

# BENEFIC EFFECTS OF HYDRO SPORT MASSAGE SCIENTIFIC RESULTS

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University of Urbino “Carlo Bo”  
Motor Science Faculty

“Flowmetry analysis of the lower limbs in healthy adults and diabetic subjects: motor activity in water with hydrobike and in hydromassage”

Ph.D. in:  
*Molecular and Morpho-functional Methodologies Applied to Physical Exercise*

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## 0. PREFACE

Over recent years Marima has started its collaboration with scientific institution in order to demonstrate, through real and incontrovertible facts, the benefic effects of the produced machines. In the following pages we will briefly summarize part of the pilot study carried out by the research centre of the Faculty of Motor Science of the University of Urbino, on our product: Hydro Sport Massage. We will therefore analyse the results of these experiences on healthy subjects.

The results we obtained demonstrate that **Hydro Sport Massage is a real wellness, health and beauty machine.**

Working directly and efficiently on the cardiovascular system, the machine represents a very useful instrument used to fight and prevent serious health problems, to act on the causes of blemishes (resolving them), to reduce overweight, to help motor rehabilitation and to increase the sense of general wellness of our users.

Hydro Sport Massage is registered as Medical Device with the Department of Health, that is why it both represents a professional tool and a class I medical device.

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## 1. INTRODUCTION

Physical effort within an anti-gravity environment makes the movement in water the key to the success, meant to grow more and more.

Among the proprieties and the physical characteristics of water, the most important are:

- **The massage** that the fluid itself impresses on the immersed subject, whether still or in movement, positively stimulating the organism
- **The resistance**, which is six times higher than the air, is determined by the following elements:
  1. density (mass/weight) almost 700 times higher than the air
  2. the apparently stillness of water
  3. movement execution's velocity
  4. friction surface (directly proportional to the applied strength)
  5. lever principle (the longer the lever, the more difficult the movement will be)
  6. flow theories (turbulent and lamellar flows depend on the velocity of the movement)
  7. the wake (difference of pressure between the anterior part of the body (higher) and the posterior part of the body (lower))
- **The viscosity**, that is the cohesion among molecules, determines the flowing action of the fluid itself, and affects the water resistance to movements. The moved segment comes across a resistance which is proportional to the acceleration it moves with.
- **The hydrostatic pressure**, that increases of one atmosphere each 10,33 meters (almost 33 feet) of depth.

In the case of **vertical position activity in water**, we have a higher pressure on the ankles than on the upper trunk (which is out of the water), with a consequent facilitation of venous return to lower limbs.

The execution of the activity in water brings positive effects on:

- the **cardiovascular system**, with the improvement of the haematic flow, thanks to the differences in temperatures and pressures, which cause an increase of the return of blood to the heart
- the **uropoietic system**, enabling the lymphatic circulation and a higher elimination of toxins through the increase of diuresis, thanks to the massage of water on skin and to hydrostatic pressure
- the **neurological system**, thanks to a total and constant perceptive stimulation, since any activity in water forces the motor behaviors to re-organize themselves, in order to adapt to different sensorial feedbacks

The body rediscovers the pleasure of moving in a natural way, measuring the intensity of the effort according to one's needs and characteristics.

New knowledge about how motor activity in water can improve physiological-functional conditions for lower limbs, has been only investigated during the last few years.

With the increase of the arterial distensibility, which induces a growth of the haematic contribution, there can be a **better venous return and, consequently, better exchanges at the capillary level.**

The research area dealing with problems related to the relationship between physical activity, diabetes, and the improvement of haematic circulation in the lower limbs, is yet little investigated.



For the development of this research, which has been conducted in order to:

- **investigate the physiological adjustments (acute effects) of moderate physical activity intensity with Hydro Sport Massage**, a machine that combines both the benefic effects of pedaling in water and hydromassage
- **therefore verify the efficiency of the methodology for preventing or mitigating the diseases connected with the limited lower limbs circulation functioning,**

we opted for an analysis on methodologies and parameters carried out before (in scientific studies), that best served the purpose of the treatment of healthy adult and diabetics subjects.

Keeping in mind the studies on scientific literature, we developed a research protocol that contemplates pedaling in water with the use of a hydromassage (Hydro Sport Massage), in order to find out information about the haematic perfusion in healthy and diabetics subjects.

