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Do Users Believe that the Efficacy of Hot Springs is Guaranteed?

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ABSTRACT

Hot springs are defined as hot water, mineral water, water vapor, and other gases that gush out from underground. Japan has many volcanoes, and hot water containing various medicinal ingredients gushes out everywhere; therefore, bathing in them can be used to treat illnesses or as a tourist attraction. This study examines whether people bathe in hot springs believing that they are truly effective. As it is believed that the effects of simply soaking in hot water other than hot springs (thermal effects) may be experienced, we will separate the effects, investigate the effects that exist, and state our findings.

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INTRODUCTION

Hot springs are defined as hot water, mineral water, steam, and other gases (excluding natural gas, whose chief components are hydrocarbons) that gush out from underground[1)]. In particular, Japan has many volcanoes, and consequently, hot water containing medicinal ingredients such as carbon dioxide and hydrogen sulfide gushes out in various places. Bathing in hot springs is used to treat illness and they are visited for sightseeing[2)]. People sometimes take *Yunohana* powder (precipitated insoluble components of a hot spring; the chief components are sulfur, calcium, aluminum, iron, and silicon) sold at hot spring resort homes and use it in their bathtubs at home to enjoy the hot spring experience. Commercially available bath salts considered the essence of hot springs, can provide people with a simulated experience of hot springs. In our opinion, almost every Japanese person has bathed in hot springs by the time they became adults.

Hot springs are believed to have certain therapeutic effects. People who recover from an illness visit a hot spring for a long period, soak in hot springs, and drink hot spring water as part of their daily routine; this is called *Toji* (in Japanese it means to cure illness using hot water). It is widely used as a folk remedy (Figure 1) [3)]. When the chemical components contained in hot springs are absorbed into the body through bathing or drinking (hot spring water), they produce various pharmacological effects on the body (scientific effects). Moreover, it has the effects of heat, water pressure, and buoyancy (physical actions and effects). The thermal effect promotes metabolism and regulates the autonomic nervous system, and the water pressure effect is expected to affect exercise and massage. The buoyancy effect reduces the burden on the body, allowing relaxation, and is effective for rehabilitation. The benefits of hot springs go beyond simply soaking in water (the change in the air effect). By gazing at the sky or sea or listening to the sound of a river, people can escape from their daily living environment, which is effective in relieving stress and mental fatigue, and helping to restore health[4)]. Many hot spring facilities commission research and analysis organizations that measure water quality to determine the concentration of ingredients in hot springs and often display the results in the bathhouse. Explanations are available regarding the therapeutic effects of each ingredient (chloride springs containing many chloride ions are effective against cuts and sensitivity to cold, Table 1).

Hot springs have been well established in Japan since ancient times, and have hot spring therapies and balneotherapy doctor[5)]. Hot springs rarely result in short-term recovery, unlike

when taking medicines or undergoing surgical treatment. Although it cannot be said that all benefits of hot springs are ineffective, some may be owing to user assumptions[2]. This study examines whether people bathe in hot springs believing they are truly effective. As bathing in a hot spring appears to have the effect of simply soaking in hot water other than a hot spring (the thermal effect), we decided to separate the effects, investigate the effects that exist, and present our findings.

Hot spring therapy and hot water treatment (Toji)

Toji refers to staying in a hot spring facility for a long period to improve the symptoms of illness and receiving medical treatment using the effects of the hot spring[5]. The custom of hot spring therapy existed as early as the Nara period (around 800 A.D.), and even old Japanese books such as *Nihon Shoki* and *Fudoki* contain descriptions of hot spring therapy.

