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AN IMPACT OF WATER-BASED EXERCISES ON MECHANICAL LOW BACK PAIN AMONG AQUACULTURE WORKERS

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ABSTRACT:

Background: Aquaculture is a rapidly growing fisheries sector in the world. A maximum of fishing industry workers has musculoskeletal problems, commonly involving the low back (92.4%). Heavy physical activity, such as weightlifting, repeated movements and prolonged periods of static posture, are the main causes of mechanical nonspecific low back pain.

Objectives: To find out the effectiveness of water-based exercises on mechanical low back pain among aquaculture workers.

Method: The study design was a pilot study. 20 aquaculture workers with mechanical low back pain were selected from Marakkanam Taluk of Tamil Nadu in India and water-based exercises were given for 6 weeks. The outcome measures (Modified Oswestry Disability Index, Numerical Pain Rating Scale) were measured in pre and post-test for 6 weeks.

Result: The statistical analysis was done with paired 't' test within the group, with the value of significance (P< 0.001). The 't' of MODI is 11.753 and the 't' value of NPRS is 14.333.

Conclusion: The 6 weeks study concluded that water-based exercises show more significant improvement in reducing mechanical low back pain among aquaculture workers.

Clinical implications: Since aquaculture workers play a major role for the production of fisheries sector, by maintaining their health, they can work efficiently thereby the country`s foreign exchange revenue will be improved.

KEYWORDS: MUSCULOSKELETAL PROBLEMS, FISHERIES, STRETCHING AND STRENGTHENING EXERCISES, MODIFIED OSWESTRY DISABILITY INDEX, NUMERICAL PAIN RATING SCALE

INTRODUCTION:

Aquaculture is a rapidly growing fisheries sector in the world. Aquaculture has been playing anessential role in the economic development of India as it contributes to food and nutritional security, national income and employment opportunities as well as generating livelihood(Ngasotter et al, 2020).The farming of aquatic species, such as fish, molluscs, crustaceans, and aquatic plants, specifically under controlled environment is known as aquaculture.Aquaculture is a multi-disciplinary sector and with a variety of environment from freshwater to marine and from simple stagnant ponds to high tech computerized closed indoor water re-circulation systems(Erondu, 2005).A considerable portion of the world's fish supply for human consumption is now coming from the fast-expanding global aquaculture fish industry (Subasinghe et al, 2009).Freshwater and marine aquaculture have significantly augmented fisheries. For many years, wild marine fisheries made up the majority of the world's seafood supply. However, aquaculture is now predicted to take over as the primary aquatic production method for years to come, with freshwater aquaculture making up about 60% of total production worldwide (Froehlichet al, 2023).

The rearing of fish in freshwater is known as inland fishery and in estuary is called brackish water fishery whereas the rearing of fish in seawater is known as marine fishery. The Spawners and Gravid matured shrimps and fishes were collected by the fishing community, after the quarantine process they were stocked in appropriate hatcheries for hatching out and rearing the post-larva for culture practice in the culture grow-out ponds. The workers were employedfull-time. They reside at the Aqua farms andwork as per the demand of the activity which couldbe at any time of day or night.The work activity of aquaculture workers couldbe divided intopre-stocking, stocking and post-stocking.Scrapping the pond bed, water filling, setting the bird fence, fixing of aerators, applying bleaching powder, liming the pond, chain pulling for blooming water culture and manuring come under pre-stocking activity. Seed stocking comes under stocking activity. Feeding, medicine and probiotic application, sampling, check tray monitoring and harvesting come under post-stocking activities. In the fishing activities the fishermen use to exercise more musculoskeletal power for dragging the fish net and lifting the heavy loaded weight of fish trough for ice packing and loading for marketing (Sharma et al, 2023).This involves a lot of forward bending from a standing position. Thus, aquaculture is associated with physical hazards (Karsky, 2009). A maximum of the fishermen has musculoskeletal problems commonly involvingthe low back (92.4%) (Dabholkaret al, 2014).

Mechanical nonspecific low back pain occurs without any specific cause. Chronic nonspecific low back pain lasts for more than 12 weeks. It is mostly due to heavy physical exertion such as weight lifting, repetitive movement and frequent static posture. Chronic nonspecific low back pain leads to heavy painwhich worsens with exertion and relieves with rest. Ligament sprain or muscle strain may be the cause in some cases. The endurance of trunk muscles is low in patients with low back pain as compared to individuals without low back pain. The deep trunk muscles mainly the transverse abdominis and the multifidus are responsible for maintaining the spine stability. The poor endurance of trunk muscles may cause strain on structures and hence lead to low back pain (Sawantet al, 2019).

