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Clinical Retrospective Analysis of Cold and Heat Diagnosis of Traditional Chinese Medicine by Application of Infrared Thermal Imaging Technology

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Abstract: Objective: Exploring the application of infrared thermal imaging technology in Traditional Chinese Medicine (TCM) diagnosis of cold and heat by comparing the cold and heat of TCM clinical dialectics with the cold and heat objectively measured by infrared thermal imaging technology. Methods: First, there were 77 patients from the Prevention and Treatment Center of Guangdong Hospital of TCM selected to analyze their clinical information retrospectively. Then, transforming the temperature index measured by infrared thermal imaging technology into the cold and heat deviation index, which can reflect the cold and heat of traditional Chinese medicine. Finally, a Correlation analysis was made between patients' cold and heat deviation index, and clinical symptoms, the type of cold and heat syndrome diagnosed by doctors. Results: The cold and heat deviation index of the outer, upper outer, and lower outer parts of the patients was significantly lower than that of the inner, upper inner, and lower inner parts of the patients and the difference in the mean values of the three groups was 0.06, 0.07 and 0.03, respectively. In all parts of the subjects, the coincidence rate of clinical dialectics of cold and cold and heat deviation index less than 0 (belonging to cold) was 70.17%. In patients with fatigue symptoms, the cold and heat deviation index of the lower inner part, the upper inner part, and the inner part was significantly higher than that of the lower outer part, the upper outer part, and the outer part. Conclusions: The pattern of human torso region division combined with the cold and heat deviation index can be used to reflect the quantitative understanding of cold and heat in the TCM clinic. Quantifying the variation of cold and heat according to the trend of torso regional temperature deviation can explain the pathogenesis of some elementary symptoms closely related to cold and heat. As a quantitative index of TCM cold and heat, the offset index can be proof for visualization, objectification, and quantification, combined with doctors' judgment, which can an effective auxiliary diagnostic means of TCM to a certain extent.

Keywords: Traditional CHINESE Medicine, Cold and Heat, Signs of Cold and Heat, Infrared Thermal Imaging, Quantification, Regular Feature

1. Introduction

Infrared thermal imaging technology has more than 35 years of research basis in the field of traditional Chinese medicine and is also an important force for the modernization of TCM clinical practice [1]. However, for the images and data detected by infrared thermal imaging technology in TCM clinical practice, there are still some problems, such as unclear standards, the insufficient sample size in clinical trials, and no clear TCM diagnostic criteria for the theoretical basis of analysis of test results combined with clinical application [2-4]. And It is difficult to play a role in assisting diagnosis in TCM clinical thinking practice [5, 6]. Based on the

understanding of cold and heat in Huangdi Neijing, the author preliminarily explored the quantitative method of cold and heat in TCM through infrared thermal imaging technology [2]. To verify the coincidence rate of this quantitative method in TCM clinical syndrome dialectical thinking and the feasibility of quantitative results in the cold and heat of TCM assisted diagnosis, 77 clinical patients were analyzed with infrared thermal imaging technology for cold and heat signs and compared with traditional TCM clinical methods of palpation to detect human cold and heat, which can not only explore the application value and application prospect of infrared thermal imaging technology in assisting TCM clinical diagnosis and decision but also promote the identification of TCM health and the objectification of auxiliary diagnosis and improve the popularity of TCM in social medical treatment.

2. Data and Methods

2.1. General Information

A total of 100 patients from the outpatient department of Guangdong Hospital of TCM from July 2013 to November 2017 were selected, and 77 patients with missing information were excluded. There were 24 males and 54 females; The mean age was (43.45±14.66) years. The chief complaint symptoms, TCM diagnosis, TCM syndrome type and Western medicine diagnosis of all patients were recorded. Testing instrument: HIR-2000 infrared thermal imaging diagnostic system. The temperature resolution was 0.025°C, the imaging speed was about 9 frames per second, the operating band was 8 ~ 14μm, the ambient temperature was (24±1)°C, and the relative humidity was 40% ~ 60%.

2.2. Positioning and Division Method of Human Torso

The Truth From the Golden Chamber of the Neijing Suwen [7] describes: "The kind of classification can also be applied to the human body. The outside of the body is considered Yang, while the inside is Yin. The back is Yang and the front is Yin."It is pointed out that the basis for dividing the inside and outside of the body is the midaxillary line. The waist and back of the human body belong to the Yang as the outside, and the chest and abdomen of the human body belong to the Yin as the inside.

According to the position projection of viscera on the body surface proposed by Li Hongjuan [8], it is pointed out that the liver and stomach correspond to the chest-lateral thorax and gastral cavity respectively, while kidney, large and small intestine and Dantian correspond to the waist, large and small abdomen and small abdomen respectively. The Chapter 1 of Jing Yue's Collected Works describes: "Cold stay in the upper part of the person will appear acid reflux, diaphragm choking, indigestion, abdominal distension and eructation with fetid odor symptoms." "Heat in the lower part of the body will appear in waist and foot swelling pain, difficult to urinate and defecate, conscious of heat pain and spermatorrhea, urine turbidness and hematochezia symptoms." Combined with the research of some famed doctors [9-10], it was found that the thoracic and chest-lateral thorax parts and the gastral cavity parts on the front of the human torso were defined as the upper part, and the parts below three parts of the greater abdomen, less abdomen, and lower abdomen were defined as the lower part. The back of the left and right waist trace as the boundary, waist (excluding waist) above the upper part, and waist (including waist) below the lower part.

