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건강 상태 관련 음성 분석을 통한 건식 족욕기의 효능에 대한 정량적 분석

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Quantitative Analysis on the Efficacy of Dry-type Footbath by Voice Analysis Related to Health Status

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요 약

일반적으로 건식 족욕기를 비롯한 건강 증진 기기와 제품 등은 해당 제품이나 기기가 건강 증진에 효능이 있다는 것에 대한 정량적인 자료 제공이 거의 없다는 것이 정확한 현 실정이다. 이에 본 논문에서는 건강 증진 기기와 제품에 대한 효능을 정량적으로 나타내기 위한 작업의 일환으로 건식 족욕기를 대상으로 족욕을 하기 전과 족욕을 하고 난 후 실제 건강과 관련된 음성에 어떤 변화가 있었는지를 고찰하여 건식 족욕기가 실제 건강에 어떠한 영향을 미쳤는지를 정량적으로 규명해 보고자 한다. 이를 위해 100명의 실험 집단을 구성하여 성별로, 나이대별로 족욕 효과에 대한 정량적 자료를 제공해 보고자 한다. 실험 결과, 40대의 연령층은 모든 장기가 족욕 후 활성화되었으며, 모든 실험자들에 있어 가장 족욕 효과가 있는 장기는 신장임을 알 수 있었다.

Key Words : dry-type footbath, Korean Medicine, kidneys, voice analysis, health promotion

ABSTRACT

Generally, health - promoting equipments and products including dry - type footbath have the problem that there is little quantitative evidence and experimental evidence that it is effective in promoting health. For this, in this paper, as a part of the work to demonstrate quantitatively the efficacy of health promotion equipments and products, we reviewed the changes in the voice related to actual health by before/after dry-type footbath. As a result, we will identify quantitatively the effect of dry-type footbath on actual health. To do this, we will provide a quantitative data on the effects of footbath by gender and age. The results of the experiment showed that all the organs in their 40's were activated after footbath. It was also found that the most effective organ for all subjects was kidneys.

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Ⅰ. Introduction

Nowadays, average life expectancy of Korean's is increasing rapidly. However, not only average life span, but also health life span are becoming more and more significant issues. According to the National Statistical Office (NSO) data from 2012, average life span of Korean is 81.4 but the health life span is 73. This shows that after the age of 73 they will suffer from such as senility and diseases for 8.4 years before they die. Therefore, several necessary measures to increase health life should be taken. Above all, we have to do a lot of things to improve our health because our immune system gets weaker and we are exposed to various kinds of diseases. From this point of view, there are many health promotion equipments in our life that can prolong health life span. However, the efficacy of these equipments is not quantified. In other words, there are a number of equipments that can improve health, but there is no quantitative test results to see how effective these equipments in promoting health. It is merely to say that it is qualitatively efficacious. Experiments about its efficacy are also dependent on questionnaires or results from experiments on animals, not human body. This is also true of the foot baths we use the most in our daily lives. There is no evidence to demonstrate efficacy of the footbath effect except for changes in body temperature or the results of the questionnaire. Therefore, in this paper, we aim to conduct a quantitative study on the change of voice related to health before/ after the footbath. This is to confirm the efficacy of health promoting equipments as numerical data. Also, we will do experiments not only footbath but also other health promotion equipments which are frequently used in our daily life.

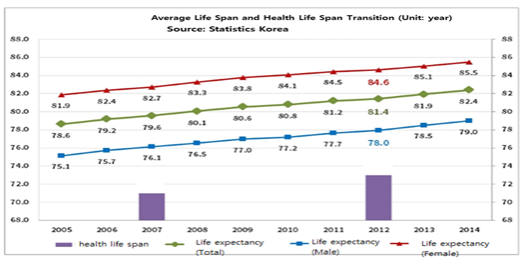

Fig. 1. Average life span and health life span transition[1]

