Horizontal Scientific Research Project of Wenzhou Medical University Research Report

Research topic 1: Sleep improvement

Research topic 2: Microcirculation improvement

Research topic 3: Relieve muscle fatigue after exercise

Research topic 4: Relieve symptom of sore muscles after exercise

Research topic 5: Remove blood lactic acid

Research Institutes

Wenzhou Medical University

Physical Science College of Wenzhou Medical University

iREST Health Technology Co., Ltd.

Zhejiang iREST Health Product Co., Ltd.

Mechanical massage is a type of massage completed by stimulating the body surface and acupoint. It mechanizes traditional massage conducted by human being by using mechanical, electronic, air bag, electromagnetic, and electric heating technique to copy the technique used by the massager in order to stimulates part of human acupoints with manipulation, squeezing, and kneading and use of heating and magnetic action.

Using mechanical massage in place of human massage is a new popular domain of massage and healthcare industry. It combines traditional Chinese massage with advanced Western science and technology, imitates the manual kneading, squeezing, beating, hitting, pressing, pushing, massaging, grabbing, rubbing, and stroking actions aided by far infrared, jade heating, magnetic therapy and other modern technology to provide customers with outstanding health and comfort brought by high technologies.

Introduction

Zhejiang iREST Health Product Co., Ltd., founded in 2003, is a national high and new technology enterprise incorporating R&D, production and sales in one. We mainly manufacture “iREST” massage chairs, massage beds, massage products, and other high-tech health products. Currently employing over 1,200 staff, we have a R&D team comprised of 85 members, including 12 with R&D engineers with intermediate and senior titles who are capable of launching 2 or more new products each season; we also have over 80 QC workers, over 300 professional test equipment to strictly ensure quality that covers raw material, manufacturing process, and finished products. We have ODM and OEM competency to provide customized service to our customers.

We have over 100 independently developed core technologies and independent intellectual property rights, including 6 patent rights for invention, 29 patents for utility models, and 2 software copyrights. In 2010, we established the first massage device complex laboratory of the industry and accredited with UL WTDP in the U.S. and Laboratory of Exit-Entry Inspection and Quarantine Bureau of Zhejiang Province. We won the titles of provincial enterprise research institute in 2014 and national intellectual property enterprise in 2015. Our Technology Center has been approved as an enterprise technology center of Zhejiang Province and a provincial level new and high-tech enterprise R&D center. Over years, we have prepared a variety of national and industrial standards for massage chairs, massage beds, and foot massager products. We have passed a variety of international management system certification, including ISO9001, ISO14001, OHSAS18001, ISO13485, QC080000, and ISO10012 and so on. Our products have won a range of international recognitions such as UL, ETL, FCC, FDA, CE, CB, GS, RoHS, EK, and SON. Our products are widely sold in more than 100 countries and regions, including Southeast Asia, West Asia, Europe, America, Middle East, Oceania, and Russia. We have established branches and offices in more than 10 countries and regions, including U.S., Spain, Russia, South Korea, Malaysia, Brazil and Taiwan.

With the full support from the headquarters, iREST Health Technology Co., Ltd., cradled in Jiaxing, Zhejiang Province-the birthplace of the Communist Party of China, started production in 2013. Covering an area of 220,000 sq.m, the entire plant offers hotel-style accommodation and self-service dining environment. This will fully take advantage the geological strengths of Jiaxing City, shortens logistics cycle, further expands development space for the company, and lay a solid foundation for “iREST”-an international healthcare brand.

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Health Concept of iREST

Throughout history, human beings have sought after happiness. However long term study by social psychologists find that among all happiness-related factors, health ranks on top of the list.

In traditional view, health means "disease-free". However in modern life, health refers to general health. According to the definition of WHO: health is not only being free of diseases or weaknesses, it also refers to physical, mental soundness and social wellbeing. Health is human being's fundamental right and one of the most valuable wealth in life; health is the foundation for living quality; health is an important component of self-awakening of human life; health is the optimal condition human life strives for and has had profound meaning in it.

In the 21st century, with the increase in material standard of living, people are more and more concerned about their own health. In notoriously busy cities, pace of life is getting faster and faster and people are facing greater and greater stress from work. Whereas we don't have time or mind to exercise or relax and often it results in exhaustion, weakness in limbs, sleep disorder and dreaminess. Our bodies are often put at the risk of subhealth and many other serious conditions, including cervical spondylosis, scapulohumeral periarthritis, lumbar spondylopathy, and many other occupational diseases. Healthkeeping has now become the most popular term in our life.

"Healthkeeping" is originated from *Guan Zi* and has the meaning of maintaining life and living a long life. In human history, health and longevity have always been the wish that people seek after. With the enrichment and extension of healthkeeping culture, it has now been spread all over the world. Compared to the healthkeeping culture in other areas of the world, Chinese healthkeeping theory and practice have contained profound ancient philosophy and Chinese traditional medicinal theory. It has combined the extensive experience in disease prevention and body building in China and incorporated the premium thoughts of Confucianism, Taoism, Buddhism and other schools, for which purpose it may be compared to a deep-rooted, exuberant and thriving wisedom tree, or a jar of virgin pulp with lingering aftertaste.

Traditional Chinese medicine believes that meridians play a significant role in qi and blood circulation that joins the inside to the outside and connects body organs. Human body usually joins all parts of tissues and organs into an organic whole through the meridians in order to maintain regular life activities. *Huangdi Neijing•Plain Questions* records that "blocked qi and blood circulations result in all sorts of diseases". The qi and blood refers to the energy that supports internal organs. As mentioned in traditional Chinese medicine: unobstructed circulation causes no pain; pain indicates obstructed circulation; with free blood circulation, people feel full of courage; with free qi circulation, people feel good. If such energy and circulation end in chaos or blockage, people will be likely subjected to diseases. Energy flow chaos may also be considered as inner circulation system disorder or autonomic nerve system disorder, which may result in all kinds of diseases. The practice of using massage to treat disease is based on the theory of organs and meridians as well as four stages in the course of epidemic febrile disease. It uses varied massage technique and force on particular area and acupoints on the surface of human body in accordance with the causes and symptoms of different diseases in order to stimulate and unblock meridian system, adjust the functions of different organs, improve meridian activities, regulate qi and

blood, boost organ functions by increasing meridian circulation, and eventually support positive qi and remove negative qi to cure the disease.

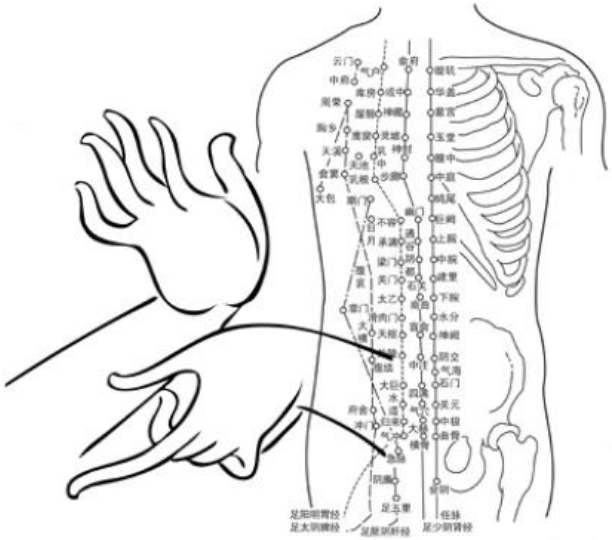
In terms of its implementation, massage is divided into human massage and machine-operated massage. Human massage is one of the most popular approaches for eliminating fatigue. However due to the limit of physical strength and technique, not to mention massive time and money required, human massage is beyond the affordability of general populace and therefore its application is rather limited. Machine-operated massage is a type of massage provided by massage devices by using mechanical force to work on the surface and acupoint of human body. It mechanizes traditional massage conducted by humanbeing by using mechanical, electronic, air bag, electromagnetic, and electric heating technique to copy the technique used by the massager in order to stimulates part of human acupoints with manipulation, squeezing, and kneading and use of heating and magnetic action to stimulate acupoints of human body. Using mechanical massage in place of human massage is a new popular approach in massage-based healthkeeping industry. It combines traditional Chinese massage with advanced Western science and technology, immitates the kneading, squeezing, beating, hitting, pressing, pushing, massaging, grabbing, rubbing, and stroking actions aided by far infrared, jade heating, magnetic therapy and other modern technology to provide customers with outstanding health and comfort brought by high technologies. It has not only broken through the limitation on time and space of traditional human massage, but also provides people with a free "family-based massager". With massage-based healthkeeping being more and more widely accepted, mechanical massage is playing a more and more significant role in the recreation and healthkeeping of modern people, and massage devices are becoming more and more popular among consumers. iREST recreation and healthcare products not only breaks through the limitation on time and space of traditional human massage and provides people with a free "family-based massager", but also is built with high and new technology and hence allows consumers to enjoy health and comfort brought by cutting-edge technology. Aided by its modern and remarkable appearance, it showcases modern feel and represents elegance and nobility.

Dozens of specialists/scholars from Wenzhou Medical University spent almost a year in studying and analyzing iREST massage chairs. They conducted an experiment by forming human massage group, massage chair group, and control group. Experiment results show: 1. iREST massage chair group has significant improvement in sleep disorder and Pittsburgh sleep quality index rate has reached 81.82%; 2. iREST massage chairs are able to effectively improve sharp changes in microcirculation of nailfold caused by strenuous exercise; 3. It remarkably improved muscle fatigue; 4. It has effectively improve muscle soreness after exercise; 5. Relaxes your body and create great comfort.

iREST massage chairs offers multiple innovative functions and integrates 3D robotic massage, airbag massage, far infrared, magnetic therapy, and negative oxygen ion functions all in one in order to provide consumers will all-round enjoyment and relaxation.

I. The effect of massage on human body

Massage is a treasure of traditional medicine in China and an important subdivision in traditional Chinese medicine. China has invented massage medicine back in ancient times. By then when people accidentally got hurt or came across sharp pains, they would massage the painful area instinctively and the pain would reduce and gradually disappear. In this way, the instinctive rubbing, after repeated use, developed and extended. People started to realize the efficacy of massage on the function of human body and massage gradually became a voluntary medical treatment.



