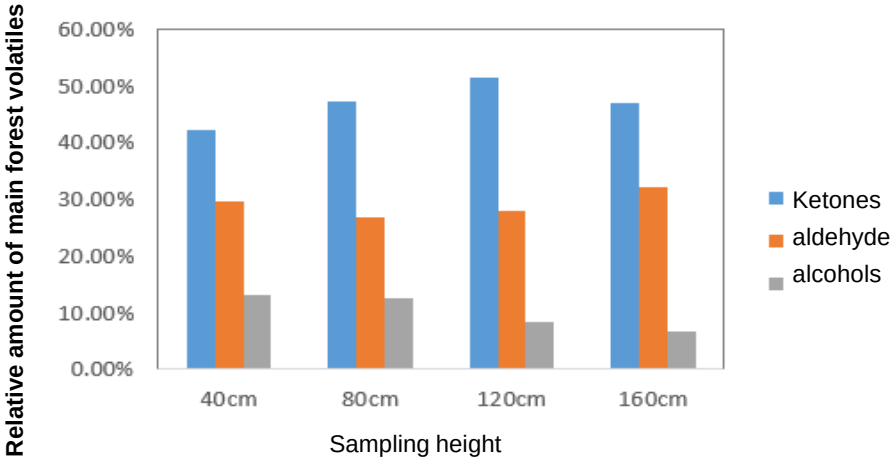
The contents of volatiles in different functional areas were different and the relative contents of ketones and aldehydes were higher, followed by alcohols. The relative content of ketones in leisure and Yoga area reached the highest in the evening, while the relative content of alcohols was the highest in the morning, then decreased slowly, and the lowest in the evening.

2.Investigation of the Health Care Environment

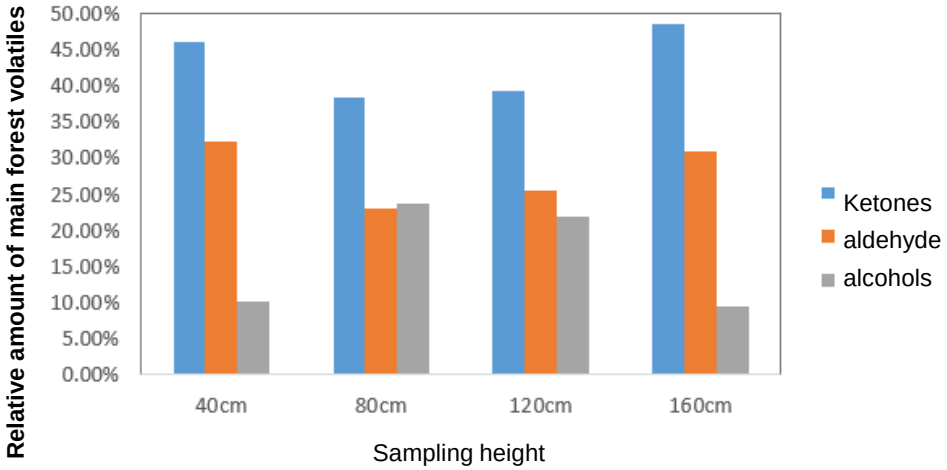
Vertical variation of main forest volatiles



Diurnal variation of main volatiles in leisure area



Diurnal variation of main volatiles in the yoga area



Diurnal variation of main volatilesIn in the forest background

The relative contents of ketones, aldehydes and alcohols in leisure activity area had little change at different heights;

Ketones in the forest yoga area showed a unimodal change with theheight, they reaches the highest contents at 120cm, the change of aldehydes was not obvious, and alcohols decreased gradually with the height.

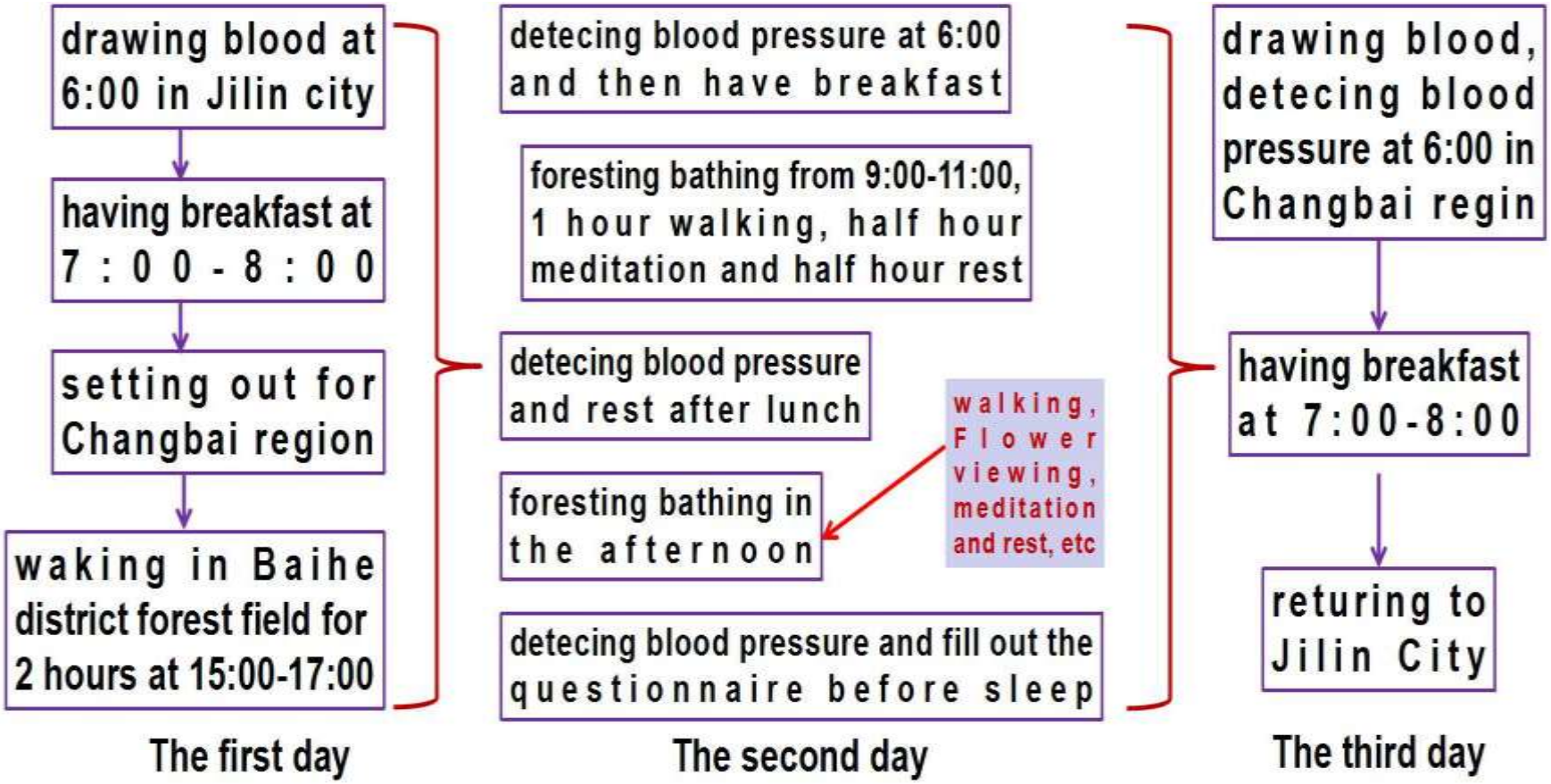
3.The Effect of Forest Health Care on the Body

•Choice of healthy population

Twelve healthy subjects, age from 50 to 60 years (average 55.8±6.68 years old, 6 males (56.3±2.25) years old, 6 females (54.67±3.01)) were selected from local governments and universities in Jilin City, China. Information on the subjects was gathered from their own questionnaire, including age, sex and lifestyle habits (cigarette smoking, alcohol consumption, eating breakfast, sleeping hours, working hours, physical exercise, nutritional balance, and mental stress) etc. Written informed consent was obtained from all subjects after a full explanation of the study procedures. None of the subjects had any signs or symptoms of infectious disease, cardiovascular disease, drug application that may affect the immunological analysis, or were taking any medication at the time of the study. It was also confirmed that none of the subjects had taken forest bathing trips within at least 3 months prior to the study. The subjects took the same diet during the forest bathing trips. To control for the effects of alcohol, the subjects did not consume alcohol during the study period. The Ethics Committees of affiliated hospital of Beihua university approved this study.

