

## ORIGINAL ARTICLE

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## DOES AQUATIC EXERCISE IMPROVE QUALITY OF LIFE IN OBESE LOW-BACK PAIN POPULATION?

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## ABSTRACT

**Background:** Low-back pain is one of the most common reasons for work stress, poor health, sickness, and reducing the quality of life. While obesity is a growing public health concern, it was proved that obesity is a risk factor for low-back pain. Whereas obese low-back pain people cannot avoid weight load on the spine in any exercise, but they can easily carry out the exercise in water. This study aimed to know the effect of aquatic exercise on quality of life among obese low-back pain people.

**Methods:** A total of 39 women with BMI $\geq$ 27 kg.m<sup>-2</sup> who had non-specific chronic low-back pain were purposively selected for this study. They randomly assigned in two groups; exercising (N=19, 37.85 $\pm$ 5.83 years with 32.97 $\pm$ 4.84 kg.m<sup>-2</sup>) and control group (N=20, 40.8 $\pm$ 5.25 years with 31.87 $\pm$ 4.79 kg.m<sup>-2</sup>). The exercising group carried out the aquatic exercise, twice per week, 60 minutes per session, for 12 weeks. Quality of life was measured using the SF-36v2 questionnaire with eight domains; physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.

**Results:** The findings showed a significant ( $p\leq$ 0.001) improvement in the quality of life in the exercising group after 12 weeks. The significant improvement was found on seven domains of the SF-36v2 in the exercising group after the aquatic exercise intervention program while there was no significant effect on mental health ( $p=$ 0.051). In the control group, a negative change in mean difference (-3.02) was observed in the mental health domain, while there was positive change (15.32) for exercising group. There was no significant change in BMI in both groups, also.

**Conclusion:** In conclusion, a 12-week aquatic exercise is an appropriate intervention program to improve the overall quality of life among obese women who are suffering from non-significant chronic low-back pain.

**Keywords:** Aquatic Exercise, Quality of Life, Obesity, Low Back Pain.

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## INTRODUCTION

Low-back pain (LBP) is a common musculoskeletal disorder in the well-experienced adult staff population worldwide [1]. The prevalence of low back pain varied between 10-63%, with a median of 37% in several studies, and recent studies in Malaysia have shown similar results[2].

It is recognized that more than 80% of the population will experience an episode of low-back pain (LBP) at some time during their lives [3] and many studies showed the use of health care services for chronic LBP had increased substantially over the past two decades[2]. While several therapeutic strategies recommend rest and more limitation in physical functions, which subsequently resulted in weight gain, obesity is one of several lifestyle factors that has been suspected of causing LBP[4, 5]. However, more recently, epidemiological studies revealed an association between obesity and LBP[3, 6]. Moreover, LBP is the most common cause of activity limitation in people younger than 45 years, the second most frequent reason for visits to the physician, the fifth-ranking cause of admission to hospital, and the third most common cause of surgical procedures[7].

Then the need to reduce pain and increase weakened muscles is an important health issue for them to improve their quality of life, especially for well-experienced adult workers[6]. People who suffer from LBP need to improve their health and life quality to be fully functioning individuals in modern society. According to previous studies, LBP is one of the most common reasons for work loss, healthcare use, and sickness benefits[2, 8]. Thus, as obesity is a growing public health concern [4] many studies were conducted to reduce weight and low-back pain through exercise programs particularly among overweight and obese women because of the pain sensitivity, hormone alteration, and the fat distribution or lean mass proportion in their body [5, 9].

On the other hand, patients who suffer from LBP have periods of rest; as a therapeutic strategy, when their symptoms become worse, which leads to gain weight and results to weakened muscles particularly for the ventral and dorsal muscles of the trunk to reduced function of the spine[10, 11]. The therapeutic suggestion is supposedly a paradox to take rest and reduce the physical activities while resting will make the patient gain more weight and become obese.

Therefore, although the importance of strengthening and fitness exercises for the weakened stabilizing muscles of the spine has now achieved wide acceptance, they cannot avoid the weight load on the spine in any exercises on land[1]. Meanwhile, the evidence revealed that variety of exercise therapy is commonly prescribed as an effective used strategy to reduce non-specific LBP [12], one of these efficient exercises according to the gait control theory can be aquatic exercise due to water properties [13, 14]. In the past two decades, aqua aerobic exercise or water-based exercise become as an alternative exercise program to achieve fitness and rehabilitation purposes for individuals who physically had difficulty exercising on land[15]. Also, aquatic exercise is safer than land-based exercise to reduce risk of injuries

and difficulty of exercise[16].