## 2. ANATOMIC SYSTEMS INVOLVED

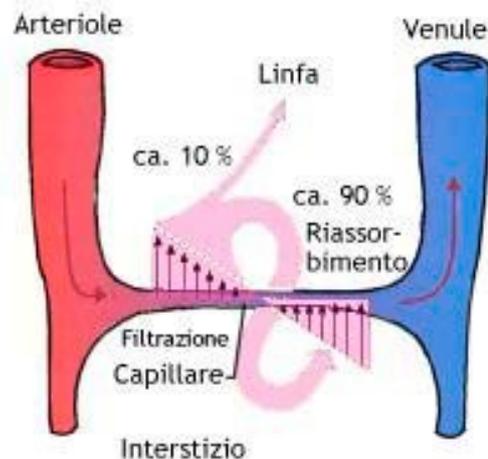
The research protocol examines the way in which motor activity with Hydro Sport Massage can produce **effects that benefit the haematic circulation of the lower limbs, in the specific the anterior and posterior tibial artery and the interdigital artery of the foot. This is important because it shows how a higher haematic perfusion can help preventing or decreasing the main causes of diseases in lower limbs.**

**The systems involved in the research are the venous system, the arterial system and the lymphatic system of lower limbs.** The venous system can lose its functionality because of a lack of physical activity, of an excessively prolonged standing or sitting position. In these cases the venous circulation gets slower with a blood stagnation (“stasis”) that causes a pressure increase and a consequent dilatation of the leg veins, and reduces the intake of oxygen and nutritive substances to the walls of the venous vessel.

The varicose veins, the telangetasia (widened capillars, main source of imperfections), the most serious diseases involving arteries and lymphatic vessels, locomotor system dysfunctions, inestetisms such as “edematous-fibrosclerotic panniculopathy” (cellulite), they usually merge, giving birth to multifactorial diseases.

The **venous insufficiency** is, for a long time, often asymptomatic but once consolidated it is a real serious and highly difficult to resolve pathology. It is therefore important to be able to catch the small signs that our organism sends us, during the initial state of the disease:

- heavy or tired legs
- pain or burning sensation at the calf muscle
- swelling legs
- night leg cramps
- pains that increase near a heat source
- pains that decrease when walking



Venous insufficiency can cause other diseases that bring to a situation called subclinical edema: the cellulite. Recent studies underlined an increase of venous insufficiency among young generations, maybe caused by a sedentary lifestyle and a higher tendency to obesity. The microcirculation ensures the nutrition of adipocytes and the regular spread of fat molecules; if different factors interfere with the proper functioning of the unity represented by the circle and the tissues, there can be an aggravation of the cellulite.

### 3. THE MACHINE

The machine used to carry out the research protocol is Hydro Sport Massage, micropool with hydromassage and hydrobike. The position of the jets, the power of the systems, the shape of the micropool, as well as the conformation and the structure of the hydrobike, have been specifically studied for the treatment of lower limbs.

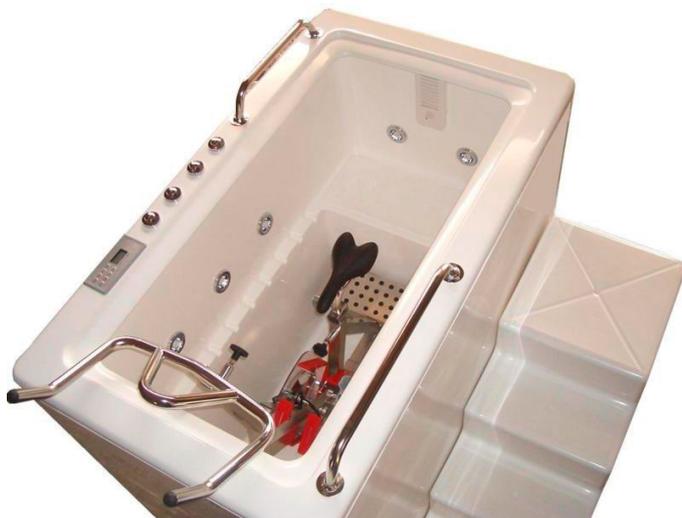
If compared with other exercises, pedaling in the water is a fairly 'harmless' activity for the knee and can contribute to ameliorate its mobility and stability. The action of pedaling is often used as a rehabilitation exercise after the injury of the knee or its surgical treatment, as well as in chronic degenerative conditions such as osteoarthritis.

The bicycle has a wide range of characteristics that make it a particularly useful tool because:

- there is no weight on the articulation, with less stimulation of the femur-rotuleo joint
- a wide range of movement, which are necessary for most of our daily activities, are used
- it is a simultaneous and controlled movement of quadriceps and ischiocrurals
- it has a variable resistance
- a stable position, due to compressive forces, is adopted
- cyclical movement reinforces the cartilage
- it's a kinetic closed chain exercise, because the two extremities of the joint are constrained
- the exercise is a cardiovascular activity (aerobics).

