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Original article

Meridian thermal stimulation diagnostic device.

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Abstract

The true nature of illness is interpreted by the theories of Yin-Yang Five Elements, meridians, acupuncture points, vital energy and blood and 5 viscera and 6 bowels of "Huangdi Neijing" in China. There are 12 main meridians and 8 extra meridians. The main meridians are classified into yin and yang meridians. A yin meridian is divided into three, greater yin, lesser yin and faint yin, and yang is also divided into three, greater yang, yang bright and lesser yang. The 12 main meridians belong to the three yang and three yin meridians in each of the hands and feet. In Chinese medicine, the trueness of the body is determined by measuring the 12 main meridians. In the thermal sensitivity measurement method, diagnosis is performed by applying a thermal stimulus to the body surface of subjects corresponding to the meridians. In this paper, we are reporting the development of a meridian thermal stimulation diagnostic device that assists in the measurement and analysis using the thermal sensitivity measurement method. This method was used to measure the heat sensitivity in 31 Japanese subjects (13 males, 18 females, 65 to 90 years old), and 200 Chinese subjects (62 males, 138 females), and the association between glycative stress index and Skin AGEs Fluorescence (SAF) was analyzed. As a result, The Bladder Meridian of Foot-Taiyang and The Kidney Meridian of Foot-Shaoyin were found to have a significant association with SAF. When the measured values for bladder meridian and kidney meridian were within the standard range, SAF tended to be low. We plan to verify whether it is possible to predict the risk of disease in the pre-symptomatic stage by collecting measurement data on thermal sensitivity.

KEY WORDS: thermal sensitivity measurement method, meridian thermal stimulation diagnostic device, meridian, advanced glycation end products (AGEs)

Introduction

Background of Oriental Medicine

In the Chinese medical text of "Huangdi Neijing," the true nature of illness is explained by the theories of Yin-Yang Five Elements, meridians, acupuncture points, vital energy and blood and 5 viscera and 6 bowels [1-4)]. According to the Yin-Yang concept, all creations in the universe can be classified into two categories, namely, Yin and Yang.

One of the interpretations according to the Yin-Yang theory in "Huangdi Neijing" is "气血同源，气为血之帅，" which when interpreted in Japanese implies that "vital energy and blood have the same source, and vital energy can regulate the blood". Rather than the literal meaning, "Qi" (vital energy) here is considered to be the energy of the whole body, and "Ketsu" (blood) implies various substances in the body. Therefore, the meaning of "气血同源，气为血之帅" is, "Energy and various substances are produced in the body at the same time and if there is a disorder in the body's energy, then subsequently, disorder is created in various substances as well" (***Fig. 1***) [1-4)].

Meridians are conceived as paths in ancient Chinese medicine through which nutrients and defenses in the human body (necessities for survival, such as vital energy, blood and water, or the metabolites in the modern sense) flow. In "keiraku" (meridian), "kei" represents "Keimyaku" or vertical channels, and "raku" represents "rakumyaku" or horizontal channels. There are 12 main meridians and 8 extra meridians. The yin meridians belong to the viscera (heart, liver, spleen, lungs, and kidney), and yang meridians belong to the gut (colon, San Jiao (three digestive organs), small intestine, stomach, gallbladder, and bladder).

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Among the eight extra meridians, only the conception vessel and governor vessel have acupuncture points (*Fig. 2*) [5-8]. There is an explanation about the function of each organ, "诸风掉眩，皆属于肝；诸寒收引，皆属于肾；诸气臌郁，皆属于肺；诸湿肿满，皆属于脾；诸热瞀瘈，皆属于火（心）；诸痛痒疮，皆属于心".

According to a concept in Chinese medicine, the meridians are channels of Qi "Energy" in the human body, and it is said that, "经络可处百病，决生死，不可不通". "经络可处百病，决生死，不可不通" means that "various diseases can be diagnosed based on the condition of a meridian, and free flow in the meridians is a matter of life and death. Therefore free flow is a must". For this reason, we established a hypothesis that "using a method that can digitize or visualize the condition of meridians, the condition can be compared with the amount of various substances and aging-related factors, and diseases can be diagnosed during the pre-symptomatic stage". The topic dealing with the medical mechanism that links the meridians with the glycative stress is particularly interesting. *Figure 3* shows the types and locations of the meridians, and *Fig. 4* and *Table 1* show the acupuncture points in the hand and legs [9].

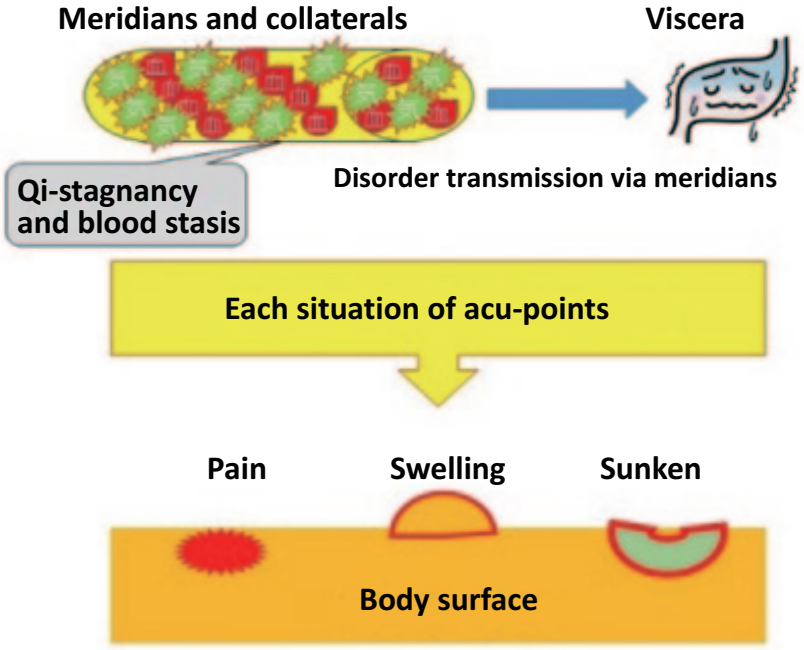


Fig. 1. **The relationship between qi and blood.**

Qi and blood are of the same origin. Qi can control and adjust the blood. Qi means energy, blood means quality.

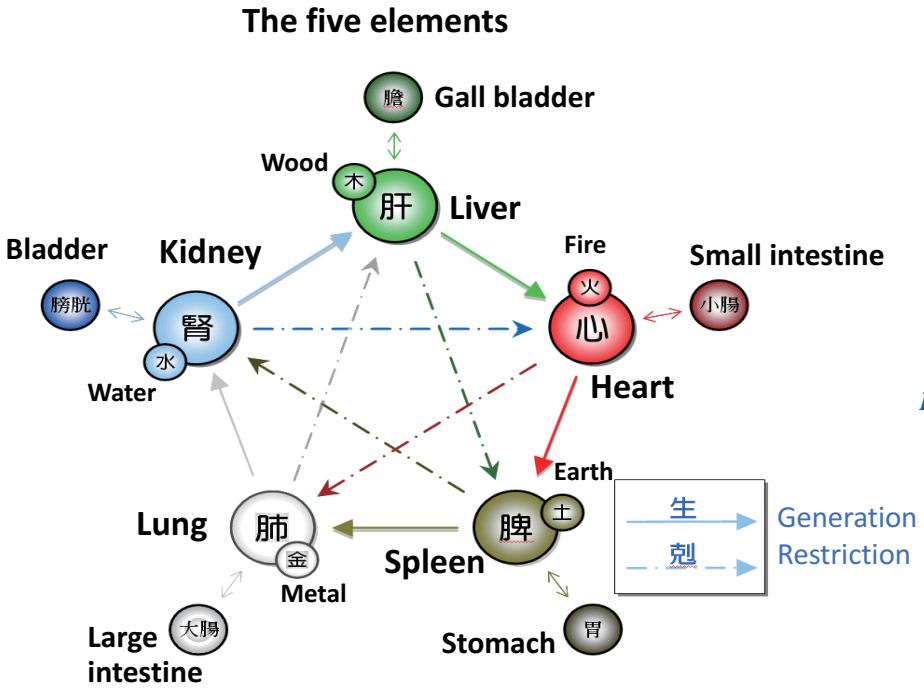


Fig. 2. **The concept of Yin Yang Five Elements theory.**

In Chinese traditional medicine science system has Ying-Yang Five Elements Theory, each organ has their own property, it can be divided to: liver (wood), heart (fire), spleen (soil), lung (metal), kidney (water).

