

JAXA Space Medicine Leaflet No.2



Tips for Health Promotion Learned from Space Medicine

JAXA, the Japan Osteoporosis Foundation, the Japan Society on Urolithiasis Research, the Japan Atherosclerosis Society, and the Japan Society of Health Promotion provide you with tips and hints for health promotion, from the viewpoints of their respective expertise.



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Mission of Astronaut Hoshide

Astronaut Hoshide, who has been on the International Space Station (ISS) since July 2012 and had stayed for about 4 months, had conducted various activities including the operation of the Japanese Experiment Module (named “Kibo”), extravehicular activities, scientific experiments for Japan, and international and domestic space medical experiments. Taking physiological countermeasures during his long-duration stay alleviating medical risk, he returned to the Earth in November 2012.

Conducting life science experiments in “Kibo” — a home in space assembled by Hoshide and other crew members

Making the most of the characteristics of his own experience as an engineer, Astronaut Hoshide conducted space experiments in the pressurized module (PM) that he assembled in 2008. Also included in his mission are inspecting and installing the Aquatic Habitat (AQH), extravehicular experiment equipment, and Multi-mission Consolidated Equipment (MCE) that were launched on JAXA’s H-II Transfer Vehicle (HTV3) KOUNOTORI3 in July 2012. AQH is an experimental long-term breeding facility for Medaka (Japanese killifish) and Zebrafish used in research on the mechanism of environmental adaptability over generations and the effects of zero gravity (microgravity) on bones and muscles. In the first experiment in space using Medaka, Astronaut Hoshide operated the AQH and conducted the sampling of small vertebrate.

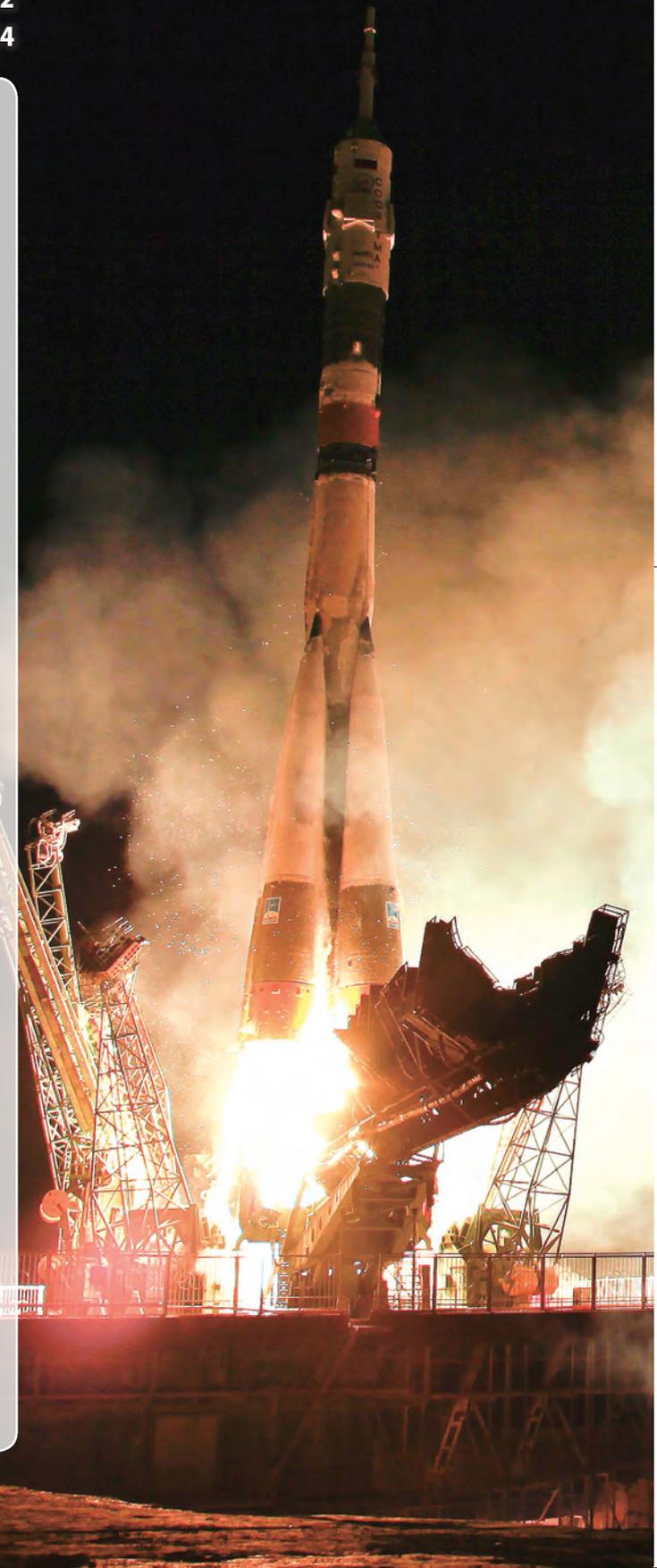
Verification of new experiment methods and opportunities through small satellite deployment

Just like ordinary parcels, five small satellites (10 cm in size) were launched onboard KOUNOTORI3 to ISS. By manipulating Kibo’s robotic arm, Hoshide successfully deployed the satellites into space. This was the first deploying method conducted in space, and will serve a key to developing and verifying new experiment methods.

Management/repair of equipment on the ISS and Kibo and related extravehicular activities

Astronaut Hoshide, the first Japanese Astronaut in charge of operating Japanese spacecraft, supported the docking and undocking maneuvers of KOUNOTORI3 (HTV3) by manipulating the robotic arm of the ISS. Along with maintenance and management, various types of equipment and systems onboard were replaced or repaired, with extravehicular activities being conducted to replace the NASA power system switching units and the camera light pans installed outside the ISS. Extravehicular activity is an essential mission for acquiring the know-how and skills needed to design and develop extravehicular facilities, and conduct research and development of space suits for the future.

Photos courtesy of JAXA and NASA



Tips for Health Promotion Learned from Space Medicine

1. Need for extension of healthy long-life

'Abridged Life Tables' released by Ministry of Health, Labour and Welfare show that Japan's average life expectancy (indicating the average number of years that a newborn in a given year can statistically expect to live) marked 65.3 years for men and 70.2 years for women in 1960, but has since reached 79.6 for men and 86.4 for women as of 2010. Five decades have thus seen an extended life expectancy of about 15 years for both men and women. Healthy life expectancy—meaning the average number of years that a newborn in a given year can expect to live in full health, living an independent daily life—has conversely been recorded at 70.4 years for men and 73.6 years for women. In other words, the last decade of life means 'an unhealthy period' that leads to higher medical and nursing care expenses. Extending healthy life expectancy and alleviating medical expenses requires lifestyle improvement, such as preventive diet and exercise for cerebral vascular and osteoporosis, along with incorporating into daily life the sustainable tips based on health science. Many countries expect the efforts made by Japan, where an aging society with a declining birthrate has been rapidly growing, as a pioneering leader in health promotion activities.