3.The Effect of Forest Health Care on the Body

- **Health Care Process**



Process and time Allocation of Forest Health Care

3.The Effect of Forest Health Care on the Body

- **Changes of mood state of healthy volunteers before and after Forest Health Care**

Changes of anxiety, perceived stress and sleep quality before and after forest health care

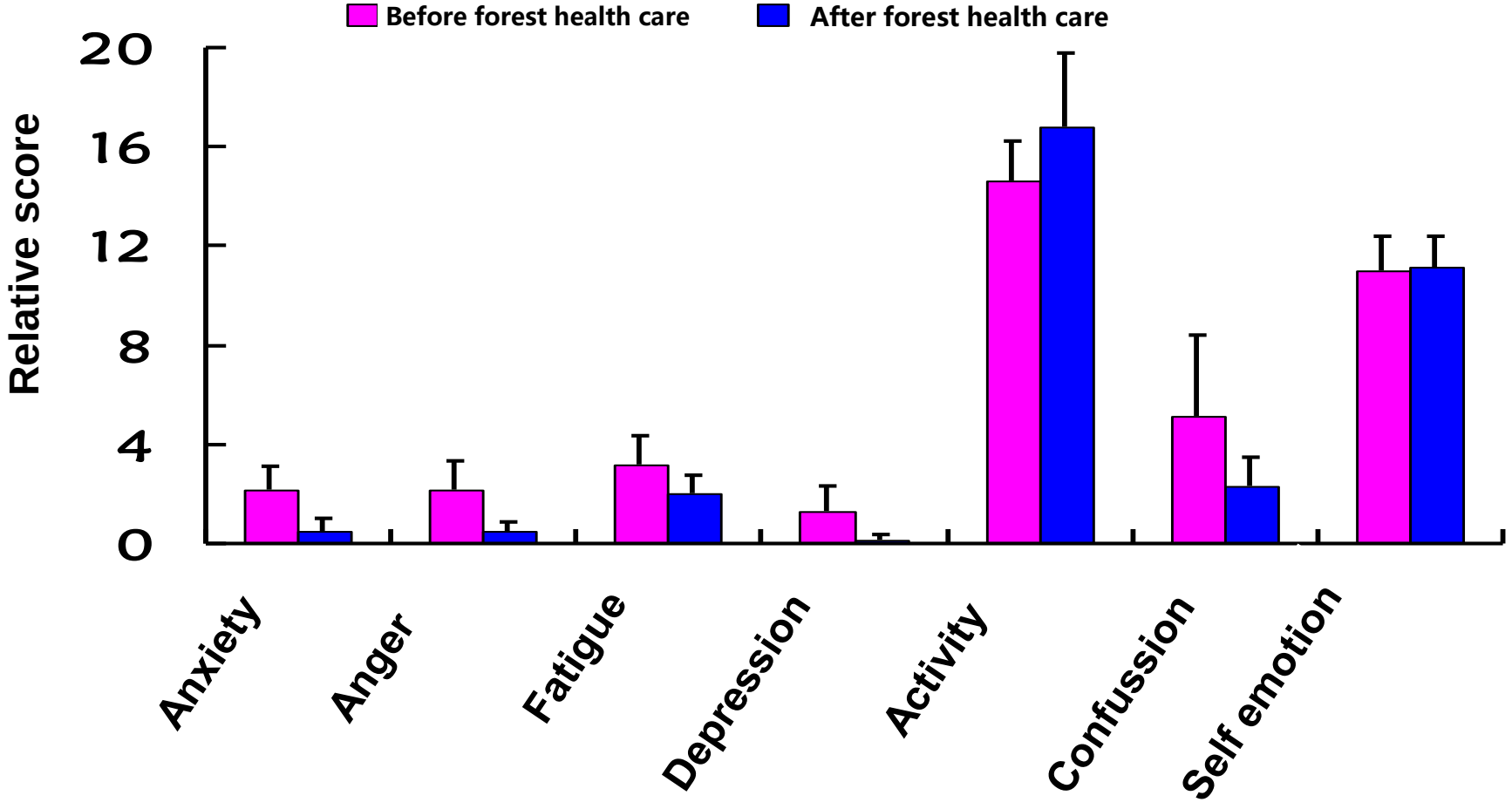
Group	n	before	after	t	p
anxiety index	12	44.00±6.75	38.15±7.85	3.280	0.007*
perceived stress	12	35.31±12.23	38.08±7.93	-1.23	0.244
sleep quality	12	55.31±12.51	23.62±9.04	14.97	0.00*

note：Comparison before and after forest rehabilitation *p < 0.05

Forest health care is helpful to improve anxiety and sleep quality

3.The Effect of Forest Health Care on the Body

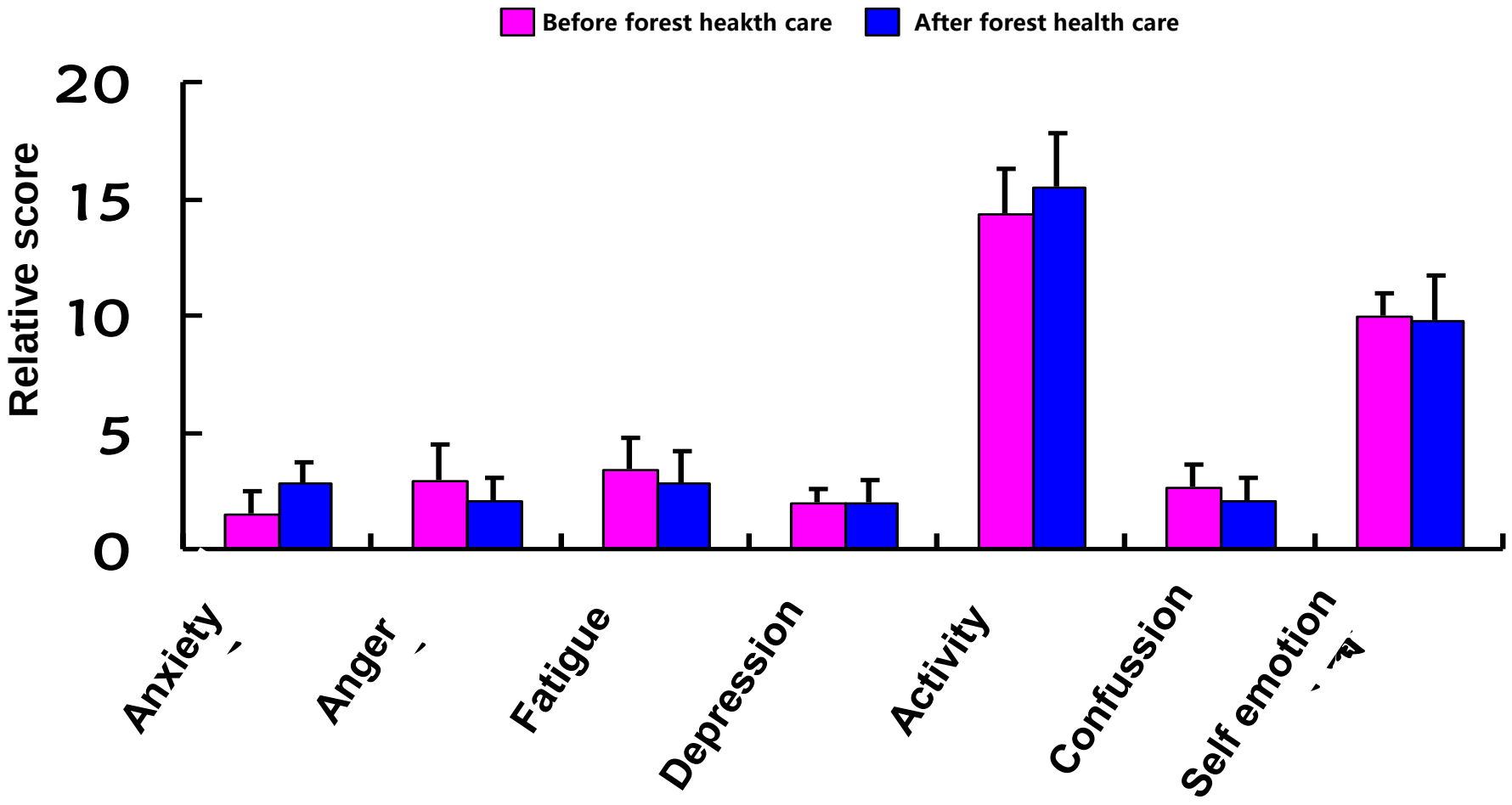
•Changes of mood state of healthy volunteers before and after Forest Health Care