Figure 3-a

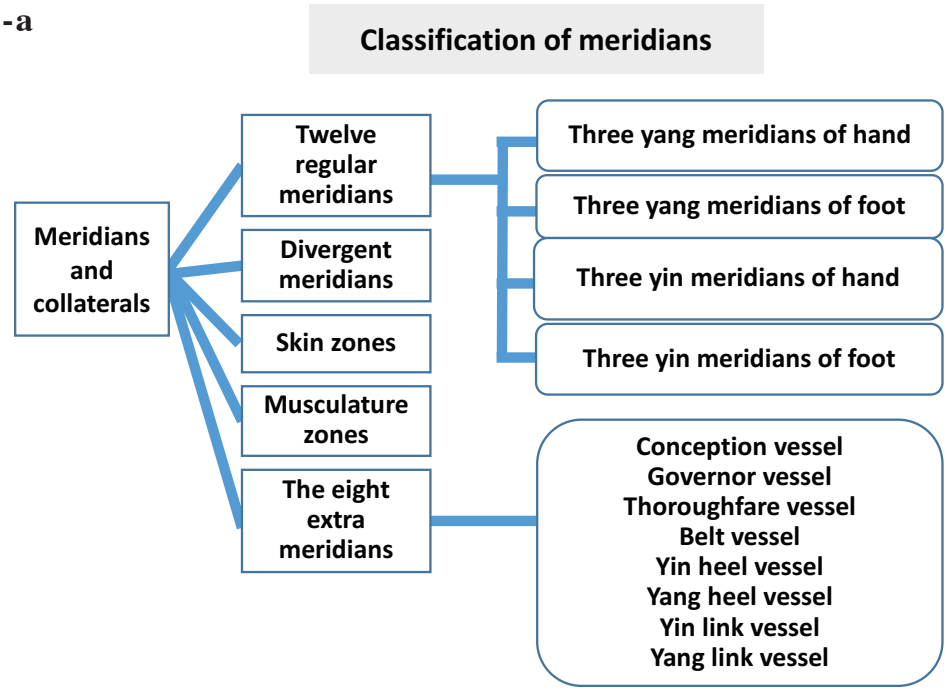


Figure 3-b

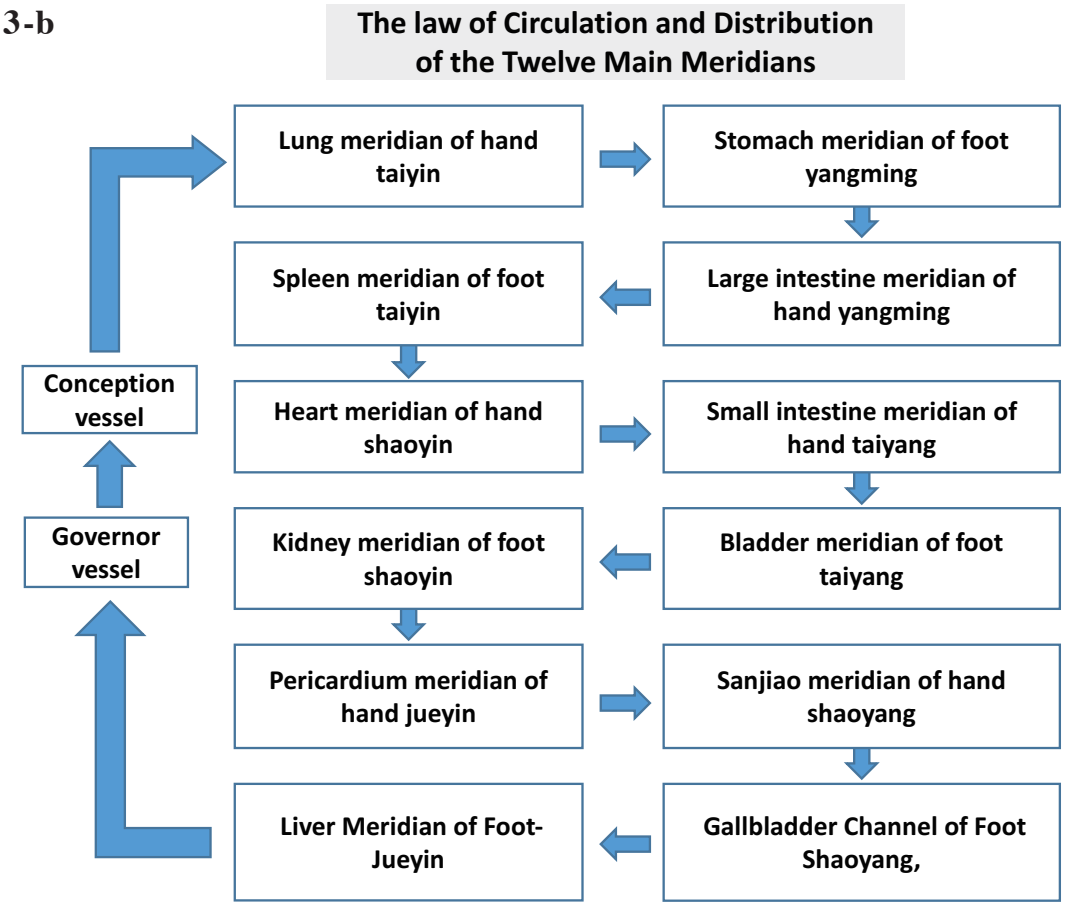


Fig. 3. **The concepts of meridians.**

a) The classification. **b)** The flow. Meridian can be divided into twelve regular meridians, divergent meridian, skin zones, musculature zones, the eight extra meridians. And the law of circulation and distribution of the twelve main meridians is from lung meridian if hand taiyin go through the entire body and end at the liver meridian of foot jueyin and back from the governor vessel to conception vessel, then back to the lung meridian of hand taiyin again.

Figure 4-a

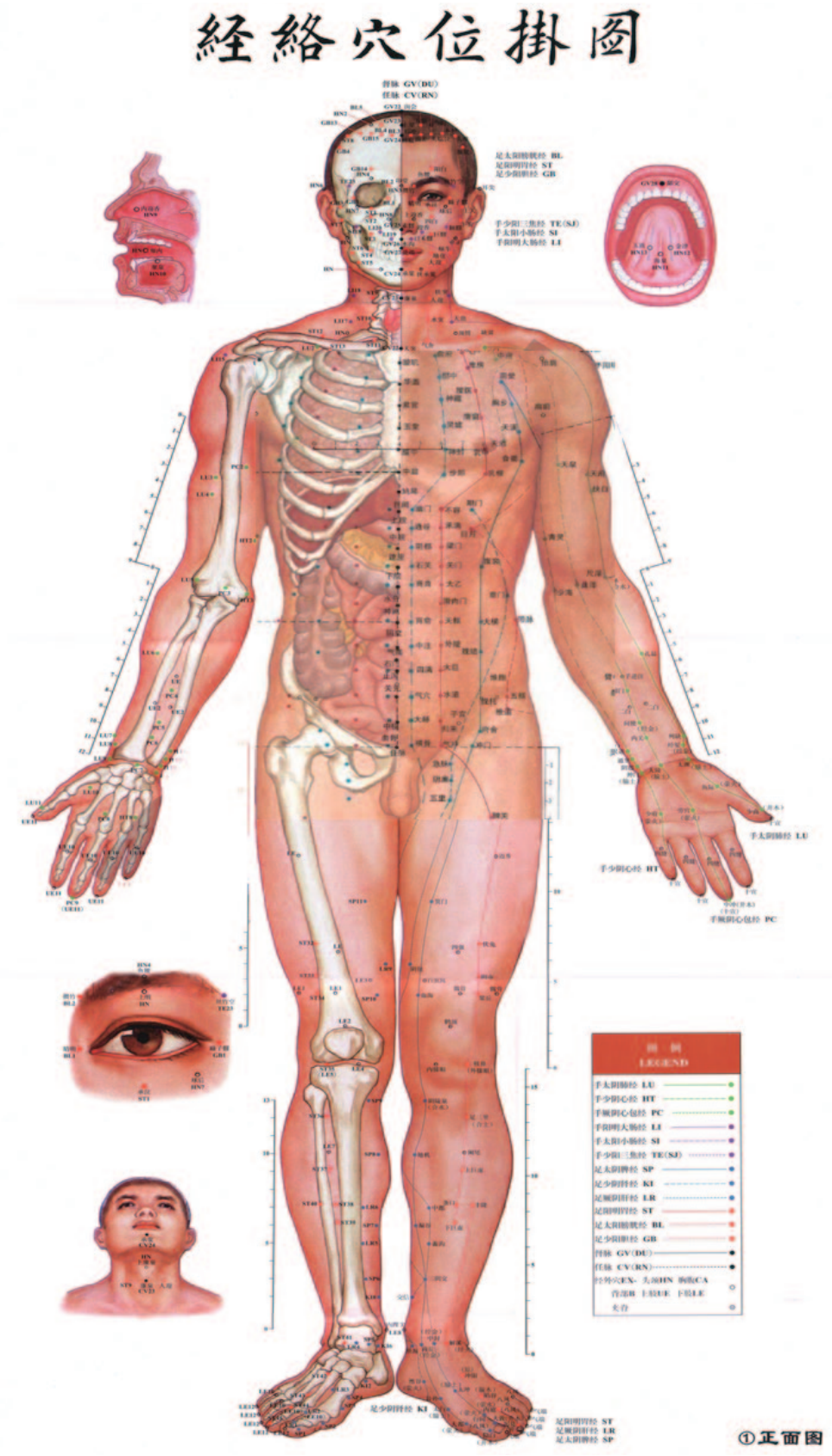


Figure 4 - b

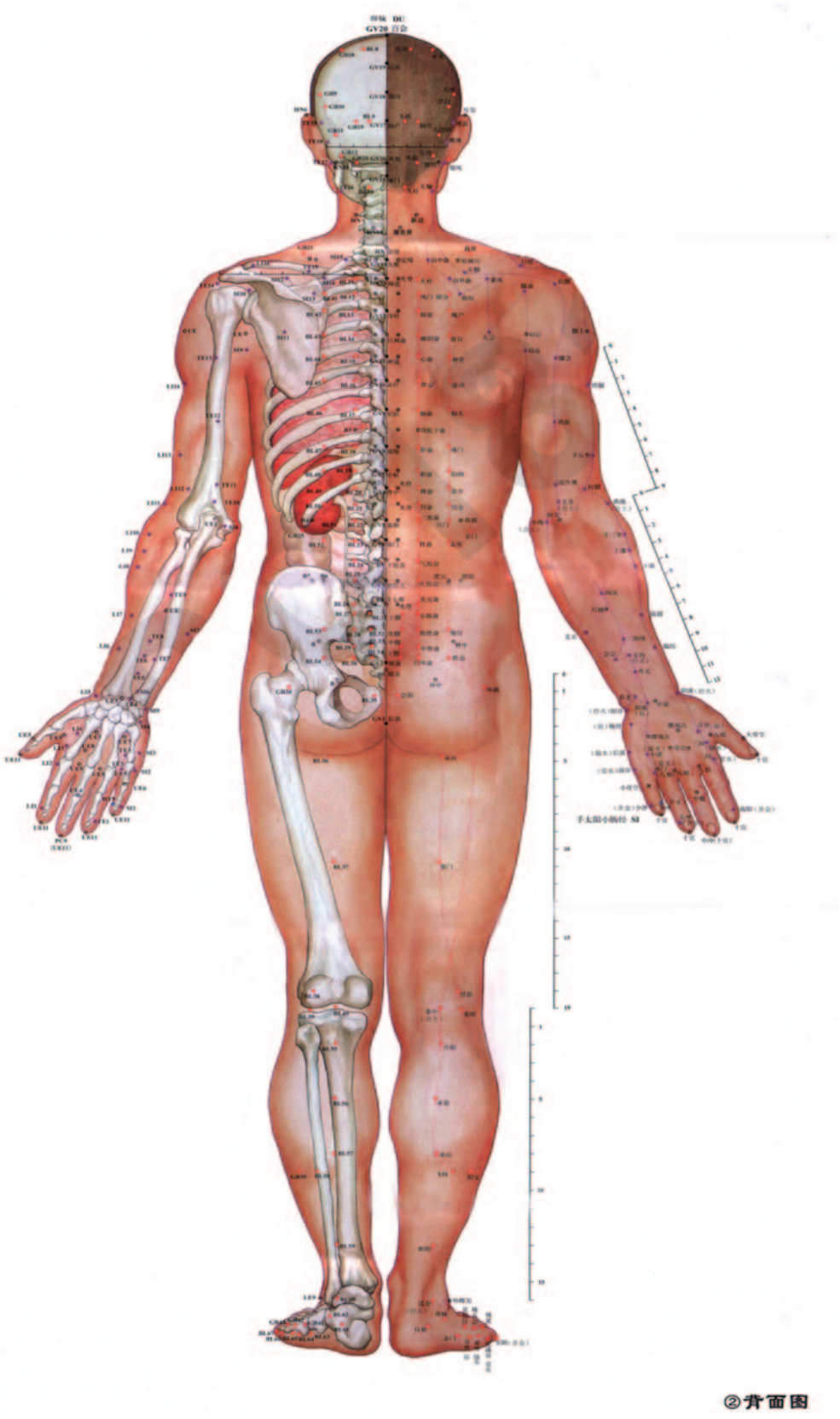


Fig. 4. **Meridians and Acu-points chart.**

a) Front of the body. **b)** Back of the body.

Quoted from the website: https://wenku.baidu.com/view/b358f106eff9aef8941e066a.html

Table 1. Names of meridians and acu-points.