2. Space medicine is the ultimate preventive medicine

Since ancient times, humans have dreamed of going to space. Cosmonaut Gagarin in Russia succeeded in making the first human spaceflight in 1961, when space medicine emerged as 'Survival technology' required for humans to stay outside the Earth, in zero-gravity or a high vacuum. For 50 years since then, about 500 astronauts have experienced spaceflights, while improved health management technology for astronauts has enabled Japanese astronauts to stay on the International Space Station (ISS) for six months. To date, space medicine has developed into 'The ultimate preventive medicine' for enhancing the performance of astronauts under severe circumstances exposed to zero-gravity and high-level radiation, while alleviating their medical risks.

3. Applying the knowledge of space medicine to life on the ground

Bone loss and urolithiasis are common medical issues among elderly people and astronauts. Space medicine applies health promotion technology on the ground to the health management of astronauts in space, while the research outcomes of space medicine are expected to enlighten health promotion directed at middle-aged people, the elderly, and children as well on Earth. For example, in Japan there are now about 13 million osteoporosis patients, of which about 160,000 undergo operations every year due to fractures and related bone problems, and many do not have any treatment until they actually break bones. This suggests that having regular bone checkups and taking preventive measures may help to avoid fractures relative to osteoporosis that accompanies the aging process. We look forward to the coming future when the outcomes of space medicine introduced in daily medical care will contribute to enlightenment in preventive medicine.

JAXA has summarized information of the tips for health promotion for children and middle-aged and elderly people, as assisted by the Japan Osteoporosis Foundation, the Japan Society on Urolithiasis Research, the Japan Atherosclerosis Society, and the Japan Society of Health Support. Returning the outcomes of space medicine to on-ground life is one of the missions of JAXA.

We do hope this brochure will help your healthy life.

JAXA Astronaut
Satoshi Furukawa



Space medicine, the ultimate preventive medicine

Objective and method of space medicine

Spaceflight entails diversified medical risks for astronauts due to living under environments that include microgravity, orbiting the Earth every 90 minutes, a closed and isolated environment, and exposure to space radiation. Space medicine aims to maintain and improve the performance of every astronaut and the teams, as well as mitigate such possible medical risks in human space flight.

Space medicine research extracts the highest priority tasks after confirming the significance of medical risks in five respective areas (physiological countermeasures, psychological support, cosmic radiation exposure management, on-orbit medical system, and monitoring of module environment), in reference to the impacts on astronauts and missions, and the frequency at which such risks occur.

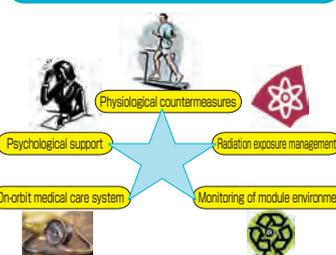
Countermeasures for the highest priority tasks such as bone loss or mental stress are devised based on scientific evidence for their effectiveness and side effects. Following the confirmation of risk mitigation through ground verification (bed rest and closed-environment experiments), and space experiments, such measures are incorporated into medical operation for astronauts. The outcomes of research on space medicine created in space, utilizing the excellent technology of health science on the ground, are now expected to contribute to your health promotion on the ground.

Space environments and Medical risks in spaceflight

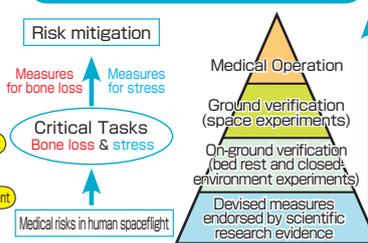
- **Microgravity**
Bone loss / muscle atrophy
Vestibular dysfunction / space motion sickness
Cardiovascular & Autonomic Deconditioning
- **Orbiting the Earth every 90 minutes**
Insomnia / Reduced efficiency in daytime work
Dozing, error, and accidents
- **Closed environment and multi-culture**
Mental stress / depression / anxiety
Decline of performance
- **Cosmic radiation exposure**
Risk of contracting cancer,
reduced immunity

To maintain the high performance of astronauts and to alleviate their medical risks in spaceflight, improved health care technologies for astronauts are indispensable.

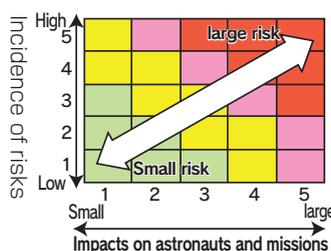
5 areas in space medicine research



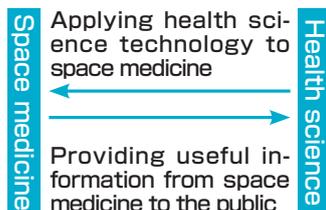
Process in space medicine research



Assessment of medical risks



Relation between space medicine and health science



Stress tolerance and team building

Long-duration stays in a closed and isolated environment result in anxiety and depression among humans. Just leaving humans in that condition will induce insomnia and less concentration during the daytime, leading to a decline in the performance of astronauts and their teams, and possibly causing error. In order to prevent such a situation, astronauts undertake training to enhance their psychophysiological stress tolerance and acquire the ability to take appropriate actions as a team member at any time.

The training starts with classroom lectures on the main stress factors and their desirable measures. Subsequent outdoor training in summer and winter provide astronauts with the skills for smooth team relations (including leadership, followership, and in-team communication) through practical experience in living together. The final step is the team's communal life in an environment that simulates such practical missions as operating a facility on the seabed or in a cave, and is intended to confirm their ability to exhibit the knowledge and skills that they acquired in training.

Abilities and training required for astronauts





Home page of JAXA Space Medicine

<http://iss.jaxa.jp/med/research/>

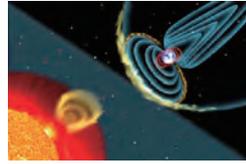
Visit this website for an outline of the research conducted by JAXA on space medicine and biology, and more useful information on workshops, etc.

Cosmic radiation exposure management

Directly affected by radiation particles from distant galaxies and the Sun, astronauts staying on the International Space Station without atmosphere or a magnetic field are exposed to radiation amounting 0.5 – 1.0 mSv per day, while on the Earth the average radiation exposure per year is about 2.4 mSv.

