

Onsen/Passive Heating

Bathing in an Onsen is beneficial to health for two main reasons:

- 1) The benefits of passively heating the body
- 2) Being exposed to the properties of the water

Taking each in turn:

1) Passive Heating

The health benefits of physical exercise have been studied for 3/4 decades. Academic research is now investigating passive heating, “thermal therapy”, and early results indicate comparable benefits.

Deep-soaking bathing has thermotherapeutic effects (a higher body temperature stretches capillaries improving circulation, increasing metabolism, and reducing fatigue), water pressure effects (improving the flow of your blood and lymph fluid), and buoyancy effects. The latter, by reducing the body’s weight to one-tenth of what it normally is, allows muscles and joints to rest, enabling tensions in the body to dissipate.

Studies have found that passive heating can induce numerous health benefits, such as improvements to cardiorespiratory fitness, vascular health, glycemic control, and chronic low-grade inflammation. ⁽¹⁾

The table below summarizes the research program to date. Research into the commonalities of the underlying mechanisms is ongoing.

Fig.1 Summary of Chronic Adaptions to Exercise (Ex) and Passive Heating (PH)									
<i>BI: Beneficial Increase, BD: Beneficial Decrease, NE: No Effect, ME: Mixed Evidence, ?: Lacking Evidence</i>									
Cardiorespiratory fitness	Ex	PH	Vascular health	Ex	PH	Cardiometabolic health	Ex	PH	
VO(2max)	BI	BI	Endothelial function	BI	BI	Fasting glucose concentration	BD	BD	
Left-ventricular function	BI	?	Peripheral arterial compliance	BI	BI	Fasting insulin concentration	BD	BD	
Left-ventricular structure	BI	?	Peripheral arterial wall thickness	BD	NE	Fasting lipid concentrations	BD	BD	
Plasma volume	BI	BI	Central arterial stiffness	BD	BD	Resting CRP-α, TNF-, IL-6 concentration	BD	ME	
Mitochondrial biogenesis	BI	ME	Central arterial wall thickness	BD	BD	Body mass	BD	NE	
Capillarization	BI	BI				Resting blood pressure	BD	BD	
Note: <i>The health benefits of passive heating and aerobic exercise: To what extent do the mechanisms overlap?</i> ⁽¹⁾									
Source: Paper noted above, Concept Asia, July 2022									

That luxuriating in a hot bath brings similar benefits to groaning in the gym is an appealing thought. We recommend doing both, a balance in all things.