Water-based exercise, is known to be a safe and more effective alternate to land-based exercise, due to its non-weight bearing nature. The development of various techniques and programs in water-based exercise is based on several important bioengineering principles. The principles include hydrostatic pressure and several forces such as buoyancy, drag and inertia. Due to the buoyancy of the water, compressive joint forces are low, as a consequence, it reduces the risk of injury (Towleret al, 1987). The movements of limbs against water produce resistance which leads to muscle strengtheningand cardiovascular benefits, especially in subjects who have low levels of physical fitness (Campbellet al, 2003; Pöyhönen et al, 2002 and Tsourlou et al, 2006). The water-based exercises produce remarkable improvement in disability and quality of life of the patient with chronic low back pain. The increase in muscle strength consequently decreases the low back symptoms (Sawant et al, 2019).

As the workers were employedfull-time, the pond in which they worked was used for water-based exercise.Considering the lower back pain aspects of the Aquaculture workers incur in their profession, the present study has been conducted among them and the water-based exercises phenomena have been implemented for the recovery of their health as well as a tool of our country's economic enhancement.The study aims to find out the effectiveness of water-based exercises on mechanical low back pain among aquaculture workers, in their working environment.

RESEARCH METHODS AND DESIGN:

This study was a Pilot study which was conducted in the aqua farms in Marakkanam Taluk of Tamil Nadu in India for 6 weeks.20 maleaquaculture workers within the age group of 30 to 50 years with non-specific chronic low back pain and who can understand the treatment process were included in this study. The participants with severe cardiovascular disease,spinal

fracture, nerve root compression, spinal cord irritation, cauda equina signs andosteoporosis were excluded. The sampling technique was randomized sampling.

PROCEDURE:

All participantswere given clear information aboutthestudyand signed aninformed consent form.The participants received an explanation and demonstration of the following exercises.

STRETCHING EXERCISE FOR HIP AND LOW BACK:

The stretching exercises were done in water prior to strengthening exercises. Each exercise was repeated four times and the hold time was thirty seconds. The following exercises were performed in alternate days.

KNEE TO CHEST EXERCISE: The participants were asked to stand in an upright position with the back straight, toes and knees facing forward theywere asked to wrapthe hands around the knee and pull it up, close to the chest and return to starting position.

LEG RAISE EXERCISE: Theparticipants were asked to **s**tand with hands on the hips and with feet, shoulder-width apart.With weight on one foot,the participantsshould slowly lift one leg straight out in front, as high as possible, without bending the knee and lower the leg back to the starting position.

SUPERMAN POSITION EXERCISE: In prone, with legs and arm extended in front, the participants were asked to keep the head in a neutral position and slowly lift the arms and legs around 6 inches along with the upper trunk and lower the arms, legs and trunk to the starting position.

STRENGTHENING EXERCISEFOR ABDOMINAL, GLUTEI, LUMBAR AND LOWER LIMB:

The strengthening exercises were following the strengthening exercises. Each exercise was repeated fifteen times and the hold time was ten seconds. The following exercises were performed in alternate days.

SWIMMING KICKS: Insupine position, the participants were asked tokick their legsin an alternating up-down manner, where the hip drives the kick.

HIP FLEXION AND EXTENSION EXERCISE: Insupine position**,** the participants were asked to**s**lowly flex one limb up without bending the knee and slowly extend the limb downwards without bending the knee.

HIP ABDUCTION AND ADDUCTION EXERCISE: Insupine position, the participants were asked to move the limb out to the side as far as possible and bring the limb back to the midline.

KNEE FLEXION AND EXTENSION EXERCISE: In **s**upine position by keeping the thigh in a straight line with the upper body, the participants were asked to bend the knee to 90 degrees angle and slowly return to the starting position.

SQUATTING EXERCISE: Standing with feet somewhat wider than hip widthand toes pointing forward the participants were asked todrive the hips back and bend at the knees and ankles. By pressing the knees slightly openthey were said to sit into a squat position while keeping heels and toes on the ground with chest up and shoulders back. They were said to strive, to reach parallel (knees bend to 90 degrees).By pressing into their heels and straightening the legs, they return to the starting position.