Moreover, aquatic exercise not only can immerse the body in water and weigh up to 90% less than on land[17], it can be an effective treatment for obese patients with LBP who have difficulty with weight-bearing when exercising on land [8, 12]. According to Sritoomma et al. (2012) findings, chronic LBP is difficult to treat, impairs quality of life, restricts physical activity and reduces psychosocial well-being [18], which increasing health care cost for the societies[3]. Despite the fact they cannot avoid the weight load on the spine in any exercises on land, they can easily control it when carrying out exercises in water media. Therefore, since the quality of life is a vital issue in public health[19], it is important to ascertain the effect of aquatic exercise on improvement of quality of life among obese LBP adults.

However, it is unclear if aquatic exercise improves the quality of life in obese women who are suffering from chronic non-significant LBP. Consequently, this study was meant to ascertain if aquatic exercise is beneficial in promoting quality of life as a public health measure. Therefore, this study aimed to investigate the effect of 12 weeks of aquatic exercise; 60 minutes, two sessions a week on domains of quality of life, particularly in obese women with BMI  $\geq 27$  kg.m<sup>-2</sup>. This study was an effort to be an eye-opener among the obese low-back pain population to improve their quality of life through aquatic exercise without discomfort or feeling extensive emotional stress.

## METHODOLOGY

### Subjects

A total of 57 volunteer subjects were recruited by advertisement. Thirty-nine subjects were finally included for the current study based on the inclusion criteria. The inclusion criteria's were obese subjects (BMI  $\geq 27$  kg.m<sup>-2</sup>) who had clinically diagnosed with non-significant LBP problems for more than six months and without any intervention procedures. Exclusion criteria included the lower BMI, surgery, cardiorespiratory health problem, water phobia, or any contra-indication for aquatic exercise and inability to safely enter and exit the pool. All the subjects were informed of the procedures of the study and signed a consent form before enrolling in the study. The participants reported no sports activity experiences within the past three years. All of the subjects were female, and they were randomly placed into two groups; aquatic exercise (n=19) and control (n=20) groups.

### Quality of life measurement

Quality of life (QOL) was measured by SF-36v2 (Short-Form 36-Item Health Survey, version 2.) questionnaire (Bilingual; English-Malaysian/Malay) [20] that contains eight subscales designed to measure the related domains of quality of life[21-23]. The domains consist of physical functioning (PF), social functioning (SF), physical role functioning (RP), emotional role functioning (RE), bodily pain (BP), general health (GH), vitality (VT) and mental health (MH). The SF-36v2 was administered for two

health-related scopes to assess the physical functioning and psychological functioning. The questionnaire scores have been valued from 0-100, and higher value indicates a better condition or improvement. The measurement of the weight, height, and body mass index (BMI), were measured via InBody Scan 370, body composition analyzer. All measurement were taken before and immediately after finishing the 12-weeks aquatic exercise program.

### The aquatic exercise intervention program

As an intervention program, a twelve-week aquatic exercise was carried out two sessions weekly for 60 minutes per session. The aquatic exercise was conducted in shallow water (chest-deep water; 120 cm and 150 cm in depth), and it was conducted under the supervision of aquatic exercise therapist. It included the static stretching of the hamstrings, calf, and upper and lower back muscles; 10-25 m front, back and sideways walking; 10-25 m front jogging; 15-20 m with self-selected speed, forward and side lunges, leg pedaling and cycling in supine position; self-selected repetition, upper body mobilization and shoulder transverse exercise. Each exercise was repeated in 3 sets in each session[24, 25]. The whole session required about 60 minutes, which 10 minutes of warm-up, 40 minutes aquatic exercise, 5 minutes of cool-down and relaxation exercises, and 5 minutes self-care free water-activity were considered for each session of exercise[26]. A summary of the programme is shown in Table 1.

The intensity and frequency of the exercise were gradually increased during the next weeks, and after week three, the aquatic exercise was performed at 150 cm in depth pool also. In this depth of water, the subjects performed the exercises (walking, jogging, pedaling, kicking, and relaxation) with the swimming woggles, as the aid equipment. The conditioning of intensity was considered 13-17 Borg-Scale (60-70%) of their maximum heart rate[25]. This intervention program conducted from October to December 2018 at UPSI outdoor swimming pool. Even though all sessions carried out at 5-6 PM, the temperature of the pool was unable to maintain due to the weather changes. It should be mentioned that there was a replace session for the subjects to fulfill two sessions of exercise per week.