Lung（手太阴肺经）			Large intestine（手阳明大肠经）			Stomach（足阳明胃经）			Spleen（足太阴脾经）			Heart（手少阴心经）			Samll intestine（手太阳小肠经）			Bladder（足太阳膀胱经）		
LU1	Zhongfu	中府	LI1	Shangyang	商阳	ST1	Chengqi	承泣	SP1	Yinbai	隐白	HT1	Jiquan	极泉	SI1	Shaoze	少泽	BL1	Jingming	睛明
LU2	Yunmen	云门	LI2	Erjian	二间	ST2	Sibai	四白	SP2	Dadu	大都	HT2	Qingling	青灵	SI2	Qiangu	前谷	BL2	Cuanzhu	攒竹
LU3	Tianfu	天府	LI3	Sanjian	三间	ST3	Juliao	巨髎	SP3	Taibai	太白	HT3	Shaohai	少海	SI3	Houxi	后溪	BL3	Meichong	眉冲
LU4	Xiabai	侠白	LI4	Hegu	合谷	ST4	Dicang	地仓	SP4	Gongsun	公孙	HT4	Lingdao	灵道	SI4	Wangu	腕骨	BL4	Qucha	曲差
LU5	Chize	尺泽	LI5	Yangxi	阳溪	ST5	Daying	大迎	SP5	Shangqiu	商丘	HT5	Tongli	通里	SI5	Yanggu	阳谷	BL5	Wuchu	五处
LU6	Kongzui	孔最	LI6	Pianli	偏历	ST6	Jiache	颊车	SP6	Sanyinjiao	三阴交	HT6	Yinxi	阴郄	SI6	Yanglao	养老	BL6	Chengguang	承光
LU7	Lieque	列缺	LI7	Wenliu	温留	ST7	Xiaguan	下关	SP7	Lougu	漏谷	HT7	Shenmen	神门	SI7	Zhizheng	支正	BL7	Tongtian	通天
LU8	Jingqu	经渠	LI8	Xialian	下廉	ST8	Touwei	头维	SP8	Diji	地机	HT8	Shaofu	少府	SI8	Xiaohai	小海	BL8	Luoque	络却
LU9	Taiyuan	太渊	LI9	Shanglian	上廉	ST9	Renying	人迎	SP9	Yinlingquan	阴陵泉	HT9	Shaochong	少冲	SI9	Jianzhen	肩贞	BL9	Yuzhen	玉枕
LU10	Yuji	鱼际	LI10	Shousanli	手三里	ST10	Shuitu	水突	SP10	Xuehai	血海				SI10	Naoshu	臑俞	BL10	Tianzhu	天柱
LU11	Shaoshang	少商	LI11	Quchi	曲池	ST11	Qishe	气舍	SP11	Jimen	箕门				SI11	Tianzong	天宗	BL11	Dazhu	大杼
			LI12	Zhouliao	肘髎	ST12	Quepen	缺盆	SP12	Chongmen	冲门				SI12	Bingfeng	秉风	BL12	Fengmen	风门
			LI13	Shouwuli	手五里	ST13	Qihu	气户	SP13	Fushe	府舍				SI13	Quyuan	曲垣	BL13	Feishu	肺俞
			LI14	Binao	臂臑	ST14	Kufang	库房	SP14	Fujie	腹结				SI14	Jianwaishu	肩外俞	BL14	Jueyinshu	厥阴俞
			LI15	Jianyu	肩髃	ST15	Wuyi	屋翳	SP15	Daheng	大横				SI15	Jianzhongshu	肩中俞	BL15	Xinshu	心俞
			LI16	Jugu	巨骨	ST16	Yingchuang	膺窗	SP16	Fuai	腹哀				SI16	Tianchuang	天窗	BL16	Dushu	督俞
			LI17	Tianding	天鼎	ST17	Ruzhong	乳中	SP17	Shidou	食窦				SI17	Tianrong	天容	BL17	Geshu	隔俞
			LI18	Futu	扶突	ST18	Rugen	乳根	SP18	Tianxi	天溪				SI18	Quanliao	颧髎	BL18	Ganshu	肝俞
			LI19	Kouheliao	口禾髎	ST19	Burong	不容	SP19	Xiongxiang	胸乡				SI19	Tinggong	听宫	BL19	Danshu	胆俞
			LI20	Yingxiang	迎香	ST20	Chengman	承满	SP20	Zhourong	周荣							BL20	Pishu	脾俞
						ST21	Liangmen	梁门	SP21	Dabao	大包							BL21	Weishu	胃俞
						ST22	Guanmen	关门										BL22	Sanjiaoshu	三焦俞
						ST23	Taiyi	太乙										BL23	Shenshu	肾俞
						ST24	Huaroumen	滑肉门										BL24	Qihaishu	气海俞
						ST25	Tianshu	天枢										BL25	Dachangshu	大肠俞
						ST26	Wailing	外陵										BL26	Guanyuanshu	关元俞
						ST27	Daju	大巨										BL27	Xiaochangshu	小肠俞
						ST28	Shuidao	水道										BL28	Pangguangshu	膀胱俞
						ST29	Guilai	归来										BL29	Zhongl Ü shu	中髎俞
						ST30	Qichong	气冲										BL30	Baihuanshu	白环俞
						ST31	Biguan	髀关										BL31	Shangliao	上髎
						ST32	Futu	伏兔										BL32	Ciliao	次髎
						ST33	Yinshi	阴市										BL33	Zhongliao	中髎
						ST34	Liangqiu	梁丘										BL34	Xialiao	下髎
						ST35	Dubi	犊鼻										BL35	Huiyang	会阳
						ST36	Zusanli	足三里										BL36	Chengfu	承扶
						ST37	Shangjuxu	上巨虚										BL37	Yinmen	殷门
						ST38	Tiaokou	条口										BL38	Fuxi	浮郄
						ST39	Xiajuxu	下巨虚										BL39	Weiyang	委阳
						ST40	Fenglong	丰隆										BL40	Weizhong	委中
						ST41	Jiexi	解溪										BL41	Fufen	附分
						ST42	Chongyang	冲阳										BL42	Pohu	魄户
						ST43	Xiangu	陷谷										BL43	Gaohuangshu	膏肓俞
						ST44	Neiting	内庭										BL44	Shentang	神堂
						ST45	Lidui	厉兑										BL45	Yixi	谚譆
																		BL46	Geguan	隔关
																		BL47	Hunmen	魂门
																		BL48	Yanggang	阳纲
																		BL49	Yishe	意舍
																		BL50	Weicang	胃仓
																		BL51	Huangmen	肓门
																		BL52	Zhishi	志室
																		BL53	Baohuang	胞肓
																		BL54	Zhibian	秩边
																		BL55	Heyang	合阳
																		BL56	Chengjin	承筋
																		BL57	Chengshan	承山
																		BL58	Feiyang	飞扬
																		BL59	Fuyang	跗阳
																		BL60	Kunlun	昆仑
																		BL61	Pushen	仆参
																		BL62	Shenmai	申脉
																		BL63	Jinmen	金门
																		BL64	Jinggu	京骨
																		BL65	Shugu	束骨
																		BL66	Zutonggu	足通谷
																		BL67	Zhiyin	至阴

Kidney（足少阴肾经）			Peri cardium（手厥阴心包经）			Sanjiao（手少阳三焦经）			Gall bladder（足少阳胆经）			Liver（足厥阴肝经）			Ren（任脉）			Dumai（督脉）		
KI1	Yongquan	涌泉	PC1	Tianchi	天池	SJ1	Guanchong	关冲	GB1	Tongziliao	瞳子膠	LR1	Dadun	大敦	RN1	Huiyin	会阴	DU1	Changqiang	长强
KI2	Rangu	然谷	PC2	Tianquan	天泉	SJ2	Yemen	液门	GB2	Tinghui	听会	LR2	Xingjian	行间	RN2	Qugu	曲骨	DU2	Yaoshu	腰俞
KI3	Taixi	太溪	PC3	Quze	曲泽	SJ3	Zhongzhu	中渚	GB3	Shangguan	上关	LR3	Taichong	太冲	RN3	Zhongji	中极	DU3	Yaoyangguan	腰阳关
KI4	Dazhong	大钟	PC4	Ximen	郄门	SJ4	Yangchi	阳池	GB4	Hanyan	颔厌	LR4	Zhongfeng	中封	RN4	Guanyuan	关元	DU4	Mingmen	命门
KI5	Shuiquan	水泉	PC5	Jianshi	间使	SJ5	Waiguan	外关	GB5	Xuanlu	悬颅	LR5	Ligou	蠡沟	RN5	Shimen	石门	DU5	Xuanshu	悬枢
KI6	Zhaohai	照海	PC6	Neiguan	内关	SJ6	Zhigou	支沟	GB6	Xuanli	悬厘	LR6	Zhongdu	中都	RN6	Qihai	气海	DU6	Jizhong	脊中
KI7	Fuliu	复溜	PC7	Daling	大陵	SJ7	Huizong	会宗	GB7	Qubin	曲鬓	LR7	Xiguan	膝关	RN7	Yinjiao	阴交	DU7	Zhongshu	中枢
KI8	Jiaoxin	交信	PC8	Laogong	劳宫	SJ8	Sanyanghuo	三阳络	GB8	Shuaigu	率谷	LR8	Ququan	曲泉	RN8	Shenque	神阙	DU8	Jinsuo	筋缩
KI9	Zhubin	筑宾	PC9	Zhongchong	中冲	SJ9	Sidu	四渎	GB9	Tianchong	天冲	LR9	Yinbao	阴包	RN9	Shuifen	水分	DU9	Zhiyang	至阳
KI10	Yingu	阴谷				SJ10	Tianjing	天井	GB10	Fubai	浮白	LR10	Zuwuli	足五里	RN10	Xiawan	下脘	DU10	Lingtai	灵台
KI11	Henggu	横骨				SJ11	Qinglengyuan	清冷渊	GB11	Touqiaoyin	头窍阴	LR11	Yinlian	阴廉	RN11	Jianli	建里	DU11	Shendao	神道
KI12	Dahe	大赫				SJ12	Xiaoluo	消泺	GB12	Wangu	完骨	LR12	Jimai	急脉	RN12	Zhongwan	中脘	DU12	Shenzhu	身柱
KI13	Qixue	气穴				SJ13	Naohui	臑会	BG13	Benshen	本神	LR13	Zhangmen	章门	RN13	Shangwan	上脘	DU13	Taodao	陶道
KI14	Siman	四满				SJ14	Jianliao	肩髎	GB14	Yangbai	阳白	LA14	Qimen	期门	RN14	Juque	巨阙	DU14	Dazhui	大椎
KI15	Zhongzhu	中注				SJ15	Tianliao	天髎	GB15	Toulinqi	头临泣				RN15	Jiuwei	鸠尾	DU15	Yamen	哑门
KI16	Huangshu	肓俞				SJ16	Tianyou	天牖	GB16	Muchuang	目窗				RN16	Zhongting	中庭	DU16	Fengfu	风府
KI17	Shangqu	商曲				SJ17	Yifeng	翳风	GB17	Zhengying	正营				RN17	Danzhong	膻中	DU17	Naohu	脑户
KI18	Shiguan	石关				SJ18	Chimai	瘈脉	GB18	Chengling	承灵				RN18	Yutang	玉堂	DU18	Qiangjian	强间
KI19	Yindu	阴都				SJ19	Luxi	颅息	GB19	Naokong	脑空				RN19	Zigong	紫宫	DU19	Houding	后顶
KI20	Futonggu	腹通谷				SJ20	Jiaosun	角孙	GB20	Fengchi	风池				RN20	Huagai	华盖	DU20	Baihui	百会
KI21	Youmen	幽门				SJ21	Ermen	耳门	GB21	Jianjing	肩井				RN21	Xuanji	璇玑	DU21	Qianding	前顶
KI22	Bulang	步廊				SJ22	Erheliao	耳和髎	GB22	Yuanye	渊腋				RN22	Tiantu	天突	DU22	Xinhui	囟会
KI23	Shenfeng	神封				SJ23	Sizhukong	丝竹空	GB23	Zhejin	辄筋				RN23	Lianquan	廉泉	DU23	Shangxing	上星
KI24	Lingxu	灵墟							GB24	Riyue	日月				RN24	Chengjiang	承浆	DU24	Shenting	神庭
KI25	Shenzang	神藏							GB25	Jingmen	京门							DU25	Suliao	素髎
KI26	Yuzhong	彧中							GB26	Daimai	带脉							DU26	Shuigou	水沟
KI27	Shufu	俞府							GB27	Wushu	五枢							DU27	Duiduan	兑端
									GB28	Weidao	维道							DU28	Yinjiao	龈交
									GB29	Juliao	居髎									
									GB30	Huantiao	环跳									
									GB31	Fengshi	风市									
									GB32	Zhongdu	中渎									
									GB33	Xiyangguan	膝阳关									
									GB34	Yanglingquan	阳陵泉									
									GB35	Yangjiao	阳交									
									GB36	Waiqiu	外丘									
									GB37	Guangming	光明									
									GB38	Yangfu	阳辅									
									GB39	Xuanzhong	悬钟									
									GB40	Qiuxu	丘墟									
									GB41	Zulinqi	足临泣									
									GB42	Diwuhui	地五会									
									GB43	Xiaxi	侠溪									
									GB44	Zuqiaoyin	足窍阴									

There are 12 main meridians and 8 extra meridians. The main meridians are classified into yin and yang meridians. The yin meridian is divided into three, namely, greater yin, lesser yin and faint yin, and yang is divided into three yang meridians, namely, greater yang, yang bright and lesser yang. The 12 main meridians belong to the three yang and three yin meridians in each of the hands and feet. The trueness of the body is determined by measuring the 12 main meridians. As a conventional evaluation method, the thermal sensitivity measurement method is widely used in clinics practicing Chinese medicine.

The five elements in the theory of Yin-Yang Five Elements, are the five concepts that have been abstracted by observing the natural phenomena associated with seasonal changes, which explain natural phenomena, characteristics that form the background of various fields such as medical treatment, cycles, and interactions[10-12]. They can be perceived not just as five basic elements but also as five states, movements and processes that change.