Ⅱ. The theory of Korean Medicine

The theory of Korean Medicine of a medical examination for checkup the disease is through the visual data of face, pulse feeling and voice from the patient[2]. In a study of Korean Medicine, on people's foot, there are responded spots to the whole body[3]. If we stimulate responded spot properly, the function of organs will revitalize. Based on the theory of Korean Medicine of a medical examination by voice, if we read the sentences correspond to the heart, lung and kidneys, we can analyze the condition of health of our organs. In this paper, we apply the auscultation theory to quantify the efficacy of the footbath as a numerical data. In addition, the auscultation theory of Korean Medicine can be very easy to find out the individual 's health condition through the each kind of communication networks. Therefore, it is an important study to implement the auscultation theory of Korean Medicine by IT technology. For this purpose, this paper is to evaluate the effectiveness of footbath by applying the auscultation theory of Korean Medicine.

Ⅲ. Characteristics of ceramic ball dry-type footbath equipment used in the experiment

Health promotion equipments that can prolong the life span of health are coming out in our life. But the broadest and most used is the footbath. The type of footbath equipments is divided into wet and dry. However, in the case of wet footbath, there were several reports of burn and electric shocks from using wet footbath equipment and the inconvenience of having to fill and replace water each time. Due to these inconveniences, we used the seramic ball dry-type footbath equipment for the experiment. The material of seramic ball, sericite, is soft and fragile,

thus considered as clay mineral rather than rock. Sericite contains various minerals and had been used as medicine in the ancient times in East Asia. The records are left in Donguibogam(Principles and Practice of Eastern Medicine)[15], Hyangyakjjipsseongbang[16], Hwangjaenegyeong[17,18]. Sericite is considered a useful mineral in fostering health as there are records from ancient western history that sericite was used as an antidote[4,5]. The purpose of this study is to conduct an experiment to see if the ceramic ball dry - type footbath actually helps help health promotion after foot bathing. Table 1 below shows the features of the ceramic ball dry footbath equipment used in the experiment.

Table 1. The characteristics of ceramic ball dry-type foot bath used in the experiment

Name	sericite dry footbath equipment
Sze	430 X 420 X 380 mm
Quality of the material	hardwood, Geumcheon sericite, TDP heater
Composition	footbath device body, wood floor pedestal, ceramic pocket, footbath device Geumcheon sericite ceramic, footbath machine, cover, power cord
Standard	voltage: 220v, temperature range: 20 ~ 60℃ temperature set up unit: 1℃
Way of using	Put your foot in the warmed sericite ceramic

Photo of dry-type footbath

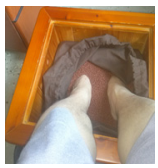

Photo of clinical experiment

Photo of sericite rough stone

Fig. 2. Experiment photos of ceramic ball dry-type footbath equipment

Ⅳ. The elements of voice analysis

To analyze the voice, we used Praat[6] program. Human voice contains emotional information and health information and so on. This paper focused on the health information and below are the voice analysis elements used in the experiment.

1. Pitch

Height of voice is the tone of voice that people perceive through auditory system[7].

2. Bandwidth of pitch

Bandwidth of pitch represents the value of maximum pitch subtracted the minimum pitch[8].

3. Energy

Energy of Voice is the measurement for intensity of the voice.

4. Voice color

Voice color has close relationship to the confidence of people. The voice color is composed of jitter[9], shimmer[10] and NHR[11].

5. Duration time and DoVB

Duration time represents the lasting time of the uttering and DoVB(Degree of Voice Breaks) indicates the ratio of voiced and unvoiced sounds during speech.