Referring to the advice of the International Commission on Radiological Protection (ICRP), JAXA has laid down the lifetime effective dose limit and tissue-equivalent effective dose limit in spaceflight of ISS. During the stay of astronauts on the ISS, their radiation environment is monitored in real time, along with such aspects of risk management as mission planning to avoid exposing astronauts to radiation exceeding those dose limits.

Cosmic radiation exposure management



Lifetime effective dose limit of astronauts

Age of the 1st flight	man (mSv)	woman (mSv)
27 ~ 29	600	600
30 ~ 34	900	800
35 ~ 39	1000	900
40 years and older	1200	1100

Source: Guideline for radiation exposure management of astronauts onboard the ISS in 2001

Kinds of space radiation

- Galactic cosmic ray
- Solar radiation
- Trapped radiation (Earth's magnetic field)

Radiation Exposure in ISS 0.5 ~ 1.0mSv/day

Measures for radiation exposure management below the limits

- Real-time monitoring of radiation environment (space weather forecasts)
- Radiation measurement of each astronaut (portable dosimeter)
- Countermeasures for space radiation (shielding or return to Earth)



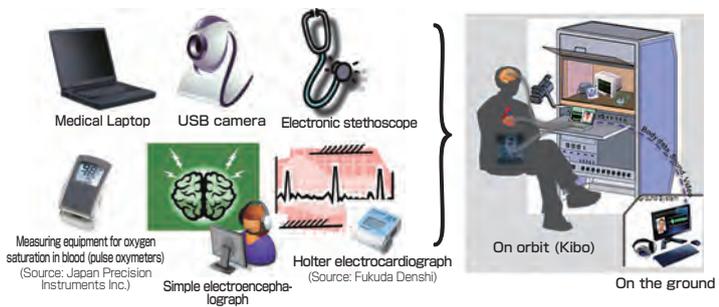
On-orbit remote medical care

During missions to the Moon or Mars, astronauts cannot immediately call an ambulance service in case of sickness. This demands an on-orbit medical care system that enables on-ground support, if necessary, once an astronaut has assessed his/her own physical condition.

JAXA has begun verifying the remote medical care system's display of medical-use PC medical data on astronauts in space as acquired through small medical equipment, which allows astronauts to assess their own physical condition. Once this system for assessing physical condition at home by referring to acquired data and external support is constructed, it is expected to help prevent severe diseases and mitigate medical expenses.

On-orbit medical care system required for missions to the Moon and Mars

- Uniform management of medical data with medical-use PC
- Physical condition assessment by astronauts in referring to medical data
- Remote medical care support from the ground provided as necessary



Health promotion for general public learned from space medicine

Japan's super-aging society is now experiencing a surge in the number of femoral neck fractures relating to osteoporosis and falling down, thereby posing a major social problem. Although enlightened medical checkups and treatment have reduced the number of fractures in Northern Europe and Canada, the low bone checkup rate of 20% in Japan has led to many cases of treatment after a fracture occurs, thus resulting in high medical expenses that become a burden for families and society. Space medicine aims to alleviate medical risks to an acceptable level by understanding medical risks and taking preventive measures. Based on an understanding of the importance of preventive medicine along with reference to efforts made in space medicine, health promotion and reduced medical expenses can be expected by incorporating health promotion technology into daily life.

Enlightenment of the importance of preventive medicine and daily practice of health promotion technology will promote people's health and reduce medical expenses

Which will be you, 10 or 20 years later?

Enjoy free action with a beautiful posture vs. Suffering from stooping and back pain

Bone age 50 vs. Actual age 70 vs. Bone age 90

For healthy life without fractures

- Young people: Save bone density! Lifestyle (exercise & diet)
- Aged people with bone loss: Prevent any more bone loss! Bone quantity checkup + Lifestyle good for bones
- Elder people with osteoporosis: Prevent fractures by increasing bone density! Continued bone medical treatment + Lifestyle good for bones

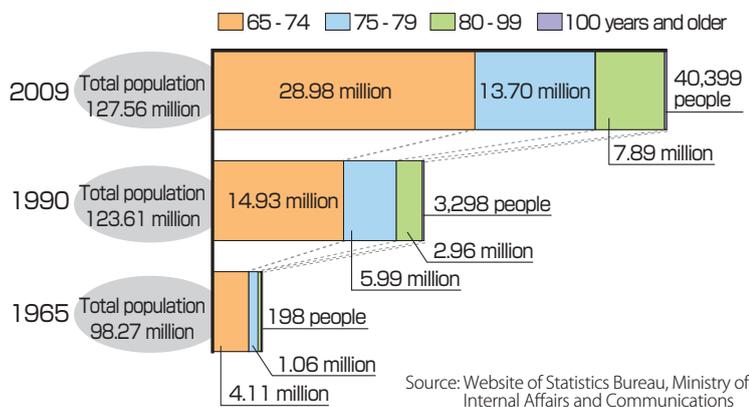
Source: "What is osteoporosis?" (compiled under the supervision of Toshitaka Nakamura)

Advice for Health Promotion from the Japan Osteoporosis Foundation

Osteoporosis patients increasing annually in Japan's current super-aging society

As one of the world's super-aging societies, Japan has a growing number of osteoporosis patients every year. The number of patients aged 40 years and older who suffer from osteoporosis has risen to 12.8 million (3 million men and 9.8 million women), while annual incidence by age marks 0.6 % of men and 2.3 % of women among those 40-79 years old, with about 970,000 new osteoporosis patients being reported every year. Previously considered not a disease but a phenomenon of aging, osteoporosis is now considered a diseased aging of the bones, and definitely 'a disease'. As shown in the pictures and in contrast to healthy bones with vertically and horizontally closely combined trabeculae that give the impression of a solid structure, the bones of patients with osteoporosis show vertical trabeculae standing out and invoking a feeble impression due to the hollow structure.

Population of the elderly in Japan



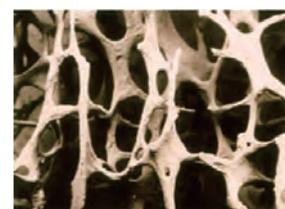
●● Osteoporosis ●●

Osteoporosis is a morbid state in which bone becomes fragile increasing risk of fracture.