Every muscle of the leg is used during the foot thrust, in particular those interested in creating the movement, that is those of the group of the quadriceps (in the specific, the anterior rectus when pushing and the femoral bicep when flexing).

During the complete round of the pedal, the knee varies from 35 to 110 degrees of flexion. Hydro Sport Massage, where the professional hydromassage, specifically designed, is combined with the motor activity in water thanks to a special hydrobike, is constructed by MARIMA, with the purpose of **improving the flow hemodynamic conditions**, enabling the functional haematic implement.



In the field of venous and lymphatic pathologies, in fact, the simple manual **lymphatic drainage**, in order to resolve most of the edemas of lower limbs, is very antique.

The tissues drainage, which concerns both the lymphatic and the haematic microcircle drainage, involves different methodologies such as lymphodrainage, that was born from Vodder and Leduc's studies.

The lymphodrainage or manual lymphatic drainage, is a methodology which uses low pressure massage maneuvers, through the compression and the traction of skin, therefore stimulating the lymphatic circulation. It presents the peculiarity of reducing the fluids' stagnation, in particular toxins accumulation, by enabling the outflow and making possible the reduction of lymphatic edemas.

The birth of this machine corresponds to what the present day proposes to a population which is more and more sensitive when it come to wellness and health.

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## 4. THE PROTOCOL

The purposes developed and pursued during the operative part of the protocol are:

- **checking of the improvement of local circulation in the interested area** - leg and foot - by estimating haematic flow velocity, which is expressed by the relationship between flow and the vessel's area section, and represents the distance covered by a certain volume of fluid in the unit of time.
- **analysis of energetic expenditure**

The cognitive analysis started with **acute feedbacks**, that is the analysis of the records obtained right after the execution of the activity.

The parameters under control during the execution of the activity are:

- 1) age 31-53 years
- 2) constant heart rate at 70%
- 3) female gender
- 4) anthropometric measurement, height and weight
- 5) METs used to calculate the level of energy consumed during the activity (intensity measured considering the relationship between the energetic expenditure of the physical activity and the basal one)
- 6) water temperature equal to 28° (influent for the physical exercise, while if the temperature is between 21.1° and 25.3° the increase of the body temperature is mitigated)

The healthy subjects involved are in good health and they have performed exercises with different central movement regulations, **in standard sessions of 20 minutes**.

Before each session (basal value) and at the end of every exercise, specialized doctors conducted the flowmetry surveys with echotomography, to record the velocity of systolic peak, the velocity of diastolic peak and the interdigital artery index of the first toe and the anterior tibial.

Diabetic subjects, insulin-dependent and not, performed the same exercises with hydromassage, at a 60% heart rate (against the 70% of healthy subjects), and the same measurement were made:

- **velocity of systolic peak VSP** before and after the sessions
- **diastolic velocity DV** before and after the sessions
- **resistance index RI** (decrease of haematic resistance down the vessel examined)
- **met**s consumed by the subjects during the sessions

Tools used:

- Hydro Sport Massage
- cardiofrequencymeter
- armband (monitoring and recording of parametres)
- ecocolor Doppler (flowmetry doppler exam and ecography)

The referring **cardiac frequency** was detected with the Hirofumi Tanaka formula:

$$FcMax = 208 - 0,7 \times age$$

This formula was accepted by American Heart Association and the America College of Sports Medicine.

Sessions were performed **at 70% by healthy subjects of FcMax**. This work intensity does not involve a significant sensation of fatigue. The intensity of the foot thrust does not exceed **60 foot thrusts per minute**, regulated with the cardiofrequencymeter.

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## 5. RESULTS

Energetic expenditure surveys on healthy subjects, presented the following results:

- Maximum of calories consumed in 20 mnutes:131, which means **393 calories/hour**, with 70% of heart rate of the FCmax, with Tanaka's formula.
- Maximum energetic expenditure **METS 6.2**, with 70% of heart rate of the FCmax

The feeling perceived by the users of the machine is a **slight tiredness** and a **soft activity**.

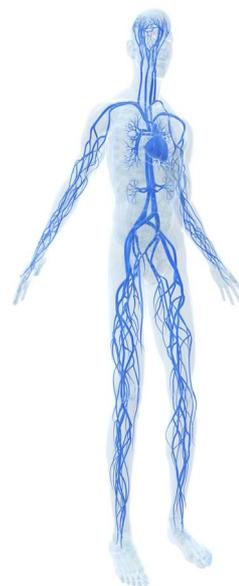
The regulations of the blades of the central movement do not interfere with the energetic expenditure; they simply improve the fluidity of the foot thrust, according to user's need.