Hot springs are used to improve symptoms and recuperate from chronic diseases that are difficult to treat with modern medicine because it is believed that by improving the body's natural healing power, it can help heal the disease naturally[5]. Long-term treatment originally involved people using hot springs, meals, and mental refreshments at the place where they stayed (Figure 1). Rather than the ingredients in hot springs having a direct effect on the body, it may be better to believe that they have a weaker complex effect, such as increasing immunity. Sickness is in the mind, however, it is also possible that taking a hot spring bath or traveling with it can make people feel better (by elevating their mood). Modern medicines have a direct effect on the target disease state however, they are only effective against that disease state. Antihypertensive drugs have the effect of lowering blood pressure but have no other effects. When the natural healing power of hot springs is increased, people with high blood pressure experience a decrease in their blood pressure, and people with low blood pressure experience a decrease in their blood pressure, which is expected to help restore the body's internal condition to normal. Such effects cannot be achieved with regular Western medicine (we believe that it may be possible to achieve this with Oriental medicine). To reap the health benefits of hot spring therapy, it should be continued for at least one week, preferably three weeks. Hot spring therapy for a week or more is considered suitable for improving symptoms and recuperating from chronic diseases (e.g., pain, atopic dermatitis, fatigue, stress, anxiety, and depression) (Table 2). In all these cases, abnormalities are difficult to manifest numerically, and it is difficult to completely cure them

using modern medicine alone. Thus, hot springs relieve what cannot be considered a clear medical condition. In addition, hot spring therapy is sometimes used to recover physical strength after cancer surgery. Considering the modern Japanese lifestyle, it is difficult to stay in hot spring areas for several weeks. Furthermore, it is difficult to conclude that the evidence is guaranteed for all diseases.

Are the effects of hot springs guaranteed?

We do not believe that hot water therapy has the same effect as hospitalization. It is possible that the thermal effect may relieve pain and chronic diseases, and that the internal ingredients may improve skin diseases. However, hot springs are natural and do not contain the types or concentrations of effective substances that people prefer or find convenient. Despite a certain ingredient being effective against skin diseases, its concentration may be too high or low in hot spring water. Concentration adjustment is not usually performed in hot springs. There are no reports of people changing the concentrations of the active ingredients. If someone did that, it would generally be considered that it was not a hot spring or that its value would be lowered. As the amount of hot spring water gushing out is small, it may be mixed with other water, such as tap water, reheated because the temperature is low, or diluted with water because it is high. Thus, there are usually no hot springs that can be conveniently optimized for therapeutic effects. It is practical that if hot water therapy is conducted for a long period some effects may be observed, despite the amount of ingredients being low.

However, hot springs may be harmful in some cases[6]. Hot springs that benefit the human body are called therapeutic springs, and the effects and compatible symptoms brought about by these springs are called indications (Table 1) [7]. Adaptive symptoms vary depending on the amount and type of chief ingredients, that is, the quality of the spring. If the symptoms are satisfactory, the hot-spring therapy is suitable for the disease or condition[4]. Hot springs can sometimes cause adverse symptoms, which are known as contraindications. In this case, it is better to avoid bathing in hot springs. For example, salt springs, such as chloride and hydrogen carbonate springs, have symptoms that are generally contraindicated for bathing (acute illness, active tuberculosis, malignant tumors, severe heart disease, respiratory failure, renal failure, bleeding disorder, severe anemia, other diseases in progress, and pregnancy). Hot springs containing iodine are contraindicated for drinking if people have kidney disease, hypertension, or other

conditions that cause swelling or if they have hyperthyroidism. Similarly, sulfate and carbon dioxide springs have general contraindications for bathing, such as drinking them in the event of diarrhea. Sulfur and acidic springs are contraindicated for people with sensitive skin and mucous membranes, particularly those with photosensitivity, and for elderly people with dry skin who cannot bathe or drink them when they have diarrhea[4)].

If people do not drink sufficient water before or after bathing in hot springs, they may become dehydrated. As dehydration can be one of the factors that induce gout attacks, this may be a contributing factor to the acceleration of gout onset when bathing in hot springs[6)]. When bathing in a hot spring, the blood on the surface of the body is pushed into the deep circulatory system, increasing venous return and causing dilation of the heart. As body temperature rises, there is a tendency for tachycardia, the stimulus conduction system is physically stretched, and simultaneously the frequency of activity increases, which is considered the basis for the onset of arrhythmia. Additionally, it has been reported that female diabetic patients have elevated blood levels of heat shock proteins. Although heat shock proteins are believed to help repair tissues in healthy individuals, they are believed to play a role in promoting the onset of diabetes in pregnant women[8)]. Habitual bathing in hot springs during pregnancy may lead to the development of diabetes later in life.