Recently people started to be aware the damage of drugs on human being and physical therapies free of by effect are receiving more attention. Massage is one of the ideal physical therapies. On the other hand, due to the limitation of physical strength and technique, hand massage has been refrained to some extent and machine-operated massage in place of hand massage is becoming a new popular trend and winning more and more recognition from consumers. With the rapid growth of modern science and technology, in overseas countries, particularly in well-developed Western countries, traditional massage technique is receiving more and more modern scientific upgradings and more advanced massage devices incorporating mechanical, electronic, optical, heat, and magnetic power is taking the place of pure hand massage. More and more high-tech smart massage devices are being invented. Mechanical massage, due to their unique strengths, are more and more widely recognized and welcomed. Social demand has provided a broad space and unprecedented opportunity for massage healthkeeping market. Mechanical massage focusing on healthkeeping has become a newly emerging subdiscipline and an important part of healthcare study.

1. Effect of massage on human skeleton system

People usually assume that massage mainly works on muscles and doesn't help much on bones. This is not correct though. Tension in muscle also places bone under pressure and stress. The bones, when "stretched" by the muscles, also result in tension of ligaments of the muscles and bones and causes blood capillaries and vein vasoconstriction just like a narrow hose, which also lead to blood circulation difficulty.

Our body needs sufficient oxygen supply, which reaches every part of our body when blood runs across veins, arteries, and blood capillaries. With massage, blood flow increases, which not only rapidly removes toxins but also provides fresh blood to the areas being massaged.

2. Effect of massage on bone and joint

Bone system is comprised of bones and joints. When joints become stiff, it is usually a consequence of fatigue or settlement of toxins on joints, which result in joint damage. In severe cases, it may also cause arthritis and gout. By massaging bone joints, we are able to improve blood circulation and relieve the symptoms of affected bones and joints.

3. Effect of massage on muscles

Massage has distinctive effect on muscles, which is also a focus of massage practice. Through massage, the originally tense muscles become soft and relaxed. Although it is very unlikely to have damaged muscle in daily life, they may still become tense or damaged particularly after overuse or after strenuous exercise. People may have had following experience: after certain time of exercise you may have sore muscles, and this is actually a result of minor damage to the muscular tissue after exercise, inflammation caused by the physiological repair and regeneration of muscular tissue cells, and press of inflammed and swollen tissue on the sensitive pain nerve of the muscle, which causes the pain. Massage, being able to promote blood circulation, can relieve muscular pain and prevent muscular inflammation from getting worse and even thoroughly eliminate the pain. Specialists from Wenzhou Medical University conducted an experiment by forming massage chair group, human massage group, and control group (participants without massage). Results show that compared to human massage, massage chair achieves outstanding effect in terms of recover muscle fatigue and eliminating blood lactic acid after exercise.

4. Effect of massage on blood circulation system

When people receive massage, muscle stretches, increases blood flow, dilates capillaries, accelerates lymph circulation, and promote blood circulations.

5. Effect of massage on the heart

While accelerating blood circulation, massage also dilates blood vessels and capillaries, which reduces the resistance to blood flowing, eases workload for the heart, increases oxygen content in the blood, promote metabolism of tissue cells, and therefore maintains the regular function of the cells.

6. Effect of massage on lymph system of human body

Massage promotes lymph circulation, helps remove lymph fluid from muscles. The removed lymph fluid (including toxins) goes into blood through lymph, is filtered by the kidney, and the waste is therefore excreted. Massage, together with certain amount of exercise, is the best way to increase lymph fluid circulation, which is able to eliminate body inflammation and edema and increase human body immunity.

7. Effect of massage on the nerve system of human body

Gentle massage may soothe exhausted nerves and relax the muscles of the whole body. When your body is warm and free of pain or discomfort, it allows the nerve system to fully relax and rest.

8. Effect of massage on the skin

Massage helps removes toxin inside your body. Blood microcirculation on the surface of the skin increases, skin becomes more flexible, and at the same time massage can improve the texture and tone of your skin, which is why iREST's unique "hand-held jade thermal therapy

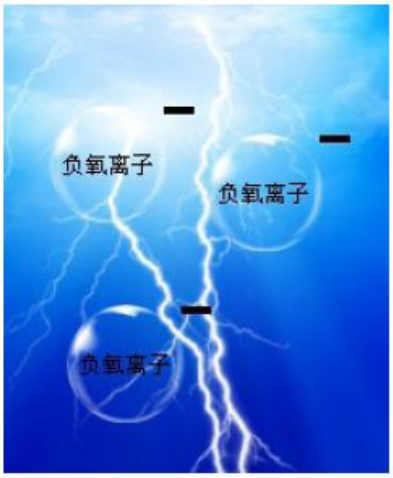
device” can significantly restore skin vitality, reduce fine lines, and add luster and pink color to your skin.

9. Effect of massage on relaxing brain

In contrast to stress and pressure, when people are relaxed, they think more clearly and faster and are more likely to make appropriate decisions and judgments. As we know, those that often take meditations often think more clearly and are able to come up with more creative solutions to address issues encountered in daily life. People can obtain thorough relaxation, achieve outstanding balance in intelligence and emotion, forget about worries and anxieties, and rebuild positive emotions through massage.

II. Functions of negative oxygen ions

Negative oxygen ions refer to those carrying negative charges and are often transparent and odorless. The causes of negative ions: air molecules, under the action of high pressure or strong radiation, produce free electrons due to ionization and most of the free electrons are obtained by oxygen. Therefore we often refer to the negative ions in the air as “negative oxygen ions”.



Negative ion is a type of far infrared material that is highly beneficial for human health. The ideal ware length of the far infrared suitable for human body is 9.6μm and the wave length of far infrared rays radiated by negative ion mineral crystals is between 2~18μm, and the radiation power emission density is 0.04w/cm^2 or slightly higher. Above data are fully verifiable. Far infrared rays radiated by negative ion mineral crystals coordinate wonderfully with human body and can be fully absorbed by human body. The life of each positive and negative ion is usually as short as dozens of minutes. The amount of negative ions in the air varies according to different geological conditions. In parks, suburbs, farms, coastal areas, lakes, waterfalls, and forests, there are usually more negative ions. That is also why when people go to above places, they think clearly and breathe smoothly. When we go to crowds or air-conditioned rooms, on the contrary, we feel stuffed and have difficulty in breathing. Generally speaking, human being needs 13 billion negative ions each day. However in our home, office, and entertainment places there are only 100 million to 2 billion negative ions available. The huge difference often results in pneumonia, bronchitis, and other respiratory diseases. Centralized heating and air conditioning system often removes negative ions; synthetic fiber and carpet usually carry positive charge, which absorbs negative ions, and steel and fiber board also absorb negative ions.

Table of negative oxygen ion content in various places

Environment	Quantity of negative ions/cm^3	Relations to the health of human being
Music fountain at the square/waterfall area	100000-500000	Natural healing power
Forest/seaside	5000-100000	Disinfection
Suburb/farm	5000～50000	Increase in immunity and anti-bacterial effectiveness
Parks in the city	1000～2000	Maintain general health
Green area on the street	100-200	On the brink of physical dysfunction
Residential area in the city	40-50	Causes physical dysfunction (such as headache and insomnia)
Enclosed air-conditioned room	0～25	Causes air-conditioner syndrome

Over 2,000 years ago, Chinese medicine proposed "correspondence between human being and the universe". It believes that human life is driven by the qi and blood circulation. Qi, according to our ancestors, is equivalent to the oxygen and negative ions in modern days. To breathe in oxygen, we need help from negative ions. After taking in sufficient negative ions, the oxygen absorbed by our body increases, blood and qi circulation becomes more unobstructed and smooth, metabolism is promoted, and immunity of our body also improves. It will have very positive effect on prevention and recuperation of all sorts of age-related diseases, chronic diseases, pains, nervous and mental illnesses, and increase our health and life in general.

Coulomb, a physician in the 18th century, found in his experiment that electric charges carried by insulated metallic conductor could disappear into the air. Physicians Roentgen and Becquerel found in their research that gas in the electrolyte solution carries positive or negative charged fine particles, which make the gas conductive. Physicians Esterel, Gertler and Wilson also attempted to justify Coulomb's conductive particles in the air using their own theory of atmospheric conductivity. Those conductive particles gained their name after they are called "ion" or "air ion" by Faraday. The "negative ion" or "positive ion" that we refer to nowadays is actually the "atmospheric ion" or "air ion" with different polarity. The effect of negative air ion and positive air ion on human body was identified by a German doctor in 1931. He shut himself in a chamber with high negative air ion concentration and felt really comfortable and refreshed. However when he stayed in a chamber with high positive ion concentration, he felt chest congestion, dizziness, headache, and restlessness. Since then, in the following half a century, it has become a popular topic in Europe, America, Russia and Japan.

According to a foreign literature, in early 20th century, the ratio of positive and negative ion in the air was 1:1.2, and the ratio is 1.2:1 in present day. Within one century only, the positive/negative ion balance has been overturned. Our environment is now surrounded by massive positive ions. We must stop and prevent the generation of more positive ions in

modern society and take effective measures to increase the proportion of negative ions in the air in order to improve our living conditions. Through monitoring and studying on the positive and negative ions in the air, we find that positive ion concentration of 400∽700/cm3, negative ion concentration of 1000~2000/cm3, and negative and positive ion ratio of 1.2~1.3 are preferred. During thundering and stormy weather, at waterfall, water fountain, and coastal area negative ion concentration can increase to thousands of negative ions/cm3; however in area with busy traffic, industrial area, and highly populated areas, positive ion centration increases and negative ion comes down to nearly zero, which is a result of 70% of tail gas emmission plus 30% from heating. People believe that it is not difficult to tell the pollution condition by referring to the ion ratio in the air, i.e. larger light/heavy ion ratio usually stands for clean air because higher light ion concentration is equivalent to less pollution; vice versa, the pollution is more serious and therefore causes more serious damage to human body.

(1) Effect of negative oxygen ion on human body is often shown in following aspects:

1. Respiratory system: negative ion can promote the formation of columnar cell in mucosa of nasal cavity, which can accelerate the cilium action of bronchial mucosa, increase edema elimination, improve ventilation of alveoli, and increase oxygen saturation. Clinical results show that 3 minutes after inhaling negative ion with therapeutic concentration, oxygen absorbed by the lungs increases 20%, CO_2 discharge increases 14.5%, bronchial smooth muscle spasm improves, and lung function and alveoli secretion function of asthma patients are restored;

2. Nervous system: negative ion can break through blood brain barrier and enter cerebrospinal fluid, and regulate cerebral cortex to balance excitement and depression. By adjusting the endorphin and interferon level of pituitary gland, it achieves soothing and analgesic effect. It may also alleviate angiotensin and regulate the balance the function of sympathetic and parasympathetic nervous system.