Xiawan is the dividing point between the epigastric and the great abdomen [11]. The upper and lower boundary of the body surface is a straight line perpendicular to the conception vessel through Xiawan, extending to the track of the costal arch on both sides and extending down to the midaxillary line along it. 2 cuns away from the left and right sides of the second lumbar spine are the left and right waist of the body surface projection area of the kidney [12], and its upper trace is located in the 12th thoracic vertebra, so the upper and lower boundary of the back of the body surface is a track extending from the 12th thoracic vertebra perpendicular to the Governor Vessel to the midaxillary line (*Figure 1*).

Therefore, the body of the human body is divided into eight positions: upper, lower, inner, outer, upper inner, upper outer, lower inner, and lower outer. The Truth From the Golden Chamber of the Neijing Suwen [7] describes: "To further categorize, the chest area is considered Yang, while the abdomen is Yin. The heart and lungs are therefore Yang types of Zang organs. The heart is Yang within Yang, while the lung is Yin within Yang. Below the diaphragm, in the abdomen, we have the Yin Zang organs: liver, spleen, and kidneys. The kidneys are Yin within Yin, the liver Yang within Yin, and the spleen is utmost Yin within Yin." According to the anatomical positioning of the five internal organs and Yin and Yang properties of the human torso, the five-Zang directions are: the heart is located in the upper outer, the lung is located in the upper inner, the liver is located in the lower outer, the spleen and the kidney are located in the lower inner.

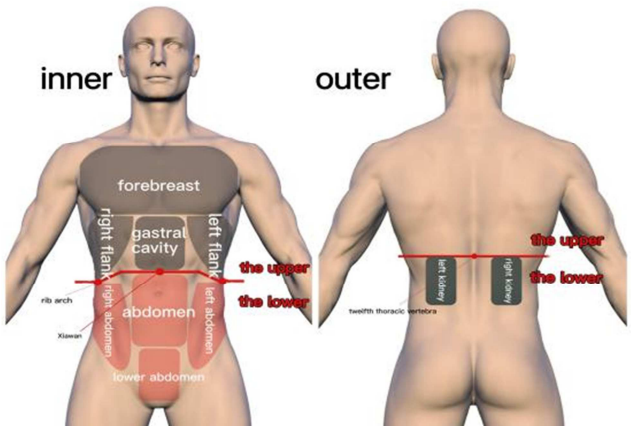

Figure 1. *Schematic diagram of the upper-lower's demarcation of the inner and outer surfaces.*

2.3. Data Collection Method

Before the measurement, the patient should fully expose the skin on the whole body and stand at a distance of 330cm in front of the camera. After standing still for 5 minutes, the body surface temperature should be collected according to the 5 action standards (*Figure 2*).

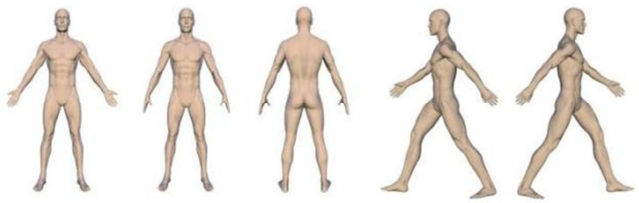

Figure 2. *Five actions of body surface temperature acquisition in infrared thermal imaging.*

2.4. Data Calculation Method

According to the regional division of the 8 parts, the average temperature T_{avg} of the 8 parts was obtained by analyzing the infrared thermal imaging data. The average body surface temperature [13-14] in the population cited by physiological zero T_0 of all parts of the torso was 34.7°C in the thoracic region (upper inner part), 34.7°C in the thoracic dorsum region (upper outer part), 34.8°C in the anterior abdominal region (lower inner part), and 34.3°C in the abdominal dorsum region (lower outer part). In women, the chest area (upper inner part) was 35.1°C, the chest dorsum area (upper outer part) was 34.9°C, the anterior abdominal area (lower inner part) was 34.9°C, and the abdominal dorsum area (lower outer part) was 34.4°C. The highest temperature T_{max} of the trunk is 43°C, and the lowest temperature T_{min} of the trunk is 25°C [15].

According to the analysis and calculation of the cold and heat quantification index method [2], the calculation formula is as follows:

$$a\ (T_{avg}>T_0)=\frac{Tavg-T0}{Tmax-T0} \quad (1)$$

$$\text{or a } (T_{avg}<T_0)=\frac{Tavg-T0}{T0-Tmin} \quad (2)$$

The region conforming to a ($T_{avg}>T_0$) is hot, and the region conforming to a ($T_{avg}<T_0$) is cold. Take the negative of the obtained value as the final index to distinguish the cold and heat index. The heat and cold deviation index of the four body parts of all patients was obtained: $a_{upper\ inner}$, $a_{lower\ inner}$, $a_{upper\ outer}$, $a_{lower\ outer}$, a_{upper}, a_{lower}, a_{outer} and a_{inner}.