LUNGES: Standing upright the participants were asked to take a step forward. By keeping the back leg straight, they were said to lunge forward and draw the gluteus towards the ground after which they return to the starting position.

ONE LEG BALANCE: By standing with feet hip-width apart, the participantslaced the hands on hips. Theywere asked to lift one leg off and bend at the knee, then return to starting position.

LEG CIRCLES: By standing with the feet, shoulder-width apart and arms at the side and the toes pointed, the participants were asked to raise one leg about kneehigh and start rotating it in a clockwise and an anti-clockwise direction.

WALKINGFORWARD AND BACKWARD: In standing position, the participants were asked to walk forward and backward in the water for 10 to 25 m.

DATA COLLECTION:

Modified Oswestry Disability Index(MODI) and Numerical Pain Rating Scale(NPRS)were used and the data were collected from the participants face to face. Both MODI (ICC – 0.43

to 0.80) and NPRS (ICC – 0.87) are reliable and valid tools to use (Baradaran et al, 2016 and Young et al, 2019)

DATA ANALYSIS:

The collected data were tabulated and analysed using descriptive and inferential statistics, the collected data were normally distributed and the mean and standard deviation were used to assess.A paired t-test was adopted to find out the effectiveness of water-based exercises to find out the difference between the mean and standard deviation of pre-test and post-test values ofMODI and NPRS of each subject treated with water-based exercises were calculated. Statistically, significance was set at $p < 0.05$ was considered as significant difference.

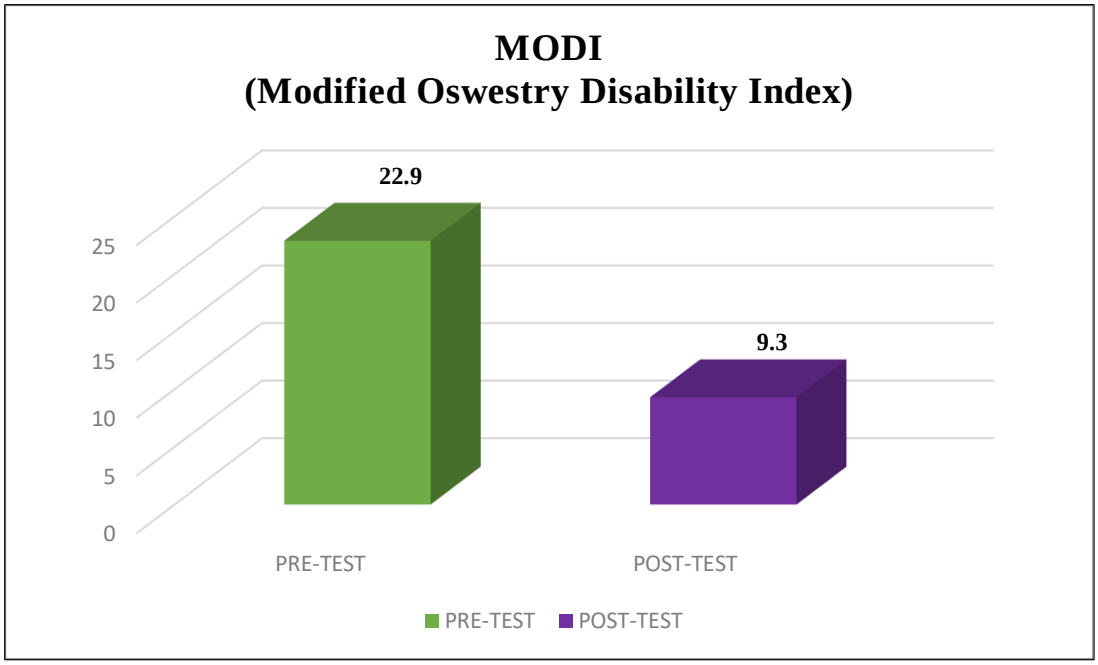
MODI analysis: The pre-test and post-test difference of MODI within the group analysis of mean and standard deviation were analysed statistically tested by paired t-test. The result is presented in Table 1 (refer graph 1).