3. Cardiovascular system: through nervous reflex and humoral effect, negative ion dilates coronary artery, increases arterial blood flow, improves myocardial function, regulate heartbeat in order to restore regular vascular reaction and blood flow speed, improves angina and restore normal blood pressure;

4. Digestive system: negative ion regulates intestinal activity, enhance digestion and absorption, and has outstanding effect on colitis, diarrhea, and habitual constipation.

5. Endocrine system: it can improve endocrine function through blood circulation, including improvement in gonad function and thyroid function;

6. Metabolic system: promote redox processing of the body, stimulate enzyme system, increase vitamin synthesis and storage, promote metabolism, reduce the content of lactic acid in the blood, eliminate fatigue, and improve working efficiency;

7. Immune system: improve cell immunity and humoral immunity, as well as increase the antibacterial ability of the body;

8. Blood system: negative ions can enter blood and impose direct impact on the composition and distribution of charged ions in the blood, increase red blood

cells, reticulocytes, hemoglobin, and serum calcium, and at the same time reduce blood sugar, blood fat and blood viscosity.

9. Motor system: negative ions can increase intraosseous pressure and electric polarization, stimulate multiplication of useful bones and dissolution and disappearance of useless bones, modify bones according to physical needs, recover pathologic bone lines, increase bone metabolism, and have distinctive therapeutic effect on cervical spondylosis, lumbar disc protrusion, and rheumatoid arthritis;

10. Skin and ENT diseases: negative ions have outstanding effect on the nerve terminal receptors of the skin and promote the subcutaneous tissue to turn alkaline.

(2) Effect of negative oxygen ions on PM2.5 improvement

PM2.5 refers to particles whose diameter is smaller than or equal to 2.5μm. Those particles have major influence on human health and air quality. Generally speaking, particles whose diameter is larger than 10μm won't enter our lungs because our respiratory organ will effectively filter and block them and stop them outside our nose. Under such circumstance, they only impose risk on our eyes, nose, and throat. However for fine particles with a diameter of under 2.5μm (PM2.5), because their diameter is only approximately 1/20 of our hair and are hard to be stopped. They can therefore fully enter bronchiole, alveoli, and blood, interfere with gas exchange inside the lungs, and lead to asthma, bronchitis, and cardiovascular diseases.

In PM2.5 era, PM2.5 has impact on everyone. We can say in PM2.5 era, everybody is under risk. Study by UN environment protection specialists shows that minor ions of negative ions in the air, also known as negative oxygen ion, can actively capture fine particles, precipitate them, and therefore effectively remove fine grains with a diameter of 2.5μm or less. It is even able to capture fine particles with a diameter of only 1μm, which can significantly reduce the damage of PM2.5 to human health. Negative ions' ability to improve air quality is derived from its ability to combine with charged particles such as bacteria, dust, and smoke, form balls and drop down on the ground to eliminate the risk of PM2.5. Tests by China Negative Ion and Ozone Research Institute show that the effective evacuation rate of PM2.5 by negative oxygen ions can reach 90% and above. It is the most effective way for PM2.5 prevention and control.

Professor Pan Xiaochuan from the School of Public Health of Beijing University says, "increase in PM2.5 can result in death rate increase. The highest priority to deal with PM2.5 pollution is to increase negative oxygen ions indoors". Investigations also show that people spend more than 80% of their time indoors. When we are unable to change the outdoor environment, we can improve indoor environment to deal with PM2.5 pollution. The approach to add negative oxygen ions indoors proposed by Professor Pan Xiaochuan is an ideal way to improve indoor environment.

In the mean time, Professor Lin Jinming, specialist of Chinese Academy of Sciences and doctoral supervisor & professor of Tsinghua University also mentions in his book *Environment*,

Health and Negative Oxygen Ions: When the negative oxygen ion concentration in indoor air reaches 20,000 per cubic centimeter, the floating dust in the air can be reduced by 98% or even higher and it will also effectively reduce PM2.5 particles that may possibly enter our lungs. In the air rich in small particle sized negative oxygen ions, there could hardly be any fine dust, bacteria or virus with the diameter of 1μm or less. Therefore we can say that the amount of negative oxygen ion in the air is an important criterion for determining air quality. According to WHO, when the concentration of negative oxygen ion in the air is not less than 1,000~1,500 per cubic centimeter, the air is deemed fresh. This shows that adding negative ions to indoor environment is an ideal way to effectively remove PM2.5 in the room.

In present days, when it is impossible to clear PM2.5 with the air blower and filter of traditional air purifier, using negative ions to clean the room has become a top priority of creating fresh and clean indoor environment. In developed North American countries, negative ions have always been used to clear PM2.5 in the room. With years gone by, we are now welcoming the time of using negative ions to clear PM2.5 particles. (Extracted from *Southern Metropolis Daily* by China Negative Ion and Ozone Research Institute).

WHO's Regulation on negative oxygen ion in the air points out that 1500/cm^3 in the air is considered fresh air. In Bama County, a longevity town in Guangxi Province, there are 20,000~30,000 negative ions/cm3, which is 20 times higher than the standard. The negative oxygen ion ejector of iREST massage chair is able to release 24,000 negative ions/cm3, which is equivalent to the level identified in a forest or waterfall and will have significant effect on clearing indoor PM2.5 and improving air quality.

Table of negative oxygen ion concentration and corresponding air quality

Negative oxygen ion concentration/cm^3	Level	Air quality
>2000	I	Very good
1500-2000	II	Good
1000-1500	III	Quite good
500-1000	IV	Average
<500	V	Not good

PM2.5 quality index and air quality

PM2.5 quality index (μg/cm^3)	Level	Recommended actions
1-50	Excellent	People can engage in all kinds of activities
51-100	Good	Highly vulnerable people should reduce outdoor activities
101-150	Mild contamination	Vulnerable people should reduce intense outdoor exercise
151-200	Intermediate contamination	Vulnerable people should minimize outdoor activities
201-300	Serious contamination	Reduce outdoor activities, vulnerable people should stop outdoor activities
>300	Major contamination	Avoid outdoor activities, vulnerable people should avoid physical exertion

Note: 1,000 microgram =1 milligram

3) Effect on sleep improvement

Researches by WHO show, sleeping disorder is a public health issue that hasn't been taken as seriously or addressed as it should have been. Human beings spend 1/3 of their lifetime in sleep. Sleeping quality is of vital importance to human health. At night, our qi and blood circulation slows down, blood viscosity increases, metabolism slows down, secretion affecting

cell activity increases, stress-related resistance of our body drops, self-repair capability decreases, blood volume becomes insufficient, circulation slows down and is unable to ensure blood and oxygen supply to major organs, and the defense and immunity of our body reduces. Hence 70% of cardiovascular and cerebrovasular diseases occur at night.

Definition of "insomnia"

The medical term for "insomnia" that we often talk about is actually called "sleep disorder", which is irregular amount of sleep and abnormal sleep patterns. It also refers to the disorder of rhythmic sleep-awake alternation. Investigations by authoritative institutes show that lots of people are suffering from sleeping disorder or other sleep-related diseases. As many as 30% of adults may have sleeping disorder. Medical experts point out that sleep is one of the most important physical functions in sustaining human life. Long-term insomnia may result in brain disorder and cause multiple damages to our body and seriously impact on our physical and mental integrity.

Insomnia is mainly divided into following five categories:

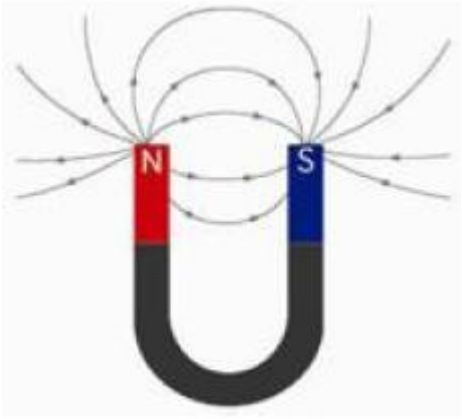
1. Difficulty falling asleep: mainly featured by taking over 30 minutes to fall asleep;
2. Difficulty maintaining sleep: mainly featured by waking up more than twice during sleep or early wake-up in the morning;
3. Poor sleep quality: mainly featured by lack of deep sleep or nightmares;
4. Lack of sleep: mainly featured by less than 6 hours of sleep;
5. Diurnal residual effects: mainly featured by dizziness, lassitude, drowsiness, and lack of energy in the following morning.

China Negative Ion and Ozone Research Institute and Queen Mary Hospital in Hongkong provided negative ion treatment to 60 patients suffering from insomnia. Clinical results show that patients took less time to fall asleep, had longer sleep, woke up less during sleep, demonstrated improvement in sleep quality and daytime activities, and all indicators showed significant improvement compared to control group. The effective rate for the test group and control group is 90% and 63%. Negative ions have outstanding effect on sleeping disorder and dysfunction of autonomic nerve. (Extracted from *Clinical Study on the Treatment of Sleeping Disorder Patients with Artificial Negative Air Ions)*

iREST worked with Wenzhou Medical University to hand out Pittsburgh sleep quality index survey to about 1,500 people at the age of 18~65 and selected 22 of them as the study subjects who are divided into 2 groups: 11 in the control group and 11 in the massage chair group. All subjects are taken to the sleep center and are monitored by the polysomnography for one night. The subjects are observed for four weeks. Results show that iREST massage has significant effect on sleeping disorder patients, and the comprehensive effectiveness rate of Pittsburgh sleep quality index reaches 81.82%. Both the subjective evaluation indicator and objective evaluation indicator suggests that it has effectiveness in improving sleeping disorder.

III. Magnetic therapy

"Magnet" is a kind of metallic oxide. Using magnet for treatment has had a long history in China. Sima Qian in Han Dynasty recorded in his *The Historical Records • History of Bianque Canggong* that there was a natural mineral called "magnet" that carried magnetism and could be used in treatment. The famous medical scientist Sun Simiao also recorded in *The Thousand Golden Prescriptions* that the honey bolus made from magnet, cinnabar and mixture of nuts, flour and herbs had "could substantially improve eyesight" when used in treating eye diseases. It also mentioned that "it could brighten eyes and allow you to read books at the year of 100". The compass, one of the four great inventions in China, is made from magnet. There have been countless recordings of using magnet in medical treatment in medical books including *Compendium of Materia Medica* and *The Dictionary of Medicinal Plant*. Magnetic therapy has been widely used in medical professional. It can produce a range of changes in our nerves and body fluid metabolism. It is effective in improving blood flow and circulation, eliminating swell, relieving pain, removing inflammation, and easing pain.