Mood state changes before and after forest helath care in female

3.The Effect of Forest Health Care on the Body

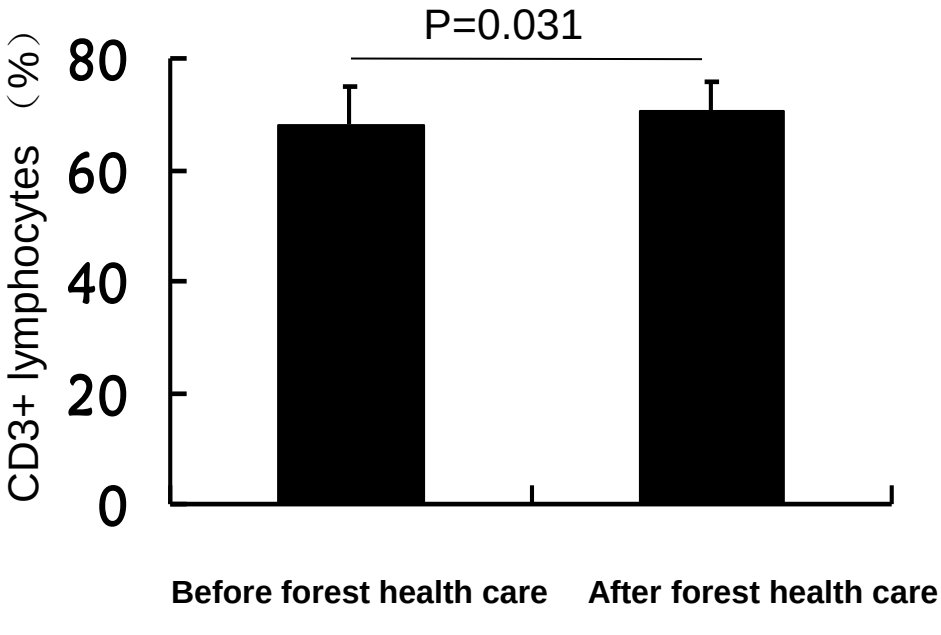
•Changes of mood state of healthy volunteers before and after Forest Health Care



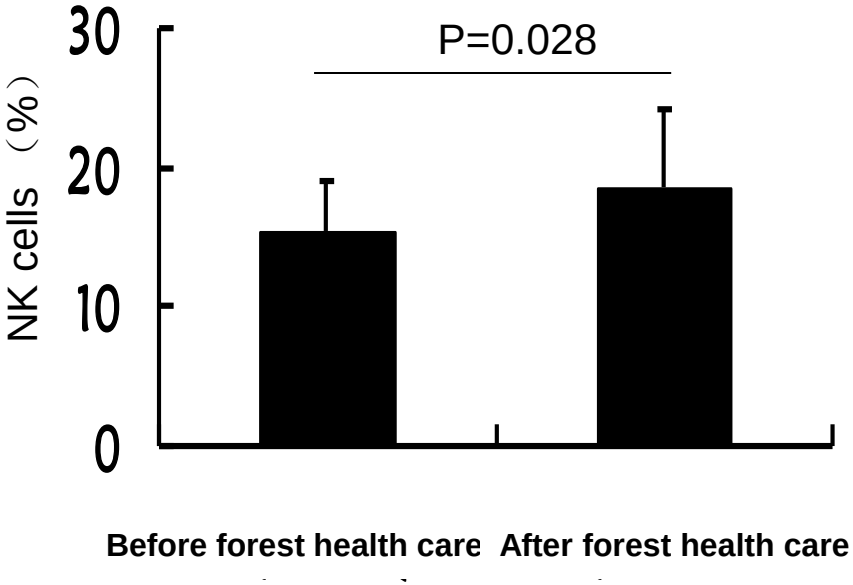
Mood state changes before and after forest health care in male

3.The Effect of Forest Health Care on the Body

- **Effect of forest environment on immunological function of healthy volunteers**



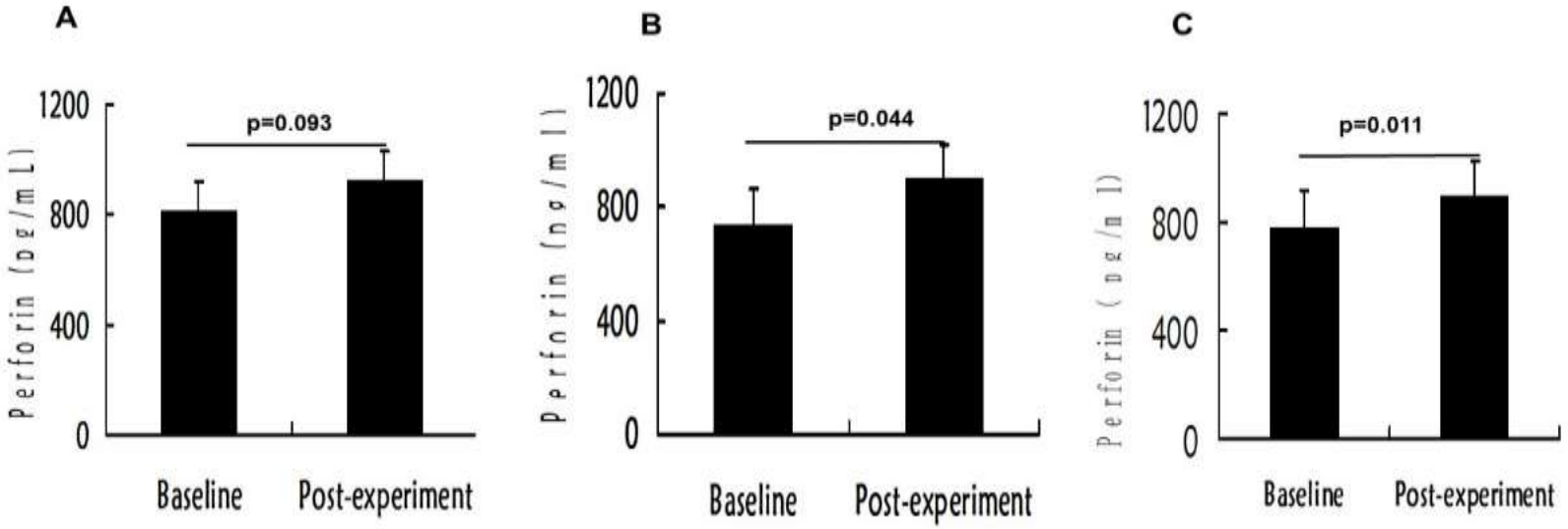
Effects of forest health care on blood lymphocytes



Effects of forest health care on blood NK cells

3.The Effect of Forest Health Care on the Body

Forest health care promotes perforin



Effect of forest health on plasma perforin level in adult subjects.

A: Effect of forest health care on plasma perforin level adult male subjects, n=6.