2.5. Statistical Methods

SPSS19.0 statistical software was used to process the data. The measurement data conforming to normal distribution were expressed as mean ± standard deviation ($\chi \pm s$), while the non-conforming data were expressed as median and quartile, and the count data were expressed as frequency and percentage (%). The independent sample t test was used for the comparison of the cold and heat migration indices among different groups that were consistent with the normal distribution, the nonparametric test was used for the comparison of the cold and heat migration indices among different groups that were inconsistent with the normal distribution, and the $\chi 2$ test was used for the analysis of the clinical dialectical cold and heat migration indices. $P<0.05$ indicated statistically significant difference.

3. Results

3.1. Analysis of Whole-Body Cold and Heat Deviation Index of Different Diseases

The data comparison of the cold and heat migration index in eight parts of the subjects showed the characteristic distribution of the cold and heat migration index in different disease types (*Figure 3*).

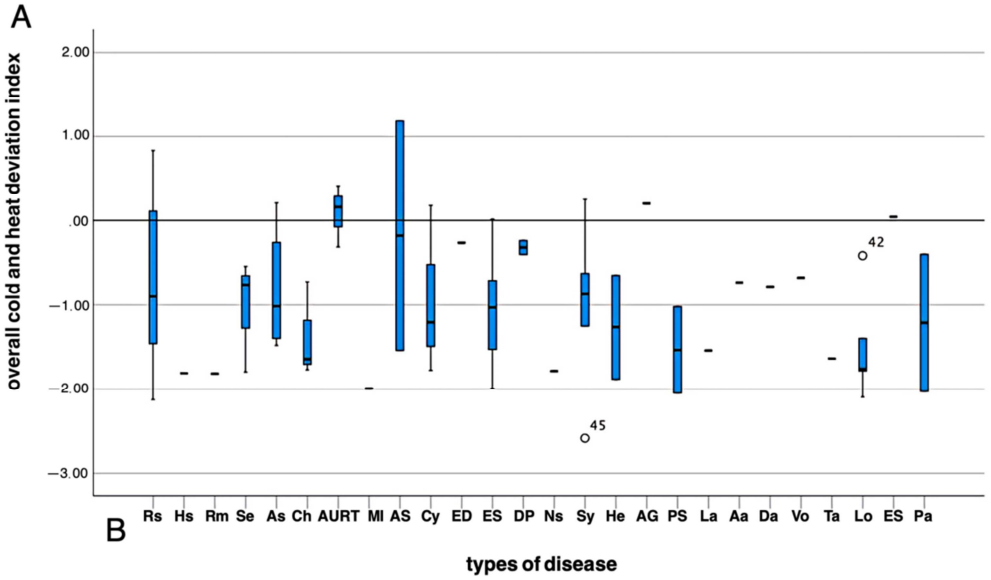

Figure 3. *Distribution of whole-body cold and heat deviation index for different diseases.*

*(A) OCHDI, Overall cold and heat deviation index. (B) Rs, Rhinitis; Hs, Hyperhidrosis; Rm, Rheumatism; Se, Stomachache; As, Arthritis; Ch, Cough; AURT, Acute upper respiratory tract infection; MI, Muscle injury; As, Ankylosing spondylitis; Cy, Cervicalspondyloticradiculopathy; ED, Endocrine dysfunction; ES, Effort syndrome; DP, Disease of the prostate; Ns, Neuritis; Sy, Somnipathy; He, Headache; AG, Atrophic gastritis; PS, Perimenopausal syndrome; La, Lipofibroma; Aa, Asthma; Da, Dyspepsia; Vo, vertigo; Ta, thrombopenia; Lo, lumbago; Es, enuresis; Pa, paramenia

3.2. Analysis of Clinical Dialectical Cold and Heat Syndrome and the Cold and Heat Deviation Index

According to the positioning and division method of the human torso, the body of the human body was divided into eight orientations: the upper, the lower, the inner, the outer, the upper inner, the upper outer, the lower inner, and the lower outer, with a total of 616 orientations. Clinical dialectics and infrared deviation index were used to determine the cold and heat of each azimuth. Chi-square test results showed that the overall judgment results of the two in the eight orientations were statistically different (P<0.05). Clinical dialectics were Cold: There were 128 parts whose cold and heat deviation index was less than 0 (belonging to Cold) and clinical dialectics were Cold, accounting for 70.17% (127/181) of the total number of Clinical Dialectical Cold parts, significantly more than Clinical Dialectical Cold but the cold and heat deviation index were greater than 0 (belonging to Heat) parts. It was also significantly more than the sites whose clinical dialectic were Heat but whose cold and heat deviation index were less than 0 (belonging to Cold), and both were statistically significant. The cold and heat deviation index were greater than 0 (belonging to Heat), and there were 0 Clinical Dialectical Heat parts, accounting for 0.00% (0/19) of the total Clinical Dialectical Heat parts. Among the patients whose clinical dialectics were TSDCHNC (The syndrome differentiation of cold and heat was not clear), there were 373 parts with the cold and heat deviation index less than 0 (belonging to Cold), accounting for 89.90%, and 42 parts with the cold and heat deviation index greater than 0 (belonging to Heat), accounting for 10.10%, indicating that Cold judged by infrared thermal imaging technology had a high consistency with the Clinical Dialectical Cold (*Table 1*). For the patients diagnosed with TSDCHNC and the patients diagnosed with Cold, the difference in the overall individual cold and heat deviation index was analyzed. The statistical results suggested that there was a statistical difference between the two. The distance between the cold and heat deviation index of the part clinically diagnosed as Cold and the physiological zero T_0 was smaller than that of TSDCHNC, which required further discussion and analysis (*Table 2*).