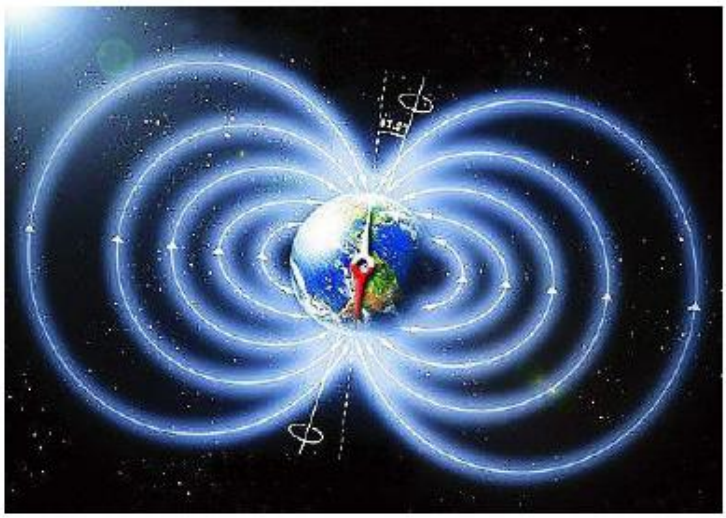


After thousands of years of medical development, medical specialists at home and in the world have had deeper understanding about magnetic therapy. Magnetic field can not be used in medical treatment but also can be used in healthcare, which drives the creation of magnetic healthcare products.

Researches by medical specialists show that in modern society people are suffering from a variety of diseases and subhealth diseases, which can't be separated from lack of magnet. To identify if one lacks magnet, we can check the following list:

1. Office is located on level 2 or higher;
2. Home is located on level 2 or higher;
3. Sleep on bed with spring mattress;
4. Spend less than 5 hours in doing activities on the surface of the ground;
5. Drive or ride for more than 2 hours in the car.

Researches show that if you have any 3 of the aforesaid 5 conditions, your body can develop magnet hunger, which is known as "magnet insufficiency syndrome". Clinical studies show that long-term lack of magnet can cause all kinds of diseases; lack of magnet in cells and low activity can speed up aging of the body; lack of magnet in blood can increase viscosity, which can result in poor blood circulation and cause blood and oxygen insufficiency in our tissues and organs and therefore result in pathological changes in our circulatory system, nervous system, urinary system, and digestive system; lack of magnet in our body can also



trigger neurological disorder, metabolic disturbance, accelerated cell death and lead to back pain, palpitation, insomnia, and general discomfort in the body. Medical researches show that magnet content in new born cells is several times and dozens of times higher than aged cells. Magnet content in the blood of young people is also significantly higher than older people, which is also one of the key causes of poor blood activity, high viscosity, and cardio-cerebrovascular diseases in old people.

Life depends on magnetic field. However the key question is: what level of the magnetic field is most beneficial for us? Scientific researches show that due to the shields from high rises, power grids, concrete blocks, and massive mining activities, in modern society, geomagnetic field intensity received by living beings is increasingly weakening. Therefore, apart from geomagnetic field, supplementary magnetic field is also beneficial for plants and animals, which is shown in the "magnet supplement" test below:

1. Magnetic therapist Professor Chen Zhi divided garlic with the same size into two groups-test group and control group. Galic in the test group receives 50GS magnetic force and galic in the control group only receives 0.3~0.5GS magnetic force. Twenty-five days later, galic in the test group is 3.3cm taller than that in the control group in average. Above test shows that: applying additional (magnet supplement) higher than geomagnetic intensity to living beings can promote their health, prevent diseases, and prolong life.

Magnetic function indicators: 1. Pursuant to the provisions in CAS 115 Healthkeeping Textiles, magnetic strength on the surface of magnetic textiles shall be 40~110mT (milli Tesla); 2. Special areas: magnetic strength on the surface of textiles used around eyes must be lower than 70mT (Note: 1mT=10G).

iREST massage chairs, according to the magnet demand of human body, produces natural magnet when it is massaging head and feet. Magnet is acrid and salty in taste, cold in property, distributes to liver, heart, and kidney; when human body becomes injured, stagnation of qi and blood occurs, meridians becomes blocks, which results in pain and swell. Magnetic regulation can promote qi and blood flow and create thriving organs.

In general, magnetic therapy has following effects:

1. Improve blood lipid metabolism and reduce cholesterol;
2. Soothe nervous system, eliminate insomnia and anxiety;
3. Promote cell metabolism, activate cells, accelerate excretion of cell wastes and harmful substances, and balance endocrine system;
4. Eliminate fatigue and restore physical strength;
5. Promote blood circulation and improve micro-circulation;
6. Anti-aging and removing free radicals inside our body;
7. Promote and improve immunity and increase the defense of human body against diseases;
8. Remove inflammation, relieve swell and pain caused by inflammation, regulate blood pressure, and bring down blood pressure.

IV. Far infrared healthcare-a key function of the massage devices

Far infrared is a type of electromagnetic wave and has thermal effect. With the wave length ranging in 7,700A~14,000A, it is a type of highly pure thermal optic and permeable light. It usually stops on the surface of the skin, therefore the therapeutic warming function is often the result of the reflex mechanism at the peripheral circulation. When the infrared ray is absorbed by the body, it can generate a type of soothing and beneficial thermal power, which will permeate into human tissues.

Far infrared rays, thanks to their unique strengths, have been widely used in the R&D and design of recreational and healthcare products. The healthcare effect of far infrared rays is mainly seen in following aspects:

1. **Promote blood circulation**
   Use of far infrared rays can increase the temperature of subcutaneous tissue of the skin, dilate microvessel, promote blood circulation, reactivate enzyme, increase blood, cell, and tissue metabolism, improve cell regeneration, and improve anemia.
2. **Regulate blood pressure**
   High blood pressure and atherosclerosis are often the result of constriction and narrowing of fine arteries of the nervous system, endocrine system, and kidney. Far infrared rays dilate microvessels, promote blood circulation, reduce high blood pressure, and improve anemia.
3. **Improve arthralgia**
   The high permeability of far infrared rays help them reach deep joint of the muscle, warm up the body, relax muscles, promote exchange of oxygen and nutrients of the micro vasoganglion, and remove the fatigue-causing substances and lactic acid and aged waste inside our body, and has outstanding effect on pain relief.
4. **Regulate autonomic nerve**
   Autonomic nerve mainly regulates our internal organs. When we are under anxiety for a long time, the autonomic nerve is tense and can cause compromised immunity, headache, dizziness, insomnia, lack of strength, and cold limbs. Far infrared rays can regulate autonomic nerve and help it remains its best condition, and improve or eradicate above symptoms.
5. **Skin care**
   Far infrared lighting produces resonance absorption. With the help from active follicular orifice and subcutaneous fat, it can remove substances causing fatigue and aging, such as lactic acid, free fatty acid, cholesterol, and spare subcutaneous fat from the skin directly without going through kidney and restore smoothness and tenderness of the skin.

6. **Cut down body fat**
   The therapeutic effect of far infrared rays can increase thermal energy in our body, activate cells, promote the matabolism of fat and tissues, burn off and decompose excess fat, and therefore achieve weight loss.

7. **Improve circulatory system**

   Far infrared ray lighting covers and enters countless micro-circulatory system in the whole body. It is the only therapeutic approach that covers the whole body. Once smooth micro-circulation is achieved, the workload for the heart decreases and more oxygen and nutrients are provided to the body, achieving healthy and strong body.

8. **Improve liver functions**

   Liver is the largest chemical plant of the body and a blood purifier. The thermal effect in the body produced by far infrared lighting is able to activate cells, increase the regeneration capacity of tissues, promote cell growth, strengthen liver, improve the detoxification effect of the liver, and maintain good condition of internal organs. In this way it can be recognized as the best way for disease prevention.

Wenzhou Medical University is a key university in Zhejiang Province.

Formerly known as Zhejiang Medical Institute founded in 1912, it relocated from Hangzhou to Wenzhou in August 1958 and was renamed “Zhejiang No. 2 Medical College”, and again was renamed “Wenzhou Medical College” using the name of the campus site. In 2013, it was renamed “Wenzhou Medical University”.

In 2013, Wenzhou Medical University was included in the first group of pilot higher education institutes for the clinical postgraduate training model reform.

It is also the first “National Doctor Qualification Examination Base, Practical Technique Test Base, and Examiner Training Base” in Zhejiang Province.

Our development history

1958: recruited students to study for the bachelor’s degree in five-year clinical medicine

1978: started to recruit postgraduate students

1981: became one of the first institutes granting master’s degree in China

2006: became an institute granting doctoral degree

2009: established post-doctoral center for the first-level discipline of clinical studies

Project number: KJHX1314

Horizontal Scientific Research Project of Wenzhou Medical University
Research Report

Project name: Study on the impact of iREST massage chair on sleep quality and microcirculation of nailfold

Project conducted by: Wenzhou Medical University

Project Manager: Fu Shan

Project period: November 2013-September 2014

Wenzhou Medical University

Table of Content

Abstract

Research study 1: Effect of iREST massage chair on sleep quality: PQSI and PSG-based study

Purpose: this research studies on the positive effect of long-term regular use of iREST massage chair on people suffering from sleeping disorder based on subjective evaluation-Pittsburgh Sleep Quality Index (PSQI)-and objective evaluation-polysomnography (PSG).

Research method: hand out Pittsburgh sleep quality index survey to about 1,500 people at the age of 18~65 and selected 22 of them as the study subjects who are divided into 2 groups: 11 in the control group and 11 in the massage chair group. All subjects are taken to the sleep center and are monitored by the polysomnography for one night. The subjects are observed for four weeks. Subjects from control group sit still on the massage chair for 30min without enabling the massage chair; subjects from massage chair group receive massage and relax on the chair for 30min. All subjects complete the PSQI form and are monitored with the polysomnography for another night.