2) Exposure to the properties of the water

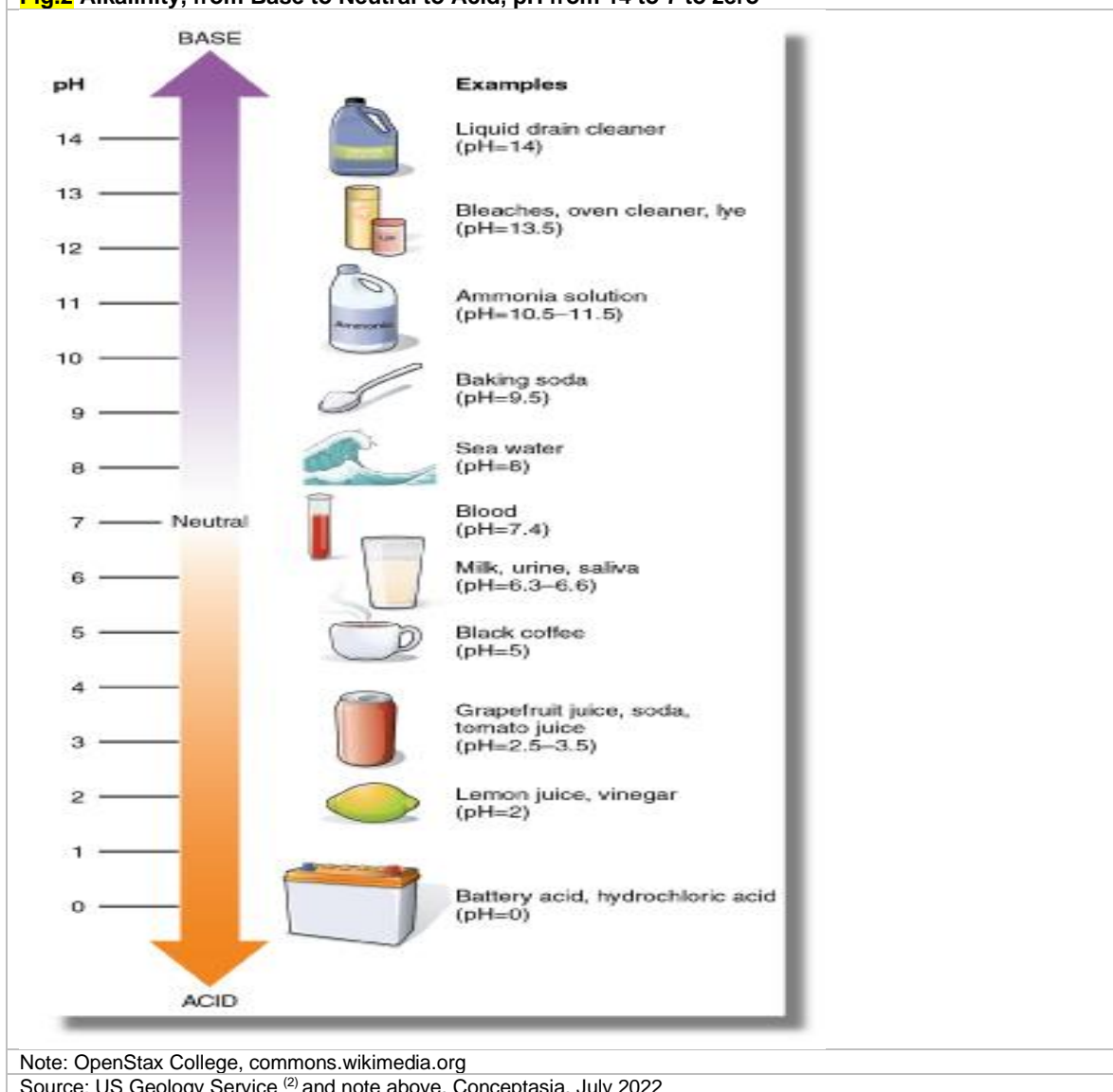
The properties of the water divide into

- A) Alkalinity,
- B) Other minerals present

Alkalinity

pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. Most water for use has a pH of somewhere between 6.5 and 8.5.

Fig.2 Alkalinity, from Base to Neutral to Acid, pH from 14 to 7 to zero



As explained by the US Government website devoted to water science, ⁽²⁾ in a surface water body, such as a lake, the alkalinity in the water comes mostly from the rocks and land surrounding the lake. Precipitation falls in the watershed surrounding the lake and most of the water entering the lake comes from runoff over the landscape. If the landscape is in an area containing rocks such as limestone, then the runoff picks up chemicals such as calcium carbonate (CaCO₃), which raises the pH and alkalinity of the water. In areas where the geology contains large amounts of granite, for instance, lakes will have a lower alkalinity.

Fig.3 pH of everyday drinks

		pH level
1.	Bottled alkaline water	8.5 to 12.0
2.	Tap water	6.5 to 8.5
3.	Bottled water	5.5 to 8.5
4.	Milk	6.3 to 6.6
5.	Black coffee	5.0
6.	Sparkling water	3.0 to 4.0
7.	Soda	2.0 to 4.0

Source: Medical News Today, ⁽³⁾ Conceptasia, July 2022

Normal rainfall has a pH of about 5.6—slightly acidic due to carbon dioxide gas from the atmosphere.

Excessively high and low pHs can be detrimental for the use of water. High pH causes a bitter taste, water pipes and water-using appliances become encrusted with deposits, and it depresses the effectiveness of the disinfection of chlorine, thereby causing the need for additional chlorine when pH is high. Low-pH water will corrode or dissolve metals and other substances. ⁽²⁾

Other minerals present

Fig.4 is a typical sign found at an Onsen. It details the minerals present in the water, and the possible physical benefits. Fig.5 provides the details in English.