The surveys of the haematic flows underlined a **very significant improvement of the flowmetry dynamic** of the interdigital artery of the first toe and the anterior tibial.

For example, in one of the healthy subjects examined, from the starting basal value – before the exercise – of 9.7 cm/sec of the systolic peak velocity of the interdigital artery, we moved to 38 cm/sec, after the exercise with Hydro Sport Massage. That means that the velocity of the haematic artery flow increased three times (291% increase)

Diastolic velocity DV moves from the starting basal value of 2.7cm/sec to 10.4 cm/sec, after the same exercise; the velocity of the haematic flow increased four times (381% increase) .

Resistance index RI decreased from 0.80 of the basal value to 0.65 after the session with hydrobike and hydromassage with a RI improvement of 18,75%



The arterial system

The same results were obtained in the case of the anterior tibial artery. <b>EXMPLES OF HEALTHY SUBJECTS</b>	<b>Percentual of improvement</b> (compared with the subject's values before the treatment)
Interdigital artery - velocity of sistolic peak VSP in cm/sec	<b>+ 291 %</b>
Interdigital artery - velocity of diastolic peak VDP in cm/sec	<b>+ 381 %</b>
Interdigital artery – resistance index RI	<b>+ 19 %</b>
Tibialis artery - velocity of sistolic peak VSP in cm/sec	<b>+ 113 %</b>
Tibialis artery - velocity of diastolic peak VDP in cm/sec	<b>+ 413 %</b>
Tibialis artery – resistance index RI	<b>+ 20 %</b>

## 6. CONCLUSIONS

The study's results confirm what the literature says about **the importance of a constant motor activity**, during a lifetime, for the psycho-physical efficiency and for preventing degenerative processes that come with age. These recommendations are even more important if the subject suffers from physical diseases or chronic illnesses that more easily can debilitate and lead to non self-sufficiency.

Scientific literature claims that, if sedentary subjects pedal for 30 minutes every day for eight weeks - at the intensity of 50% of the maximum oxygen's consumption - heart rate as well as blood pressure, nitric oxide levels and skin perfusion, will increase.

**In the following pilot protocol on motor activity in water with hydro sport massage, it is clearly shown that the haematic flow perfusion increases in healthy, non-arteriopathic subjects**; this is demonstrated by the remarkable reduction of resistance indexes' values, both in interdigital artery of the first toe and in the anterior tibial.

After the sessions, there was a significant implementation of flometry dynamic in the considered arteries.

The recorded results are statistically significant.

**From the surveys it appears that after a session with Hydro Sport Massage:**

- **in all healthy subjects there is an increase of the velocity of the systolic peak of every vessel examined, with an improvement that goes from 16% to 291%**
- **in all healthy subjects there is an increase of the velocity of the diastolic peak of every vessel examined, with an improvement that goes from 48% to 413%**
- **in all subjects there is a reduction of the resistance indexes (reduction of the haematic resistance of the vessel examined) at the level of the anterior tibial artery and the interdigitals; there is an improvement of the flow that goes straight to the distal extremities (improvement up to 36.7%)**

The research is also helpful for treating legs'swelling (a medical and aesthetical matter): **with the increase of the arterial circle, in fact, the pump and the venous return increase too, and the veins 'empty' themselves, reducing the swelling.**

Researches show how the activity in water with Hydro Sport Massage brings benefic effects to:

- the **cardiovascular system**, improving the haematic flow and increasing both the return of blood to the heart and the lymphatic drainage;
- the **uroipoietic system**, enabling the lymphatic circulation and a higher elimination of toxins through diuresis

Since activity in water forces the re-organization of motor behaviors, in order to adapt to different sensorial feedbacks, the **neurological system too** gets a benefit from activity in water, thanks to a constant and total perceptive stimulation.

The results show that Hydro Sport Massage is a **real wellness, health and beauty machine**, with excellent, scientifically demonstrated, effects.

Working directly and efficiently on the cardiovascular system, Hydro Sport Massage - if frequently used - is a very useful instrument to fight and prevent serious health problems at lower limbs, to act on the main causes of feminine blemishes, to reduce overweight, and to increase the sense of general wellness of our users, thanks to a real healthy action and thanks to a high energetic consumption with no fatigue.

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