Research results: the PSQI total and sleep duration, sleep effectiveness, daytime activities of subjects from the massage chair group after the test have dropped in comparison to before the test and displays significant difference ($P<0.01$); the results also show significant decrease in comparison to control group ($P<0.01$); the score for other factors of the massage chair group, including sleep quality, sleep duration, sleeping disorder, and use of hypnotic agent also show decrease in comparison to that before the test and of the control group, displaying statistical significance ($P<0.05$). The total and individual score of the PSQI survey for the massage chair group and control group as well as before and after the test have shown no changes with statistical significance ($P>0.05$). Comprehensive therapeutic effect of massage chair group is comparatively high with recovery rate of 18.18%, significant improvement rate of 27.27%, progress rate of 36.37%, invalid rate of 18.18%; the recovery rate, significant improvement rate, progress rate, and invalid rate for control group are 0.00%, 9.09%, 18.18%, and 72.73% respectively. The total sleep duration, sleep efficiency, sleep maintenance rate, and REM cycle of massage chair group have all increased in comparison to those before the test and the control group, displaying statistical significance ($P<0.05$); whereas the awake time, number of wakeups, N2, and total micro-arousal time of the massage chair group after the test are all lower than those before the test and the control group, showing statistical significance ($P<0.05$); other factors from before and after the test and in comparison to control group have shown no statistical significance ($P>0.05$); no changes from the control group before and after the test has demonstrated statistical significance ($P>0.05$).

Study on the effect of iREST massage chair on sleep quality and nailfold micro-circulation

Research background

Sleep is an essential physiological process of human body. It is essential for consolidating our learning and memory, detoxicating neurons, preserving energy, and improving immunity and defense. It is also important in regulating endocrine and metabolic system. The causes for sleeping disorder are still not known. Currently we believe that it might be related to the sleep-wake cycle regulation, complex interaction of endogenous day-night rhythm and in-sleep steady-state process, as well as the changes in autonomic nervous system.

Pittsburgh Sleep Quality Index (PSQI) survey was developed by Buysse in 1989 on the basis of previous literature review and testing tools. It is used to fully and objectively investigate on the sleep quality of the subjects. Tests conducted at home and abroad both approved the credibility and effectiveness of PSQI evaluation in testing the sleep quality of the subjects over the last one month period. It is comprised of 19 self-evaluation items and 5 peer evaluation items. The 19th self-evaluation item and 5 peer evaluation items are not counted. All the items are divided into 7 components, including sleep quality, bed time, sleep duration, sleep efficiency, sleep disorder, hypnotic agent, and day activity.

Sleep medicine is one of the most important research field of neuroscience in the 21st century. Using polysomnography in the study has become a new area of neurological clinical study and it has only just started in China. PSG is a type of technology that is used to diagnose sleep disorders by synchronously monitoring the bioelectrical activities and physiological activities of the body. It requires synchronous recording of electroencephalogram (EEG), electrooculogram (EOG), electromyogram (EMG), snore intensity, body position, breath, and electrocardiogram (ECG). The first three items are necessary for determining wake, slep, and sleep stages. The electrical activity of the brain of healthy human being is divided into three status: wake, non-rapid eye movement sleep (NREM sleep), and rapid eye movement sleep (REM sleep).

According to 2007 American Academy of Sleep Medicine (AASM), the most up-to-date sleep stage standard has divided sleep process in detail in the form of polysomnogram: 1. (stage wake): there two kinds of background waveforms of brain electricity: low-voltage frequency hybrid frequency wave dominated by ß wave (wake, quiet, and eyes-open status) and α wave (wake, quiet, and eyes-closed status). EOG lead produces rapid eye movement and slow eye movement, and EMG displays high-tension activity; 2. NREM2 phase sleep (S1 phase), α

wave of EEG drops to below 50%. Characteristic EEG includes parietal sharp wave, θ wave, and EOG background waveform is of slow eye movement and EMG activity drops slightly than before; 3. Under NREM2 phase sleep (S2 phase), the background waveform is relatively low-voltage hybrid frequency wave whose frequency is slower than that of S1 phase and the characteristic wave is sleep shuttle wave and K hybrid wave; oculo-electric and myo-electric activity drops slightly than before; 4. NREM 3,4 phase sleep (S3 and S4 phase) are also known as slow-wave sleep. EEG δ wave reaches 20% or above; oculo-electric and myo-electric activity significantly drops; 5. REM sleep phase (R phase), EEG background waveform is relatively low-voltage hybrid frequency wave, which is similar to S1 phase, EOG shows rapid eye movement, myo-electric activity disappears or stays at the lowest condition. Polysomnogram result review indicator, sleeping structure parameter: 1. Proportion of each sleep stage (%): total sleep hours of each stage/total sleep hoursx100; 2. REM sleep incubation period (RL, min): the interval of the first REM sleep unit starting from going to sleep; 3. REM sleep time (RT, min): the total REM sleep hours; 4. REM activity (RA): total number of occurrence of REM during the sleep (i.e. divide REM sleep in every minute into 0-8 of 9 units). Sleep process parameters: 1. Total record time (TRT, min): the time from switching off light to turning on light; 2. Total sleep time (TST, min): total record time-total awake time; 3. Sleep incubation period (SL, min): the time interval between turning off light and entry into the first sleep time unit; 4. Awake time (AT): the total of wake-up times during the sleep; 5. Sleep efficiency (SE, %): total sleep time/total record time×100.

Microcirculation is a kind of body fluid circulation participating in the exchange of body tissues and cellular materials. Nailfold microcirculation is a good place to observe the peripheral microcirculation of human body and a common method to reveal the physiological change during exercise, recover from exercise, and regain health. As the devices are easy to use and non-destructive, they have been used in sports research and achievements have been achieved. After intense exercise, nailfold blood circulation slows down, blood vessels constrict and vessels narrow; some people may have mild or medium erythrocyte aggregation, and the morphological score, the flow score, and total score all increase. After long time training, nailfold wall may slightly dilate and the blood flow speed is still below average; morphological score, flow score, and total score are still above average.

With continuous development of electronic and IT technology, intelligent furniture has become a trend of future furniture industry. Massage chair, as a typical intelligent leisure chair, will become more and more popular among consumers. Massage chair can avoid the discomfort caused by different massagers due to variation in technique and strength. It also avoids psychological discomfort caused by skin contact. In addition, massage chair is easy to use. It features versatile and easy-to-control massage technique and strength, and controllable massage location and time. For which purpose, it is becoming more and more popular among consumers and has been accepted by the market.

There has been little report on the study of massage chair in treating people with sleeping

disorder. iREST is a leading massage chair brand in China, which is why this study mainly focuses on iREST massage chair. This research studies on the positive effect of long-term regular use of iREST massage chair on people suffering from sleeping disorder based on subjective evaluation-Pittsburgh Sleep Quality Index (PSQI)-and objective evaluation-polysomnography (PSG). It also triggers dramatic change in nailfold circulation through intense exercise. It discusses the active role of massage chair on nailfold microcirculation after intense exercise by observing the changes of the indicators for nailfold microcirculation after receiving massage from the massage chair.

Conclusion: iREST massage chair has outstanding therapeutic effect on sleeping disorder. Pittsburgh sleep quality index rate has reached 81.82%. Both subjective evaluation indicators and objective evaluation indicators have proved the therapeutic effect of massage chair on sleeping disorder.

Research study 2: Study on the effect of iREST massage chair on nailfold microcirculation after intense exercise

Purpose: In this study, those that have taken intense exercise relax on the massage chair. It aims to assess the effect of massage chair on settling the drastic changes of nailfold microcirculation caused by intense exercise by looking into the form of the microvascular loop, blood flow form, and loop peripheral conditions.

Research method: Wenzhou Medical University selected 20 mentally and physically healthy male undergraduates as the subjects of this research. The 20 subjects are randomly divided into two groups: 10 in the control group and 10 in the massage chair group. The research is completed on the Cosmos treadmill and Cortex cardiopulmonary function evaluation system by increasing intensity 2.5h after meal. The initial slope of the treadmill is 0, the speed is set at 9.6km/h, and the slope starts to increase by 2% every 2min till the subject is exhausted and stops the exercise. We test the form of the microvascular loop, blood flow form, and loop peripheral conditions of the left hand of the subjects and aggregate the scores using Tian Weighted Integral Method. Then the subjects from massage chair group receive massage for 15min and subjects from control group sit still on the massage chair for 15 min without starting the chair. Both groups receive the same nailfold microcirculation test again 15min after the intervention.

Research results: In the massage chair group, after the test, the total nailfold microcirculation score, loop peripheral conditions, and blood flow form significantly dropped in comparison to before the test, displaying distinctive statistical significance ($P<0.01$), and above data is also lower than that of the control group, also resulting in notable statistical significance ($P<0.05$); in the control group, after the test, the total nailfold microcirculation score and blood flow form significantly dropped in comparison to before the test, displaying distinctive statistical significance ($P<0.01$), and the loop peripheral condition also dropped in comparison to before the test, also showing statistical significance ($P<0.05$); no statistical significance has been identified in regards to other indicators in both groups ($P>0.05$).

Conclusion: iREST massage chair can effectively ease the dramatic change in nailfold microcirculation caused by intense exercise.

Research study 1: Effect of iREST massage chair on sleep quality
-PSQI and PSG-based study

Pittsburgh Sleep Quality Index survey (PSQI) was developed by Buysse in 1989 on the basis of previous literature review and testing tools. It is used to fully and objectively investigate on the sleep quality of the subjects. Tests conducted at home and abroad both approved the credibility and effectiveness of PSQI evaluation in testing the sleep quality of the subjects over the last one month period.

PSG is a type of technology that is used to diagnose sleep disorders by synchronously monitoring the bioelectrical activities and physiological activities of the body. It requires synchronous recording of electroencephalogram (EEG), electrooculogram (EOG), electromyogram (EMG), snore intensity, body position, breath, and electrocardiogram (ECG). The first three items are necessary for determining wake, sleep, and sleep stages.

Therefore this paper aims to study on the positive influence of iREST massage chair on sleeping disorder patients through subjective evaluation-Pittsburgh Sleep Quality Index (PSQI)-and objective evaluation-polysomnography (PSG).

1. Research subject and method

1.1 Research subject: hand out Pittsburgh sleep quality index survey to about 1,500 people at the age of 18~65 and selected 22 of them as the study subjects.

1) Take part in the test on free will and informed consent has been signed.

2) Comply with the *International Classification of Sleep Disorders* (ICSD) and minimum criteria for the diaglosis of primary insomnia (psycho-physiological insomnia);

3) The sum of 7 items of Pittsburgh Sleep Quality Index >7;

4) 1 month<course of disease≤12 months;

5) Age is between 18 and 65 years.

The research subjects are randomly divided into 2 groups: 11 in control group and 11 in massage chair group.