**Table 1:** Aquatic exercise program

		Intensity & Frequency (week 1 → week 8)
Main Exercise (40 min)	Water walking/ jogging	Self- selected speed 10m×4 → 25m×8 (forward and backward)
	Forward lunges	Self- selected rpm ×3 →10
	Side lunges	Self- selected rpm ×3 →10
	Supine position with hip & knee bent	Self- selected rpm ×3 → 20 ×6
	Supine position + leg pedaling	Self- selected rpm×3 → 20 ×6
	Supine position + cycling	Self- selected rpm ×3 5 → 20
	Shoulder transvers abduction & adduction Flexion & extension	Repeated slowly ×3 6 → 15
	Upper body mobilization (with kickboard)	Self- selected rpm ×3 → 10
	Arm pendulum (in different intense)	Repeated slowly ×3 6 → 15
	Deep water cycling (with woggle)	30sec → 1 minute ×3
	Pool plank (with woggle)	Self- selected rpm ×3 3 → 10
	Wall push up	Self- selected → 10
	Warm-up (10 min)	Static walk, combination of stretching exercise, water walking for range of motion & relaxation)
	Cool-down (10 min)	Stretching+ deep breathing technique +relaxation Self-care free water-activity

The power of analysis was conducted by G\*Power 3.0.10, which indicated a sample size of 18 would give 80% power. Type I error was considered with a 0.05 chance to detect the significant differences between aquatic exercise and control groups. The data was collected via pre (before the intervention program) and post-test (after intervention program period) process. The mean and standard deviation for the demography data, and each QOL domains were analyzed using SPSS software (version 23). A multivariate analysis of variance (MANOVA) was performed to determine the effect of 12 weeks of aquatic exercise is significant. MANOVA was conducted throughout the test measurements (pre and post-test) for both groups (time\* group). Since sample size of this study was less than 50, normality of data was verified using Shapiro-Wilk normality test, and also the equality of variances for all domains of QOL between both groups assessed by using levne's test. The significance level was considered at  $p \leq 0.05$ .

## RESULTS

According to the preliminary examination, there was no significant difference between aquatic and control group subjects about their age, weight, height, and BMI, and both studied groups were statistically comparable. Finally, of the 40 enrolled participants, 19 of 20 in the aquatic exercise group and all of the subjects in the control group completed the post-test of SF-36v2 questionnaire. There was one dropout from the aquatic exercise group due to pregnancy (n=1). The average attendance of aquatic exercise group was 92 % of aquatic exercise sessions during 12 weeks (24

sessions).

In the control group, 15% (3 subjects) of the participants had physiotherapy exercise instruction, which was done irregularly at home, 15-20 minutes 2-3 times weekly. Even though the participants were in the control group, the researchers were not able to control this condition. The primary demographic data for aquatic and control groups shows in Table 2. It should be mentioned that although the weight and BMI of aquatic group after three months of aquatic exercise inclined, the changes were statistically not significant.

**Table 2:** Demographic characteristics of subjects for aquatic and control groups

Variables/ Group	Aquatic (n=19)		Control (n=20)	
	(Mean±SD)	Min-Max	(Mean±SD)	Min-Max
Age (years)	37.85±5.83	31-53	40.8±5.25	34-50
Height (cm)	157.3±6.17	146-168	156.8±4.53	150-166
Pre-Weight (kg)	81.77±14.23	65.4-116.3	78.3±11.64	65-104.3
Post-Weight (kg)	79.45±13.12	63-110.6	77.9±11.93	65.3-106.1
Pre-BMI (kg.m <sup>-2</sup> )	32.97±4.84	27.22-41.98	31.87±4.79	28.13-45.33
Post-BMI (kg.m <sup>-2</sup> )	32.08±4.47	26.22-40.48	31.71±4.92	27.74-45.56

The MANOVA results displayed a significant interaction (group \* time) effect on the eight domains of QOL as it shows in Table 3.

**Table 3:** Multivariate analysis of variance of the QOL domains (SF36v2 scores) at different measurement times

QOL Domains (SF-36v2 Scores*) (0-100)	Aquatic (n=19) (Mean±SD)		Control (n=20) (Mean±SD)		Group×time interaction effects	
	Pre	Post	Pre	Post	f	p
Physical Functioning (PF)	61.84±17.81	79.21±12.61	59.04±10.74	62.05±11.50	11.14	.001
Role of Physical (RP)	56.57±12.48	72.38±13.25	53.12±11.01	55.94±13.74	5.87	.018
Bodily Pain (BP)	45.00±22.07	68.42±18.35	44.12±18.21	38.88±17.43	12.35	.001
General Health (GH)	49.47±11.65	62.63±12.06	46.60±9.78	48.85±10.54	11.13	.001
Vitality (VT)	48.68±13.75	63.16±14.11	45.62±10.23	46.56±9.15	13.92	.000
Social Functioning (SF)	50.65±17.90	64.47±16.27	47.5±20.68	48.75±17.25	5.13	.027
Role of Emotional (RE)	48.68±18.05	72.37±25.28	44.16±27.24	48.33±22.36	6.94	.010
Mental Health (MH)	59.47±13.93	71.31±15.40	62.5±11.41	56.04±12.62	3.93	.051