Fig.4 Nanasawasou Onsen, Kanagawa Prefecture

【天然温泉】
天狗の湯

【主成分】

水素イオン濃度 (PH)	9.54
メタケイ酸	37.10mg
メタホウ酸	3.60mg
カルシウム	0.42mg
ナトリウム	58.90mg
カルシウム	2.94mg

【効能】

- ・神経痛
- ・リウマチ
- ・全身の凝り
- ・胃腸病
- ・冷性
- ・美肌効果

Source: Author Photo, Conceptasia, July 2022

Water Ingredients	Measure		Efficacy of the Water
Hydrogen ion concentration	pH 9.54	1.	Rheumatoid arthritis
Metasilicic	37.10 mg	2.	Whole body stiffness
Metaboric acid	3.60 mg	3.	Gastroenterology
Potassium	0.42 mg	4.	Colds
Sodium	58.90 mg	5.	Beautiful skin effect
Calcium	2.94 mg		

Source: Conceptasia, July 2022

The Japan Spa Association was founded in 1929 with the stated purpose to contribute to the promotion of the national health and the utilization of tourism resources by researching Onsen, diffusing the knowledge of Onsen, attempting to protect Onsen as limited resources, and improving as well as developing the facilities for their easier use. Currently, there are some 20,972 Onsen in Japan, two-thirds of the global total, providing a rustic, authentic, hyper-specific Wellness experience.

Japan's "Hot Springs Act" provides a legal definition for those wishing to use the Onsen designation. Acquirors of these properties are encouraged to undertake due diligence. An Onsen is defined as hot water, mineral water, water vapor and other gas (excluding natural gas whose major component is hydrocarbons) gushing out from the ground at temperatures of 25 degrees centigrade or more or having one or more of the substances listed in the table below.

Substance name	Amount in 1kg	Substance name	Amount in 1kg
Dissolved substances	Total amount over 1,000mg	Fluoride ion (F-)	Over 2mg
Free carbon dioxide (CO ₂)	Over 150mg	Hydro Arsenate ion (HAsO 4 ²⁻)	Over 1.3mg
Lithium ion (Li+)	Over 1mg	Meta Arsenous acid (HAsO 2)	Over 1mg
Strontium ion (Sr ²⁺)	Over 10mg	Total sulphur (S) *	Over 1mg
Barium ion (Ba+)	Over 5mg	Metabolic acid (HBO ₂)	Over 5mg
Ferro/Ferri ion (Fe ²⁺ /Fe ³⁺)	Over 10mg	Metasilicic acid (H ₂ SiO ₃)	Over 50mg
First manganese ion (Mn ²⁺)	Over 10mg	Bicarbonate soda (NaHCO ₃)	Over 340mg
Hydrogen ion (H+)	Over 1mg	Radon (Rn)	Over 20 unit: ten ppb curie
Bromine ion (Br-)	Over 5mg	Radium salt (as Ra)	
Iodine ion (I-)	Over 1mg		

Footnote: * corresponding to HS- + S₂O₃²⁻ + H²S

Source: Japan Spa Association, July 2020

Fig.7 and Fig.8 come from the Japan Spa Association website. (4) Detailed there are the different water types. For the 10 main classifications, the principal, ingredients, and water characteristics (Fig.7), and the believed associated medical efficacy shown (Fig.8). Fig.8 also gives examples of each Onsen type.

It is unclear, for example, how long and how frequently one needs to be exposed to each different type of water, for the efficacy benefits to be realized.