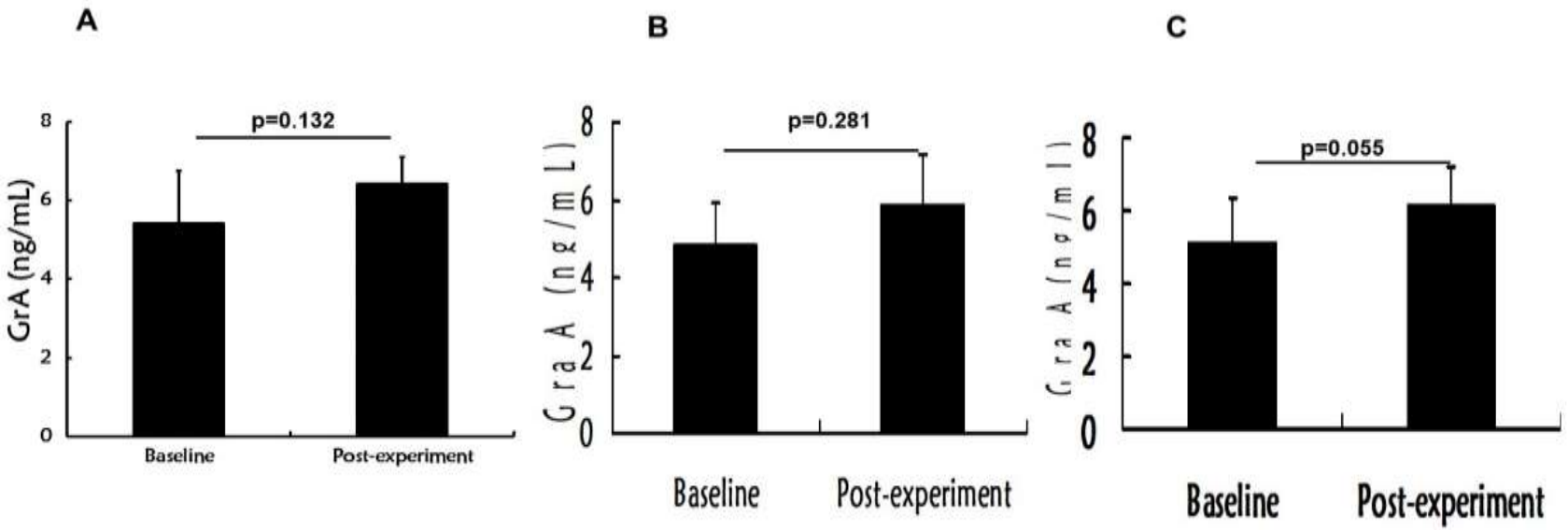
B: Effect of forest health care on plasma perforin level of adult female subjects, n=6.

C: Effect of forest health care on plasma perforin level of the total subjects, n=12.

The level of perforin was determined with Elisa kits.Mean ± standard error. $p < 0.05$, paired t-test.

3.The Effect of Forest Health Care on the Body

Forest health care promotes granzyme release



Effect of forest health care on plasma Gra A level in adult subjects

A: Effect of forest health care on plasma Gra A level adult male subjects, n=6.

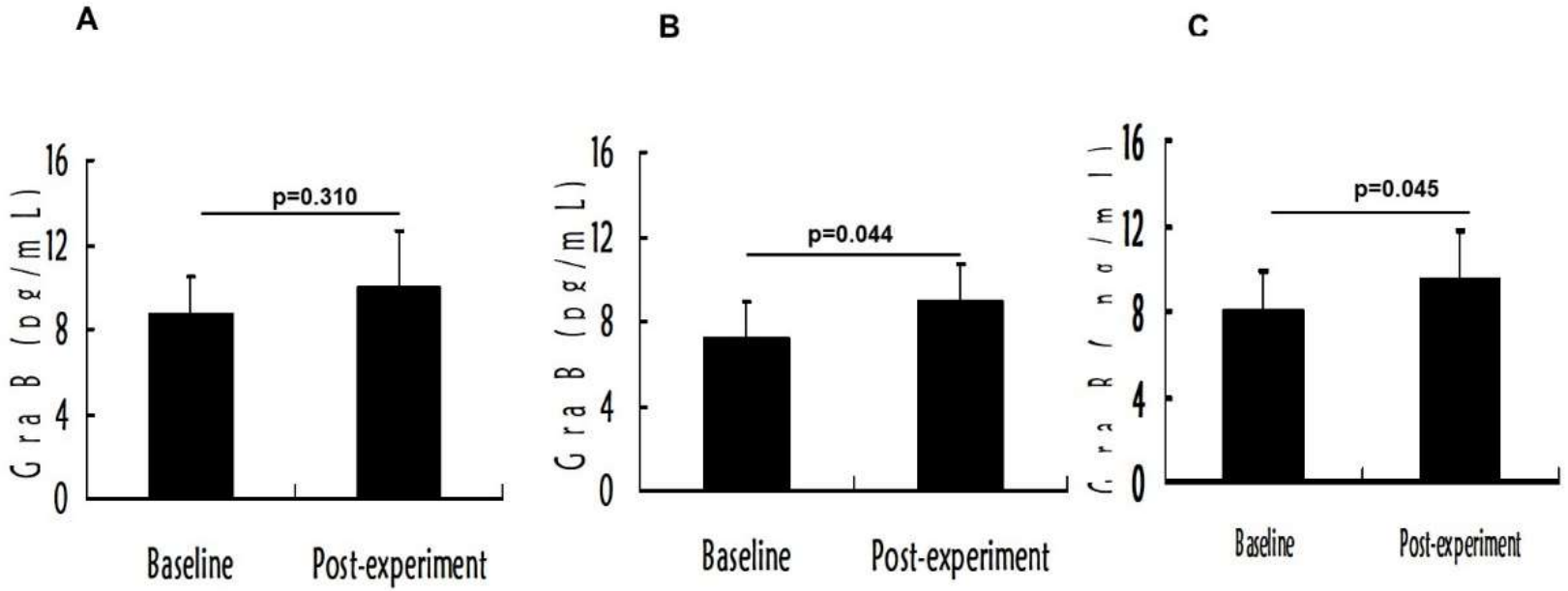
B: Effect of forest health care on plasma Gra A level of adult female subjects, n=6.

C: Effect of forest health care on plasma Gra A level of the total subjects, n=12.

The level of GrAwas determined with ELISA kits. Mean ± standard error. $p < 0.05$, paired t-test.

3.The Effect of Forest Health Care on the Body

Forest health care promotes granzyme release



Effect of forest health on plasma Gra B level in adult subjects.

A: Effect of forest health care on plasma Gra B level adult male subjects, n=6.

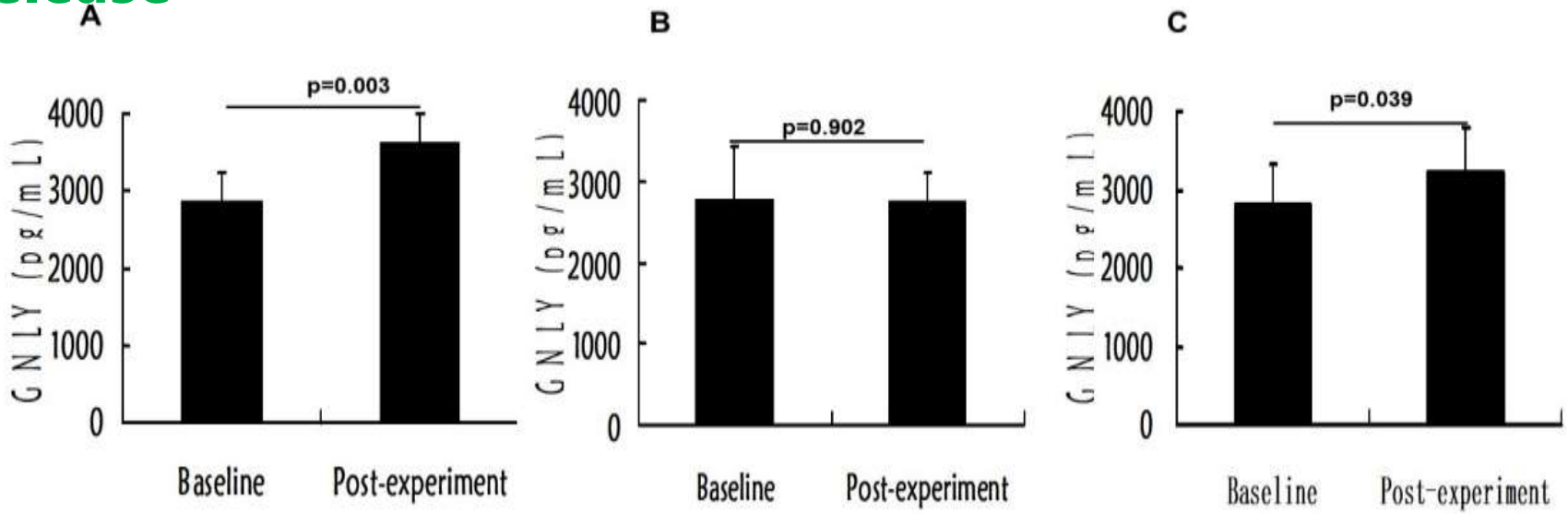
B: Effect of forest health care on plasma Gra B level of adult female subjects, n=6.