Ⅴ. Experiment and Observations

5.1 Selection of subjects and experiment methods

This experiment was done on the 20's age to 60's. First, before the foot bathing, 100 subjects were asked to read the sentences corresponding to each organ in human body, and their voices were recorded in human body. Likewise, we recorded the voice reading the sentence corresponding to each organ of 100 subjects after foot bathing for 30 minutes. Finally, whether or not the footbath was effective is verified by comparing the voice before and after the foot bathing. Table 2 shows gender and age distribution chart and table 3 represents the short vowels related to human organs. Also, Table 4 shows the sentences used in this paper. The relationship between voice and organs is called auscultation. The auscultation is a method of examining the disease through a strange change of

sound from the patient. In other words, it refers to the patient's language, breathing, coughing, speech, asthma and sound from the stomach[13-18]. In Donguibogam[15], the voice does not come out of the throat but is related to the organ located deep inside the body. In other words, the vocal impairment can be caused not only by the damage of the neck, but also by the deterioration of organs function in the body. Based on these references, in this paper, we made the following table 3, table 4 and conducted experiments based on them.

Table 2. Subjects' age and gender distribution

age	Unit(Persons)
20'	51
30'	12
40'	12
50'	10
60'	7
Total	100
Gender	Unit(Persons)
Male	49
Female	51
Total	100

Table 3. Short vowels related to human organs

Relevant organ	Related voice
Heart	'E-' sound. Sound from the tongue, does it vibrate a lot? When they make high pitch, do they lose power at the end or pitch down?
Lung	'Ah-'sound. Sound from the teeth
Kidneys	'Uh-'sound. Sound from lips. Does sound sink from lip sound?

Table 4. Sounds related to human organs

Relevant organ	The sentences that will be used
Heart	'Nakttangnulkang'
Lung	'Siso, 'Jajangga, 'Chukchukhada'
Kidneys	'Meokppangpulbang'

We applied mean pitch, bandwidth of pitch, intensity, jitter, shimmer, NHR and DoVB for the experiments in table 4.

5.2 Results of experiment

Fig. 3 shows the voice analysis before foot bathing and Fig. 4 shows after foot bathing

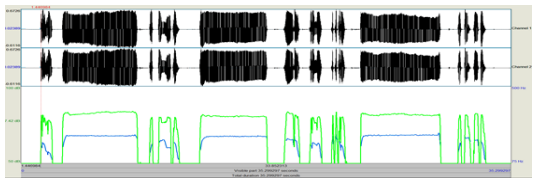

Fig. 3. Voice analysis photos of footbath equipment experiment(before foot bathing)

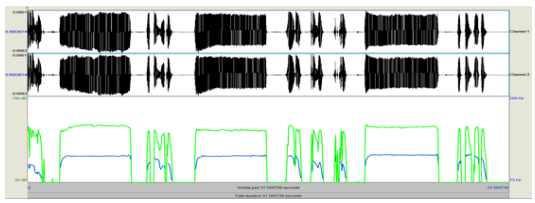

Fig. 4. Voice analysis photos of footbath equipment experiment(after foot bathing)

5.3 Observations

We showed the average of total to table 5 below. It shows relevant data of heart that increase in the part of duration time, intensity, DoVB in the case of 'E-'. Also, the value of jitter, shimmer and NHR on the sound of 'Nakttangnulkang' are improved. This means that the function of heart is improved. For lung, lung capacity is crucial part of the data. The duration time and DoVB values are related to lung capacity. In order to verify this, it was confirmed that duration Time and DoVB values improved after foot bathing. Compared to this, in the case of 'siso, jajangga, chukchukada', only DoVB improved. In conclusion, we can not be sure that lung function improves. Now we will see whether kidney function improves. The duration time, jitter, shimmer, NHR and DoVB values increased for 'Uh-' sound associated with the kidneys. For 'Meokppangpulbang', it improved the parts of jitter, shimmer and NHR. This means that the function of kidneys is improved.