- Stooped back and shortened height
- Decline in motor function
- Mostly women



Healthy bones

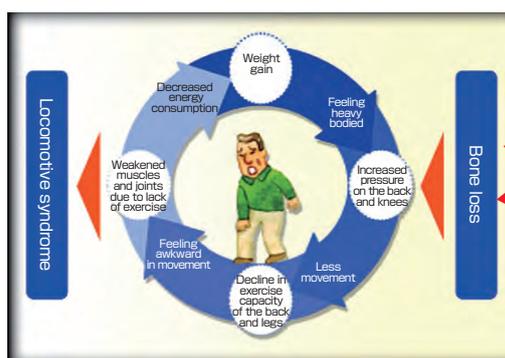
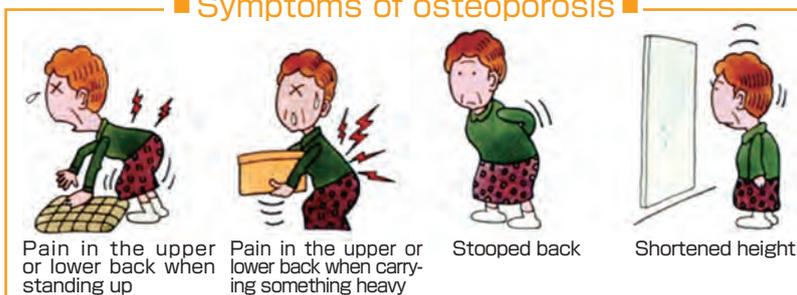


Bones of patients with osteoporosis

Orderly lifestyle for the prevention of osteoporosis

Osteoporosis causes pain in the upper or lower back when one stands up and carries heavy objects, a stooped back, or shortened height. As shown in the figure, bone loss leads to a vicious circle that subsequently includes locomotive syndrome, which weakens joints and muscles. Fractures arising from osteoporosis, particularly in the proximal part of thigh bones, are also highly likely to result in a person becoming bedridden, thereby adversely affecting the patient's vital prognosis. Thus, the prevention of osteoporosis is so important that people should get into the habit of living an orderly lifestyle.

■ Symptoms of osteoporosis ■



This is a vicious spiral for aging of the back and legs!



The principles of prevention are diet, sunbathing, and exercise.

Japanese generally lack calcium (Ca) intake. Prevention of osteoporosis requires the intake of such high-calcium foods as small fish and dairy products like milk, and vitamin D to help absorb Ca. Fish, Jew's ear, and sun-dried shiitake mushroom are good sources of vitamin D.

Sunbathing following the intake of Ca and vitamin D brings about synthesized vitamin D. Keep in mind that the use of UV protection cosmetics disturbs vitamin D synthesizing. As for exercise, 3 – 5 days a week of light sweating exercise lasting 30 – 60 min. per day are recommended.

Vitamin D intake and sunbathing that help calcium absorption

Vitamin D from daily diet: fish, cloud ear mushroom, etc.



Effectiveness of exercise

Exercise does not increase bone density immediately, but ...



1. Muscle strength maintenance

Weakened muscles mean weakened bones. Strengthened abdominal muscles strengthen the internal organs.

2. Fall prevention by maintaining a sense of balance

Falling is the most frequent cause of fractures.

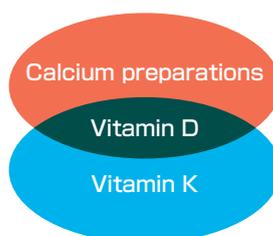
Exercise reduces the possibility of fractures!

Take medicine properly and regularly

Once diagnosed as having osteoporosis, one must take the prescribed medicine properly and have an orderly lifestyle. In fact, taking the prescribed medicine properly and regularly was recently found to reduce the incidence of fractures by half, and medicine that increases bone density is now available on the market. This means that drug therapy for osteoporosis has achieved remarkable progress. What is the most important for osteoporosis patients is to properly and regularly take the medicine prescribed by doctors without giving up.

For strengthened bones

Medicine that helps calcium absorption from diet



Medicine making healthy bones

Medicine that helps stop calcium depletion from bones

Female hormone
Selective estrogen receptor modulator (SERM)
Bisphosphonate

Medicine that encourages osteogenesis

Para-thyroid hormone preparations



Bright and active everyday life

It is hard for a sick or long bedridden person to wish for a bright future. Everyone needs to review their own lifestyle and make efforts toward improvements in daily life for the benefit of a healthy and happy life.



For the benefit of a healthy and happy society of longevity

1. Checkup before fractures

Let's have a bone checkup regularly

2. Maintenance of strong bones

Sunbathing, exercise, calcium

3. People who need medicine

Reducing the incidence of fractures to half

Advice for Health Promotion from the Japan Society on Urolithiasis Research

7000-year history of urolithiasis

Since ancient times, humans have suffered from urolithiasis, the history of which dates back to 4800 B.C., as confirmed by the discovery of urinary stones in Egyptian mummies. (Source: Trans Path Soc Lond 56: 275-290, 1950)
In today's space era, urolithiasis were reportedly found in more than 10 astronauts involved in the manned space programs of NASA. (Source: Nephron 89: 264-270, 2001)



A 13-year-old Egyptian boy who suffered from urolithiasis

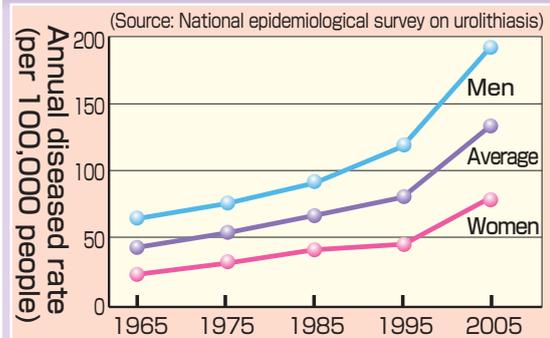
Growing number of patients suffering from urolithiasis

Developed countries are now seeing a rapidly growing number of urolithiasis patients. The incidence rate of having urinary calculi once in a lifetime is high in Japan (at 1 in 7 men and 1 in 15 women), coupled with a high recurrence rate of about 40% in five years.

