



Science Press

Contents lists available at ScienceDirect

Journal of Integrative Medicine

journal homepage: www.jcimjournal.com/jim
www.journals.elsevier.com/journal-of-integrative-medicine

Original Research Article

Determination of symptoms associated with *hiesho* among young females using *hie* rating surveysHidetoshi Mori ^a, Hiroshi Kuge ^{a,b}, Shunji Sakaguchi ^c, Tim Hideaki Tanaka ^{a,*}, Junji Miyazaki ^d^a Faculty of Health Sciences, Course of Acupuncture and Moxibustion, Tsukuba University of Technology, Tsukuba 305-8521, Japan^b Department of Anesthesiology, Osaka Medical College Hospital, Osaka 569-8686, Japan^c Research Division of Acupuncture and Moxibustion, Kansai University of Health Sciences, Osaka 590-0482, Japan^d Takarazuka University of Medical and Health Care, Takarazuka 666-0162, Japan

ARTICLE INFO

Article history:

Received 6 June 2017

Accepted 1 October 2017

Available online 8 December 2017

Keywords:

Cold hypersensitivity

Questionnaires

Health surveys

Quality of life

Regression analysis

Reproducibility of results

ABSTRACT

Objective: *Hie* (cold sensation) is one of the most well-known health complaints in Japan and elsewhere in East Asia. Those who suffer from severe *hie* are considered to have *hiesho* (cold disorder). This study was conducted to determine symptoms associated with *hie* in young females using a survey consisting of the *hie* scale and *hie* diary.

Methods: Two hundred and seventy-one participants were included for the analysis. Survey forms were distributed to the participants. Diagnosis of *hiesho* was determined by using the *hie* scale. A discriminant score of over -0.38 was considered *hiesho*. The Short Form-8 Health Survey Standard Version (SF-8) was used to measure health-related quality of life (QOL). The participants were also asked to respond to the questionnaire evaluating 14 physical and emotional symptoms, utilizing a six-level Likert scale item.

Results: The 1st factor (*hie* factor) was correlated with *hie* ($r = 0.546$), dry mouth ($r = 0.332$), lower-extremity edema ($r = 0.450$), headrushes ($r = 0.470$), shoulder stiffness ($r = 0.311$), headrushes with chills ($r = 0.726$), and fatigue ($r = 0.359$). Cronbach's α of the 1st factor was 0.748, which indicated reliability between the items. When *hie* factor was the dependent variable, standardized partial regression coefficient was $\beta = -0.387$ for physical component score ($P < 0.001$) and $\beta = -0.243$ for mental component score ($P < 0.001$).

Conclusion: This study indicated that *hiesho* symptoms among young female adults were associated with bodily pain and general health perceptions of the SF-8 QOL survey.

Please cite this article as: Mori H, Kuge H, Sakaguchi S, Tanaka TH, Miyazaki J. Determination of symptoms associated with *hiesho* among young females using *hie* rating surveys. *J Integr Med*. 2018; 16(1): 34–38.

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1. Introduction

Hie (cold sensation) is one of the most well-known health complaints in Japan and elsewhere in East Asia [1,2]. Those who suffer from severe *hie* are considered to have *hiesho* (cold disorder) [3]. The characteristic symptom of *hiesho* is a feeling of cold, mainly in the feet and hands, typically at environmental temperatures in which a healthy person does not feel cold [4–7]. Moreover, many individuals with *hiesho* also manifest various physical and emotional complaints that affect their quality of life (QOL) [8,9].

According to the Comprehensive Survey of Living Conditions, conducted in 2013, by the Japanese Ministry of Health and Welfare,

15.3 men and 32.6 women out of 1000 in the general population complained of cold sensation in their hands and feet [10]. It has also been suggested that over 50% of Japanese women suffer from *hiesho* [8,11–13]. *Hiesho* used to be considered specific to postmenopausal women [2,6]. However, in recent years it has also been reported to affect young males and females [14,15].

Typically, *hiesho* has been screened based on autonomic functioning tests which include evaluating skin temperature and/or blood flow [16–18]. However, these evaluation methods require devices such as infrared thermography, and often require patients to undergo stressful procedures such as cold immersion [2]. It would be useful in clinical and research settings if simple, non-invasive, and comprehensive *hie* diagnostic methods were available.