Fig.7. Hot Spring Types, Water Principal Ingredients and Characteristics			
	Hot Spring Type	Principal Ingredients	Water Characteristics
1.	Simple Alkaline	pH 8.5 or higher	sweet, mild texture, little irritation to the skin, smooth feelings
2.	Chloride: sodium-chloride spring, calcium-chloride spring, magnesium-chloride spring	negative ions, chloride ions	Salty taste (salt component) or bitter (high salinity, or high in magnesium)
3.	Carbonated: hydrogen carbonate spring, calcium hydrogen carbonate spring, magnesium hydrogen carbonate spring	Hydrogen carbonate ion	
4.	Sulphate: sodium-sulphate spring, calcium-sulphate spring, magnesium-sulphate spring	Sulphate ion	
5.	Carbon dioxide	Free carbonate (CO ₂)	Small bubbles of carbonic acid adhere to the skin, feels refreshing
6.	Ferruginous: bicarbonate type, sulphate type	Iron ion (20 mg/kg or more)	Red colour when exposed to air (iron being oxidised)
7.	Acidic	Hydrogen ion (1 mg/kg or more)	Sour taste, sterilization effect
8.	Iodine-containing	Iodine ions (10 mg/kg)	Mainly non-volcanic Onsen, water has yellow tinge
9.	Sulphur: Sulphur type, hydrogen sulphide type	Sulphur (2 mg/kg)	Rotten eggs odour (hydrogen sulphide)
10.	Radioactive	3 nanocuries/kg or more of radon	
Footnote: Hot springs that contains mass of dissolved ingredients (exclusive of those that in the form of gas) 1,000 mg/kg or below, and the temperature measured at the gushing point is 25 degrees Celsius or more.			
Source: Japanese Spa Association, Conceptasia, July 2022			

Fig.8 Hot Spring Types, Efficacy from Bathing, Onsen examples			
	Hot Spring type	Efficacy from Bathing (useful for combatting)	Onsen Examples (Prefecture)
1.	Alkaline	Autonomic instability, insomnia, and depression	Gero (Gifu), Kakeyu (Nagano)
2.	Chloride	Cuts, peripheral circulation failure, excessive sensitivity to cold, depression, dry skin	Atami (Shizuoka), Katayamatsu (Ishikawa)
3.	Carbonated	Cuts, peripheral circulation failure, excessive sensitivity to cold, dry skin	Kawatsu (Wakayama), Otani (Nagano)
4.	Sulphate	Cuts, peripheral circulation failure, excessive sensitivity to cold, dry skin	Hoshi (Gunma), Amagi-yugashima (Shizuoka)
5.	CO ₂	Cuts, peripheral circulation failure, excessive sensitivity to cold, autonomic instability	Nagayu (Oita), Kogane (Yamagata)
6.	Ferruginous		Arima (Hyogo)
7.	Acidic	Atopic dermatitis, plaque psoriasis, impaired glucose tolerance, (diabetes), epidermoid suppuration	Tamagawa (Akita), Sukawa (Iwate)
8.	Iodine		Aomori (Chiba), Maenohara (Tokyo)
9.	Sulphur	Atopic dermatitis, plaque psoriasis, chronic eczema, epidermolysis. (Peripheral circulation failure as well in hydrogen sulphide type)	Nikko Yumoto (tochigi), Kowakudani (Kanagawa)
10.	Radioactive	Hyperuricemia (gout), rheumatoid arthritis, ankylosing spondylitis	Misasa (Tottori), Masutomi (Yamanashi)
Footnote: Hot springs that contains mass of dissolved ingredients (exclusive of those that in the form of gas) 1,000 mg/kg or below, and the temperature measured at the gushing point is 25 degrees Celsius or more.			
Source: Japanese Spa Association, Conceptasia, July 2022			

For those interested in more information, *Onsen in Japan* ⁽⁵⁾ is a recently published guide to Japan's Onsen.

For those interested in reproducing an Onsen bath experience at home, Bathclin ⁽⁶⁾ also provides some background on the health benefits of its products.

References

- 1) *The health benefits of passive heating and aerobic exercise: To what extent do the mechanisms overlap?* by Tom Cullen, Neil D. Clarke, Matthew Hill, Campbell Menzies, Christopher J. A. Pugh, Charles J. Steward, and C. Douglas Thake, September 2020
- 2) <https://www.usgs.gov/special-topics/water-science-school/science/ph-and-water>
- 3) *Medical News Today* website, part of Healthline Media UK Ltd.,
<https://www.medicalnewstoday.com/articles/327185>
- 4) *Japan Spa association*: <https://www.spa.or.jp/en/>
- 5) *Onsen of Japan: Japan's Best Hot springs and Bathhouses*, by Steve Wide and Michell Mackintosh, 2018
- 6) <https://www.bathclin.co.jp/en/happybath/bath-additive/a-masterclass-in-the-effects-of-six-bath-additives/>