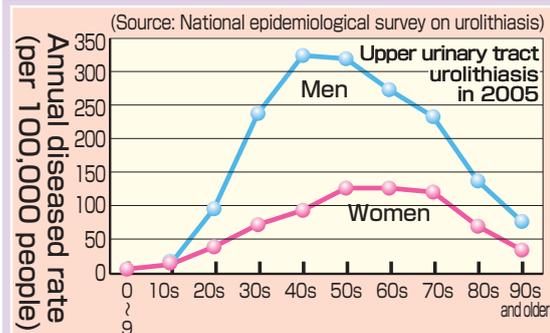
The frequency of occurrence peaks among men in their 30s-60s who are in the prime of life, and among women after the age of 50. This is because men develop urolithiasis due to their westernized diet, while this condition among women is mainly due to osteoporosis. The incidence ratio of men and women stands at 2.35 versus 1, which is considered due to the preventive effects afforded by female hormones. Generally, urolithiasis consists of 95% of upper urinary tract urolithiasis and only 5% of vesical calculi. Urolithiasis accounts for about 90% of the content of urolithiasis, which means that urolithiasis results from westernized diet and bone diseases.

Rapid increase in the number of urolithiasis patients

Men: 1 in 7 Women: 1 in 15



Women are liable to urolithiasis after menopause, Just as osteoporosis!



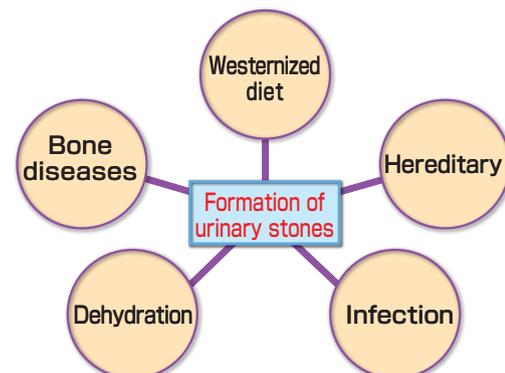
Urolithiasis symptoms and diagnosis, and severe abdominal pain

The most common symptoms of urolithiasis include hematuria, severe abdominal pain, and lower back pain, sometimes accompanied by vomiting and painful urination. Although relatively easy to diagnose with X-ray and CT examinations, this disease definitely requires diagnosis so as to discriminate it from cancer.

Surgical treatment with less pain

Urinary calculi no larger than 1 cm are treated as being naturally excreted, and urinary calculi no larger than 5 mm are generally expected to be excreted naturally in particular. Cases requiring surgical treatment are as follows: ① patient with large-sized urinary calculi, ② patient with declining kidney function, and ③ repeated infection and pains. This type of treatment employs an Extracorporeal Shock Wave Lithotripter (ESWL) that uses shock waves generated outside the body to break urinary stones into small pieces, and promotes the excretion thereof. In Japan, more than 90% of patients undergo treatment using the ESWL, sometimes with endoscopic surgery.

Urolithiasis caused by many factors

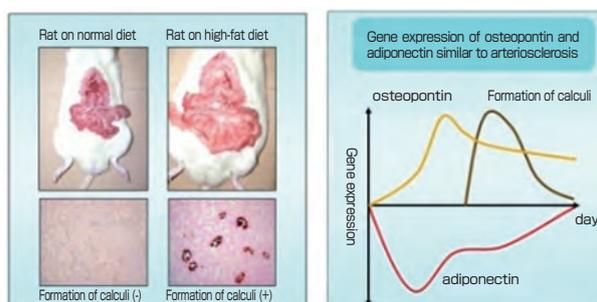


Various causes of urolithiasis

Urolithiasis is caused by various factors. Though the key factor is the Westernized diet of the Japanese people, other factors include bone diseases, dehydration, infection, and hereditary. In the Westernized diet, an excessive consumption of cholesterol in particular is identified as the main culprit. The figures show a rat that developed kidney stones after visceral fat obesity due to excessive cholesterol consumption.

Recent studies revealed that people with lifestyle-related diseases or visceral fat obesity often develop urolithiasis complications. Regarding its relation with bone diseases, urolithiasis often develops among many women after menopause or long-term bed rest. This disease often occurs in summer, due to the thicker nature of urine then. At present, only 1% of urolithiasis is attributed to hereditary.

Is urolithiasis metabolic syndrome?



Dietary cure, Eicosapentanoic acid, and PPAR γ (PPAR-gamma)

Principles of diet guidance

Foods to limit excessive consumption

- Animal protein (1.0 g per kg per day)
- Oxalate
- Salt (less than 10 g per day)
- Fat
- Sugar

Principles of diet guidance

Foods to be recommended for proper-quantity consumption

- Calcium (600 – 800 mg per day)
- Grain
- Vegetables
- Blue-black fish
- Citric acid

Guidance on drinking water

- Standard of water intake
- More than 2,000 ml, diets not included (Urine volume amounting more than 2,000 ml.)
- Source of water supply

Not specified

Desirable to avoid excessive drinking of:

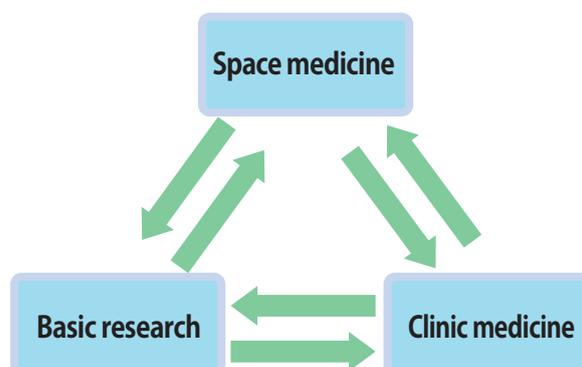
- Soft drinks
- Sweetened drinks
- Coffee & tea
- Alcoholic drinks

Preventive measures for urolithiasis and its recent incredible progress

As seen in the causes of this disease, a dietary cure is the most effective method of prevention. The main principle is to consume less fat, animal protein, and sugar—all of which are commonly used in the westernized diet. Given the fact that calcium oxalate is the main constituent of urinary stones, consuming less oxalate is also effective. Desirable foods for a cure include plenty of calcium and vegetables. This cure also requires the daily intake of more than 2,000 ml of water. Sweeteners and alcohol should be avoided, though the source of the water supply is not designated.

Urolithiasis in space medicine

The microgravitational environment in space dissolves calcium in bones because of accelerated resorption, which increases the risks of bone loss and urolithiasis. Joint research conducted by JAXA and NASA on preventive countermeasures has confirmed that bisphosphonate preparations used for osteoporosis treatment also help prevent urolithiasis. The outcomes of space medicine research that applies on-ground basic research are returned to Earth and then applied to clinical medicine. Our medicine is thus steadily making progress.