Table 1-1 Basics about the research subjects

	Gender M (%)	F (%)	Age (y)	Height (cm)	Weight (kg)
Massage chair group (n=ll)	80.00%	20.00%	29.60±14.19	1.64±5.16	65.71±17.99
Control group (n=ll)	70.00%	30.00%	31.00±17.58	1.67±4.38	67.31±15.56

1.2 Research devices:

(1) Massage chair: iREST massage chair. Provide a group of four-wheel drive massage robots that can walk up and down at the back; the robots have 5-gear speed; when the chiropractic, flapping, and beating massage technique is applied individual, the robots have 3 gears-wide, intermediate, and narrow control.

(2) Pittsburgh Sleep Quality Index (PSQI): PSQI is comprised of 23 items which are divided into 7 categories, including sleep quality, bed time, sleep duration, sleep efficiency, sleep disorder, hypnotic agent, and day activity. Aforementioned items are marked as 0, 1, 2, 3 and the sum will be PSQI total. Higher total means poorer sleep quality. Comprehensive PSQI effect is evaluated according to following four aspects:

Full recovery: PSQI total reduction rate at the end of four weeks' treatment ≥75%

Significant improvement: PSQI total reduction rate at the end of four weeks' treatment ≥50%

Progress: PSQI total reduction rate at the end of four weeks' treatment ≥25%

Invalid treatment: PSQI total reduction rate at the end of four weeks' treatment <25%

(3) Polysomnography (PSG): 1) test requirements: test must be conducted in the room that is free of disturbance, quiet, comfortable at the temperature of 18-25℃, and light blocked. 2) subject requirements: insomnia patients must stop hypnotic agent one week before the monitoring test. All subjects must start PSG monitoring at 8pm on the monitoring day. Subjects must be subject to daily routine. 3) Polysomnography technique and parameters: sleep monitor is of Philips Respironics Alice 5 type of polysomnography system. The lead shall include (F4-M1, C4-M1, 02-M1, F3-M2, C3-M2, O1-M2). Sleep is staged according to American Academy of Sleep Medicine (AASM) and relevant evaluation standard (2007).

1.3 Test design:

Hand out Pittsburgh sleep quality index survey to about 1,500 people at the age of 18~65 and selected 22 of them as the study subjects who are divided into 2 groups: 11 in the control group and 11 in the massage chair group. All subjects are taken to the sleep center and are monitored by the polysomnography for one night. The subjects are observed for four weeks. Subjects from control group sit still on the massage chair for 30min without enabling the massage chair; subjects from massage chair group receive massage and relax on the chair for 30min. All subjects complete the PSQI form and are monitored with the polysomnography for one night.

1.4 Test indicators:

(1) Pittsburgh Sleep Quality Index: sleep quality, bed time, sleep duration, sleep efficiency, sleep disorder, hypnotic agent, day activities, PSQI total

(2) Polysomnography: time in bed (TIB), sleep period time (SPT), total sleep time (TST), wake-up time after falling asleep, awake time (AT), sleep latency (SL), sleep efficiency (SE),

sleep maintenance time (SMT); structural ratio of N1, N2, N3 and REM and proportion of REM cycle (NRP), total number of wake-ups, time, wake-up time/sleep time.

1.5 Statistical method:

All data has been analyzed using SPSS13.0 statistical software and EXECL 2003 and the results are shown as "average mean±standard deviation". Comparison between groups is done with group t test, and in-group comparison before and after the test is conducted using paired t test; recovery comparison is conducted using chi-square test, in which $P<0.05$ indicates statistical significance and $P<0.01$ indicates outstanding statistical significance.

2. Research results

2.1 Pittsburgh Sleep Quality Index survey total and score for each item

As shown in table 1-2, the PSQI total, sleep duration, sleep efficiency, and day activities of subjects from massage chair group have decreased compared to before the test and indicates significant difference ($P<0.01$); the results also show significant decrease in comparison to control group ($P<0.01$); the score for other factors of the massage chair group, including sleep quality, sleep duration, sleeping disorder, and use of hypnotic agent also show decrease in comparison to that before the test and of the control group, displaying statistical significance ($P<0.05$). The total and individual score of the PSQI survey for the massage chair group and control group as well as before and after the test have shown no changes with statistical significance ($P>0.05$).

Table 1-2 PSQI survey total and score for each item before and after the test

PSQI	Before test		After test	
	Massage chair group (n=11)	Control group (n=11)	Massage chair group (n=11)	Control group (n=11)
PSQI total	12.50±2.13	11.84 ±2.77	9.75 ±1.72**##	12.09 ±2.38
Sleep quality	1.92 ±0.63	1.89 ±0.55	1.65 ±0.27*#	1.90 ±0.57
Bed time	1.85 ±0.34	1.79 ±0.41	1.52 ±0.21*#	1.81 ±0.32
Sleep duration	1.76 ±0.29	1.83 ±0.22	1.41 ±0.20**##	1.79 ±0.26
Sleep eficiency	1.54 ±0.25	1.59±0.31	1.14±0.17**##	1.57 ±0.29
Sleep disorder	1.48 ±0.36	1.42 ±0.33	1.18±0.14*#	1.44 ±0.37
Hypnotic agent	0.98 ±0.17	0.92 ±0.10	0.66 ±0.09*#	0.99 ±0.15
Day activities	1.57±0.21	1.49±0.18	1.05 ±0.11**##	1.50 ±0.26

* means P<0.05 compared to before the test; ** means P<0.01 compared to before the test

means P<0.05 compared to control group; ## means P<0.01 compared to control group

2.2 Comprehensive therapeutic effect of PSQI

As shown in table 1-3, massage chair has higher comprehensive therapeutic effect than control group with massage chair group achieving a full recovery rate of 18.18%, significant improvement rate of 27.27%, progress rate of 36.37%, invalid rate of 18.18%, and the recovery rate, significant improvement rate, progress rate, and invalid rate for control group are 0.00%, 9.09%, 18.18%, and 72.73% respectively.

Table 1-3 Comprehensive therapeutic effect of PSQI

Comprehensive therapeutic effect	Massage chair group (n=11)%	Control group (n=11)%
Full recovery	2 (18.18)	0 (0.00)
Significant improvement	3 (27.27)	1 (9.09)
Progress	4 (36.37)	2 (18.18)
Invalid	2 (18.18)	8 (72.73)

Comprehensive therapeutic effect of PSQI of massage chair group

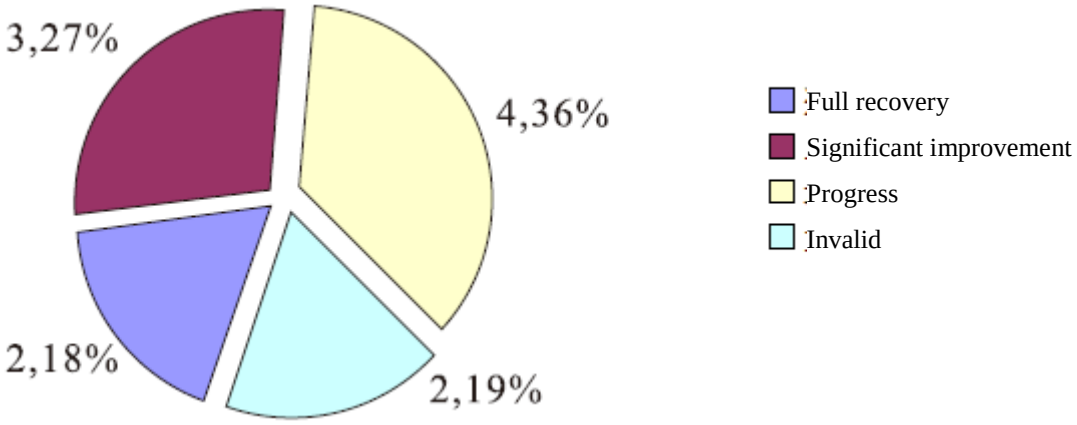


Figure 1-1 Comprehensive therapeutic effect of PSQI of massage chair group

2.3 PSG monitoring indicators

As shown in table 1-4, the total sleep duration, sleep efficiency, sleep maintenance rate, and REM cycle of massage chair group have all increased in comparison to those before the test and the control group, displaying statistical significance (P<0.05); whereas the awake time, number of wakeups, N2, and total micro-arousal time of the massage chair group after the test are all lower than those before the test and the control group, showing statistical significance (P<0.05); other factors from before and after the test and in comparison to control group have shown no statistical significance (P>0.05); no changes from the control group before and after the test has demonstrated statistical significance (P>0.05).

Table 1-4 Indicators for each item of PSG test before and after the test

PSG indicators	Before the test		After the test	
	Massage chair group (n=11)	Control group (n=11)	Massage chair group (n=11)	Control group (n=11)
Time in bed (TIB)/min	603.16± 27.14	589.25 ±58.49	570.37 ±83.22	593.35 ±63.93
Sleep period time (SPT)/min	492.09 ±67.52	453.01 ±82.43	513.45 ±95.28	469.77 ±72.65
Total sleep time (TST)/min	408.59± 63.17	426.33 ±79.49	471.66 ±39.27*#	411.58± 59.22
Wake-up time after sleep/min	108.67 ±42.88	94.35 ±57.19	78.45 ±39.54*#	115.51 ±54.77
Awake time (AT)/test	21.78± 10.36	23.03 ±9.44	16.52 ±9.72*#	21.45 ± 10.83
Sleep latency (SL)/min	18.33 ±12.54	16.87± 11.32	14.99 ± 10.15	16.07 ± 10.48
Sleep efficiency (SE)/%	75.43 ±17.32	78.33 ±23.61	82.12± 21.47*#	73.15 ± 18.65
Sleep maintenance time (SMT)/%	77.18± 12.55	74.84± 11.82	88.69 ±7.59*#	76.34 ± 14.13
N1/min	48.66 ±31.29	49.45 ±29.36	45.37 ±29.56	46.34 ±30.78
N2/min	256.59 ±53.94	243.99 ±67.71	235.18. ±39.30*#	251.98± 61.09
N3/min	42.51 ±25.10	45.46 ±22.95	37.64 ±28.36	40.17 ±28.92
REM cycle (NRP)	4.13 ±2.74	5.20 ±3.79	4.76 ± 1.96	4.28 ±2.60
Total arousal time/time	23.44± 17.74	35.22± 26.18	29.35 ± 19.30	33.62± 21.29
Total arousal time/min	87.11 ±41.34	93.2± 51.14	67.24 ±36.55*#	90.65 ±49.23
Arousal time/sleep time ratio	23.72 ±10.47	21.38± 11.07	19.54 ± 13.66	22.18±9.11

* means P<0.05 compared to before the test; ** means P<0.01 compared to before the test
# means P<0.05 compared to control group; ## means P<0.01 compared to control group

3. Discussion and analysis

PSQI is adopted to fully evaluate the sleep quality of the subjects. Results from tests conducted in China and in the world show that PSQI has outstanding credibility and effectiveness but is categorized as a subjective evaluation method. PSG may help understand the true sleep conditions, evaluate level of insomnia, identify type of insomnia, and select the right treatment.