Table 1. *Comparison of clinical dialectical cold and heat deviation index and TSDCHNC. TSDCHNC, The syndrome differentiation of cold and heat was not clear.*

Clinical dialectical cold and heat	Cold and heat deviation index			
	Cold	Heat	χ^2	p
Cold	128	54		
Heat	19	0	40.375	0.00
TSDCHNC	373	42		

[a]each cell (16.7%) has an expected count less than 5.
[b]The minimum expected count is 2.96.

Table 2. *Comparison of the overall cold and heat deviation index between patients clinically diagnosed with Cold and patients with TSDCHNC. TSDCHNC, The syndrome differentiation of cold and heat was not clear. SD, Standard deviation.*

	Cold (n=36)	TSDCHNC (n=32)	t	p
Mean ± SD	-0.74±0.93	-1.23±0.63	-2.490	0.016

3.3. Analysis of the Cold and Heat Deviation Index of Each Part

Make an analytical comparison of the cold and heat deviation index of the six groups of the patient within groups through upper inner part and lower inner part, upper outer part, and lower outer part, lower inner part and lower outer part, upper inner part, and outer part, upper part and lower part respectively. The cold and heat deviation index of the lower inner part, upper inner part, and inner part were significantly higher than that of the lower outer part, upper outer part, and outer part (P<0.05). In patients with fatigue symptoms, the cold and heat deviation index of the lower inner part, the upper inner part, and the inner part was significantly higher than that of the lower outer part, the upper outer part, and the outer part (P<0.05) (*Table 3*).

Table 3. *Analysis of the cold and heat deviation index of each part.*

	Upper inner-lower inner			
	Upper inner	Lower inner	t/Z	p
Whole (n=77)	-0.089±0.998	-0.096±0.1029	0.442	0.659
Loose stool (n=4)	-0.051±0.044	-0.057±0.058	0.159	0.879
Drainage difficulty (n=3)	-0.078±0.137	-0.125±0.149	0.403	0.708
Hyperhidrosis (n=9)	-0.099±0.066	-0.092±0.073	-0.211	0.836
Dryness (n=6)	-0.046 (0.163, 0.054)	-0.036 (0.174, 0.045)	0.908	0.825*
Runny nose (n=11)	-0.093±0.095	-0.100±0.121	0.144	0.887
Dizzy (n=3)	-0.120±0.079	-0.096±0.085	-0.346	0.747
Pharyngeal discomfort (n=13)	-0.043±0.141	-0.072±0.141	0.523	0.606
Physical fatigue (n=21)	-0.103±0.668	-0.114±0.072	0.500	0.620

	Upper inner-lower inner			
	Upper inner	**Lower inner**	**t/Z**	**p**
Fear the wind and cold (n=12)	-0.094 (0.045, 0.093)	-0.078 (0.077, 0.081)	1.461	0.930*
Somnipathy (n=11)	-0.1129 (0.0297, 0.0521)	-0.1253 (0.0216, 0.0526)	1.092	0.865
Cardiopalmus (n=7)	-0.148 (0.091, 0.088)	-0.1273 (0.156, 0.080)	0.908	0.825*

	Upper outer-lower outer			
	Upper outer	**Lower outer**	**t/Z**	**p**
Whole (n=77)	-0.160±0.112	-0.134±0.111	-1.469	0.144
Loose stool (n=4)	-0.085±0.095	-0.062±0.098	-0.333	0.751
Drainage difficulty (n=3)	-0.182±0.136	-0.123±0.105	-0.599	0.581
Hyperhidrosis (n=9)	-0.167±0.091	-0.123±0.103	-0.969	0.347
Dryness (n=6)	-0.049 (0.248, 0.037)	-0.053 (0.195, 0.005)	-0.303	0.392*
Runny nose (n=11)	-0.143±0.133	-0.135±0.144	-0.140	0.890
Dizzy (n=3)	-0.224±0.042	-0.176±0.090	-0.831	0.453
Pharyngeal discomfort (n=13)	-0.101 (0.156, 0.107)	-0.117 (0.118, 0.159)	-1.401	0.081*
Physical fatigue (n=21)	-0.208 (0.089, 0.086)	--0.167 (0.094, 0.062)	0.781	0.783*
Fear the wind and cold (n=12)	-0.152 (0.093, 0.130)	-0.102 (0.128, 0.103)	0.626	0.737*
Somnipathy (n=11)	-0.1897 (0.0598, 0.0463)	-0.1606 (0.0532, 0.0670)	1.529	0.937
Cardiopalmus (n=7)	-0.250 (0.062, 0.073)	-0.199 (0.084, 0.123)	2.119	0.987*