Table 5. Average of all age

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.390	145.076	224.637	79.467	192.498	189.656
After footbath	5.777	139.476	216.508	77.679	188.930	185.820
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.739	110.363	250.211	139.291	170.258	176.190
After footbath	1.736	112.671	261.442	148.770	167.604	167.604

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	77.531	0.421	0.330	0.032	0.192
After footbath	77.776	0.456	0.408	0.035	0.170
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.898	1.811	0.956	0.193	30.434
After footbath	74.475	1.742	0.888	0.185	33.057

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.023	145.640	202.936	57.295	179.004	180.529
After footbath	5.479	141.057	197.540	56.483	180.586	179.402
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.080	108.735	304.643	195.908	192.239	190.476
After footbath	2.978	115.063	328.293	213.229	186.178	187.942

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.500	0.352	0.337	0.031	0.262
After footbath	78.954	0.385	0.346	0.026	0.187
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.742	1.832	0.953	0.199	36.696
After footbath	75.123	1.889	0.921	0.202	36.254

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.040	149.865	245.849	95.984	192.472	192.567
After footbath	5.752	143.836	211.487	67.651	187.539	184.261
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.033	113.481	270.857	157.376	193.538	189.619
After footbath	1.914	112.434	266.900	154.465	186.624	183.476

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.493	0.452	0.360	0.028	0.471
After footbath	78.779	0.390	0.395	0.018	0.083
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.552	1.963	0.972	0.204	37.738
After footbath	74.887	1.897	0.959	0.192	38.317

Now let's look at the effects of footbath by age group. First, let's look at the results of 20's. Table 6 shows the results of the experiment for the age group of 20's. It shows relevant data of heart that increase in the parts of duration time from sound 'E-'. Also, jitter in the case of sound 'Nakttangnulkang' is improved. Experimental results of the short vowel 'Ah-" in the lung, duration time and DoVB are improved. In the case of kidneys, duration time and DoVB are improved from sound 'Uh-'. For 'Meokppangpulbang'. it improved the parts of jtter and NHR. In conclusion, in the case of twenties, we can conclude that the duration time of the short vowels is improved, but the other factors are not significantly improved. This means that the metabolism in the twenties is so active. So, in the twenties, the effect of footbath does not work much. Now let's look at the results of 30's experiments. Table 7 below shows the experimental results. It shows relevant data of heart which increased in the parts of Intensity and DoVB from sound 'E-'. For lung, duration time and DoVB are improved for the sound of 'Ah-'. Also, in the case of kidneys, the

short vowel ‘Uh-‘ is improved duration time and DoVB. For ‘Meokppangpulbang’, the values of jitter, NHR and DoVB are improved. This means that the function of kidneys is improved specially. In addition, the experimental results of age group of 40’s are shown in table 8 below. For the short vowel ‘E-’ associated with the heart, the duration time, intensity, and DoVB are improved. Also, jitter in the case of sound ‘Nakttangnulkang’ is improved. For lung, duration time and DoVB are improved for the sounds of ‘Ah-‘. Also for ‘siso, jajangga, chukchukada’, jitter, shimmer and NHR are improved. In the case of the short vowel ‘Uh-‘, duration time is improved. For Meokppangpulbang’ related to the kidneys. it improved the parts of jitter, shimmer, and NHR. This means that among the heart, lung, and kidneys, especially the function of kidneys is improved. Next, looking at the experimental results of 50’s, as shown in table 9, it is increased in the part of DoVB from short vowel ‘E-‘ and sound ‘Nakttangnulkang’. In the case of lung, duration time and DoVB are improved for the short vowel of ‘Ah-‘. For kidneys, duration time from short vowel ‘Uh-‘ is increased. Also, in the case of ‘Meokppangpulbang’, it improved the parts of jitter, shimmer, NHR and DoVB. This means that among the heart, lung, and kidneys, especially the function of kidneys is improved. Finally, let’s look at the case of the age group of 60’s. The experimental results are shown in table 10. First, the value of DoVB is increased for ‘E-’ which is a short vowel related to the heart. Also, jitter in the case of sound ‘Nakttangnulkang’ is improved. For lung, duration time and DoVB are improved for the short vowel of ‘Ah-‘. In the case of kidneys, duration time and DoVB are improved from short vowel ‘Uh-‘. For the sound of ‘Meokppangpulbang’. the parts of jtter shimmer, NHR and DoVB are improved. This means that among the heart, lung, and kidneys, especially the function of kidneys is improved.