In this test, subjective evaluation by PSQI shows, with four weeks' 30min/d massage chair intervention, subjects' score in PSQI total and sleep quality, bed time, sleep duration, sleep efficiency, sleep disorder, hypnotic agent, and day activities all dropped significantly, showing effectiveness of massage chair in improving sleep quality. PSQI comprehensive therapeutic effect has also proved this, with the massage chair group achieving a full recovery rate of 18.18%, significant improvement rate of 27.27%, progress rate of 36.37%, invalid rate

of 18.18%, and the recovery rate, significant improvement rate, progress rate, and invalid rate for control group are 0.00%, 9.09%, 18.18%, and 72.73% respectively. The total effectiveness of long-term regular massage chair intervention reached 81.82% and the total effectiveness of control group without massage chair intervention only reached 27.27%.

The objective indicator of PSG in this research shows that after four weeks' regular massage chair intervention, the total sleep duration, sleep efficiency, sleep maintenance rate, and REM cycle of have all increased in comparison to those before the test; after falling asleep, the wake-up time, arousal time, N2, and total micro-arousal time of the massage chair group after the test have all dropped compared to those before the test and also showed statistical significance compared to that of the control group. By comparing subjective and objective indicators, subjective indicators have shown more significant changes, which is consistent with literature. People with sleep disorders showed subjective exaggeration. However changes in objective indicators show that the change trend is existent.

4. Conclusion: iREST massage chair has outstanding therapeutic effect over sleep disorder with PSQI comprehensive effect rate reaching 81.82%, which is proved by both subjective evaluation indicators and objective evaluation indicators.

Research study 2: Effect of iREST massage chair on nailfold microcirculation after intense exercise

Microcirculation is a kind of body fluid circulation participating in the exchange of body tissues and cellular materials. Nailfold microcirculation is a good place to observe the peripheral microcirculation of human body and a common method to reveal the physiological change during exercise, recover from exercise, and regain health.

Research shows that massage on plantar reflex area can improve the speed of nailfold blood microcirculation and red cell aggregation. However due to the limitation of good massagers and great cost for human massage, it drives the study on the use of iREST massage chairs in order to find out if it can match the human massage and whether it can ease the massive impact on nailfold microcirculation after intense exercise. This study also aims to study on the relaxation on massage chair provided to people after intense exercise and evaluate on the effect of massage on the drastic change caused by intense exercise by looking into the form of the microvascular loop, blood flow form, and loop peripheral conditions.

1. Research subject and method

1.1 Research subject

20 mentally and physically healthy male students from Wenzhou Medical University are selected as the subjects of this study; all subjects have signed informed consent. The subjects are randomly divided into 2 groups: 10 in the control group and 10 in the massage chair group. Please refer to table 2-1 for the information:

Standard for the exclusion of subjects:

1. Subjects suffering from cardiovascular diseases;
2. Subjects suffering from chest pain, dyspnea, and general discomfort;
3. Subjects have engaged in intense exercise in the last 7 days or long-term sports training;
4. Subjects who opt out of this project within the research period;
5. Subjects that are unable to take the activities and test scheduled by the researchers.

Table 2-1 Information about the research subjects

	Age (y)	Height (cm)	Weight (kg)
Massage chair group (n=10)	20.67 ±1.67	169.12±8.27	63.71 ± 10.05
Control group (n=10)	20.33 ±1.72	170.88±9.13	60.54 ± 11.22

1.2 Research devices

(1) Massage chair: same as research 1. wheel drive massage robots that can walk up and down at the back; the robots have 5-gear speed; when the chiropractic, flapping, and beating massage technique is applied individual, the robots have 3 gears-wide, intermediate, and narrow control.

(2) German Cosmos treadmill and Cortex cardiopulmonary function evaluation system.

(3) Microcirculation tester: XW880 microcirculation tester and microcirculation image analysis system to observe the form of the microvascular loop, blood flow form, and loop peripheral conditions of the left hand of the subject, and calculate the scores using Tian's weight integral method.

1.3 Research design

Treadmill method: The research is completed on the Cosmos treadmill and Cortex cardiopulmonary function evaluation system by gradually increasing intensity 2.5h after meal. The initial slope of the treadmill is 0, the speed is set at 9.6km/h, and the slope starts to increase by 2% every 2min till any 3 indicators from the following items appear, which means the subject is exhausted and the score reaches V •O2max: 1) with the increase in workload, the oxygen intake remain unchanged or slightly increases but remains smaller than 2mL/kg/min; 2) respiration quotient ≥1.10; 3) Maximum heart rate>190 times/min; 4) The subject complains that they are unable to continue with exercise even with encouragement.

Subjects shall not take any drugs that may affect cardiovascular system one day prior to the test. After treadmill exercise, the subject shall sit down in the test room (room temperature 22~24℃, and relative humidity 70%), place the ring finger of the left hand on the platform, apply little pitch on the nailfold skin to minimize scattering from the skin and increase transparency. Adjust lighting angle and make all lightings focus on the test area. All observation must be recorded and sampled at all times; nailfold microcirculation image analysis system is used to measure the number, diameter, and blood flow speed of the nailfold. Repeat the same nailfold circulation test 15min later. The post-exercise pretreatment plan is shown as below:

Table 2-1 Post-exercise treatment plan

Group	Intervention plan
Control group	Sit still on the massage chair for 15 min without enabling massage
Massage chair group	Sit on the massage chair and massage for 15min

1.4 Test indicators

(1) Observe the form of the microvascular loop, blood flow form, and loop peripheral conditions of the test subject and calculate score using Tian's weighted integral method.

1.5 Statistical method

All data has been analyzed using SPSS13.0 statistical software and EXECL 2003 and the results are shown as "average mean±standard deviation". Comparison between groups is done with group t test, and in-group comparison before and after the test is conducted using paired t test, in which P<0.05 indicates statistical significance and P<0.01 indicates outstanding statistical significance.

2. Research results

2.1 Nailfold circulation indicators

As shown in table 2-2, The total nailfold circulation, the form of the microvascular loop, blood flow form, and loop peripheral conditions of massage chair group have all significantly dropped in comparison to those before the test, displaying distinctive statistical significance (P<0.01); they are also lower than the control group, also showing statistical significance (P<0.05); whereas the total nailfold microcirculation and blood flow form of the control group after the test have distinctively dropped, showing distinctive statistical significance (P<0.01), the form of the microvascular loop also dropped compared to before the test, showing statistical significance (P<0.05); the other indicators have demonstrated no statistical significance (P>0.05).

Microcirculation indicators	Before the test		After the test	
	Massage chair group (n=10)	Control group (n=10)	Massage chair group (n=10)	Control group (n=10)
Form of the microvascular loop	1.26 ±0.21	1.31 ±0.27	0.48 ±20**#	0.76 ±0.27 ▲
Blood flow form	1.77 ±1.03	1.79±1.12	0.52 ±0.31**#	0.83 ±0.51 ▲▲
Loop peripheral conditions	1.32 ±1.54	1.51 ±1.93	1.29±0.83	1.37 ±0.78
Total score	3.87±1.36	3.37±1.52	1.52±0.65**##	1.89± 1.13▲▲

* refers to comparison of massage chair group after and before the test P<0.05; ** refers to comparison of massage chair group after and before the test P<0.01

refers to comparison of massage chair group with the control group after the test P<0.05; ## refers to comparison of massage chair group and the control group after the test P<0.01

▲ refers to comparison of control group after and before the test P<0.05; ▲▲ refers to comparison of control group after and before the test P<0.01

3. Discussion analysis

Microcirculation is a place for blood, tissue and cell exchanges. Lots of severe diseases shown by the macro-system of human body, including ischemic heart disease and coma, are all result of microcirculation disorder. Microcirculation disorder can be deemed as the most primary stage of human body disease. When microcirculation occurs before diseases form, we

can improve microcirculation to prevent the occurrence of diseases from the beginning. If the microcirculation disorder continues for a long time without being remedied or improved, some organs may develop from functional disorder into local necrosis and cause severe disease in various body systems.

This research causes distinctive drop or even termination of blood flow speed in nailfold microcirculation, slight-severe red cell aggregation, constriction of blood vessels, shortening, and score increase as well as increase in total score. After the test, the total nailfold microcirculation score, the form of the microvascular loop, and blood flow form of massage chair group and control group have significantly dropped in comparison to before the test, and the total nailfold microcirculation score, the form of the microvascular loop, and blood flow form of the massage chair group after the test are also lower than the scores of the control group after the test, causing dramatic change in the form of the microvascular loop, and blood flow form of nailfold microcirculation due to intense exercise. Massage chair is able to help ease such dramatic change.

4. Conclusion: iREST massage chair can effectively ease the dramatic change in nailfold microcirculation caused by intense exercise.

Abstract

Research 1: Evaluation on the effect of iREST massage chair on relieving muscle fatigue-sEMG and EGG based

Purpose: Evaluate the effect of iREST massage on improving muscle fatigue during intermittent static exercise and the comfort experience brought to human body by basing on surface electromyography (sEMG) and electroencephalogram (EGG) in combination with as well as combining with fine motor function test.

Research method: Select 45 mentally and physically healthy male teachers aged between 20 and 60 as research subjects, who are randomly divided into 3 groups: 15 in the control group, 15 in the massage chair group, and 15 in the hand massage group. Subjects from all three groups first of all take the static back-stretch program. Two breaks of 15min for each group and 1min interval between two breaks. Record the duration of each back stretch and the sEMG signals. Repeat aforementioned test for all three groups 10 days later and provide massage intervention during the break time-massage chair group receives massage from massage chair and human massage group receives massage from experienced massager to relax erector spinae using rubbing, pushing, and rolling technique for 5 minutes each; subjects from control group sit in the massage chair and rest for 15min without enabling the chair. All three groups are connected to electroencephalogram recorder before, during, and after the break to record the electrical signals of the brain.