According to the Five Elements theory, the normal range of meridians also changes cyclically with seasonal changes. Also, the normal range is the same for all 12 main meridians in the body [10].

Apart from seasons, the condition of the meridians is said to change in relation to the examination room, room temperature, sea level and orderly changes in the temperate climate [13].

It is expected that using the measurement of the meridians may enable predicting the effect of the meridian condition on aging factors for various diseases. In this study, we attempted to analyze the association between measurement results of thermal sensitivity and glycative stress index.

Method

Background Technology of Meridian Thermal Stimulation Diagnostic Device

In "kei" and "raku," "kei" represents "Keimyaku" or vertical channels, and "raku" represents "rakumyaku" or horizontal channels. However, even at present, there is only one traditional method of taking the pulse with the fingers to medically examine the 12 main meridians. At present, it is not possible to perform a medical examination while distinguishing the 12 main meridians and identifying each of them.

We have obtained a patent for the meridian thermal stimulation diagnostic device used in our research. In the patent, we have described the usefulness of the meridian test when used as a method of clinical examination and evaluation [14]. We showed that the meridian test could be used to detect physical disorders even before one becomes aware

of them and to show physical changes in the body after the treatment that is minor to the extent of not noticing, using indicators such as the number of positive meridian tests.

Also, the usefulness of acupuncture meridian treatment for medical diseases is described [15]. When there is a disorder in an organ, the meridians associated with the organ undergo changes (for example, deterioration in the flow of vital energy and blood). Therefore, we described that by stimulating the acupuncture points on the body surface corresponding to the meridians using needles and moxibustion, changes in the meridians (for example, flow of vital energy and blood) are regulated, which might enable maintaining homeostasis in the body, restoring the balance among the bodily functions and keeping the viscera in good health.

Principle of Meridian Thermal Stimulation Diagnostic Device

First, we will describe the diagnosis using meridian thermal stimulation. The device used in this study was developed for diagnosis by applying a thermal stimulus to the body surface of subjects corresponding to the meridians. The examination technique is as follows. A thermal stimulation terminal for applying thermal stimulus is brought close to the body of the subject, and the time (in seconds) taken by the subject to sense the thermal stimulus is measured and recorded. Since this is a non-contact method, the distance between the surface of the skin and terminal is kept at about 5 mm. A total of 24 measurement points are considered on the body surface of the subjects that correspond to the meridians, ten on each side. The measured time is defined as normal if the subject takes between 8 to 12 seconds to sense the simulation. The finding is considered to be abnormal if the measured time is more or less than the range.

Structure of the Meridian Thermal Stimulation Diagnostic Device

The structure and function of the device are explained using ***Fig. 5*** and ***Fig. 6***.

The meridian thermal stimulation diagnostic device 10 consists of a thermal stimulator 1, action potential measuring unit 2, power switch 3, SD card insertion slot 4, information display screen 5, body judgment unit 6, cooling fan 7, and

Figure 5-a

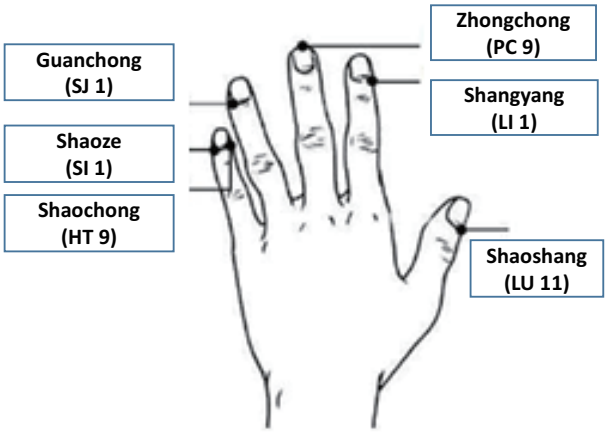
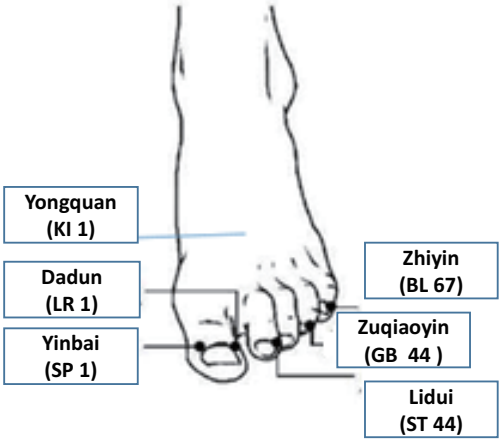


Figure 5-b



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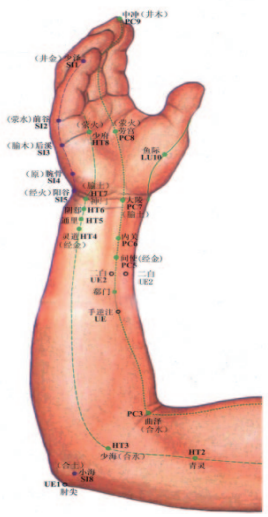

Figure 5-d

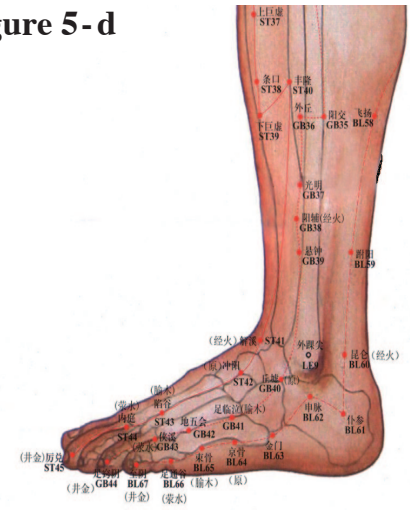

Fig. 5. **The first Acu-point of each meridian on the hand and foot.**

a) Hand. **b)** Foot. **c)** Forearm. **d)** Leg.

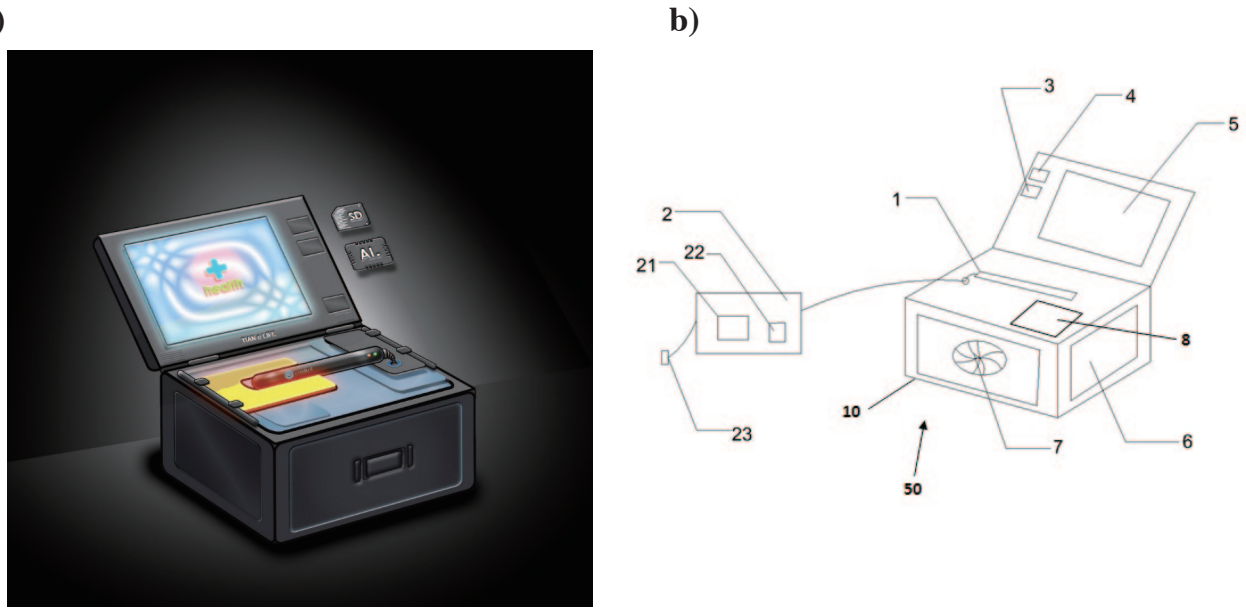

Fig. 6. **Design of the equipment for meridian check.**

a) The outlook. **b)** The structure.

time measuring unit 8. The action potential measuring unit 2 consists of an action potential calculator 21, signal magnifying unit 22 and measurement section for affixing 23.

Thermal stimulator 1 has a rod-like structure, and the temperature of the heater at the tip can be adjusted in the range 50°C to 80°C.

The time measuring unit 8 has a timer function and measures the time from when the subject is given a thermal stimulus until they sense the stimulus. If the subject is unable to provide a proper signal of feeling the thermal stimulus (such as infants or the elderly), the action potential of the subject is calculated with the action potential calculator 21 and the response time is measured by affixing the measurement section for affixing 23 to the arms and legs, and the action potential produced by the thermal stimulation is detected and magnified using the signal magnifying unit 22.

The 12 meridians consist of The Lung Meridian of Hand-Taiyin, The Large Intestine Meridian of Hand-Yangming, The Stomach Meridian of Foot-Yangming, The Spleen Meridian of Foot-Taiyin, The Heart Meridian of Hand-Shaoyin, The Small Intestine Meridian of Hand-Taiyang, The Bladder Meridian of Foot-Taiyang, The Kidney Meridian of Foot-Shaoyin, The Pericardium Meridian of Hand-Jueyin, The San Jiao Meridian of Hand-Shaoyang, The Gallbladder Meridian of Foot-Shaoyang, and The Liver Meridian of Foot-Jueyin. The examination is conducted by applying thermal stimulator 1 of the meridian thermal stimulation diagnostic device 50 to the body surface of the subject corresponding to all 12 meridians. For example, the subject can be examined by applying thermal stimulator 1 to the body surface, as shown in ***Fig. 2***.

Vital energy and blood flow sequentially (***Fig. 3-a***) through different types of the 12 meridians (***Fig3-b***), starting with The Lung Meridian of Hand-Taiyin, then flowing sequentially to The Liver Meridian of Foot-Jueyin in order and again flowing back to The Lung Meridian of Hand-Taiyin. However, there are no particular restrictions on the order in which the 12 meridians are to be examined. The Lung Meridian of Hand-Taiyin belongs to the lungs and connects with the large intestine, while The Large Intestine Meridian of Hand-Yangming belongs to the large intestine and connects with the lungs. The Pericardium Meridian of Hand-Jueyin belongs to the pericardium and connects with San Jiao (three digestive organs), while The San Jiao Meridian of Hand-Shaoyang belongs to San Jiao and connects with the pericardium. The Heart Meridian of Hand-Shaoyin belongs to the heart and connects with the small intestine, while The Small Intestine Meridian of Hand-Taiyang belongs to the small intestine and connects with the heart. The Spleen Meridian of Foot-Taiyin belongs to the spleen and connects with the stomach, while The Stomach Meridian of Foot-Yangming belongs to the stomach and connects with the spleen. The Liver Meridian of Foot-Jueyin belongs to the liver and connects with the gallbladder, while The Gallbladder Meridian of Foot-Shaoyang belongs to the gallbladder and connects with the liver. The Kidney Meridian of Foot-Shaoyin belongs to the kidney and connects with the bladder, while The Bladder Meridian of Foot-Taiyang belongs to the small intestine and connects with the kidney. That is, the lung meridian and large intestine meridian, pericardium meridian and San Jiao meridian, heart meridian and small intestine meridian, spleen meridian and stomach meridian, liver meridian and gallbladder meridian, and kidney meridian and bladder meridian are said to have a mutual internal-external relationship with each other.

Table 2 [9] shows the recommended measurement points (points to which the terminal is applied), and ***Table3*** [16] shows the diseases that are assumed from the measurement results.

Table 2. Measurement points for the meridian evaluation (acupuncture points).