	Upper inner-upper outer			
	Upper inner	**Upper outer**	**t/Z**	**p**
Whole (n=77)	-0.089±0.0998	-0.160±0.112	4.149	0
Loose stool (n=4)	-0.510±0.0444	-0.084±0.095	0.642	0.544
Drainage difficulty (n=3)	-0.078±0.137	-0.182±0.136	0.937	0.402
Hyperhidrosis (n=9)	-0.099±0.066	-0.167±0.091	1.816	0.088
Dryness (n=6)	-0.058 (0.151, 0.080)	-0.049 (0.248, 0.037)	-0.303	0.392*
Runny nose (n=11)	-0.093±0.095	-0.143±0.133	1.011	0.324
Dizzy (n=3)	-0.120±0.079	-0.224±0.042	2.014	0.114
Pharyngeal discomfort (n=13)	-0.049 (0.104, 0.103)	-0.101 (0.156, 0.107)	-0.600	0.277*
Physical fatigue (n=21)	-0.103±0.0668	-0.204±0.104	3.710	0.001
Fear the wind and cold (n=12)	-0.094 (0.045, 0.093)	-0.152 (0.093, 0.130)	-1.044	0.150*
Somnipathy (n=11)	-0.1129 (0.0297, 0.0521)	-0.1891 (0.0598, 0.0463)	-0.655	0.260
Cardiopalmus (n=7)	-0.148 (0.091, 0.088)	-0.250 (0.062, 0.725)	-0.303	0.392*

	Lower inner-lower outer			
	Lower inner	**Lower inner**	**t/Z**	**p**
Whole (n=77)	-0.096±0.103	-0.134±0.111	2.161	0.032
Loose stool (n=4)	-0.057±0.058	-0.062±0.098	0.091	0.931
Drainage difficulty (n=3)	-0.125±0.149	-0.123±0.105	-0.019	0.986
Hyperhidrosis (n=9)	-0.092±0.073	-0.123±0.103	0.733	0.474
Dryness (n=6)	-0.028 (0.201, 0.037)	-0.053 (0.195, 0.048)	0.908	0.825*
Runny nose (n=11)	-0.100±0.121	-0.135±0.144	0.616	0.545
Dizzy (n=3)	-0.096±0.085	-0.176±0.090	1.112	0.328
Pharyngeal discomfort (n=13)	-0.059 (0.133, 0.081)	-0.117 (0.118, 0.159)	-1.001	0.157*
Physical fatigue (n=21)	-0.125 (0.034, 0.063)	-0.167 (0.094, 0.062)	-0.469	0.320*
Fear the wind and cold (n=12)	-0.078 (0.077, 0.081)	-0.102 (0.128, 0.103)	0.626	0.737*
Somnipathy (n=11)	-0.125 (0.022, 0.053)	-0.161 (0.053, 0.067)	-0.655	0.260*
Cardiopalmus (n=7)	-0.127 (0.156, 0.080)	-0.199 (0.084, 0.123)	0.908	0.825*

	Inner-outer			
	Inner	**Outer**	**t/Z**	**p**
Whole (n=77)	-0.093±0.099	-0.147±0.110	3.234	0.001
Loose stool (n=4)	-0.054±0.045	-0.073±0.095	0.370	0.724
Drainage difficulty (n=3)	-0.101±0.142	-0.153±0.118	0.489	0.650
Hyperhidrosis (n=9)	-0.095±0.068	-0.145±0.094	1.284	0.217
Dryness (n=6)	-0.043 (0.176, 0.059)	-0.049 (0.224, 0.038)	0	0.608*
Runny nose (n=11)	-0.097±0.105	-0.139±0.135	0.824	0.420
Dizzy (n=3)	-0.108±0.080	-0.200±0.065	1.556	0.195
Pharyngeal discomfort (n=13)	-0.051 (0.130, 0.089)	-0.109 (0.138, 0.134)	0.000	0.582*
Physical fatigue (n=21)	-0.1088±0.06700	-0.1879±0.09109	3.206	0.003
Fear the wind and cold (n=12)	-0.079 (0.082, 0.080)	-0.132 (0.102, 0.121)	1.461	0.930*
Somnipathy (n=11)	-0.100 (0.047, 0.042)	-0.174 (0.073, 0.045)	1.092	0.865*
Cardiopalmus (n=7)	-0.136 (0.126, 0.079)	-0.228 (0.063, 0.097)	2.119	0.987*