Table 6. Average experimental results of 20’s

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.941	126.683	192.761	66.077	166.692	166.833
After footbath	6.479	134.336	185.493	52.428	167.609	165.401
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.656	106.187	209.308	103.120	148.072	153.780
After footbath	1.638	110.949	220.311	109.362	148.302	152.494

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	78.123	0.402	0.346	0.031	0.088
After footbath	76.814	0.411	0.367	0.032	0.098
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.383	1.797	0.911	0.201	29.961
After footbath	72.576	1.705	0.918	0.185	34.910

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.492	130.656	176.131	45.475	155.195	157.485
After footbath	5.871	121.076	169.630	48.554	157.598	156.643
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.808	100.331	256.628	156.297	164.818	162.765
After footbath	2.723	107.595	293.790	186.195	162.444	166.061

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.55071	0.335216	0.353235	0.030471	0.043784
After footbath	78.68124	0.386647	0.313194	0.027992	0.227137
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.2782	1.895	0.928	0.218	38.366
After footbath	74.31178	1.880333	0.970235	0.2160	37.613

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.367	134.305	213.278	78.973	167.994	168.197
After footbath	6.260	129.259	180.024	50.765	165.408	164.596
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.568	110.413	228.996	118.582	169.035	165.916
After footbath	1.612	107.638	225.837	118.198	165.528	161.337

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.320	0.409	0.378	0.027	0.586
After footbath	77.743	0.376	0.424	0.018	0.070
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.170	1.928	0.995	0.218	37.150
After footbath	74.104	1.890	1.025	0.206	39.445

Table 7. Average experimental results of 30's

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	6.705	134.868	194.594	59.725	177.994	177.994
After footbath	5.838	125.863	195.390	69.527	177.681	177.067
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.976	110.783	227.648	116.865	162.835	162.835
After footbath	2.104	95.606	243.628	148.022	158.440	161.535

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	76.272	0.365	0.284	0.011	0.024
After footbath	77.546	0.358	0.288	0.015	0.000
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.522	1.725	0.829	0.145	38.905
After footbath	73.962	1.845	0.817	0.156	37.184

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	6.047	139.773	181.776	42.002	173.243	173.243
After footbath	6.228	148.385	189.101	40.715	170.329	169.911
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.882	109.354	343.414	234.060	179.461	179.461
After footbath	3.732	97.656	321.026	223.369	174.076	175.481

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.354	0.380	0.297	0.035	0.138
After footbath	78.687	0.321	0.463	0.014	0.000
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.921	1.878	0.868	0.172	41.755
After footbath	74.806	1.982	0.841	0.170	42.113

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	6.256	139.977	204.076	64.098	178.029	178.029
After footbath	6.371	147.466	220.544	73.077	176.353	176.498
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.152	108.815	234.406	125.591	177.060	177.060
After footbath	2.038	107.396	236.047	128.651	177.407	174.780

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	77.046	0.315	0.230	0.009	0.100
After footbath	77.326	0.353	0.510	0.020	0.055
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.191	1.981	0.878	0.152	43.370
After footbath	75.636	1.827	0.834	0.152	40.802

Table 8. Average experimental results of 40's

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.065	169.477	259.887	89.9385	230.833	219.958
After footbath	5.776	134.832	267.010	132.177	219.434	212.405
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.723	108.057	297.127	186.286	195.124	204.071
After footbath	1.739	119.158	293.674	174.516	192.004	198.238

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	75.346	0.432	0.323	0.030	0.432
After footbath	79.135	0.438	0.551	0.028	0.246
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.938	1.939	0.896	0.195	28.306
After footbath	75.593	1.718	0.896	0.181	30.582

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.750	181.343	232.854	51.510	225.611	224.542
After footbath	5.146	163.585	235.011	71.425	214.970	214.209
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.093	120.728	339.394	218.666	231.438	229.110
After footbath	2.979	127.978	355.139	227.160	222.974	216.221