Name of meridians	Acupoint The most suitable acupuncture point				
The Lung Meridian of Hand-Taiyin (太陰肺経)	Shaoshang (L11) (少商)	Zhongfu (L1) (中府)	Yunmen (L2) (云門)	Tianfu (L3) (天府)	Xiabai (L4) (侠白)
The Large Intestine Meridian of Hand-yangming (陽明大腸経)	Shangyang (LI1) (商陽)	Erjian (LI2) (二間)	Sanjian (LI3) (三間)	Hegu (LI4) (合谷)	Yangxi (LI5) (陽谿)
The Stomach Meridian of Foot-yangming (陽明胃経)	Lidui (S45) (兌)	Jiexi (S41) (解渓)	Chongyang (s42) (衝陽)	Xiangu (S43) (陥谷)	Neiting (S44) (内庭)
The Spleen Meridian of Foot-Taiyin (太陰脾経)	Yinbai (SP1) (隠白)	Dadu (SP2) (大都)	Taibai (SP3) (太白)	Gongsun (SP4) (公孫)	Shangqiu (SP5) (商丘)
The Heart Meridian of Hand-Shaoyin (少陰心経)	Yinqie (H6) (陰郄)	Qingling (H2) (青霊)	Shaohai (H3) (少海)	Lingdao (H4) (霊道)	Tongli (H5) (通里)
The Small Intestine Meridian of Hand-taiyang (太陽小腸経)	Shaoze (SI1) (少沢)	Qiangu (SI2) (前谷)	Houxi (SI3) (後渓)	Wangu (SI4) (腕骨)	Yanggu (SI5) (陽谷)
The Bladder Meridian of Foot-Taiyang (太陽膀胱経)	Zhiyin (B67) (至陰)	Jinmen (B63) (金門)	Jinggu (B64) (京骨)	Shugu (B65) (束骨)	Zutonggu (B66) (足通谷)
The kidney Channels of Foot-Shaoyin (少陰腎経)	Yongquan (K1) (湧泉)	Rangu (K2) (然谷)	Taixi (K3) (太渓)	Dazhong (K4) (大鐘)	Shuiquan (K5) (水泉)
The Pericardium Meridian of Hand-Jueyin (厥陰心包経)	Zhongchong (P9) (中衝)	Jianshi (P5) (間使)	Neiguan (P6) (内関)	Daling (P7) (大陵)	Laogong (P8) (労宮)
The Sanjiao Meridian of Hand-Shaoyang (少陽三焦経)	Guanchong (SJ1) (関衝)	Yemen (SJ2) (液門)	Zhongzhu (SJ3) (中渚)	Yangchi (SJ4) (陽池)	Waiguan (SJ5) (外関)
The Gallbladder Meridian of foot-Shaoyang (少陽胆経)	Zuqiaoyin (G43) (足竅陰)	Qiuxu (G40) (丘墟)	Zulinqi (G41) (足臨泣)	Diwuhui (G42) (地五会)	Xiaxi (G42) (侠谿)
The Liver Meridian of Foot-Jueyin (厥陰肝経)	Dadun (Liv1) (大敦)	Xingjian (Liv2) (行間)	Taichong (Liv3) (太衝)	Zhongfeng (Liv4) (中封)	Ligou (Liv5) (蠡溝)

Measurement points are selected from each meridian spot for the meridian evaluation. The table is quoted from Reference 9).

Table 3. Estimated pathological conditions by the pain threshold test.

Hypertension	For abnormal of lung meridians and heart meridians
Headache or Encephalatrophy	For abnormal of lung meridians and large intestine meridians
Leukemia	All the meridians are below 8 seconds
Colon cancer	Large intestine meridians and small intestine meridians are below 8 seconds
Diabetes or Pancreatic cancer	For abnormal of stomach meridians and spleen meridians and liver meridians
Gallstone	For abnormal of gallbladder meridians and liver meridians
Insomnia	For abnormal of heart meridians and gallbladder meridians
Glioma	Lung meridians, large intestine meridians, pericardium meridians, Sanjiao meridians and heart meridians are below 8 seconds
ALS	For abnormal of lung meridians and large intestine meridians and pericardium meridians
Diabetes	For abnormal of stomach meridians and spleen meridians and liver meridians

Each disease is estimated by the pain threshold test. ALS, amyotrophic lateral sclerosis. The table is quoted from Reference 16).

Subjects

The subjects were 31 participants of "Kempou Juku" (13 men and 18 women aged 65 to 90 years old) leading an independent life in Kyoto, and 200 people (62 men and 138 women) who visited the Seishin-Dou acupuncture clinic in Xi'an City, Shaanxi Province, China. "Kempou Juku" is a health promotion activity sponsored by our laboratory for self-dependent elderly people living in the Yurin district of Shimogyo ward, where they are encouraged to walk, and an anti-aging medical examination is conducted once a year [17-20]. The subjects underwent meridian thermal stimulation diagnosis and glycative stress evaluation up to December 2018.

Glycative Stress Index

Glycative stress was evaluated using AGE Reader™ (DiagnOptics, Groningen, Netherlands) in Japan and TruAge scanner mini (Morinda, UT, USA) in China. SAF (skin autofluorescence) value, which is integral data of the autofluorescence value derived from advanced glycation end products (AGEs), was measured during ultraviolet irradiation [21-23]. The measurement was carried out on the backside of the upper right arm at a point 10 cm from the elbow, with the arm horizontal to the ground and elbow bent at a right angle. A positive correlation was observed between the measurement value (x) of AGE Reader and the measurement value (y) of the TruAge scanner mini ($y = 66.782x + 49.118$, $r = 0.813$, $n = 53$, $p < 0.01$) [23].

Measurement of Thermal Sensitivity

An incense stick made of carbon (approximately 7 mm in diameter) was lit, the tip of the incense stick was kept at a distance of about 5 mm from the 24 acupuncture points at the tips of fingers and toes of the left and right hands of the subject, and the time (seconds) taken by the subject to sense the heat was measured, and the trueness of the Yin-Yang meridian flow was inferred [24, 25].

Measurement of Anti-aging Medical Examination Data

During the anti-aging medical examination, the Japanese subjects were analyzed for the relationship with neural age, vascular age, bone age, muscle age, and hormone age data [26].

The Wisconsin Card Sorting Task Test (WCST) [27] was used to evaluate neural age. A fingertip photoplethysmogram (Dynapulse SDP-100; Fukuda Denshi, Bunkyo ward, Tokyo) was used to evaluate the vascular age. An ultrasound bone densitometer (A-1000; GE Yokogawa Medical Systems, Hino City, Tokyo) was used to evaluate bone age, which was calculated using the calcaneus stiffness value and young adult means (% YAM) as indices. A bioelectrical impedance method (high precision muscle mass meter Physion MD; Nippon Shooter Ltd, Tokyo) was used to evaluate the muscle age, and the weight-bearing index (WBI) was measured [28]. Hormone age was evaluated by measuring serum levels of insulin-like growth factor-I (IGF-I) and dehydroepiandrosterone sulfate (DHEA-S) [29].

For the evaluation of functional age from all data, the relative functional age was calculated from the database using Life Style Compas (Nippon Shooter Ltd, Tokyo) with a modified Age Management CheckR system (Ginga Kobo Co., Ltd., Nagoya city, Aichi) [26].

Statistical Analysis

OriginPro 2016 (64-bit) b9 3.226 (OriginLab Northampton) was used for statistical analysis. Since there was no gender difference in the working of the meridians, the data were analyzed in this study by combining the data of men and women.

Ethical Review

When starting this study, subjects were allowed to decide to participate in the program freely, and signed informed consent was obtained from the subjects after explaining that they would not suffer any disadvantages even if they withdraw from participation due to any circumstances. This research has been approved by the Ethics Review Committee for "Research on Human Subjects" of Doshisha University (Application Number: #14089, #16027).

Results

Example of measurement cases in China (cases 1 and 2).

Case 1: 69 years old female

The test was performed by applying a thermal stimulator to the left and right surfaces of the body corresponding to the 12 meridians. As shown in ***Table 4***, abnormality of timing was observed in The Stomach Meridian of Foot-Yangming, The Spleen Meridian of Foot-Taiyin and The Liver Meridian of Foot-Jueyin. The findings suggested the possibility of diabetes. A subsequent medical examination diagnosed the subject as having diabetes.

Case 2: 45 years old female

As a result of meridian thermal simulation tests, as shown in ***Table 4***, abnormal timing was observed in The Heart Meridian of Hand-Shaoyin and The Gallbladder Meridian of Foot-Shaoyang. The finding suggested the possibility of the presence of gallstones. A subsequent medical examination diagnosed the subject as having gallstones.

Next, examples in Japan are shown in ***Table 5***. Though the cases of Japan are the elderly with an average age of 79, they were living independently and practiced walking with the Kempou Juku program. Muscle and bone ages were well maintained.

Association with Glycative Stress Index

Next, age and SAF results of the cases examined at the Seishin-Dou acupuncture clinic in Xi'an City, Shaanxi Province, China, are shown in ***Fig. 7***.

The relationship between measured values of thermal sensitivity and glycative stress index was analyzed in Japanese people (***Fig. 8***). In the primary correlation analysis, a significant correlation was not observed between SAF and

Table 4. Results of a pain threshold test: Case 1& 2.

		Case 1		Case 2	
		Left	Right	Left	Right
The Lung Meridian of Hand-Taiyin	太陰肺経	10	15	4	4
The Large Intestine Meridian of Hand-yangming	陽明大腸経	15	11	3	9
The Stomach Meridian of Foot-yangming	陽明胃経	19	28	3	13
The Spleen Meridian of Foot-Taiyin	太陰脾経	52	15	3	5
The Heart Meridian of Hand-Shaoyin	少陰心経	22	22	3	5
The Small Intestine Meridian of Hand-taiyang	太陽小腸経	55	11	4	4
The Bladder Meridian of Foot-Taiyang	太陽膀胱経	80	55	4	11
The kidney Channels of Foot-Shaoyin	少陰腎経	32	55	5	3
The Pericardium Meridian of Hand-Jueyin	厥陰心包経	27	42	5	4
The Sanjiao Meridian of Hand-Shaoyang	少陽三焦経	26	51	4	5
The Gallbladder Meridian of foot-Shaoyang	少陽胆経	64	40	8	8
The Liver Meridian of Foot-Jueyin	厥陰肝経	47	22	5	6

Units: second.

Table 5. Data of Anti-Aging Medical Checkups in the Japanese subjects.

Number	31 (Male:13 Female:18)	95% C1
Age (year)	77.9	2.2
Height (cm)	155.6	3.4
Weight (kg)	55.3	2.4
BMI	22.7	0.8
Muscle age (year)	58.8	0.6
Bone age (year)	68.1	4.7
Hormone age (year)	72.7	3.2
Neurological age (year)	69.8	4.1
Blood vessel age (year)	64.4	1.4

BMI, body mass index; SAF, skin autofluorescence measured by AGE Reader.

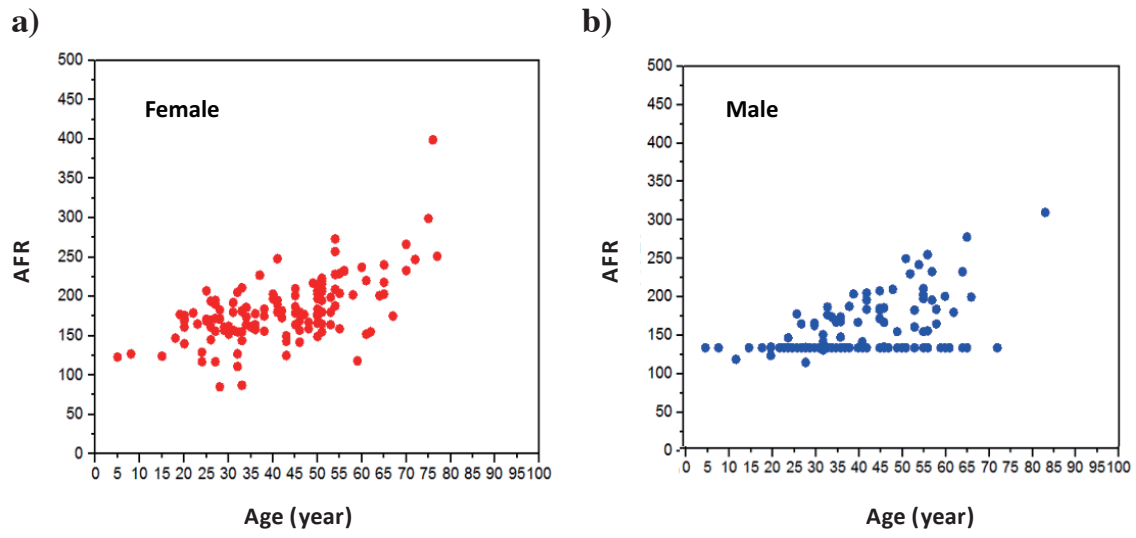

Fig. 7. **AFR data in Chinese subjects.**

The relationship between age and AGEs in Chinese **a)** women (n = 94) and **b)** men (n = 65) is shown. Measuring equipment: Tru-age scanner Mini. Measurement site: left forearm inside. AFR, index unit by autofluorescence reader indicating skin AGEs which correspond to SAF; SAF, skin autofluorescemce; AGEs, advanced glycation end products.

measurement values of heat sensitivity for any of the items.