Research results: the first two back stretch time of subjects from massage chair group 10 days after the interval period shows no statistical difference from that of the control group, however the third and fourth back stretch time, 63.34s and 61.89s, is longer than that of the control group which is 51.35s, showing statistical significance. In surface electromyography of all three groups, iEMG and RMS both increase along with the increase in the number of back stretches, but MF and MPF decrease instead. For massage chair group, when massage intervention is available, during the third back stretch, increase in RMS is less than that of control group and the increasing tendency is also less; the decreasing tendency and sloping of MF and MPF is more moderate than that of control group; the α wave energy of all three groups before, during, and after the 15min break decrease whereas the θ wave energy increases. The decreasing tendency of the α wave energy in massage chair group is more significant and the increase in θ wave energy is also more significant.

Conclusion: iRest massage chair is capable of easing muscle fatigue, relax body, and bring great comfort.

Research 2: Study on the effect of massage with iRest massage chair on easing delayed onset muscle soreness

Purpose: This research aims to study on the relaxation on massage chair provided to people after intense exercise and evaluate on the effect of massage on delayed onset of muscle soreness (DOMS) by looking at the blood index of muscle tissue injury and inflammation as well as subjective pain through creatine kinase (CK), prostaglandin E2 (PGE2), interleukin 2 (IL-2) and interleukin 6 (IL-6).

Research method: The subjects are the same as research 1. Firstly all subjects undertake elbow joint isokinetic muscle test (Isomed 2000, Germany) to measure the maximum torque (60°/s); rest for one day, use isokinetic muscle test system to engage subjects in centrifugal (20°/s) movement on both elbow joints to trigger DOMS, provide massage intervention 30min after exercise: massage chair group receives massage from massage chair and human massage group receives massage from massager on the left and right upper arm using rubbing, pushing, and rolling technique; the control group sit on the massage chair to rest without starting the massage chair. Evaluate the subjective muscle soreness symptom (6 scale method) of both the left and right upper arm and serum CK, IL-2, IL-6 and PGE2 values of the subjects at immediately after exercise, 24h, 48h, and 72h after exercise.

Research results: after isokinetic muscle exercise, DOMS is triggered in the subjects: the highest soreness score of the control group appeared at 48h after exercise; the highest soreness score of massage chair group and human massage group appeared at 24h and the score at 24h, 48h and 72h were all lower than the control group. No inter-group difference in serum CK content of all three groups before the exercise. At 2h after the exercise, serum CK content of massage chair group is lower than that of the control group ($P<0.01$) but showed no significance difference in comparison to the human massage group. Serum IL-2, IL-6 and PGE all increased first before decreasing. At 2h, 72h after exercise, serum IL-2 content of massage chair group is lower than that of the control group ($P<0.01$), serum Il-6 content at 2h and 24h after the exercise is lower than that of the control group ($P<0.05$), and serum PGE2 content at 2h and 24h after the exercise is also lower than that of the control group ($P<0.01$).

Conclusion: Use of iRest massage chair to relax muscle after strenuous exercise can effectively ease muscle soreness.

Research 3: Study on the effect of iRest massage chair in removing blood lactic acid after exercise

Purpose: In this research, subjects receive massage intervention after intermittent exercise on cycle ergomete. It aims to find out whether massage intervention from iRest massage chair can speed up removal of blood lactic acid.

Research method: The subjects are the same as research 1. Firstly all subjects undertake intermittent exercise to reach the highest blood lactic acid level (ride on the cycle ergometer with 4 maximum anaerobic powers at the interval of 3min, 3min, and 2min); take the finger blood to measure the blood lactic acid before, immediately after, and 5min after the exercise. Afterwards, subjects from control group sit on the massage chair to rest for 30 min without starting the massage chair; massage chair group receive massage from massage chair for 30min (full body massage); and human massage group receives massage from massager on the thigh and trunk for 30min using rubbing, pushing, pulling, and rolling technique; all three groups test their blood lactic acid level again during and after the 15min break (massage).

Research results: Subjects from all three groups showed no significant difference in blood lactic acid before, immediately after, and 5min after the exercise. However the blood lactic acid level of subjects from massage chair group at 15min and at the end of the massage is lower than that of the control group and human massage group. There has been no statistical difference between human massage group and control group ($P>0.05$).

Conclusion: iRest massage chair can remarkably remove blood lactic acid after exercise.

Research Report on the Effect of iRest Massage Chair in Easing Muscle Fatigue and Delayed Onset Muscle Soreness

Research background

Study on sports fatigue recovery has always been the focus of sport medicine, athletic psychology, medical science, biological science, and social science. When sports fatigue occurs, human not only shows athletic ability decline in the body but also shows behavioral change psychologically, which is a the result of a combination of factors.

Massage is an easy healthcare approach. It stimulates muscles, ligaments or acupoints on the surface of the human body by using hands, feet or instruments to treat all kinds of diseases and achieve healthkeeping purpose. It has had a long history in the world and has been widely used. After intense training and exercise, it can help athletes to eliminate fatigue and renew strength by having self-massage and massaging each other. It can boost the control of nervous system, which will further affect other systems, improve respiratory, circulation, and metabolism, strengthen nutrition of the muscle tissue, promote metabolism, quickly remove lactic acid out of the body, and eventually recover the body from fatigue. Massage can also ease the tension of the muscle after workload, relax the muscles and stimulate the blood circulation, increase blood supply to local areas, improve the activity of the nerves, muscles, and organs, accelerate excretion of lactic acid from exhausted muscles, and in the end eliminate fatigue.

There has been massive study on the effect of hand massage on easing muscle fatigue and anxiety, including Deborah's study on the muscle discomfort encountered by sonographers by using massage to ease muscle discomfort and verify the feasibility of using massage; Black et al also studied on the effect of massage on easing the side effect occurred to anxiety patients when they are trying to come off medication. However the number of experienced hand massager is rather limited. At the same time, with economic and ergonomic development and increasing sharp demand on massage, massage chair and other automatic massage devices are designed and quickly commercialized. Massage chair can avoid the discomfort caused by different massagers due to variation in technique and strength. It also avoids psychological discomfort caused by skin contact. In addition, massage chair is easy to use. It features versatile and easy-to-control massage technique and strength, and controllable massage location and time. For which purpose, it is becoming more and more popular among consumers and has been accepted by the market.

Study on the effect of massage chair on easing muscle fatigue has just started in China and

there is also little research on what level of strength and specific type of massage chair work best on easing muscle fatigue. Yin Xiaoqin et al studied on the direction of force and freedom of motion required by four massage techniques (vibration, pressing, rubbing, and rolling) used by the end effecter of massage robot. Kolich et al also compared the impact of car seat with and without waist support (fine tuning or massage) on muscle activities to verify the effectiveness of waist support mechanism. Zullino et al also studied on the effect of back massage from automatic massage chair on easing muscle tension and compared the differences of three different mechanical massage techniques. In comparing the electromyographic signals of gastrocnemius muscle they found rolling massage and pressing can quickly ease muscle tension, whereas tapping massage doesn't work quite as effectively. They also pointed out that the test itself is a process of relaxing the subject's muscles, which may exaggerate the effectiveness of massage theoretically, taking into the consideration that people's individual demand on the type and strength of massage varies. Yang Zhongliang et al proposed the use of sEMG signals in evaluating the effect of massage chair on easing muscle fatigue, which can effectively address the quantization problem from the perspective of muscle tension. However his study only recruited two subjects, which may negatively affect the accuracy of the results. Chen Haomiao et al proposed the use of brain electricity in evaluating the comfort level brough by massage chair, which actually assessed the effect of massage chair from the perspective of nerve electrophysiology.

sEMG signals are bioelectricity signals induced by electrode from muscle surface and recorded during the neuromuscular activities. They are mainly the combined effect of superficial muscle and electrical activities of the nerve trunk. It is related to the active state and functional state of the muscle to certain degrees and therefore is able to display the activities of nerve muscles to some extent. It is also non-invasive and able to achieve real-time and continuous monitoring. sEMG parameters mainly include time-domain analysis and frequency-domain analysis. Time-domain analysis is adopted to elaborate on the amplitude response of time series signals, which mainly include IEMG, RMS, and AEMG. IEMG refers to the total electricity discharge of certain motor units in the muscle within certain time frame. It can reflect the changes of sEMG signal amplitude within certain time limit and therefore demonstrate the muscle activities in a real-time and non-invasive way. RMS value reflects the changes of emg amplitude. It is often believed that it is to do with the synchronization of motor unit engagement and exciting rhythms. During the muscle contraction process, if the demand on muscle force is quite high, athletes need to put in more motor units. Within certain degree, muscle force need to be in proportion to the number of motor units engaged in the activity and

the motor units must be in proportion to the emg amplitude at the same time. Increase in muscle force needs synchronized increase in motor unit in order to increase the RMS of emg. AEMG is an indicator for reflecting the changes in the amplitude of sEMG signals. The changes are mainly for showing the number of activated motor units during exercise, type of the motor unite engaged in the activity and its synchronization level, which is to do with the centrol control ability under varied muscle strengths. Frequency spectral analysis is an indicator for evaluating emg signals. It obtains emg signals through fast Fourier transform system (FFT) and then conducts spectral analysis on the signals. It has been widely used in muscle disease diagnosis and muscle fatigue detection. Common indicators include mean power frequency (MPF), median frequency (MF). MPF is a biological and physical indicator for reflecting signal frequency features. The level of MPF is related to the transmission speed of peripheral motor unit action potential, type of motor unit engaged in the activity, and the synchronization level. MF refers to the median value of muscle fiber discharge frequency during the skeletal muscle contraction process. Researches show that changes in MF and MPF are good indicators of muscle fatigue level, which means when muscles are fatigued, MF and MPF values are likely to decrease.

EEG signals are voluntary and rhythmic electrical activities of brain cell clusters recorded with electrodes. Electrophysiology theory shows when α wave is dominant wave, people are sober, under which circumstance, physical and mental energy consumption is minimal and receives more energy from the brain, works more swiftly and smoothly, and brain activities are also more vibrant. Generally speaking, increase in α wave indicates increase in the excitement of nerve cells; when θ wave is dominant, brain is relaxed, the consciousness of humanbeing blackouts, and the body deeply relaxes to relieve the pressure of the body. Therefore we can choose α wave and θ wave as primary measuring and observing wave forms to evaluate the comfort level of the massage chair.

iRest massage chair is a leading domestic brand in China, which is why this study mainly focuses on iRest massage chair. This research uses the motor ability of the body, sEMG, EGG, subjective appraisals, and various physiological and biochemical indexes as indicators in evaluating its performance and studying on the effect of massage chair in muscle fatigue recovery after exercise.