Is it okay not to have the effects of hot springs? (How should we face hot springs?)

It is believed that people visit hot-spring facilities for various purposes. Some people visit hot springs as part of a sightseeing trip, whereas others visit for hot spring treatment. For those visiting as a travel destination even if the hot springs do not have any effect, they only visit as an experience at a travel destination, and there is no purpose to cure illness or anything similar. In this case, whether the hot spring has an effect or strength is not a particular issue. If a medicinal effect occurs from using a hot spring, it may remain in one's memory or encourage visiting the same place repeatedly. Those visiting hot springs for treatment, expect that bathing or drinking from hot springs will increase immunity or heal injuries, even if the effects are weak. It may be true that the ingredients in hot springs have a therapeutic effect, however, whether the concentration of those ingredients is appropriate to provide that effect is another issue.

As presented in Figure 1, the benefits of hot springs are not always the same as those achieved

through treatment at a hospital. People may not be able to realize any effects after experiencing it for a short period. The effects of hot springs can include rest and recreation that would not be considered therapeutic and may even result in stress relief and relaxation. Moreover, there may be preventive measures, such as making people less likely to become unwell over a long period. When people take a break from work and leisurely soak in a hot spring, they experience a non-daily space, which can have some positive effects, such as energizing them for work. These are extremely ambiguous effects on improving diseases and poor physical condition, and although it is difficult to say that hot springs can be linked to treatment, they are often considered to be part of the effects of hot springs. Bathing and drinking from hot springs outside one's home is unusual and rare. It cannot be denied that this may bring about a feeling of euphoria or that simply thinking about it may have a placebo-like effect. Many Japanese people indeed like to visit hot springs for some type of experience, including these effects, and few users complain that they cannot obtain certain effects. However, it is noteworthy that there are cases where the purpose is medical treatment. There is no answer to whether users believe that the efficacy of hot springs is guaranteed, and the percentage is believed to be small. It is believed that certain effects cannot be called treatments, and we believe that this is the reason why Japanese people, in particular, visit hot springs.

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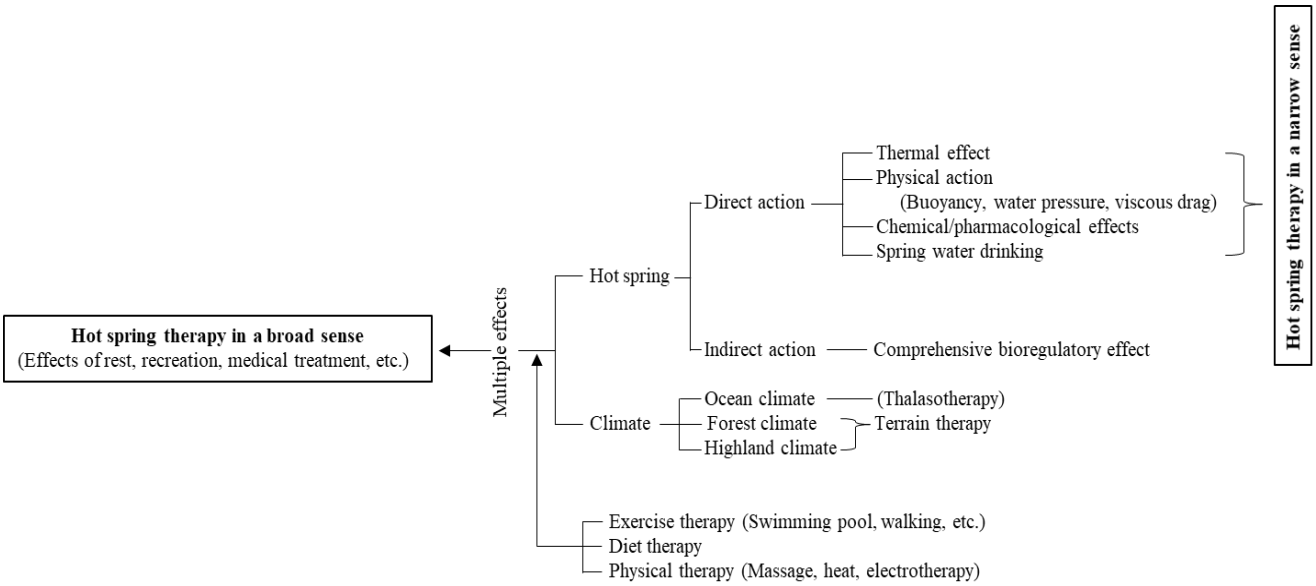

Figure 1 Hot spring therapy (broad definition)

Modified as part of reference 3).