C: Effect of forest health care on plasma Gra B level of the total subjects, n=12.

The level of Gra Bwas determined with Elisa kits. Mean ± standard error. $p < 0.05$, paired t-test.

3.The Effect of Forest Health Care on the Body

Forest health care promotes GNLY release



Effect of forest health care on plasma GNLY level in adult subjects.

A: Effect of forest health care on plasma GNLY level adult male subjects, n=6.

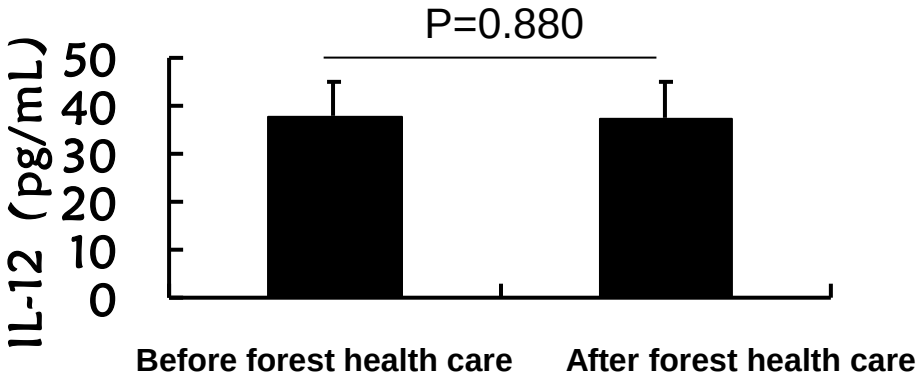
B: Effect of forest health care on plasma GNLY level of adult female subjects, n=6.

C: Effect of forest health care on plasma GNLYlevel of the total subjects, n=12.

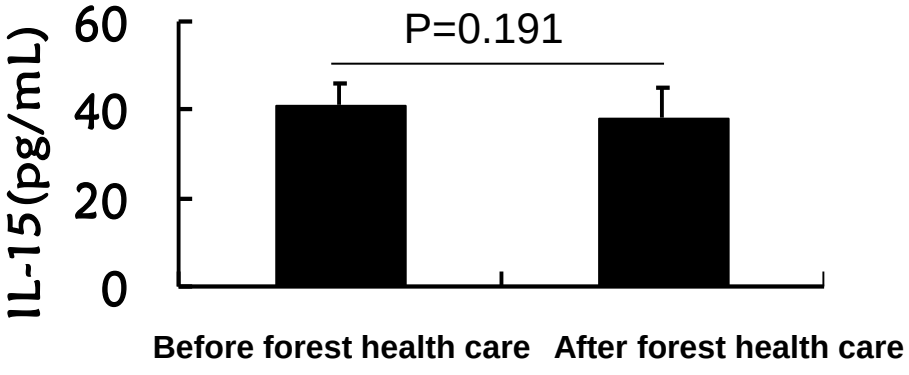
The level of GNLY was determined with ELISA kits. Mean ± standard error. $p < 0.05$, paired t-test.

3.The Effect of Forest Health Care on the Body

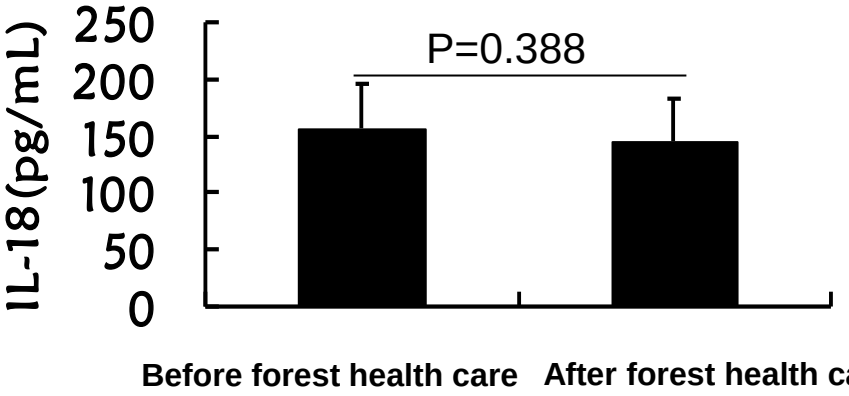
•Effect of forest health care on serum cytokines



Effect of forest health care on serum IL-12 level



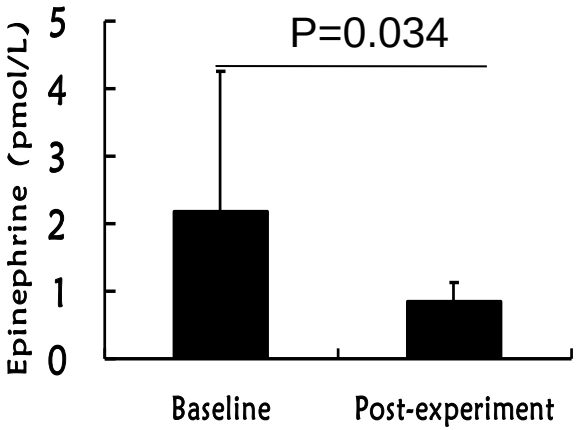
Effect of forest health care on serum IL-15 level



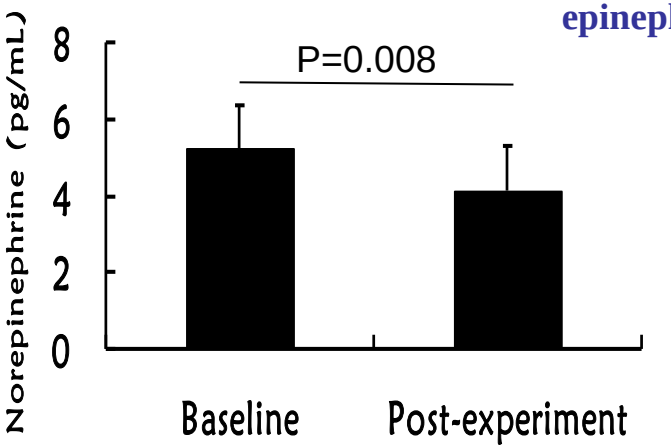
Effect of forest health care on serum IL-18 level

3.The Effect of Forest Health Care on the Body

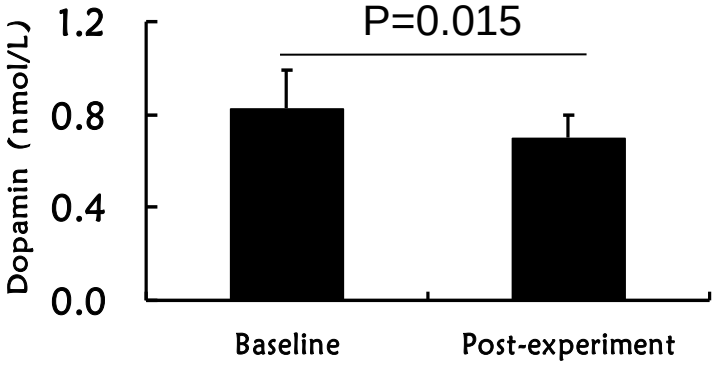
- **Effect of forest environment on plasm catecholamine of healthy volunteers**



Effect of forest health care on plasma epinephine level in adult subjects



Effect of forest health care on plasma norepinephine level in adult subjects



Effect of forest health care on plasma dopamine level in adult subjects

3.The Effect of Forest Health Care on the Body

•The choice of patients with diabetes mellitu (old age)

Eighteen adult (65.16 ± 5.75) (including 6 male(64.91 ± 6.16) and 12 female (65.42 ± 5.58)) had been previously diagnosed or were newly diagnosed with diabetes. Participants were considered to suffer from TⅡD if previously diagnosed TⅡD or with glycated hemoglobin (HbA1c) level ≥ 6.5% on two different determinations, or with at least two fasting glucose levels ≥ 7.0 mmol/L, or with a random glucose level of ≥ 11.1 mmol/l, or with a glucose level ≥ 11.1 mmo/L, 2 h after an oral glucose tolerance test (OGTT) with 75 g anhydrous glucose dissolved in water.