In the second correlation analysis, there was no significant relationship with The Lung Meridian of Hand-Taiyin, The Large Intestine Meridian of Hand-Yangming, The Stomach Meridian of Foot-Yangming, The Spleen Meridian of Foot-Taiyin, The Heart Meridian of Hand-Shaoyin, The Small Intestine Meridian of Hand-Taiyang, The Bladder Meridian of Foot-Taiyang, The Kidney Meridian of Foot-Shaoyin, The Pericardium Meridian of Hand-Jueyin, The San Jiao Meridian of Hand-Shaoyang, The Gallbladder Meridian of Foot-Shaoyang, and The Liver Meridian of Foot-Jueyin. ***Figure 9*** shows the results for The Heart Meridian of Hand-Shaoyin and The Small Intestine Meridian of Hand-Taiyang.

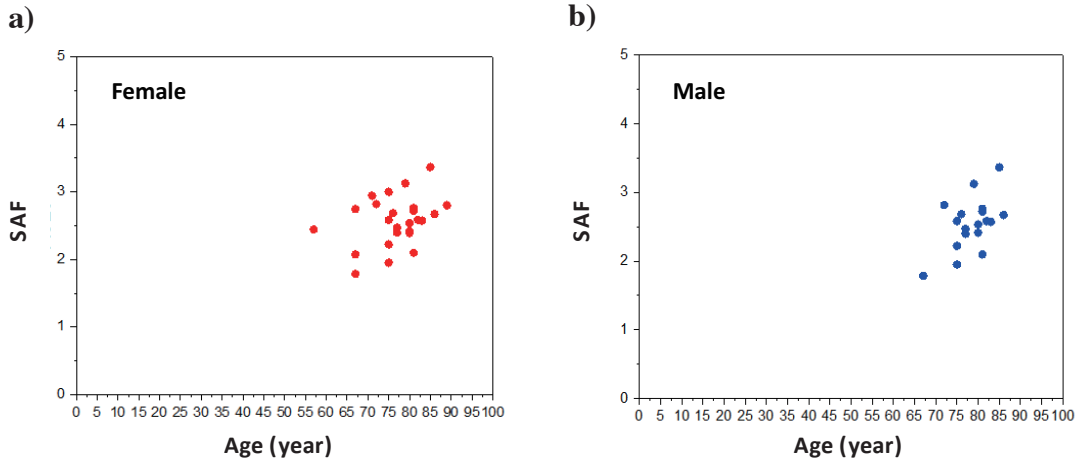

Fig. 8. **SAF data in Japanese subjects.**

The relationship between age and AGEs in Japanese **a)** women (n = 25) and **b)** men (n = 18) is shown. Measuring equipment: AGE reader. Measurement site: left forearm inside. SAF, skin autofluorescence; AGEs, advanced glycation end products.

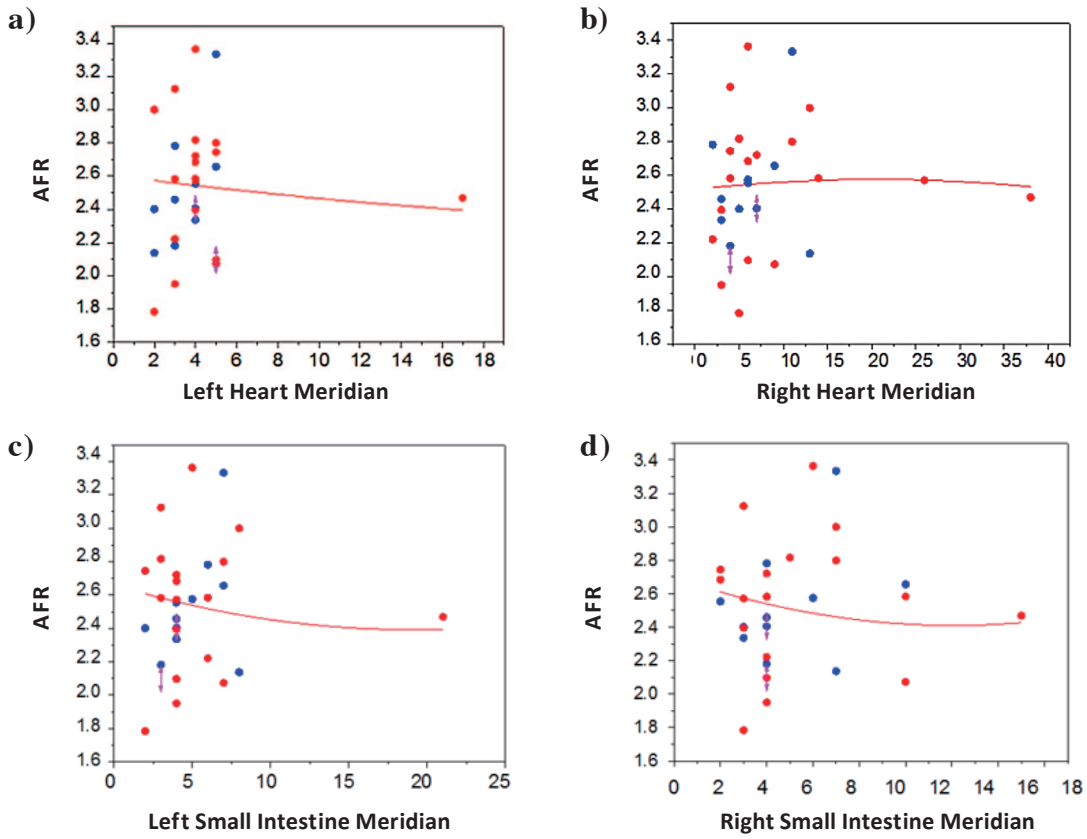

Fig. 9. **Meridian data of the heart and small intestine by the pain threshold test and AFR (skin AGE index).**

The heart meridian of left **(a)** and right **(b)** Hand-Shao-Yin. The small intestine meridian of left **(c)** and right **(d)** Hand-Tai-Yang. **a)** R^2 =0.01, **b)** R^2 =0.00, **c)** R^2 = 0.01, **d)** R^2 = 0.03; no correlation noted. Subjects: Chinese women (n = 94) and men (n = 65). Measuring equipment: Tru-age scanner Mini. Measurement site: left forearm inside. AGE, advanced glycation end product; AFR, index unit by autofluorescence reader indicating skin AGEs which correspond to SAF; SAF, skin autofluorescence.

The weakest correlation with SAF was observed in The Bladder Meridian of Foot-Taiyang and The Kidney Meridian of Foot-Shaoyin (***Fig. 10***). A significant secondary correlation was observed between the thermal sensitivity of the left kidney meridian and the skin AGEs index ($p < 0.05$). When data of bladder meridian and kidney meridian were within the normal range, the accumulation of skin AGEs tended to be low.

Relationship between Measurement Values of Thermal Sensitivity and Functional Age

We analyzed the relationship between the results of thermal sensitivity (bladder meridian and kidney meridian) and functional age (muscle age, hormone age, bone age, neural age and vascular age).

A significant secondary correlation was observed between The Bladder Meridian of Foot-Taiyang and The Kidney Meridian of Foot-Shaoyin, and the hormone age (***Fig. 11***). In other words, if the measurement values of heat sensitivity are within the appropriate range, the hormone age will remain low. Since hormone age is calculated from the serum concentrations of DHEA-s and IGF-I, it suggests that persons with proper thermal sensitivity have an appropriate secretion of the hormones.

For muscle age, a significant secondary correlation was observed with The Bladder Meridian of Foot-Taiyang (***Fig. 12***). The subjects with a proper balance of The Bladder Meridian of Foot-Taiyang tended to maintain their muscle age. A significant correlation was not observed between The Kidney Meridian of Foot-Shaoyin and muscle age.

A significant correlation was not observed between the vascular age (***Fig.13***), bone age (***Fig.14***) and neural age (***Fig. 15***) with the thermal sensitivity of bladder meridian and kidney meridian.

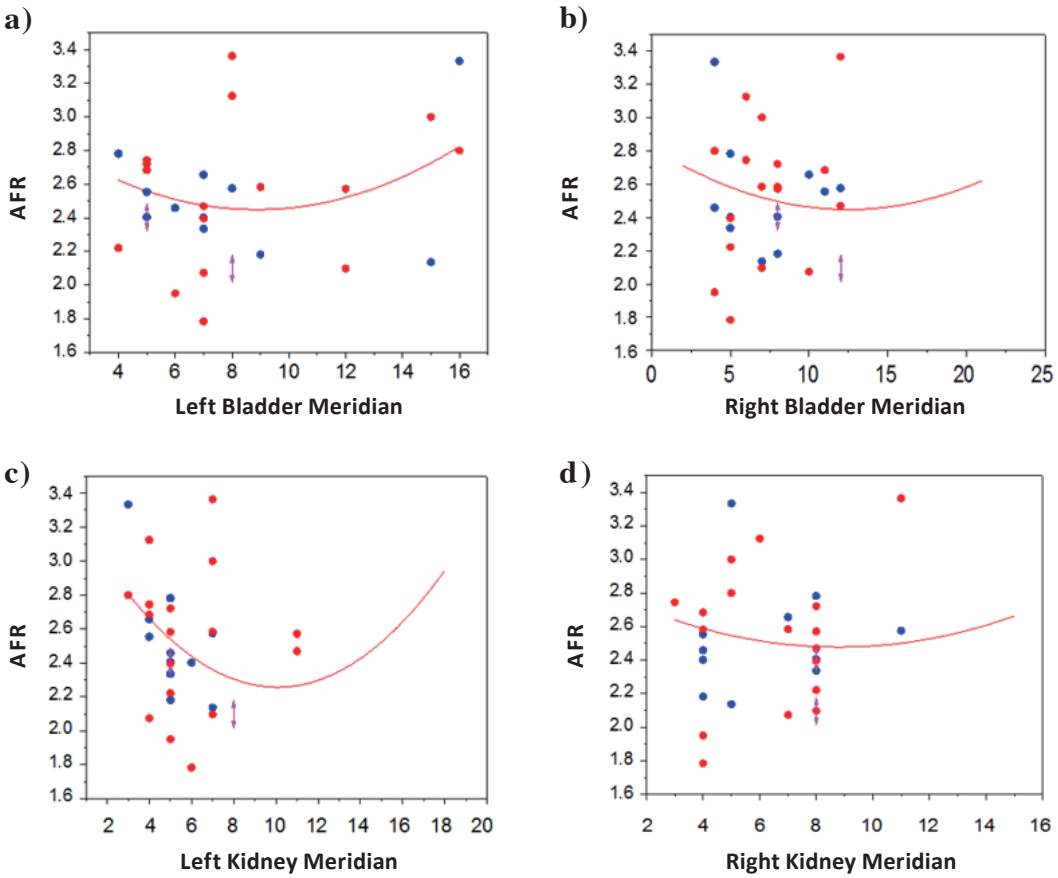

Fig. 10. **Meridian data of the bladder and kidney from the pain threshold test and AFR (skin AGE index).**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.05$, **b)** $R^2 = 0.04$, **c)** $R^2 = 0.23$, $p < 0.05$, **d)** $R^2 = 0.02$. Subjects: Chinese women (n = 94) and men (n = 65). Measuring equipment: Tru-age scanner Mini. Measurement site: left forearm inside. AGE, advanced glycation end product; AFR, index unit by autofluorescence reader indicating skin AGEs which correspond to SAF; SAF, skin autofluorescemce.