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	80.108	0.331	0.320	0.023	0.382
After footbath	80.067	0.373	0.307	0.021	0.173
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	77.102	1.904	1.198	0.196	31.781
After footbath	76.885	1.846	0.873	0.189	32.225

Kidn-eys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.378	180.611	308.799	128.188	235.058	234.075
After footbath	5.438	158.013	251.278	93.265	220.577	218.908
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.760	122.384	320.872	198.487	223.355	221.098
After footbath	1.788	114.844	336.589	221.744	212.119	212.055

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	81.070	0.572	0.378	0.037	0.708
After footbath	80.604	0.416	0.365	0.020	0.113
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	76.322	2.094	0.984	0.213	37.387
After footbath	76.048	1.904	0.921	0.193	38.739

Table 9. Average experimental results of 50's

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.526	183.675	326.409	142.734	244.501	239.191
After footbath	2.319	172.887	272.600	99.713	235.609	231.875
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.760	116.308	335.091	218.782	218.522	224.212
After footbath	1.668	118.804	296.079	177.274	210.024	210.227

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.252	0.544	0.318	0.039	0.573
After footbath	78.882	0.842	0.495	0.077	0.419
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.756	1.675	0.740	0.216	27.676
After footbath	75.342	1.626	0.769	0.225	26.114

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.447	163.693	248.883	85.190	199.650	206.975
After footbath	2.520	181.057	253.316	72.259	226.235	222.177
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.159	115.222	368.823	253.601	247.402	244.032
After footbath	3.108	142.931	388.005	245.074	235.733	236.029

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	78.959	0.384	0.304	0.047	0.860
After footbath	78.708	0.477	0.395	0.039	0.078
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	76.213	1.520	0.789	0.170	31.473
After footbath	75.998	1.692	0.826	0.178	32.451

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.296	180.248	318.925	138.677	234.129	236.705
After footbath	2.429	182.849	256.604	73.755	234.210	212.139
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.670	121.444	349.387	227.943	249.261	237.958
After footbath	1.629	128.152	316.728	188.575	235.914	226.467

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	80.222	0.590	0.345	0.033	0.050
After footbath	80.617	0.410	0.247	0.018	0.077
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	76.209	1.851	0.907	0.183	35.101
After footbath	75.408	1.702	0.871	0.156	32.440

Table 10. Average experimental results of 60's

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.138	171.721	262.284	90.563	221.559	220.355
After footbath	5.497	165.799	254.246	88.447	209.712	207.843
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.930	91.791	194.144	102.352	133.433	135.337
After footbath	1.808	93.198	203.722	110.523	129.879	132.688

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.162	0.444	0.331	0.065	0
After footbath	79.709	0.456	0.383	0.042	0.415
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.360	1.901	0.928	0.210	34.016
After footbath	74.015	1.864	0.930	0.203	38.509

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.315	137.071	283.386	146.315	199.683	196.511
After footbath	6.522	152.562	228.608	76.046	202.195	200.933
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.134	92.627	241.746	149.118	143.581	145.192
After footbath	3.040	93.673	273.434	179.760	141.367	145.437

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	78.420	0.448	0.383	0.037	0.865
After footbath	78.575	0.397	0.429	0.036	0.419
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.424	1.963	0.936	0.227	41.103
After footbath	74.757	1.962	0.973	0.225	41.245

Kidneys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	6.385	148.927	270.513	121.585	214.378	213.900
After footbath	6.634	147.578	247.047	99.469	206.893	202.028
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.745	93.476	194.256	100.780	146.031	143.947
After footbath	1.823	93.083	197.419	104.335	144.249	140.170

Kidneys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.394	0.461	0.414	0.035	0.194
After footbath	80.971	0.450	0.291	0.019	0.152
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.193	2.044	1.020	0.221	40.013
After footbath	74.605	1.913	1.013	0.218	41.309

Now we will look at the experimental results by gender, not by age. First is male. About the average of male showed on the Table 11. It shows relevant data of heart which increased in the parts of duration time and DoVB from short vowel ‘E-‘. Also, the value of jitter improved from sound ‘Nakttangnulkang’. This means that the function of heart is improved. For lung, duration time is improved only for the short vowel of ‘Ah-‘. In the case of kidneys, duration time and DoVB improved from short vowel ‘Uh-‘. For the ‘Meokppangpulbang’ sound related to the kidneys, the parts of jitter and NHR are improved. This means that among the heart and kidneys, especially the function of kidneys is improved.