Descriptions of Metabolic Syndrome and Dyslipidemia

Finding in-depth information on the health problem

1 Metabolic syndrome

Metabolic syndrome risk factors include glucose metabolism disorder, dyslipidemia, and hypertension. It is well known that although these individual disorders are not severe alone, any combination of these increases the likelihood of developing coronary artery disease. Clustering of these risk for atherosclerosis is found to occur based on visceral obesity. The key to treating metabolic syndrome is not only the medical treatment of respective pathological conditions but also improvement of life-style such as dietary care and exercise therapy toward visceral fat loss, which is more important.

2 Dyslipidemia

Dyslipidemia is recognized as a prominent risk factor for atherosclerosis. Along with such healthy practices as not smoking and the management of hypertension, the treatment of dyslipidemia is essential to prevent coronary heart disease (line3; coronary artery disease) and cerebral artery diseases. Medical examinations should be required at an appropriate medical institution when dyslipidemia is suspected in a medical checkup.

●● Criteria for Clinical Diagnosis of Metabolic Syndrome ●●

Accumulation of visceral fat (abdominal fat)

Waist circumference Men \geq 85 cm
 Women \geq 90 cm
 (Visceral fat area: Men & Women \geq 100 cm² equivalent)

The management of elevated LDL cholesterol (though not including the conditions of metabolic syndrome) is essential for prevention of atherosclerosis. Lifestyle improvement focused on dietary care and exercise therapy is essential to visceral fat loss.

*For visceral fat measurement, such checkup methods as taking a CT scan are recommended.

*Waist circumference is measured at the navel level, with the person standing upright and breathing normally.

*Once diagnosed as having metabolic syndrome, a person should undergo a glucose tolerance test (though not mandatory). However, in case of undergoing drug therapy for hypertriglyceridemia, low HDL cholesterol, hypertension or diabetes, the respective condition of B is considered to be positive.

*The existence of diabetes or hypercholesterolemia does not exclude the diagnosis of metabolic syndrome.

Besides the waist circumference as indispensable prerequisite, two or more of the following three conditions are required for the diagnosis.

Hypertriglyceridemia \geq 150 mg/dL
 and / or
 Reduced HDL cholesterol (Hypo-alpha-lipoproteinemia) $<$ 40 mg /dL Men & Women

Systolic blood pressure \geq 130 mmHg
 and / or
 Diastolic blood pressure \geq 85 mmHg

Elevated fasting glucose \geq 110 mg /dL



○cm!

Is this metabolic syndrome?

●● Dyslipidemia: diagnostic standard for screening (fasting blood test*) ●●

LDL cholesterol	140 mg/dL or more	High LDL cholesterol
	120 - 139 mg/dL	Borderline high LDL cholesterol **
HDL cholesterol	less than 40 mg/dL	Low HDL cholesterol
Triglyceride	150 mg/dL or more	Hypertriglyceridemia

Borderline high LDL cholesterol: Treatment of high LDL cholesterol must be considered for people with a high risk of arteriosclerosis, and who have cerebral infarction, atherosclerosis after menopause, diabetes, and chronic kidney disease.

● LDL cholesterol is estimated with Friedewald's equation (TC-HDL-C-TG/5). (For TG less than 400mg/dL)

● For TG of 400 mg/dL or more in a fasting blood test, non HDL-C (TC - HDL-C) is used with LDL-C+30 mg/dL as standard.

* " Fasting " refers to 10 - 12 hours of fasting or longer. Water supplied through drinks with no calories, such as water and tea is allowed.

** When screening shows borderline high elevated LDL cholesterol, both high risk conditions and the need for treatment must be considered.



Non smoking, diet and exercise

1 Non smoking

Smoking increases the risk of developing atherosclerotic diseases. One should therefore quit smoking immediately as coexistence with other risk factors accelerates mortality.



2 Diet

- Adjusts total energy value.
- Adjusts nutritional balance.
- Adjusts intake of cholesterol, saturated and unsaturated fatty acids.
- Corrects inappropriate diet and eating behavior



3 Exercise

- Prevents atherosclerotic diseases and metabolic syndrome.
- Has treatment effects.
- Increases HDL-cholesterol and decreases triglyceride.
- Improves insulin resistance.
- Reduces stress, enhances bone density and cerebral function, and improves quality of life (QOL).



Lifestyle improvement



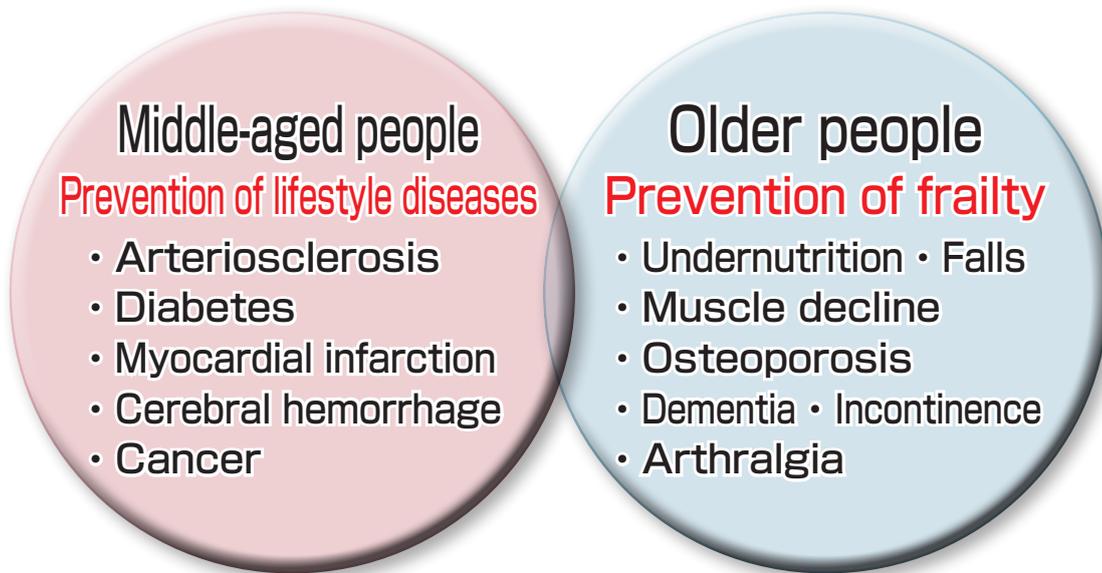
—Tips for maintaining motivation—

The first tip is to have an interest in addressing lifestyle diseases. The second is to become aware of your own health and improvements in the quality of life, thereby leading to your family's happiness. Information on your condition is thus conveyed to the people around you and society, resulting in your finding new motivations for better living as well as your own good health.