Table – 1: Showing the pre-test and post-test values of MODI (paired t-test value)

MODI	**Mean**	**SD**	**Sample size**	**SEM**	**t-value**	**p-value**
PRE-TEST	22.9	6.97	20	1.55	11.8	P<0.001
POST-TEST	9.3	3.85	20	0.86		

It was found that the mean value of MODI before the water-based exercises program was 22.9 and after the water-based exercises program, it was 9.3. The p-value is 0.001. Since the p value is less than 0.001, it is concluded that there is a very significant improvement in MODI. The t-value of the paired t-test for the Modified Oswestry Disability Index was 11.8.

Graph 1: Showing the pre-test and post-test values of MODI

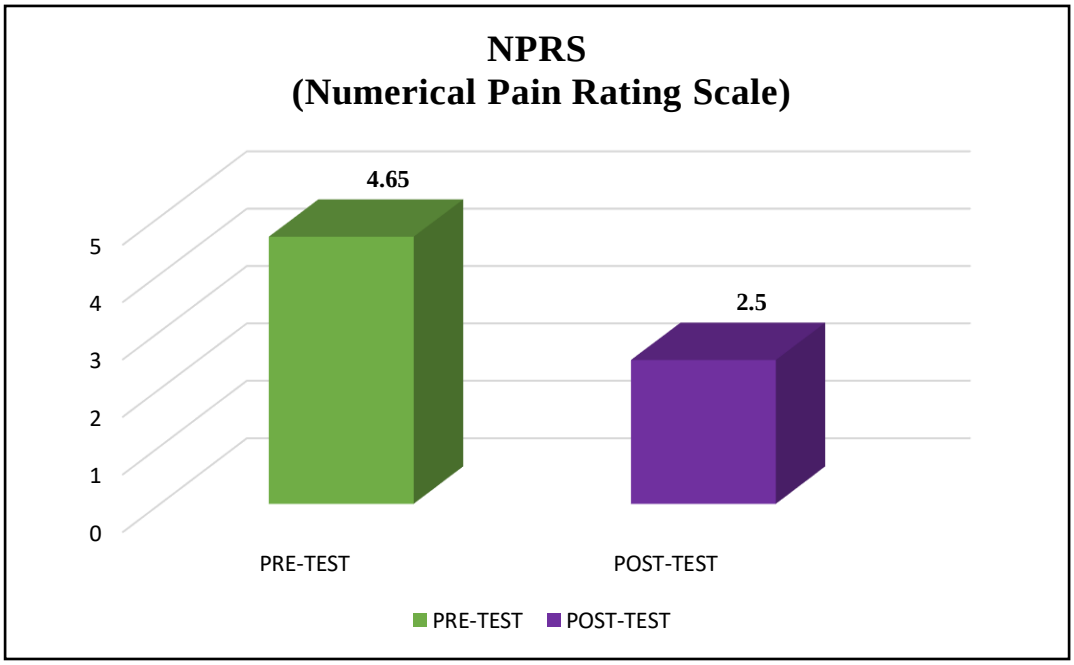


NPRS analysis: The pre-test and post-test differences of NPRS within the group analysis of mean and standard deviation were analysed and statistically tested by paired t-test. The result is presented in the Table 2 (refer graph 2)

Table – 2: Showing the pre-test and post-test values of NPRS (paired t-test value)

NPRS	**Mean**	**SD**	**Sample size**	**SEM**	**t-value**	**p-value**
PRE-TEST	4.65	0.98	20	0.21	14.3	P<0.001
POST-TEST	2.5	0.6	20	0.13		

It was found that the mean value of NPRS before the water-based exercises program was 4.65 and after the water-based exercises program was 2.5. The p-value is 0.001. Since the p-value is less than 0.001, it is concluded that there is a very significant improvement in NPRS.The t value of the paired t-test for the Numerical Pain Rating Scale was 14.3.



Graph 2: Showing the pre-test ad post-test values of NPRS

ETHICAL CONSIDERATIONS:

Ethical clearance was obtained from the Internal Ethical Committeeof sri venkateshwaraa college of physiotherapy, sri venkateshwaraa college of paramedical sciences, affiliated under the Pondicherry University and the relevant authorities of the institutions. Written informed consent from participants was sought and obtained before the interview.