Participants with severe anemia, a history of acute myocardial infarction or stroke in the last 6 months, type Ⅰ diabetes mellitus, high-sensitivity C-reactive protein (hsCRP) > 10 mg/l, thyroid dysfunction, hepatic disease, renal disease other than diabetic nephropathy and with estimated glomerular filtration rate (eGFR) < 15 ml/min/1.73m2, patients with ethanol consumption > 20 g/day and pregnancy were excluded from the study.

3.The Effect of Forest Health Care on the Body

- **Forest Health Care Process**

A

Living environment during health care

B

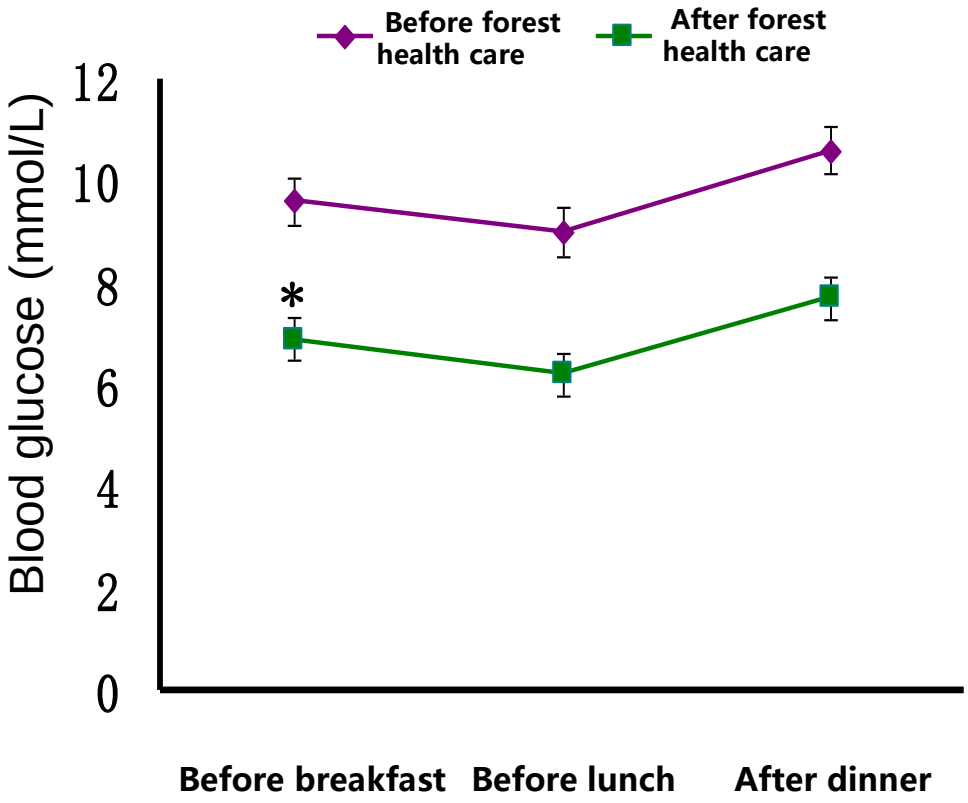
Forest walking during health care

C

Forest meditation during health care

3.The Effect of Forest Health Care on the Body

- **Effect of forest helath care on blood glucose of diabetic patients**

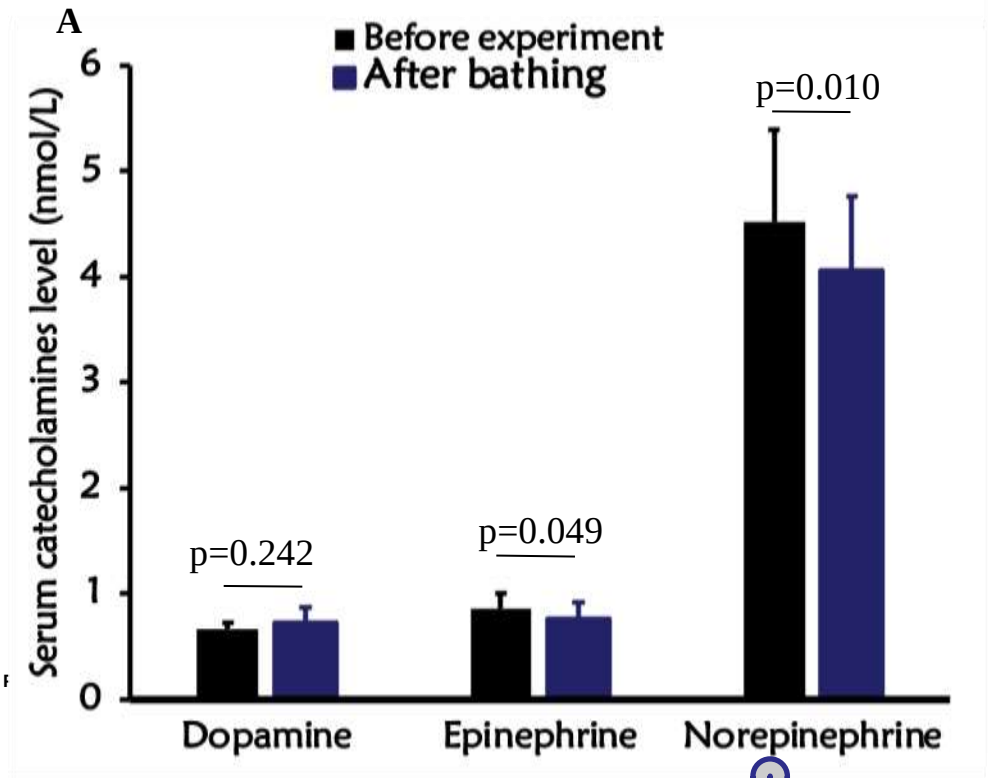


Effect of helath care for 3 days on blood glucose in patients with diabetes mellitus

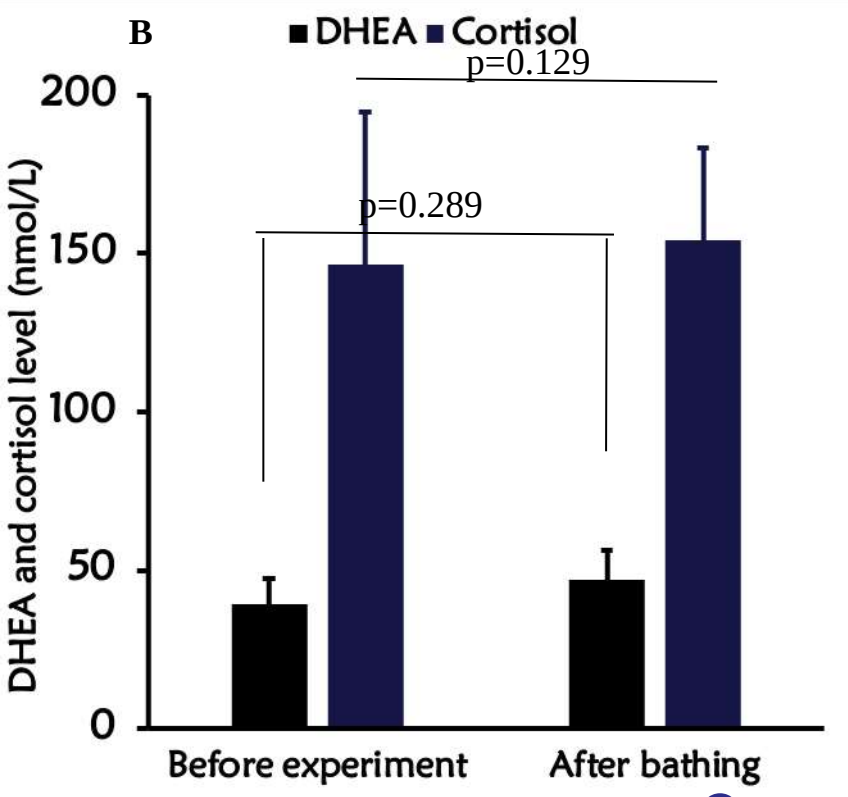
Paired t-test showed that there was significant difference before and after health care *: $p<0.05$.