	Upper-lower			
	Upper	**Lower**	**t/Z**	**p**
Whole (n=77)	-0.124±0.102	-0.115±0.104	-0.592	0.555
Loose stool (n=4)	-0.068±0.067	-0.059±0.074	-0.176	0.866
Drainage difficulty (n=3)	-0.131±0.133	-0.124±0.127	-0.064	0.952
Hyperhidrosis (n=9)	-0.132±0.075	-0.107±0.084	-0.689	0.501
Dryness (n=6)	-0.051 (0.202, 0.060)	-0.040 (0.208, 0.042)	1.514	0.933*
Runny nose (n=11)	-0.118±0.110	-0.117±0.131	-0.021	0.983
Dizzy (n=3)	-0.171±0.060	-0.135±0.084	-0.601	0.580
Pharyngeal discomfort (n=13)	-0.075 (0.145, 0.111)	-0.084 (0.136, 0.124)	1.001	0.843*
Physical fatigue (n=21)	-0.156 (0.074, 0.068)	-0.155 (0.047, 0.067)	-1.094	0.137*
Fear the wind and cold (n=12)	-0.115 (0.079, 0.110)	-0.090 (0.116, 0.095)	1.461	0.930*
Somnipathy (n=11)	-0.143 (0.067, 0.042)	-0.118 (0.063, 0.029)	-0.218	0.410*
Cardiopalmus (n=7)	-0.196 (0.076, 0.075)	—0.166 (0.105, 0.097)	0.908	0.825*

*Non parametric test for non conformance to normal distribution

4. Findings

(1) Clinical Dialectical Cold can have a high consistency with the detection results of infrared thermal imaging technology, suggesting that it is in line with clinical practice to use the measure of torso region division combined with the cold and heat deviation index to reflect the quantitative understanding of TCM clinical understanding of Cold and Heat.

(2) The partial contrast of cold and heat in the torso of patients with physical fatigue has obvious regularity, and the quantitative change of cold and heat according to the regional temperature deviation trend can explain the pathogenesis of some basic symptoms closely related to cold and heat.

(3) As a quantitative index of TCM cold and heat, based on TCM palpation thinking positioning, qualitative and quantitative cold and heat, the cold and heat deviation index is verified about the application of infrared thermal imaging technology in the field of TCM. As a basis for visualization, objectification, and quantification, the results can be combined and verified with doctors' judgment, and it is an effective auxiliary diagnostic means of TCM.

5. Discussion

If infrared thermal imaging technology were widely used in TCM clinics, the first task would clarify the temperature output principle of infrared thermal imaging technology and the theoretical basis and clinical significance of information acquisition in TCM diagnosis. This process is a close interaction and combination of TCM theory, modern physics, and modern science and technology, which is discussed as follows:

5.1. The Relationship Between TCM Cold and Heat Identification Thinking and Objective Reflection of Body Surface Temperature and Its Distribution

In TCM, four diagnoses are the main measure of clinical identification of cold and heat by doctors. In terms of the perception of cold and heat, temperature changes reflected by temperature sensation represent human cold and heat as a basic component [16]. Therefore, temperature, as the main objective factor of the change of cold and heat, can indirectly reflect the qualitative and quantitative relationship between cold and heat. However, whether temperature can correctly reflect the information of cold and heat in TCM and assist clinical diagnosis needs to be combined with the identification thinking of cold and heat in palpation of TCM to construct the cold and heat deviation index. According to The Truth From the Golden Chamber of the Neijing Suwen [7], Yin and Yang reflect different performances in the front, back, and five-Zang directions of the human torso. Therefore, the identification of cold and heat needs to be based on different parts of the torso for partial identification, and through the joint analysis of the relationship between the cold and heat of each part, to accurately diagnose the cold and heat state of the human body. The position division of TCM includes upper and lower and inner and outer, but the position divisive demarcation of the body has not been clearly pointed out. According to the literature summary, it is found that the projection position of the disease state of cold and heat in the body surface position can determine the upper and lower division boundaries of the human torso, and then the body is divided into the upper, the lower, the inner, the outer, the upper inner, the upper outer, the lower inner, the lower outer eight directions to reflect the changes in body surface temperature. Therefore, the combination of TCM cold and heat dialectics with the eight parts of the human body can provide a theoretical basis for the current clinical diagnosis category of TCM cold and heat, providing a more complete and more accurate approach in reflection of cold and heat identification.

5.2. The Relationship Between Infrared Thermal Imaging Technology and Palpation of Cold and Heat in TCM

The application of infrared thermal imaging technology in the medical field is to collect infrared radiation from the human body surface without contact and trauma, and then convert it into an infrared thermal imaging map including the visual display of body surface temperature and regional division. This technology can accurately reflect both immediate and dynamic temperature regions of the human body surface. Thus, the physiological and pathological functions of the human body can be effectively evaluated and

identified [17]. In terms of the regionalization of body surface temperature distribution and reflection of numerical accuracy, infrared thermal imaging is closely related to the operation thinking and available information of the cold and heat palpation method of TCM and can be used as an extension to assist diagnosis. First of all, infrared thermal imaging technology is to collect all the infrared radiation of the human body within the photographing range and reflects it on the image. TCM palpation in perception of cold and heat through the practitioner's hands contributes a limitation on the indirect comparisons of temperature sensation information from local or multiple parts in the human brain. The overall temperature distribution reflected by infrared thermal imaging maps implements the TCM holism and expands the visualization and regional expression of cold and hot palpation information in TCM in terms of the positioning accuracy of temperature distribution and the comparative analysis of temperature changes in different temperature regions. Secondly, infrared thermal imaging can reflect the cold and heat information obtained by TCM palpation. Through structuring the quantization formula of cold and heat and the physiological zero degrees of the human body, the temperature distribution reflected in the infrared thermal imaging map is transformed into the cold and heat state of the human body, and the nature and deviation of cold and heat are reflected in the cold and heat deviation index.