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To that end, we had previously conducted a study in an attempt to develop a questionnaire (hereafter referred to as a *hie* scale) in order to evaluate existence and severity of *hiesho* [19]. The *hie* scale used in the study showed that the sensitivity was 84.5% for males and 83.3% for females, and the specificity was 86.0% for males and 85.2% for females. We determined that the *hie* scale could identify *hiesho* in young males and females with a high level of accuracy. The *hie* scale used in the previous study could be useful in clinical settings as the *hie* evaluation tool, as it is non-invasive and requires no diagnostic equipment.

In addition to the aforementioned coldness or chilly sensations in various parts of the body, *hiesho* patients often manifest various symptoms which are likely associated with autonomic dysfunction [8,20]. Thus, we have been utilizing a *hie* diary when evaluating an acupuncture treatment for *hiesho* patients. This *hie* diary consists of an evaluation sheet with the list of 14 physical and emotional *hie*-associated symptoms utilizing a Likert scale item.

Our *hie* diary was created based on the Blood Stasis Questionnaire by Terasawa et al. [21] We modified their questionnaire by adding more questions and the Likert item was changed from four-level to six-level. In our previous study, we had not examined the internal consistency and relationship between *hie* intensity and the *hie*-associated symptoms. This study was conducted in order to determine the associated symptoms with *hie* on young females using a survey consisting of the *hie* scale and *hie* diary.

2. Subjects and methods

2.1. Participants

The study participants were recruited among female students attending three health science universities and two health science vocational schools. Three hundred and forty-eight students initially responded to the survey. Participants who were taking any prescribed medications at the time of study were excluded ($n = 6$). In addition, respondents who had a history of health conditions

including allergies, gynecological conditions, asthma, dysautonomia, renal diseases, hyperthyroidism, herpes labialis, hemorrhoids, and anemia were excluded from the analysis ($n = 25$). Incomplete items on any of the survey sheets were also excluded (*Hie* daily: $n = 8$; *hie* scale: $n = 8$; health-related QOL: $n = 3$; height and/or weight: $n = 27$). After accounting for exclusions, 271 participants remained for the analysis (Fig. 1). The participants' age range was 18 to 29 years old (mean age: (20.4 ± 2.0) years). The body mass indexes (BMIs) of the participants were between 14.2 kg/m^2 and 34.0 kg/m^2 (mean BMI: $(20.6 \pm 2.6) \text{ kg/m}^2$). The study was approved by the ethics committee of each educational facility where the data were collected.

2.2. Measures

The investigation period lasted two months, from September 1 to October 31, 2012. The survey forms were distributed to the participants. After the participants voluntarily filled out their responses in each field, the forms were inserted into the designated collection box at each survey location. The survey forms were collected on October 31.

Diagnosis of *hiesho* was determined by using *hie* scale. According to the report of Sakaguchi et al. [19], a discriminant score of over -0.38 was considered *hiesho*.

2.3. Construction of the linear discriminant function model from discriminant analysis

The formula of the discriminant score was described in detail in our previous paper [19]. Briefly, the discriminant score was calculated based on the sum of the order scores from the following 7 questions minus 1.715 (expression constant): (A) Compared to others, I tend to be more sensitive to the cold (order score $\times (-0.083)$); (B) I sometimes suffer because my entire body is cold (order score $\times (-0.044)$); (C) I have been suffering from the cold for the last several years (order score $\times 0.233$); (D) Compared to