3.The Effect of Forest Health Care on the Body

- **Effects of forest helath care on serum catecholamine, DHEA and cortisol in patients with diabetes mellitus**



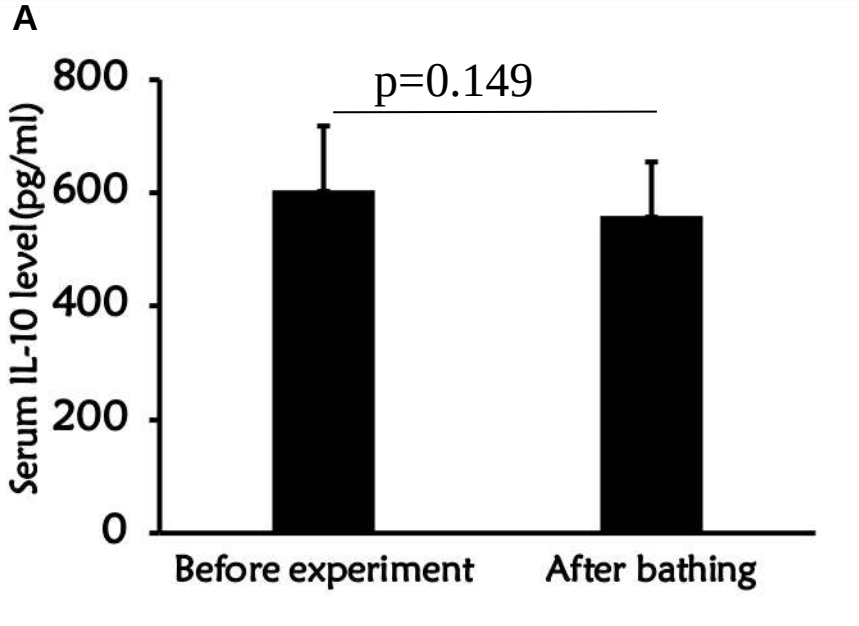
Forest helath care could slow down the stress response and decrease the serum catecholamine level

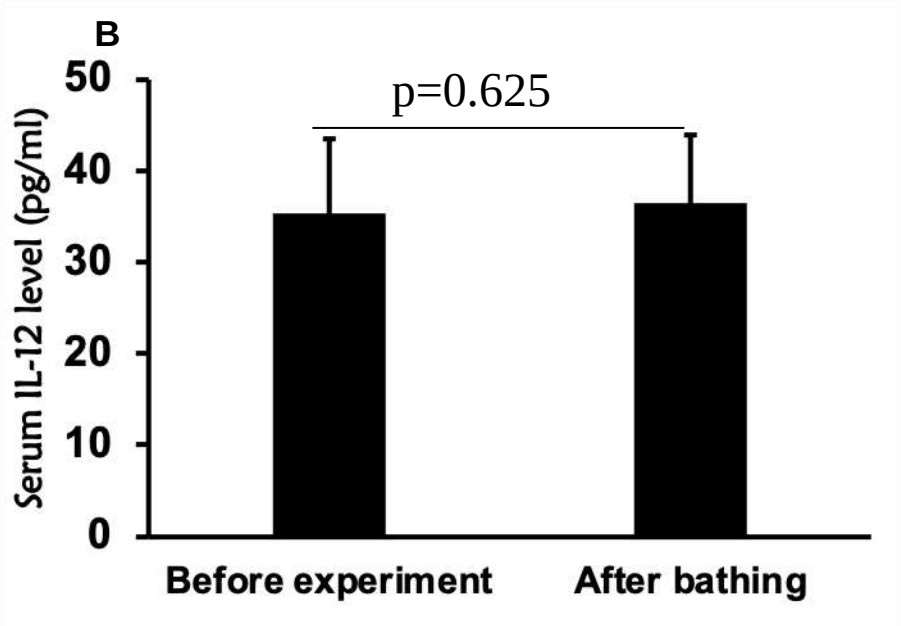


The effect of forest health care on serum DHEA and cortisol in diabetic patients was not obvious

3.The Effect of Forest Health Care on the Body

- **Effect of forest health care on serum cytokines in patients with diabetes mellitus**

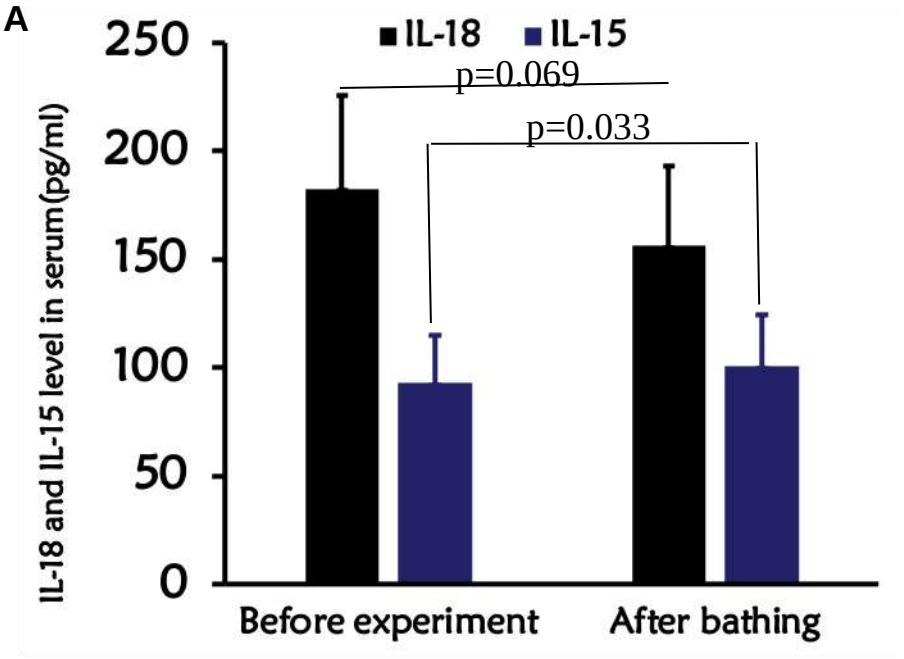


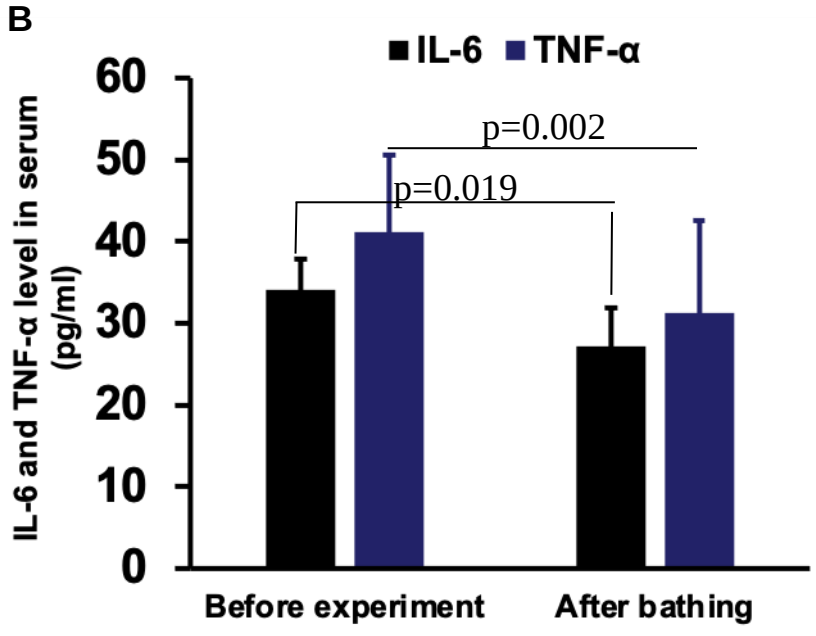


There was no significant effect of forest health care on serum IL-10 and IL-12 in diabetic patients

3.The Effect of Forest Health Care on the Body

- **Effect of forest health care on serum related cytokines in patients with diabetes mellitus**