RESULTS:

In this pilot study conducted among the fulltime aquaculture workers,paired ‘t’ test was used to find out the mean and standard deviation of pre-test and post-test values of MODI and NPRS. In the statistical analysis, the calculated mean and standard deviation values for the pre-test and post-test of MODI are 22.9 ± 6.972 and 9.3 ± 3.853 and the ‘t’ value is 11.753. The calculated mean standard deviation values of the pre-test and post-test of NPRS are 4.65 ± 0.988 and 2.5 ± 0.606 and the ‘t’ value is 14.333.Hence the statistical data shows that the paired ‘t’ test values of MODI and NPRS are highly significant ($p < 0.001$).

DISCUSSION:

This pilot study was conducted at the aquaculture farms at Marakanam Taluk for 20 male aquaculture workers with mechanical low back pain. The outcome measures used to assess the low back pain were MODI and NPRS. Using these outcome measures the pre-test and post-test.Buoyancy assists a movement when the body part moves in the direction of the force of buoyancy and it resists a movement when the body part moves against the force of buoyancy. Hydrostatic pressure exerts equal pressure on all the surface of an immersed body, this helps the individual to perform exercise easily. The viscous nature of the water produce resistance to the movement regardless of the direction of the movement. Water-based exercise, takes a load off the painful joint. It also improves muscle strength, flexibility and range of motion. It enhances the balance and coordination of the muscle group. This stabilizes the spine and reduces the stress on the painful low back which reduces the low back pain. Water-based exercises provide a great advantage for the participants to improve their quality of life and reduce disability (Sawant et al, 2019).

Tejashree Ajit Dabholkar et al, conducted a study on Common musculoskeletal problem experienced by fishing industry workers in Mumbai. They used an anonymous questionnaire to study the prevalence of WMSD. The degree of pain was measured using avisual analogue scale. Their results of NMQ showed that WMSD prevalence was reported in thelow back (92.4%), shoulder (64.8%), knee (31%) and hand (25%). They concluded that maximum musculoskeletal problems were found to be repeated pulling and throwing of the net and bending forward action to lift heavy loads.As the prevalence of the low back is higher when compared to other regions, in this study the low back pain has been addressed.

Rakhi Sadanand Sawant et al,conducted a study on the Effect on hydrotherapy based exercises for chronic non-specific low back pain. Their study is to compare the effect of Hydrotherapy based exercises andconventional physiotherapy in chronic nonspecific low back pain. The results between the two groups revealed that there was a statistically significant difference seen with P values of VAS. They concluded that there was significant improvement in subjects who underwent conventional therapy and hydrotherapy.As hydrotherapy based exercise shows significant effect on reducing low back pain, water based exercises were employed for the aquaculture workers,

Tapani Pöyhönen et al,conducted a study onEffects of aquatic resistance training on neuromuscular performance in healthy women. This study shows that resisted aquatic training results in functional and hypertrophic adaptations in thehealthy neuromuscular system.The simpleexercises result in earlier hypertrophy than multi-joint exercises, which

need a longer time of initial neural adaptation which leads to delayedhypertrophy.They concluded that aquatic resistancetrainingcan be used for neuromuscular conditioning in healthy persons, and for those with limited capacity to exercise on land.

Thomaitsourlou et al.,conducted a study on The effects of a twenty-four-week aquatic training program on muscular strength performance in healthy elderly women. theirstudy shows that resistance aquatic exercise can increase upperand lowerextremity isometric and dynamic strength. Also, the treatment program that was usedimproved the functional performance.

Water base exercises were given to several sectors of people for low back pain but lacunae have been observed especially with the aquaculture workers. Since the study has been carried out in their working environment, the workers need not to leave work place. The aquaculture workers could adapt water-based exercise easily, as the exercise program is related to the nature of their job.Only low back pain was concentrated in this study.The temperature of the water was not able to control. The study is feasible and further study can be conducted for larger population. Other types of low back pain can be included in the studies. Further study can be conducted for regions other than low back and occupational workers other than aquaculture workers.

CONCLUSION:

From the above discussion, the water-based exercises have reduced the mechanical low back pain. Therefore, in this study, water-based exercises are used for treating the aquaculture workers with mechanical low back pain. This study proved that water-based exercises significantly reduce the mechanical low back pain experienced by aquaculture workers by using MODI and NPRS as outcome tools.This study concludes that there is a reduction in mechanical low back pain experienced by aquaculture workers, after six weeks of intervention in water-based exercises.

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