Three Tips for a Healthy Long-Life

Health promotion for older adults differs from that for middle-aged people

The health promotion for older adults focuses on “frailty prevention”, preventive measures for undernutrition, muscle decline, bone loss, and falling, while that for middle-aged people focuses on the “prevention of lifestyle diseases” such as diabetes which result from excessive nutritional intake and lack of exercise. Elderly people face new health issues even after overcoming the risks of lifestyle diseases.

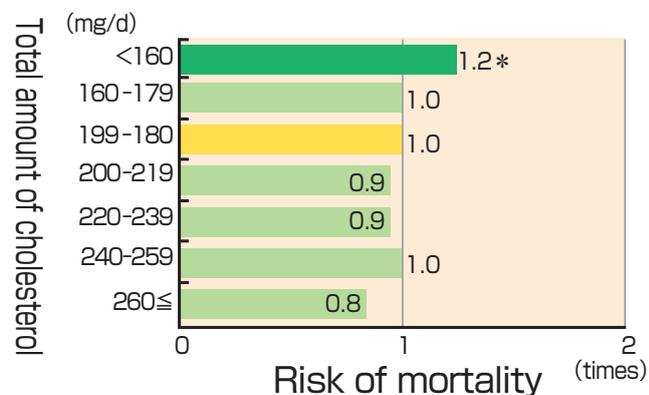


1 Older people require a good nutritious daily diet to stay healthy

In the current era of excessive eating, middle-aged people need controlled energy intake to prevent obesity, while the elderly need an intake of sufficient good nutrition to counter muscle decline and the loss of fat and bone density that accompany aging.

Recent epidemiological studies have confirmed that people with high cholesterol live longer lives and people with low cholesterol live shorter lives. This is because the shortage of cholesterol plays an important role as a cell membrane material and a shortage damages blood vessels, thereby tending to cause such circulatory diseases as cerebral hemorrhage. Moreover, people with low cholesterol can fall into a state of undernutrition, which is considered a sign of frailty.

Older people are advised to consume meals containing high-protein foods such as soybean, fish, meat, eggs, and dairy products every day. The intake of the proper quantity of carbohydrates, fat, and milk, together with vegetables, seaweed, mushrooms, and fruits will help prevent undernutrition.



Total amount of cholesterol and risk of mortality

(Source: Partly revised Ibaraki prefecture business report on follow-up survey on vital prognosis of medical examinees 2008)
This survey shows the 12-year follow-up data on 32,641 men aged 40-79 living in Ibaraki prefecture.





日本健康支援学会

Home page of the Japan Society of Health Promotion

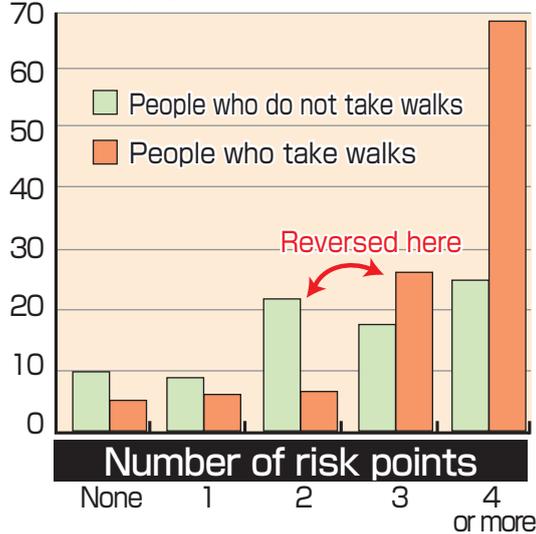
<http://www.kenkousien.med.kyushu-u.ac.jp/index.htm>

The Japan Society of Health Support pursues health support focused on human sensitivity beyond academic borders, with people engaged in health, medical and nursing care, and welfare.

2 Circumspect walking practice for older people

Although it is well known that walking is good for your health, several points must be checked before older people start a walking program. The figure on the right shows the combination of three or more fall risks as listed below that accelerate the fall rate of people who walk (including those taking a simple walk). People with three or more fall risk factors should pursue such indoor exercises as TV or radio gymnastic exercises, simple and light weight training, and Taijiquan (traditional Chinese exercise). People with two or less fall risk factors should actively engage in walking exercises. Keep in mind that excessive walking can damage joints, so people with weak knees should start with short steps and a slow pace.

Fall rate accompanying falling or injury two or more times (%)

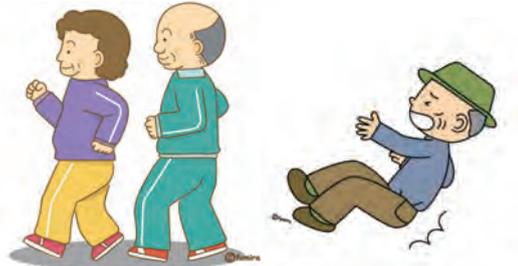


Simple check on fall risks

- Can you stand on one leg for more than 10 seconds?
- Do you feel difficulty in walking upstairs?
- Do you have a pain in the knee?
- Do you use a cane or a rollator when walking?
- Do you sometimes lack motivation?
- Do you take more than 4 types of medicine?

Relationship between falling and walking based on number of fall risk factors

(Okubo and colleagues : The Japanese Journal of Physical Fitness and Sports Medicine 2011) This provides cross-section data on 708 men and women aged 60 – 91.



3 Active participation in social activities

The decreased social roles of older people due to mandatory retirement and other factors can lead to a dull life, and may result in cognitive decline and depression. Thus, actively participating in community, organizations for the elderly, a health club, and volunteer activities, as well as holding family events, dramatically increase the opportunities for social interaction and are the keys to a healthy life.



Aiming for successful aging

Many diseases may be prevented by middle age, but it is difficult to completely prevent the diseases and decline in mental and physical functions in old age. Successful aging (or happy aging marked by a healthy, happy, and cheerful life) refers to healthy and cheerful old-age dealing well with diseases and the decline in physical and mental functions. Let's aim for successful aging by sharing the pleasure of eating delicious food and enjoying refreshed feelings through exercise with friends and family.