Table 11. Average value of experimental results for male subjects

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	6.010	118.649	168.967	50.317	151.275	150.412
After footbath	6.287	117.739	164.226	46.487	146.647	145.199
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.799	90.303	194.144	103.840	133.433	135.337
After footbath	1.808	91.666	203.722	112.055	129.879	132.683

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	78.847	0.344	0.300	0.029	0.065
After footbath	77.855	0.374	0.320	0.028	0.039
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	74.360	1.901	1.085	0.210	34.016
After footbath	72.649	1.864	0.930	0.203	38.509

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.669	121.081	164.018	42.936	143.973	147.005
After footbath	6.052	114.476	153.610	39.134	140.774	140.463
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.134	92.627	241.746	149.118	143.581	145.192
After footbath	3.040	93.673	273.434	179.760	141.367	145.437

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	80.187	0.344	0.342	0.029	0.039
After footbath	79.450	0.353	0.298	0.021	0.146
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.424	1.963	0.936	0.227	41.103
After footbath	74.757	1.962	0.973	0.225	41.245

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	5.534	123.513	195.208	71.694	154.328	154.413
After footbath	6.362	118.746	158.351	39.605	147.465	146.442
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.745	93.476	194.256	100.780	146.031	143.947
After footbath	1.823	93.083	197.419	104.335	144.249	140.170

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.940	0.359	0.318	0.023	0.607
After footbath	78.926	0.314	0.373	0.014	0.039
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.193	2.044	1.020	0.221	40.013
After footbath	74.605	1.913	1.013	0.218	41.309

Let's look at the results of experiment on female. This showed on the table 12. It shows relevant data of heart which increased in the parts of duration time and DoVB from short vowel 'E-'. Also, the value of jitter improved from sound 'Nakttangnulkang'. This means that the function of heart is improved. For lung, duration time and DoVB are improved from the short vowel of 'Ah-'. Also, for 'siso, jajangga, chukchukada', DoVB improved only. In the of kidneys, duration time and DoVB are improved from short vowel 'Uh-'. Also, for the 'Meokppangpulbang' sound related to the kidneys, the parts of jitter and NHR are improved. This means that among the heart and kidneys, especially the function of kidneys is improved.

Table12. Average value of experimental results for female subjects

Heart

E-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.794	170.466	278.125	107.474	232.104	227.362
After footbath	5.287	160.361	266.739	107.649	229.554	224.847
Nakdang Nulkang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	1.681	129.635	304.080	173.352	209.019	215.442
After footbath	1.666	132.853	316.898	184.045	203.850	210.084

Heart

E-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	77.872	0.494	0.359	0.034	0.313
After footbath	77.700	0.536	0.413	0.041	0.297
Nakdang Nulkang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.414	1.725	0.832	0.176	26.992
After footbath	74.917	1.626	0.847	0.1685	27.819

Lung

Ah-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.403	169.236	240.328	71.091	212.661	212.738
After footbath	4.929	166.595	239.747	73.151	218.836	216.814
Siso, Jajangga, Chukchukhada	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	3.028	124.212	365.074	240.862	238.990	238.503
After footbath	2.919	135.614	381.000	245.386	229.231	229.598

Lung

Ah-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	78.840	0.360	0.332	0.034	0.475
After footbath	78.477	0.417	0.392	0.031	0.227
Siso, Jajangga, Chukchukhada	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	76.048	1.704	0.971	0.173	32.461
After footbath	75.474	1.820	0.871	0.180	31.460