5.3. Clinical Interpretation of Cold and Heat Deviation Index at Different Parts

The average cold and heat deviation indexes of the eight parts of the torso of the case were all negative, that is, the cold and heat attributes of the eight parts were Cold. According to the analysis of the syndrome type and symptoms of the patients and the clinical dialectics of cold and heat, the percentage of Cold to Heat was 37:5, so the patients in this group were considered to be cold as a whole. The cold and heat deviation indexes of eight parts of the torso were all negative, which was consistent with the clinical dialectics of the Cold attribute. In addition, the cold and heat deviation indexes of the outer, the upper outer and the lower outer parts of the patient were significantly lower than those of the counterparts. The cold and heat deviation indexes of the outer, the upper outer and the lower outer parts of the patient were relatively Cold, which was summarized as Outer Cold. Chapter Shengqi Tongtian Lunpian of Neijing Suwen was saying that Yangqi, is the essence of the spirit. It is believed that Yangqi is an important reason for maintaining physical and mental health. "The thirty Chapter Xuezheng of Jingyue's Collected Works was saying that Yang dominates Qi, so full of Qi can elevate the spirit. Qi deficiency will ultimately contribute to Yang deficiency, and deficiency of Yangqi leads to mental fatigue, and then body deficiency causes disease beginning. Furthermore, the cases in this study are mainly characterized by subhealth and chronic diseases, and long-term illness leads to the depletion of essential Qi, which belongs to Yang deficiency [18-19]. It is said in the Chapter Tiaojing Lunpian of Neijing Suwen that Yang deficiency leads to outer Cold. Thereby, the case in this study is closely related to the constitution of Yang deficiency. However, matching the clinical dialectics of Heat with the deviation index of Heat showed that consistency was low, the following details were considered: 1. The patients were collected from the department of preventive treatment of disease, and there were no patients in the emergency or disease onset period, and most of the patients were stable subhealth and chronic disease patients. TCM emphasizes that Vital Qi in the body, pathogenic can not attack, indicating that the patients with the dialectics of Cold can be considered deficient in Vital Qi, while most patients are the dialectics of Cold and lack cases with that of Heat. There is a high proportion of patients without a clear diagnosis of cold and heat. The following details are considered: 1. Due to the clinical cold and heat identification system standard for the position of five-Zang, it is difficult to judge the Cold or Heat in a single part of the human body, so the diagnosis of Cold and Heat is not clear temporarily. 2. Stasis, depression, phlegm, and dampness are the main causes of diseases clinically. The disease has a wide range of types, and the bias of cold and heat is not obvious from time to time, so it can also be summarized as having no clear diagnosis of cold and heat.

There was no significant difference in the cold and heat deviation index of one symptom except tiredness and fatigue, after comparisons of cold and heat deviation index in each part of different symptoms. Among the patients with tiredness and fatigue, the cold and heat deviation index of the upper inner part was significantly higher than that of the upper outer part ($P<0.01$), the cold and heat deviation index of the lower inner part was significantly higher than that of the lower outer part ($P<0.05$), and the cold and heat deviation index of the inner part was significantly higher than that of the outer part ($P<0.01$). There is a saying in Chapter Zhizhen Yaoda Lunpian of Neijing Suwen, "work needs warm." It is pointed out that deficiency diseases are usually treated with warm tonic, and fatigue is the characteristic symptom of subhealth and chronic disease patients with deficient Cold. The results of the cold and heat deviation index showed that the patients were generally Cold, and the back was more Cold than the front. The outer Cold indicates Yang deficiency in Neijing Suwen. So the result of the cold and heat deviation index is consistent with the clinical dialectics and the constitution of the patient's characteristic disease. However, there was no significant difference in other characteristic symptoms. The following details were considered: 1. The sample size was not sufficient to reflect the characteristic differences of the cold and heat deviation index in each part under symptoms. 2. The sample size of the two symptoms with opposite Cold and Heat characteristics was very different, which did not meet the sample requirements of statistical analysis, resulting in the absence of some relative symptoms, and the difference in other symptoms was not significant. 3. For some symptoms such as runny nose and hyperhidrosis, the dialectics of cold, heat, deficiency, and excess are not clear, and the cold and heat deviation index is not significantly different, and there may be Cold or Heat sub-symptoms of those symptoms in clinical

dialectics.