Table 1: Types of hot springs

Type of spring quality	Standards for hot spring water*	Specific indications
Simple spring	The amount of dissolved substances (excluding gaseous substances) in 1 kg of hot spring water is less than 1,000 mg, and the spring temperature at the time of gushing is 25°C or higher.	Autonomic instability, insomnia, depression
Chloride spring	The amount of dissolved substances (excluding gaseous substances) in 1 kg of hot spring water is 1,000 mg or more, and the chief anion component is chloride ions.	Cuts, peripheral circulation disorders, sensitivity to cold, depression symptoms, dry skin symptoms
Hydrogen carbonate spring	The amount of dissolved substances (excluding gaseous substances) in 1 kg of hot spring water is 1,000 mg or more, and the chief anion component is hydrogen carbonate ions.	Cuts, peripheral circulation disorders, sensitivity to cold, dry skin symptoms
Sulfate spring	The amount of dissolved substances (excluding gaseous substances) in 1 kg of hot spring water is 1,000 mg or more, and the chief anion component is sulfate ions.	Cuts, peripheral circulation disorders, sensitivity to cold, dry skin symptoms
Carbon dioxide spring	Hot spring water that contains 1,000 mg or more of free carbon dioxide per 1 kg.	Cuts, peripheral circulation disorder, autonomic instability
Iron-containing spring	Hot spring water that contains 20mg or more of total iron ions (divalent or trivalent iron) per 1kg.	Iron-deficiency anemia
Acidic spring	Hot spring water containing 1 mg or more of hydrogen ions per 1 kg.	Atopic dermatitis, plaque psoriasis, diabetes
Iodine-containing spring	Hot spring water containing 10 mg or more of iodide ions per 1 kg.	Hypercholesterolaemia
Sulfur spring	Hot spring water containing 2 mg or more of total sulfur per 1 kg.	Atopic dermatitis, plaque psoriasis, chronic eczema
Radioactive spring	Hot spring water containing radon of 30 x 10-10 curies or more (more than 8.25 mass units) per 1 kg.	Gout, rheumatoid arthritis, ankylosing spinal inflammation

The chief components are underlined.

This is simply a standard, and it does not necessarily lead to effectiveness.

* The factors listed here determine the differences between hot springs, and other factors determine whether it is a hot spring. In addition to the temperature being 25°C or higher, one or more of the substance concentration conditions must be met, such as dissolved substances being 1000 mg/kg or more, free carbonate concentration being 250 mg/kg or more, and lithium ions being 1 mg/kg or more.

Based on References 1), 3), and 7).

Table 2: Effects of hot springs

Types of chief effects	Applicable symptoms
Pain relief	Chronic pain and stiffness in muscles and joints (chronic diseases such as rheumatoid arthritis, osteoarthritis, low back pain, neuralgia, frozen shoulder, bruises, sprains) Hemorrhoid pain
Improvement of muscle and joint contractures	Muscle stiffness owing to motor paralysis
Blood circulation promotion effect	Cold sensitivity, peripheral circulation disorder Mild hypertension
Immunity enhancing effect	Recovering from fatigue, improving health (improving lifestyle-related diseases)
Others	Decreased gastrointestinal function (heavy stomach, gas buildup in the intestines) Impaired glucose tolerance (diabetes) Mild dyslipidemia (hypercholesterolemia) Mild asthma and emphysema Symptoms caused by autonomic nervous system instability and stress (sleep disorders, depression) Post-illness convalescence period

The above effects are primarily owing to the general application of heat.

In addition to thermal effects (hot water), hot springs contain chemical substances and environmental factors.

The above does not indicate the differences depending on the type of spring quality.

Based on reference 3).