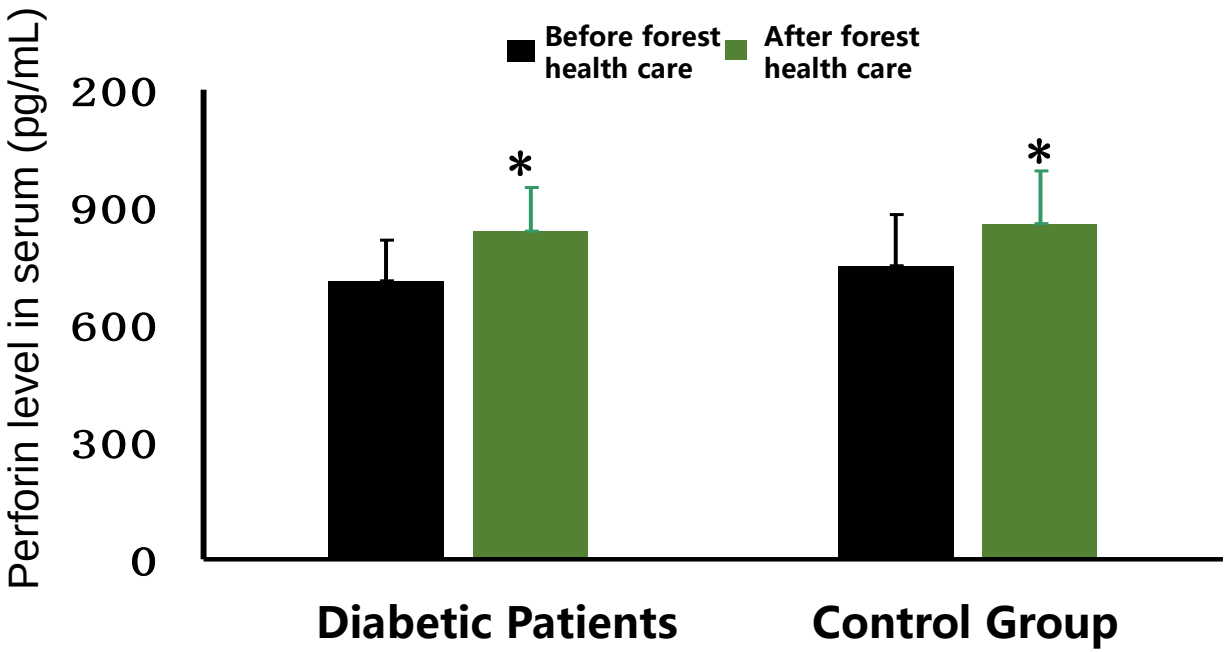




Forest health care could increase level of serum IL-15, while the level of IL-6 and TNF was decreased

3.The Effect of Forest Health Care on the Body

•Effect of forest health care on serum perforin in patients with diabetes mellitus



Effect of helath care for 3 days on serum perforin in patients with diabetes mellitus

Paired t-test showed that there significant difference before and after health care *: $p<0.05$.

Forest health care could enhance serum perforin level in patients with diabetes mellitus

4.Research Foundation and Advantages

- **Advantages in Discipline and Specialty**

Beihua University is the only comprehensive university with forestry and medicine in China

Discipline Advantage

Key disciplines of SFA:
First class discipline in Jilin Province:
The most important subjects:
Forestry
Key Disciplines:
Forestry, Basic medicine, Clinical medicine
Master's degree authorization point:
Forestry, Basic medicine, Clinical medicine, Pharmacy, Landscape architecture, Nursing

Specialty Advantage

Specialty with national characteristics:
Forestry、Landscape architecture、Clinical medicine
Specialty with provincial characteristics:
Forestry, Landscape architecture, Clinical medicine, Pharmacy
Provincial brand specialty:
Forestry, Landscape architecture, Clinical medicine, Pharmacy
New major:
Rehabilitation therapeutics

4.Research Foundation and Advantages

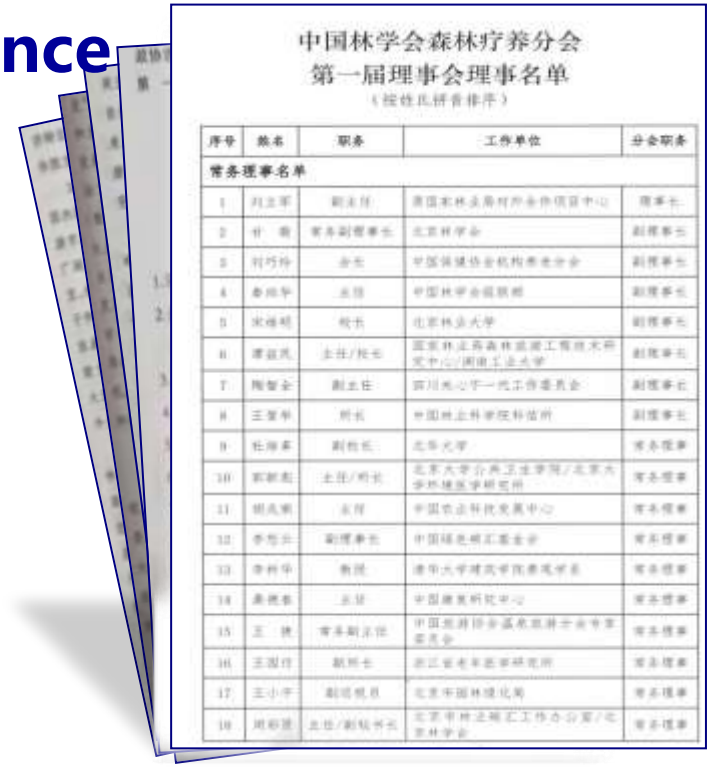
• Advantages of academic influence

- In 2018, Beihua University became a member of forest recuperation branch of China forestry society, and pro. Peige Du was the executive director of the first Council.

- In 2018, Pro. Hongjun Wang, a member of the platform, was elected as the vice president of the Forest Rehabilitation Branch of Jilin forestry society and the consulting expert of China Forestry Association.

- In May 2019, Pro. Peige Du, Hongjun Wang and Huanqi Wang were elected as international experts in natural and forest medicine.

- In 2018, the discipline of forest medicine was rated as the dominant characteristic discipline in Jilin Province (platform).


中国林学会森林疗养分会
第一届理事会理事名单
（按姓氏拼音排序）

序号	姓名	职务	工作单位	分会职务
常务理事名单				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
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15				
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17				
18				

4.Research Foundation and Advantages

• Advantages of teaching staff

There are 22 main members in this platform, including 10 professors, 20 doctors, 15 master's supervisors and 4 doctoral supervisors, all of them 9 with overseas study experience.

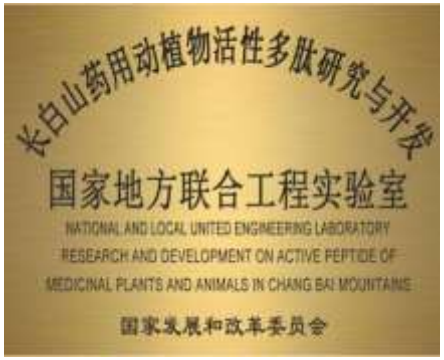
professional and technical title	Number of full-time teach	Under 35 years old	from 36 to 45	from 46 to 55	from 56 to 60	older than 61	Doctoral degree	Teacher with overseas experience	Foreign teachers
high professional title	10	0	1	7	2	0	9	6	0
associate professor	10	6	3	1	0	0	9	3	0
intermediate	2	2	0	0	0	0	2	0	0
other	0	0	0	0	0	0	0	0	0
total	22	8	4	8	2	0	20	9	0

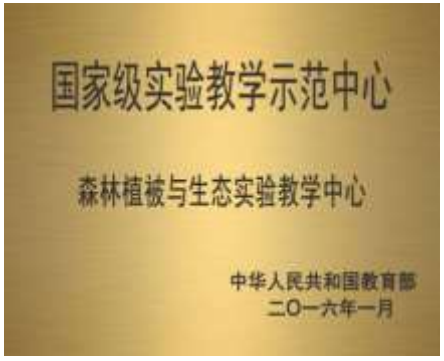
Number of teachers with the highest degree who got a degree from other university (percentage)	The number of tutors (Ratio)	The number of doctoral adviser (Ratio)
21 (95.45%)	15 (68.18%)	4 (18.18%)

4.Research Foundation and Advantages

- **Advantages of scientific research platform**

➢ 3 National Innovation Platforms ➢ 4 Provincial innovation platforms





- **National Research Base**
- **Talent training base of agricultural science and education cooperation of Jiaohe experimental administration in Jilin Province**
- **Provincial Research Base**
- **Forestry Science and Technology Innovation Center in Jilin Province**
- **Key Laboratory of forestry and Ecological Environment in Jilin Province**
- **Forest specialty development and industrialization Collaborative Innovation Center in Jilin Province**
- **Key Laboratory of Molecular geriatrics in Jilin Province**

Thanks