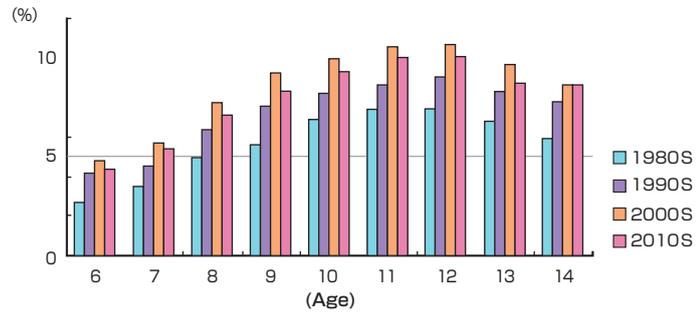
Physical Exercises and Healthy Diets for Children

Health problems in children

- Health promotion activities aimed at children have become a global priority task, as well as those aimed at adults.
- Children's obesity has been increasing since the 1980s, with a growing number of children engaged in less than 60 minutes of total exercise time per week.
- Acquiring a healthy lifestyle and building a healthy body in childhood are essential to maintaining good health through adolescence, adulthood, and old age.

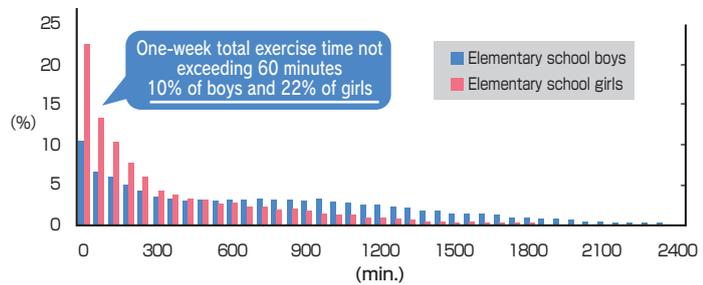


■ Changes in ratio of obese children ■



Source: School Health Examination Survey, Ministry of Education, Culture, Sports, Science and Technology

■ Average one-week total exercise time of elementary school children ■



Source: 2009 National Survey on Physical Strength, Athletic Ability, and Exercise Habits, Ministry of Education, Culture, Sports, Science and Technology

Learning from the health management of astronauts



- Astronauts train their muscle endurance and cardiopulmonary functions through daily exercise. In their rehabilitation after missions, astronauts also add another type of training to restore body balance, agility, and spatial cognitive ability.
- Nutrition management starting prior to a mission is a requisite for long-duration stays in space. A well-balanced diet is indispensable for astronauts who maintain good health and complete missions.
- Introducing to children these efforts of astronauts toward long-duration stays in space will surely raise awareness among children about the importance of exercise habits and diet for the benefit of developing a healthy body, and encourage their practice with high-level awareness in daily life.





Home page of Mission X

<http://trainlikeanstronaut.org>

Mission X promotes an awareness program on diet and exercise for good health—topics being addressed by many space agencies in the world toward promoting a healthy society.

Practice of space education

●● Mission X: Train Like an Astronaut ●●

- The activities used in Mission X: Train Like an Astronaut were developed collaboratively with the National Aeronautics and Space Administration (NASA), European Space Agency (ESA), scientists, and fitness professionals who work directly with astronauts.
- Physical activities are modeled after the real-life training that astronauts do to prepare for exploring space. Kids will experience hands-on science that relates to the needs of their bodies on Earth and to the needs of an astronaut in space.
- Children learn the importance of water supply, maintaining bone health, the mechanism of how calories are transformed into energy, and a well-balanced diet.



Astronaut exercising to train body core strength after returning from space



Challenging the same exercise!



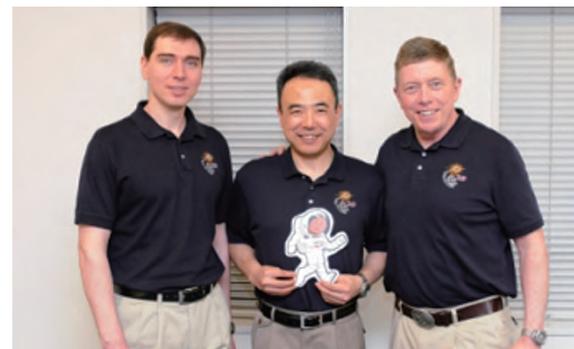
Children in a lecture

For further information about the program, please visit the following website:

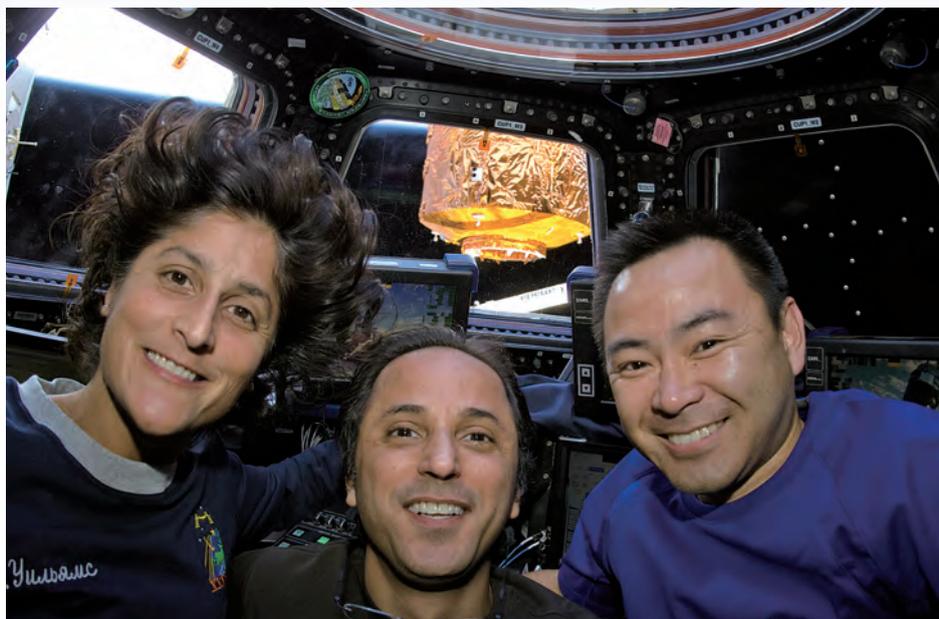
<http://iss.jaxa.jp/med/missionx/>

Challenge a healthy life together!

- Although designed for 8-12 year olds, the challenge is for anyone and everyone who is curious about space exploration and what it takes to be an astronaut.
- Why don't you try acquiring a healthy lifestyle with your family and local residents around you through space?



Mission X mascot character and International Space Station (ISS) Expedition 28/29 crew members for a long-duration stay.



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HP of the International Space Station (ISS), Japanese Experiment
Module (JEM; nicknamed "Kibo"), and Public Relations Center:
<http://iss.jaxa.jp/en>

HP of Space Medicine: http://iss.jaxa.jp/med/index_e.html
JAXA HP: http://www.jaxa.jp/index_e.html

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Photos courtesy of JAXA and NASA