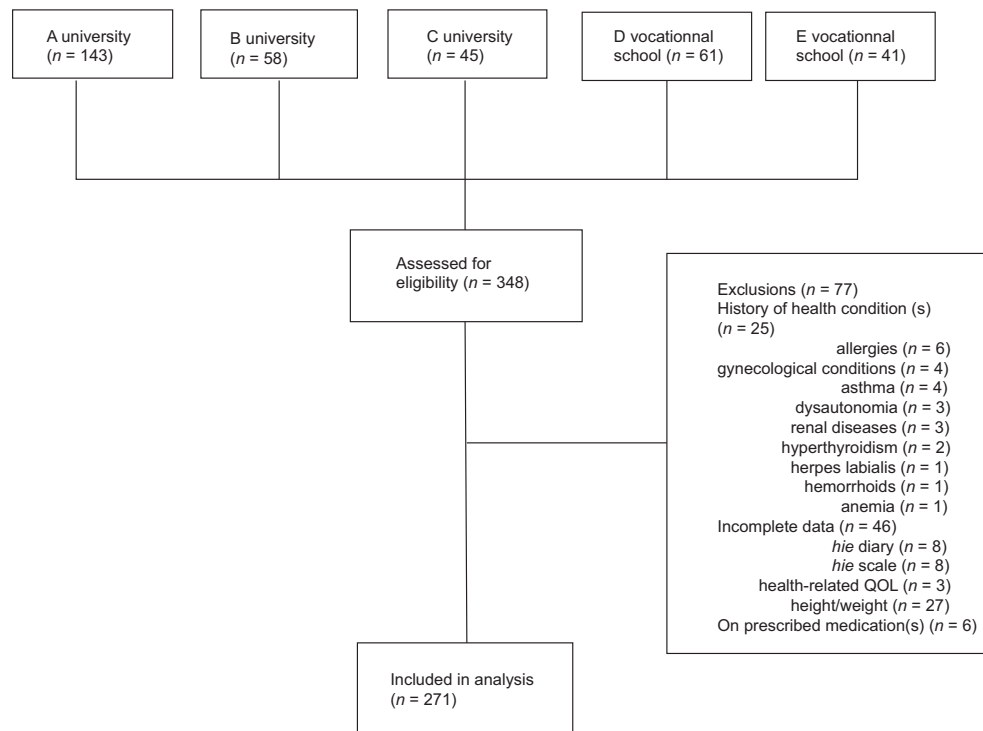


Fig. 1. Flow chart of recruitment of participants.

others, my hands and feet are cold (order score $\times 0.471$); (E) My hands and feet are always cold (order score $\times 0.502$); (F) I suffer because my back, hands and feet or some parts of my body are cold (order score $\times 0.25$); (G) Especially in the winter, I often have difficulty falling asleep due to cold feet (order score $\times (-0.002)$). Each question was answered with the following four grades: almost always true (3 points), often true (2 points), occasionally true (1 point) and never true (0 point). The linear discriminant function obtained was: $y = (-0.083) \times A - 0.044 \times B + 0.233 \times C + 0.471 \times D + 0.502 \times E + 0.250 \times F - 0.002 \times G - 1.715$.

The Short Form-8 Health Survey Standard Version (SF-8) was used to measure health-related QOL [22]. The SF-8 includes multi-item scales to measure the following 8 dimensions: physical functioning (PF); role limitations due to physical health problems; bodily pain (BP); general health perceptions (GH); vitality, energy or fatigue; social functioning; role limitations due to emotional problems (RE); general mental health, covering psychological distress and well-being. Two sets of scores were derived from the SF-8: a profile of eight section scores, and two summary scores, one for the physical component score (PCS) and one for the mental component score (MCS).

The participants were also asked to respond to the questionnaire evaluating 14 physical and emotional symptoms utilizing a Likert scale item. The six-level Likert item is used for symptom evaluation (0 means there is no symptom at all while 5 means the symptom is strongest) (Table 1).

2.4. Analysis

Correlation between *hie* and intensity of the 14 symptoms was analyzed using Spearman's rank correlation coefficient test. Factors were extracted by principal factor analysis with varimax rotation and reliability analysis was conducted.

Based on the *hie* diary and SF-8, *hiesho* and non-*hiesho* were compared through Welch's *t*-test. Stepwise multiple linear regression analysis was conducted to compare *hiesho* and other scales of measurements. The dependent variables were the factors extracted in the *hie* diary. Independent variables were the eight subscale scores of health-related QOL and two summary scores.

SPSS Statistics 22.0 (IBM Corporation, North Castle Drive) was used as the statistical analysis software. Cronbach's α of 0.7 was used as a cut-off value for reliability index [23]. The level of significance was set at $P < 0.05$. The values presented were mean \pm standard error.

Table 1
The six-level Likert item used for symptom evaluation.

Item	Level					
1. Irritability	0	1	2	3	4	5
2. Headaches	0	1	2	3	4	5
3. Sensation of warmth in hands and feet [*]	0	1	2	3	4	5
4. Polyhidrosis	0	1	2	3	4	5
5. Myalgia	0	1	2	3	4	5
6. Dry mouth	0	1	2	3	4	5
7. Edema of lower extremities [†]	0	1	2	3	4	5
8. Insomnia	0	1	2	3	4	5
9. Nobose [‡]	0	1	2	3	4	5
10. Shoulder stiffness	0	1	2	3	4	5
11. Hie-nobose [§]	0	1	2	3	4	5
12. Lumbago	0	1	2	3	4	5
13. Fatigue	0	1	2	3	4	5
14. Nocturia	0	1	2	3	4	5

^{*} Hereafter referred to as "warm hands and feet".