Therefore, based on the manifestations of Cold and Heat changes in different parts of the human body and the analysis of Cold and Heat manifestations, infrared thermal imaging technology can provide the support of Cold and Heat information through the Sanjiao syndrome differentiation, Bagang syndrome differentiation, and Zangfu syndrome differentiation in TCM clinical practice, so as to guide the clinical diagnosis of TCM.

5.4. The System of "Symptom - Pathogenesis - Syndrome Type" Was Used to Identify Cold and Heat in Infrared Thermal Imaging

In the patients with fatigue symptoms, the cold and heat deviation index of the upper inner, the lower inner, and the inner parts were significantly higher than that of the upper outer, the lower outer, and the outer parts. The symptoms are cold in inner part and outer part for infrared thermal imaging. Because the outer cold is heavier than the inner cold, the change of pathogenesis is deficiency of Yangqi, so that the outer part can not get warm, and becomes the outer cold more. So the identification of syndrome type is Yang deficiency. In addition, the Chapter Yingwei Shenghui Lunpian of Neijing Lingshu pointed out that Shangjiao is like fog, Zhongjiao is like retting, and Xiajiao is like blasphemy. It indicates that there are differences in the physiological functions of human Sanjiao. Li Hongjuan [8] et al. found that the temperature gradient of human Sanjiao is the most Heat state of Xiajiao and the most Cold state of Xiajiao, which belongs to the homeopathic non-equilibrium thermodynamic system. In this study, the average value of the cold and heat deviation index of the upper outer parts is lower than that of the lower outer parts. The symptoms show that the upper and upper outer part is more cold than the lower and lower outer part. The change of pathogenesis is that Yangqi flourishing in the upper part, while Yin Cold alone in the lower part, causing the upper cold is not very much, but the lower cold is more prosperous, because the upper part of ordinary people is significantly more cold than the lower part. So the identification of syndrome type is upper heat and lower cold. The results show Li Hongjuan's temperature gradient of ordinary human Sanjiao. However, the reason why the difference is not significant is considered that compared with healthy people, sub-healthy people have the characteristics of upper heat and lower cold [20]. Through the bridge of "symptom-pathogenesis - syndrome type", the preliminary identification of syndrome type related to cold and heat can be realized by infrared thermal imaging. Therefore, the characteristics of Cold and Heat with the characteristics of location division obtained by infrared thermal imaging can explain the changing trend of Cold and Heat in human body, and then explain the relationship between Yin and Yang and Pathogenic and Vital Qi changes in the human body, and contribute to the identification of patients' syndrome types, as well as the evolution of syndrome types and the analysis of typical symptoms.

5.5. An Auxiliary Diagnosis Formula Combining Positioning, Qualitative and Quantitative Methods with the Thinking of Taking Images in TCM

Only the temperature index shown by infrared thermal imaging can not reflect the human body's Cold and Heat correctly, because the understanding of temperature and the concept of Cold and Heat in TCM are not directly equivalent, but can be used as a major factor to measure Cold and Heat. The application of infrared thermal imaging technology in TCM clinics should conform to the diagnostic thinking of TCM and should convert the temperature index to the index that can reflect the Cold and Heat information of TCM. The Chapter Wuzang Shengcheng Lunpian of Neijing Suwen proposes that the image of the five-Zang can be analogized. Zhang Jiabin in Volume 3 of Class Classics notes image hide inside, from outside. It shows that the thinking method of taking images is widely used in TCM diagnosis, and the research of auxiliary diagnosis of TCM should conform to its thinking of taking images. Palpation of traditional Chinese medicine uses touch to perceive the surface temperature of the body to construct the image of Cold and Heat, so as to dialectically use medicine. For infrared thermal imaging, it is to take the image of the cold and heat deviation index with parts of the figure, and further get the triple information description of human Cold and Heat: location, qualitative and quantitative. The correct Image Taking of three kinds of Cold and Heat information is an effective guarantee, which is more suitable for the Image Thinking of TCM, to establish the idea of diagnosing Cold and Heat with infrared thermal imaging technology. It can fully explain the clinical characteristics of Cold and Heat in the "symptom-pathogenesis-syndrome type", and then supplement the clinical application of the auxiliary diagnosis system of TCM.

6. Conclusion

In this study, by combining infrared thermal imaging technology with palpation of TCM and the idea of Taking Images, the quantification formula of human Cold and Heat based on infrared thermal imaging was obtained. The triple Cold and Heat indexes of Bagang syndrome differentiation were formed in line with the diagnosis idea of TCM, and the related characteristics of Cold and Heat along the "disease syndrome-pathogenesis - syndrome type" path in the TCM Bagang clinical diagnosis were accurately reflected. The research data show that the application of infrared thermal imaging technology can have a high consistency with the Cold dialectic of TCM, but there are still some shortcomings in the study, such as limited sample size, differences in regional division due to individuation and the limited samples of sub-health patients. Therefore, the establishment of standardized information collection methods and sufficient sample data collection is very important for making more accurate clinical judgments and more reliable statistical results, and further discussion on standardized and large sample clinical studies is needed.

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