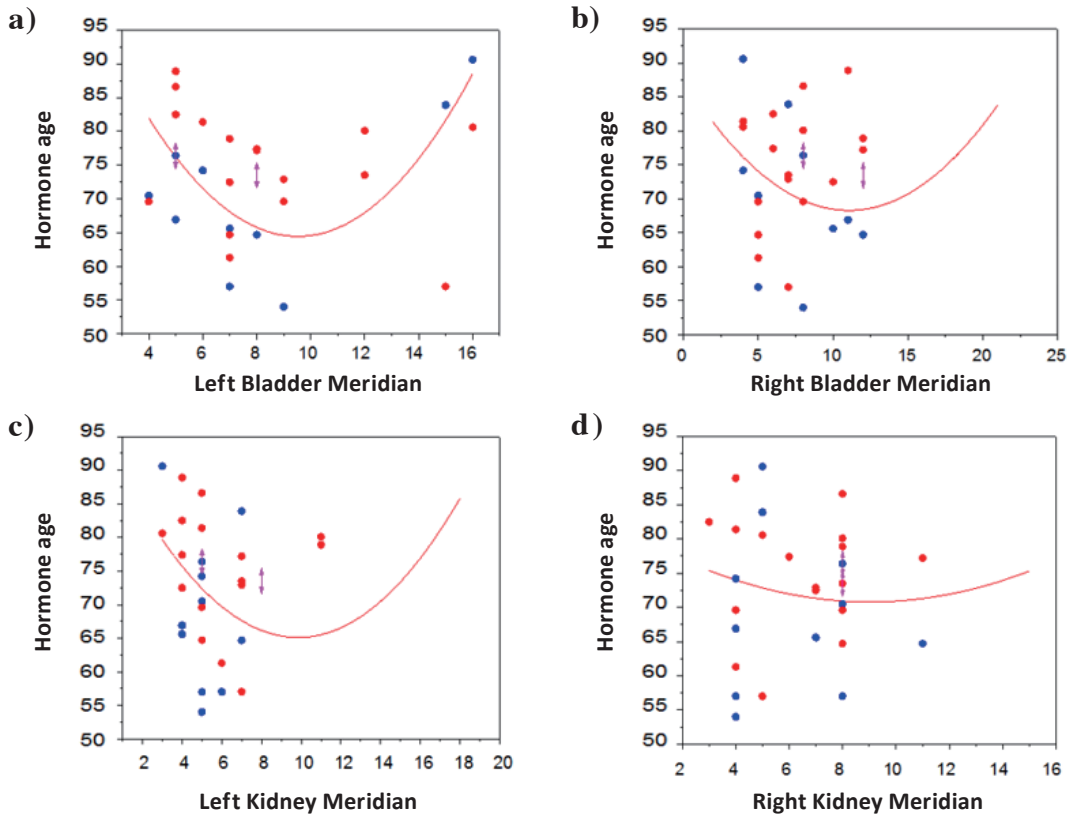

Fig. 11. **Meridian data from the pain threshold test and the hormone age.**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.46$, $p < 0.05$, **b)** $R^2 = 0.17$, **c)** $R^2 = 0.26$, $p < 0.05$, **d)** $R^2 = 0.02$. Subjects: Chinese women (n = 94) and men (n = 65).

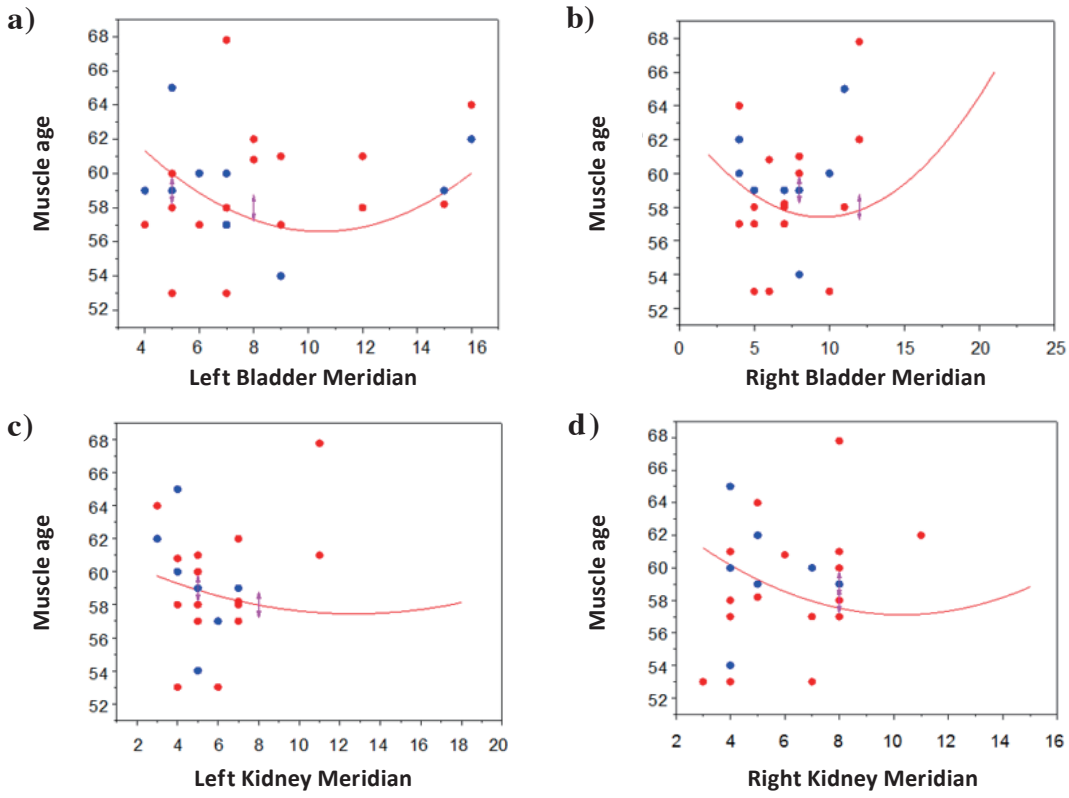

Fig. 12. **Meridian data from the pain threshold test and the muscle age.**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.20$, $p < 0.05$, **b)** $R^2 = 0.24$, $p < 0.05$, **c)** $R^2 = 0.04$, **d)** $R^2 = 0.14$. Subjects: Chinese women (n = 94) and men (n = 65).

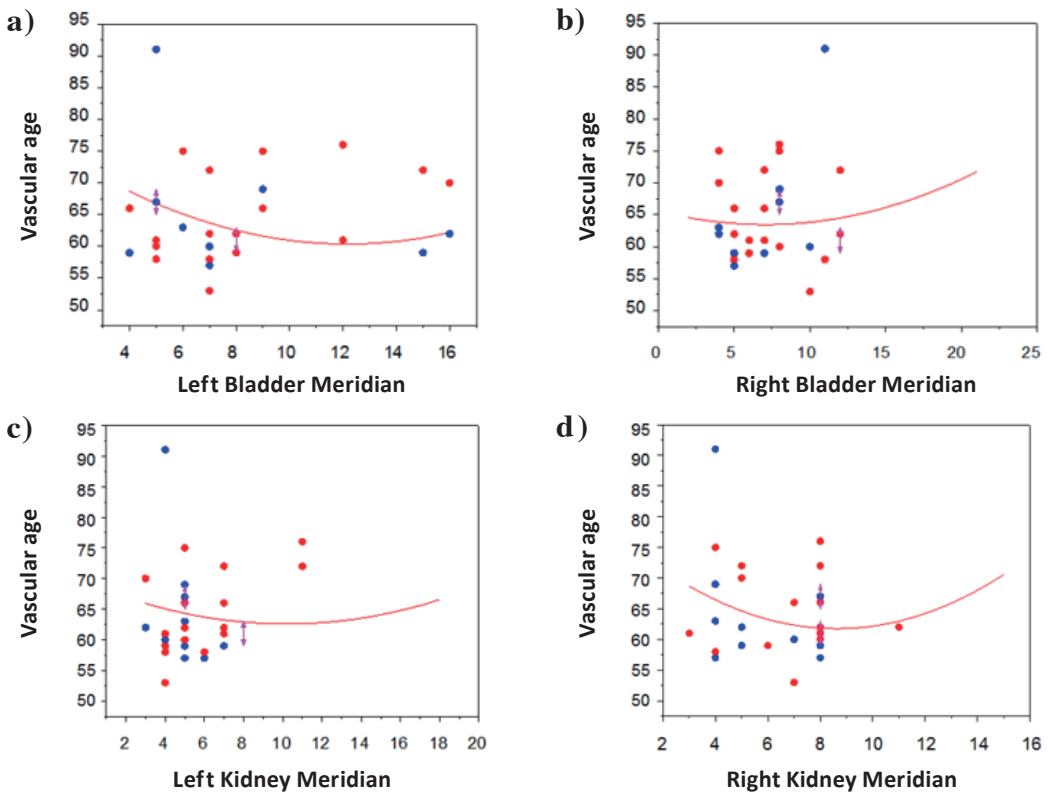

Fig. 13. **Meridian data from the pain threshold test and the vascular age.**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.11$, **b)** $R^2 = 0.04$, **c)** $R^2 = 0.02$, **d)** $R^2 = 0.09$; no correlation noted. Subjects: Chinese women (n = 94) and men (n = 65).

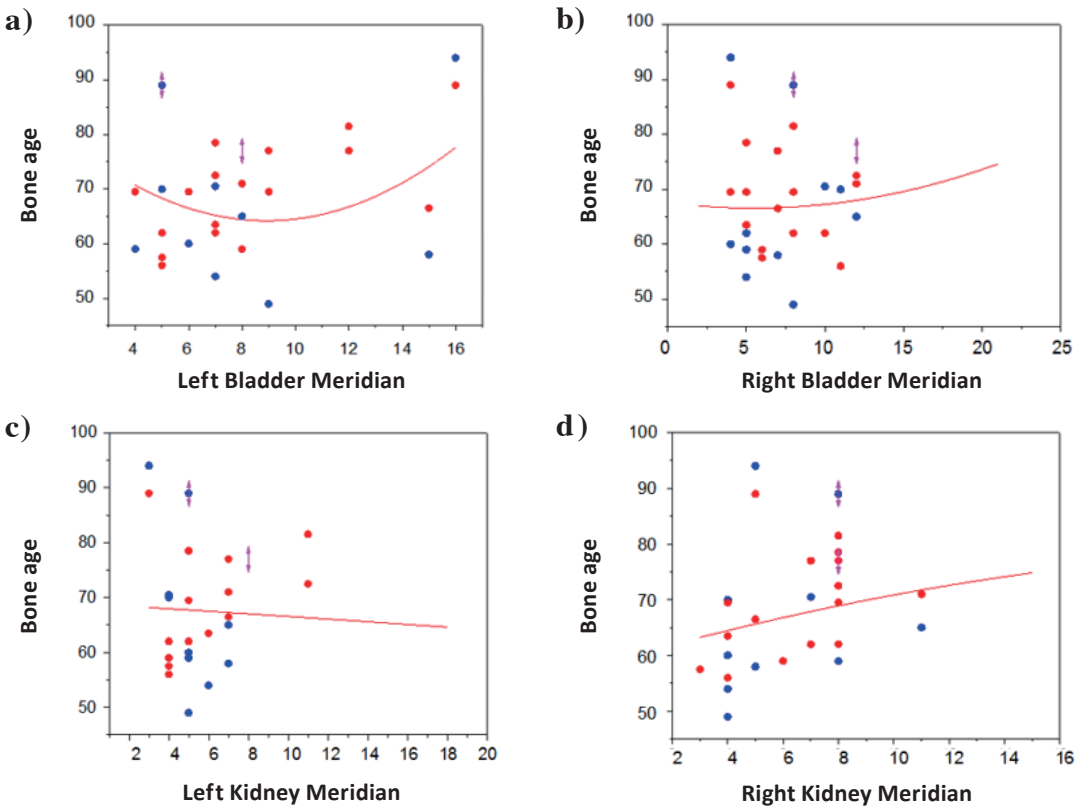

Fig. 14. **Meridian data from the pain threshold test and the bone age.**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.10$, **b)** $R^2 = 0.03$, **c)** $R^2 = 0.01$, **d)** $R^2 = 0.08$; no correlation noted. Subjects: Chinese women (n = 94) and men (n = 65).