[†] Hereafter referred to as "lower-extremity edema".

[‡] *Nobose* is a commonly used Japanese expression referring to an uncomfortable sensation of heat in the upper body, especially in the head, often with visible flushing in the face and accompanied by lightheadedness. Shibata and Wu [6] adapted the English term "headrush". Headrush includes phenomenon of hot flash, but is broader in scope, hereafter referred to as "headrushes".

[§] Symptoms of "headrushes" with sensation of chilliness in lower body, hereafter referred to as "headrushes with chills".

3. Results

3.1. Relationship between *hie* and accessory symptoms in *hie* diary

The following 11 symptoms had significant correlation with *hie*: irritability ($r = 0.183$, $P = 0.002$), headaches ($r = 0.197$, $P = 0.001$), dry mouth ($r = 0.171$, $P = 0.004$), lower-extremity edema ($r = 0.325$, $P < 0.001$), insomnia ($r = 0.165$, $P = 0.006$), headrushes ($r = 0.270$, $P < 0.001$), shoulder stiffness ($r = 0.268$, $P < 0.001$), headrushes with chills ($r = 0.415$, $P < 0.001$), lumbago ($r = 0.197$, $P = 0.001$), fatigue ($r = 0.291$, $P < 0.001$), and nocturia ($r = 0.243$, $P < 0.001$).

Table 2 summarizes internal consistency of the symptoms in the *hie* diary. The *hie* factor was correlated with *hie* ($r = 0.546$), dry mouth ($r = 0.332$), lower-extremity edema ($r = 0.450$), headrushes ($r = 0.470$), shoulder stiffness ($r = 0.311$), headrushes with chills ($r = 0.726$), and fatigue ($r = 0.359$). Cronbach's α was used to assess internal consistency. Cronbach's α of the *hie* factor was 0.748, which indicated reliability between the items. The indefinite complaint factor was correlated with irritability ($r = 0.386$), headaches ($r = 0.488$), shoulder stiffness ($r = 0.405$), lumbago ($r = 0.593$), and fatigue ($r = 0.616$). Cronbach's α of the indefinite complaint factor was 0.665, which did not indicate reliability between the items. The headrushes factor was correlated with warm hands and feet ($r = 0.692$), polyhidrosis ($r = 0.533$), and headrushes ($r = 0.519$). Cronbach's α of the headrushes factor was 0.661, which did not indicate reliability between the items. The other complaint factors were correlated with myalgia ($r = 0.650$), dry mouth ($r = 0.464$), and nocturia ($r = 0.373$). Cronbach's α of the other complaint factors was 0.587, which did not indicate reliability between the items. The *hie* factor did not show multicollinearity.

3.2. Comparison between *hiesho* and non-*hiesho*

The *hie* group had higher sum scores with *hie* factor ($P < 0.001$) and indefinite complaint factor ($P < 0.001$). The *hie* group had lower sum scores with BP ($P = 0.011$), and GH ($P = 0.017$) of the health-related QOL (Table 3).

3.3. The relationship between the extracted factors and health-related QOL in *hie* diary

When *hie* factor was the dependent variable, standardized partial regression coefficient was $\beta = -0.387$ for PCS ($P < 0.001$)

Table 2
Internal consistency of the symptoms in the *hie* diary.

Item	Factor			
	<i>Hie</i>	Indefinite complaint	Headrushes	Other complaint
<i>Hie</i>	0.546	0.163	−0.066	0.076
Irritability	−0.033	0.386	0.137	0.085
Headaches	0.159	0.488	0.131	0.154
Sensation of warmth in hands and feet	0.043	0.225	0.692	0.119
Polyhidrosis	0.042	0.073	0.533	0.259
Myalgia	0.018	0.249	0.201	0.650
Dry mouth	0.332	0.099	0.190	0.464
Edema of lower extremities	0.450	0.234	0.088	0.192
Insomnia	0.282	0.179	0.043	0.146
Headrushes (<i>nobose</i>)	0.470	0.077	0.519	0.148
Shoulder stiffness	0.311	0.405	−0.064	0.185
Headrushes with chills (<i>hie-nobose</i>)	0.726	0.105	0.244	0.029
Lumbago	0.247	0.593	0.065	0.011
Fatigue	0.359	0.616	0.122	0.137
Nocturia	0.251	0.082	0.204	0.373

Table 3
Comparison between *hiesho* and non-*hiesho*.