Kidne-ys

Uh-	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	4.565	175.183	294.505	119.322	229.119	229.226
After footbath	5.166	167.942	262.539	94.596	226.042	223.855
Meokpang pulbang	Duration Time	Min Pitch	Max Pitch	Bandwidth of Pitch	Median Pitch	Mean Pitch
Before footbath	2.311	132.702	344.454	211.752	239.182	233.500
After footbath	2.004	131.025	333.656	202.630	227.337	225.083

Kidne-ys

Uh-	Intensity	Jitter	Shimmer	NHR	DoVB
Before footbath	79.062	0.541	0.399	0.032	0.340
After footbath	78.637	0.463	0.370	0.023	0.126
Meokpang pulbang	Intensity	Jitter	Shimmer	NHR	DOVB
Before footbath	75.898	1.885	0.925	0.188	35.551
After footbath	75.158	1.882	0.908	0.167	35.442

Now we will to summarize the experimental results by gender and age group focusing on the short vowels. The experimental results for 'E-'vowels, Ah-vowel, and 'Uh-'vowel in turn are shown by gender and age group

In the case of E-vowels, the average duration time and DoVB of both male and female are improved. However, the point to note here is that it is most effective in the forties. 'Ah -' vowel was effective for women. Also, the age that showed a significant effect on duration time and DoVB was just in their 40's just like 'E-'vowel. In the case of 'Uh-'vowel, duration time and DoVB are improved with the largest average value. Moreover, the age of 40's of them are the best ones. In conclusion, the age of 40's compared to other ages has the greatest effect on improvement of organ function. More important than anything, experimental results were obtained that it is the most helpful for improving kidneys function especially in other organs. It is believed that this is because the effect of footbath is not greatly influenced by the metabolism is active at the young age. On the contrary, it is considered that since the metabolism in the 50's or older is not active, the effectiveness of footbath was not significant.

Table 13. 'E-'vowels(Related to heart)

	Division	Duration Time increase/decrease value	DoVB increase/decrease value
'E-' Increase/ Decrease Value (Heart)	Average of Total	0.387	-0.022
	Male	0.277	-0.026
	Female	0.493	-0.016
	20'	0.538	0.01
	30'	-0.867	-0.024
	40'	0.711	-0.186
	50'	-0.207	-0.154
	60'	1.359	0.415

Table 14. 'Ah-'vowels(Related to lung)

	Division	Duration Time increase/decrease value	DoVB increase/decrease value
'Ah-' Increase/ Decrease Value (Lung)	Average of Total	0.456	-0.074
	Male	0.383	0.107
	Female	0.526	-0.248
	20'	0.379	0.183
	30'	0.181	-0.138
	40'	0.396	-0.208
	50'	0.073	-0.782
	60'	2.206	-0.446

Table 15. 'Uh-'vowels(Related to kidneys)

	Division	Duration Time increase/decrease value	DoVB increase/decrease value
'Uh-' Increase/ Decrease Value (Kidneys)	Average of Total	0.657	-1.632
	Male	0.716	-0.11
	Female	0.601	-0.214
	20'	0.786	-0.076
	30'	0.115	-0.044
	40'	1.06	-0.595
	50'	0.133	0.027
	60'	-0.249	-0.042

Ⅵ. Conclusions

Our feet play a vital role as they bear weight of whole body and known as five organs are all connected. In this paper, through the dry sericite ceramic ball footbath equipments, we figured out the improving of kidney's function compared to other organs by comparing the voice before and after footbath. Above all, the age group that showed the greatest effect through the footbath is just in their 40s. In the forties, the function of all the organs was activated through the footbath, especially the kidneys function was better than the other organs. This is thought to be due to the fact that the age group in the forties is most affected by health-care equipments than other age groups. In the future, we will continue to study the efficacy of various kinds of health promotion equipments in a quantitative

way.

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