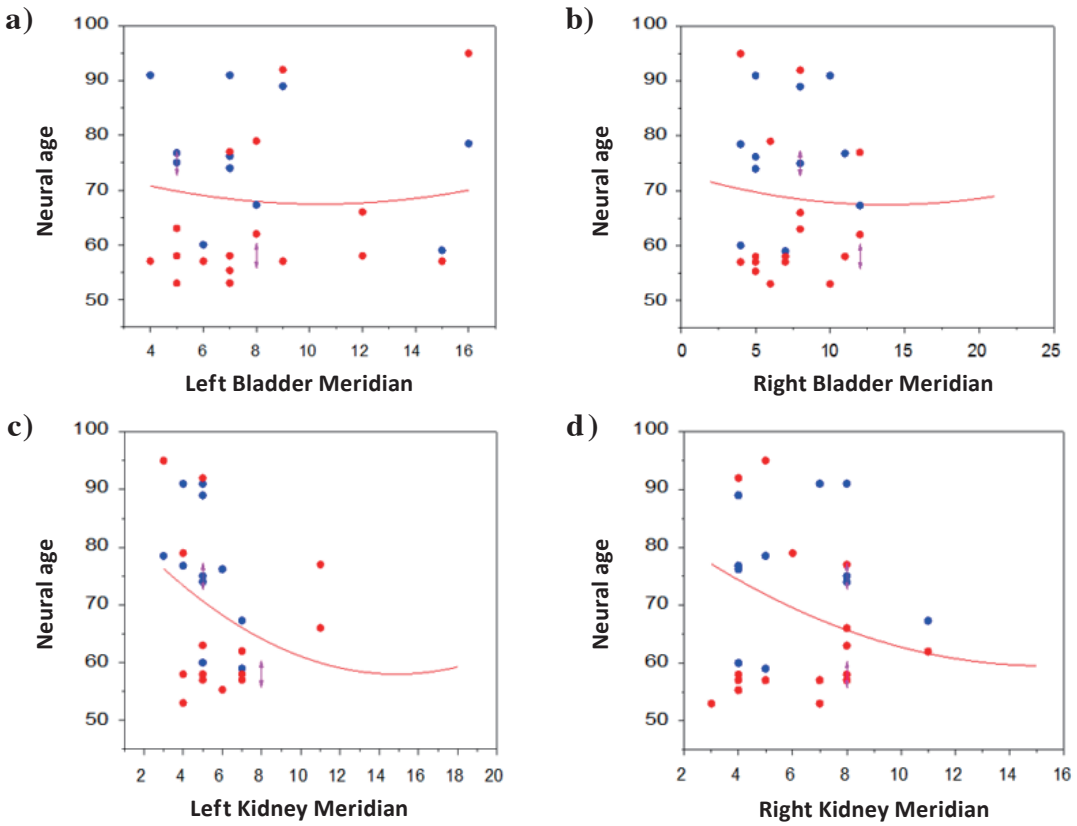

Fig. 15. **Meridian data from the pain threshold test and the neural age.**

The bladder meridian of left **(a)** and right **(b)** Foot-Tai-Yang. The kidney meridian of left **(c)** and right **(d)** Foot-Shao-Yin. **a)** $R^2 = 0.01$, **b)** $R^2 = 0.01$, **c)** $R^2 = 0.16$, **d)** $R^2 = 0.14$; no correlation noted. Subjects: Chinese women (n = 94) and men (n = 65).

Thermal Sensitivity Measurement Method

Kobe Akabane developed the thermal sensitivity measurement method. Kobe Akabane is an acupuncturist from Gunma who made a significant contribution to the development of acupuncture treatment in Japan[14, 15, 24, 25, 30-40]. Though there are not many results for thermal sensitivity measurement method in Japan, we will introduce the method to the extent we could investigate.

Manaka *et al.* have reported the results of the comparison between the measurement results of the thermal sensitivity measurement method and clinical findings[41]. They showed that an appropriate treatment improves the left-right imbalance of thermal sensitivity measurement and the left-right ratio approaches 1, and this tendency is particularly strong with the measured values of the acupuncture points having the highest degree of imbalance.

Wang *et al*. have reported the result of the Ryodoraku and measurement of thermal sensitivity performed on 50 students of the Kansai College of Acupuncture Medicine[42]. In the Ryodoraku measurement, heart, San Jiao (three digestive organs), spleen, stomach, liver, gallbladder, kidney and bladder were found to have an internal-external relationship with each other. Although there was a left-right difference in the thermal sensitivity, there were no noticeable changes. The internal-external relationship in the measurement of thermal sensitivity showed a slight association between the heart and small intestine, and the spleen and stomach.

Takeuchi *et al*. have reported the results of cases where the therapeutic effect when using intradermal and circular acupuncture for pain was evaluated by measurement of thermal sensitivity[43]. The subjects were (1) 43-year old woman with restricted movement and pain in the right shoulder joint, (2) 60-year old woman with backache, (3) 63-year old man with a cervical contusion. When the insertion sites of intradermal acupuncture and circular acupuncture are appropriate, the pain is observed to have been mitigated in the muscular diagnosis and therapy method, and also the left-right difference vanishes with the thermal sensitivity measurement method resulting in a restoration of balance. Incidentally, the muscular diagnosis and therapy method applies the "muscle strength test method", invented by Tadao Kono, focusing on the fact that the abnormal tension in specific muscles is closely associated with the abnormalities of particular meridians.

Kamewari *et al*. carried out an evaluation of the therapeutic effects of intradermal acupuncture and Satoryu Tai Chi therapy on ten acupuncture students with the thermal sensitivity measurement method, and reported the results[44]. An incense stick was rubbed on the acupuncture points and the number of thermal sensitive acupuncture points was measured by the thermal sensitivity measurement method. The side having a higher number of thermal sensitive acupuncture points with a difference of two times or more between the acupuncture points with the same name on the left and right sides was considered to be deficient, and intradermal acupuncture needles were inserted at the back-Shu points along the meridian. Satoryu Tai Chi therapy

was also performed with an interval of 3 days or more. As a result, the number of occurrences of thermal sensitive acupuncture points decreased from 11.4 times before treatment to 8.5 times after therapy for the intradermal acupuncture method, and from 15.3 times to 12.7 times for Tai Chi therapy. The difference between left and right acupuncture points decreased from 6.3 times to 3 times for the intradermal acupuncture method, and from 9.6 times to 5.1 times for Tai Chi therapy. In general, though the intradermal acupuncture method and Tai Chi therapy are expected to adjust the balance of the whole body, the fluctuations in the measurement results of the thermal sensitivity measurement method are also towards restoring the left-right balance and are thought to support the findings of the above methods.

Sugita et al. measured the fluctuations in the meridian using Akabane's thermal sensitivity measurement method and reported the results[45]. The subjects were divided into the intradermal acupuncture method group (27 cases) and the Satoryu Tai Chi therapy group (27 cases), and students of both groups were healthy. A difference of two times or more was not observed between the meridians of the left and right sides in both groups. In the intradermal acupuncture method group, a fluctuation was observed in the numerical values of the meridians where the intradermal acupuncture needles were not inserted directly into the back-Shu points. In the cases with improvement in the symptoms, the numerical values of thermal sensitivity became lower, and fluctuated towards restoring the balance of the entire meridian. Among cases with poor therapeutic effect, there were cases in which the left-right difference in thermal sensitivity could not be corrected after treatment, or the numerical values on the left and right were reversed, and difference of two or more times was caused in the meridians that initially did not have any left-right differences. In the case of the Tai Chi therapy group, improvement of the main complaint was observed when the numerical values of thermal sensitivity were low. These results suggest that Akabane's thermal sensitivity measurement method is useful as a basis for measuring the effectiveness of the treatment.

To summarize, these reports agree on the points that a left-right imbalance arises in the values measured by the thermal sensitivity measurement method depending on the acupuncture points, and this imbalance is corrected if an appropriate treatment improves the physical findings. These findings indicate that the thermal sensitivity measurement method provides some information from the body, which may even be useful in determining the therapeutic effect. However, the reports so far do not appear to have obtained the findings that indicate which acupuncture points correspond to which symptoms.

Association with Glycative Stress Index

The relationship of many of the measurement results of thermal sensitivity was based on a quadratic curve rather than a linear regression line. This relationship suggests that the balance in thermal sensitivity is important for maintaining physical health.

When the association between thermal sensitivity data and glycative stress index was analyzed, the skin AGEs fluorescence intensity as the glycative stress index had a significant association with the condition of the bladder meridian and kidney meridian. When the data of the bladder meridian and kidney meridian were distributed within the normal range, the amount of accumulated skin AGEs tended to be low. The function of the meridians other than the bladder meridian and kidney meridian had no noticeable effect on the accumulation of skin AGEs.

Glycative stress increases AGEs production and is said to exacerbate degenerative diseases such as atherosclerosis, chronic renal failure, and Alzheimer's dementia[46-48]. AGEs are also a cause of vascular complications of diabetes. Active oxygen is said to accelerate cell damage causing changes in the cell functions.

Skin AGEs fluorescence intensity has a significant association with the condition of the bladder meridian and the kidney meridian. Treatment of the bladder meridian and the kidney meridian may help in the metabolism of skin AGEs. The accumulation of AGEs is considered to increase as the function of the bladder meridian and kidney meridian gradually deteriorates with age. In traditional Asian medicine, it is believed that the dysfunction of the bladder meridian and kidney meridian causes accumulation of AGEs, which is a risk factor for aging.

According to a theory of Western medicine, AGEs are metabolized in the kidney, which is related to the kidney meridian, and excreted in the urine. The results of this paper are the findings that support this relationship. If we look at the data of the liver meridian and AGEs, it appears that the function of the liver affects the accumulation of AGEs. The results do not contradict the fact that the liver is a major organ involved in gluconeogenesis and glycolytic reactions.

Relationship with Chinese Medicine

Diseases in humans are congenital and acquired. Environmental factors and lifestyle are the leading causes of acquired diseases. These are the factors affecting the meridians in the body, causing deterioration in their function and disorder in the condition of Qi (energy) flowing through the meridians, leading to the onset of various diseases. This is "气滞" and "血瘀" in Chinese medicine, which can be interpreted as, a disorder in energy results in organ disorder.

Disorders in the meridians do not cause diseases immediately, but when the "气滞" state continues over a long time, it causes disorder in various substances in the body and eventually results in the onset of a disease. Even if diseases are not contracted, the body will age faster. Even if the progression of aging of the body is not observed in particular, the body may not necessarily be in a healthy condition.

With the development of the thermal sensitivity measurement device, in the future, it may become possible to examine various medical diseases in advance. This examination method is non-invasive, inexpensive, and can be easily administered even in developing countries, for children and disabled people, at the asymptomatic and pre-symptomatic stages.

In the future, collecting more measurement data and physical information will increase the accuracy of predicting disease risks. Developing software that automatically predicts potential diseases is the next challenge.

Conclusion

We analyzed the association of glycative stress index AGEs with the data of the thermal sensitivity method and the types of diseases for 31 Japanese and 200 Chinese subjects for whom thermal sensitivity was measured. As a result, those with the right balance of the bladder meridian and kidney meridian were observed to maintain appropriate glycative stress. If the analysis of measurement data of thermal sensitivity progresses, it may be possible to predict potential diseases in the pre-symptomatic stage and the future risk of developing diseases.

Conflict of interest statement

The authors claim no conflict of interest in this study.

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