Item	Non- <i>Hiesho</i> (n = 128)	SE	<i>Hiesho</i> (n = 143)	SE
PF	49.2	0.5	48.7	0.5
RP	48.7	0.6	48.4	0.5
BP*	48.0	0.8	45.1	0.8
GH*	47.7	0.7	45.4	0.7
VT	48.0	0.6	47.1	0.6
SF	45.5	0.7	44.5	0.7
RE	46.1	0.6	44.8	0.7
MH	42.7	0.7	41.7	0.7
PCS	49.5	0.6	48.2	0.5
MCS	42.6	0.7	41.7	0.7
<i>Hie</i> **	11.3	0.5	17.3	0.5
Indefinite complaint**	11.8	0.5	14.7	0.5
Headrushes	3.9	0.3	3.9	0.3

PF: physical functioning; RP: role limitations due to physical health problems; BP: bodily pain; GH: general health perceptions; VT: vitality, energy or fatigue; SF: social functioning; RE: role limitations due to emotional problems; MH: general mental health, covering psychological distress and well-being; PCS: physical component score; MCS: mental component score; SE: standard error. * $P < 0.05$, ** $P < 0.001$.

and $\beta = -0.243$ for MCS ($P < 0.001$). When indefinite complaint factor was the dependent variable, standardized partial regression coefficient was $\beta = -0.308$ for BP ($P < 0.001$), $\beta = -0.180$ for GH ($P = 0.002$) and $\beta = -0.114$ for RE ($P = 0.046$). When headrushes factor was the dependent variable, standardized partial regression coefficient was $\beta = -0.293$ for PF ($P < 0.001$). When other factors were dependent variables, standardized partial regression coefficient was $\beta = -0.213$ for PF ($P < 0.001$).

Discussion

By utilizing our *hie* diary, seven factors were extracted based on the factor analysis. The reliability of those seven *hie* factors was confirmed. The participants who considered having *hiesho* were determined by the classification reported by Sakaguchi et al. [19] *Hie* diary score was distinctly different between participants having *hie* and not having *hie* symptoms. Participants with *hiesho* showed lower scores of BP and GH.

According to Miyazaki et al. [9] the average age of persons suffering from *hiesho* was higher in females than males. Their study also reported that females were more prone to be affected by their social life due to physical and emotional symptoms that were associated with *hiesho*. Moreover, *hiesho* symptoms in females are highly associated with psychological factors, based on path analysis [8].

Our *hie* diary consists of evaluating various issues including musculoskeletal, emotional, systemic and vasomotor nerve-related symptoms. This study demonstrated that *hie* was associated with all of these issues except for emotional symptoms. We speculate that symptomatic characteristics of *hiesho* may differ between premenopausal and menopausal females.

Our *hie* diary used in this study was an itemized composition mainly focused on symptomatic factors. Thus, it might have been substantially affected by scores of BP and PCS. The contradictory findings of the study by Miyazaki et al. [8,9] and the present study results may be due to the subjective symptomatic *hie* classification of our study. We classified participants with *hie* and non-*hie* based on the cut-off value of the *hie* scale according to the study by Sakaguchi et al. [19]

5. Conclusion

This study indicated that *hiesho* symptoms among young female adults were associated with bodily pain and general health perceptions of the SF-8 QOL survey. We believe that our *hie* diary can be useful in evaluating *hiesho* by focusing on physical symptoms. In addition, the *hie* diary would be useful for tracking the severity of *hie* and evaluating clinical efficacy of administered treatments.

Acknowledgements

We would like to express our gratitude to Taro Takeda, Ph.D. (Meiji University of Integrative Medicine), Noriko Ikegami, B.A. (Morinomiya College of Medical Arts and Sciences), Yoshihisa Kojima, Ph.D. and Ryota Tsuji, M.Sc. (Morinomiya University of Medical Sciences) for their assistance in conducting the survey and data entry.

Grant support or other sources of funding

This work was supported by Tsukuba University of Technology, Promotional Projects for Advanced Education and Research.

Competing interests

The authors declare no conflict of interest.

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