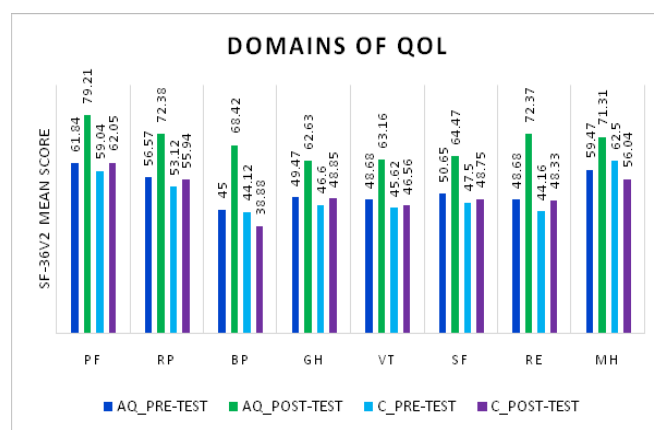
\* Pre-test was conducted at week 0, post-test immediately after week 12, and a higher value indicates a better condition or improvement.

The results showed a statistically significant group×time interaction effect on 7 of QOL domains included the physical functioning  $F(2, 37) = 11.14$ ; ( $p < 0.001$ ), role of physical  $F(2, 37) = 5.87$ ; ( $p < 0.018$ ), bodily pain  $F(2, 37) = 12.35$ ; ( $p < 0.001$ ), general health  $F(2, 37) = 11.13$ ; ( $p < 0.001$ ), vitality  $F(2, 37) = 13.92$ ; ( $p < 0.000$ ), social func-

tioning  $F(2, 37) = 5.13$ ; ( $p < 0.001$ ), role of emotional  $F(2, 37) = 6.94$ ; ( $p < 0.027$ ).

These results indicated an outstanding improvement in all domains as of QOL, exception mental health  $F(2, 37) = 3.93$  ( $p=0.051$ ). Although there was significant improvement within the subject of the aquatic group ( $p < 0.001$ ), the control group showed a reducing in the mental health score after 12 weeks. The scores change was negative, and the mental health of the control group was less than pre-test, which could affect the interaction of group factor (Table 3).

Figure 1. also illustrates the comparison of pre and post-test of SF-36v2 scores in 8 domains of QOL for aquatic and control groups.



**Figure 1:** Comparison of pre and post-test of SF-36v2 scores in 8 domains of QOL in both groups

## DISCUSSION

Since LBP is rising as a public health concern, this study investigated the effect of twelve weeks of aquatic exercise on quality of life (QOL) among obese women who are suffering from chronic-non-significant LBP. The study's findings illuminated that the progressive intervention aquatic exercise significantly lead to improve physical functioning (PF), social functioning (SF), physical role functioning (RP), emotional role functioning (RE), bodily pain (BP), general health (GH), vitality (VT) and mental health (MH) as the domains of QOL in obese LBP women.

Although there are several studies about exercise therapy and quality of life, there are only a few studies that investigate about the intervention of aquatic exercises on LBP particularly among obese people who are suffering from non-significant LBP. The findings of this study agree with Waller et al. (2009) that suggested therapeutic aquatic exercise is potentially beneficial to patients suffering from chronic LBP[1]. Even though the investigation was conducted among pregnancy-related LBP, their evidence supported the efficiency of water on improving quality of life. Similarly, Fiskén et al. (2015) found that aqua fitness might have several positive functional and psychosocial benefits for older adults who suffered from osteoarthritis[27]. They stated aqua fitness could increase the daily tasks of the subject and reducing fear of falling.

Moreover, the results of this study were in contradiction

with the study by Esther Intveld et al. (2010) that carried out aquatic physiotherapy on LBP in thirty-three subjects (31.8 ± 4.8 years)[28]. Their findings indicated that LBP scores did not increase significantly in the pregnant group who not participate in aquatic physiotherapy (p=0.74) since the pregnant group irregularly attended physiotherapy sessions once or twice monthly.

Evidence of previous studies has revealed that aquatic, water-based or therapeutic aquatic exercise could significantly assist patients who are suffering from chronic low back pain or stop the progression of their pain [1, 12, 24]. Whereas gate control theory has extrapolated that water-based exercise can probably improve muscle strength, muscle tension and muscle mass which effected on physical function, and body pain release, aquatic exercise can play a more prominent role to preserve obese people with LBP. Therefore, obese women with LBP can take part in aquatic exercises to engage in more high-intensity activities in water [16], and they can also be more motivated to exercise without having to worry about pain sensitivity in the water [5].

However, the most important available evidence to support this argument could be related to water properties. The physical properties of water enforce relaxation and diminish the pressure on the joint, which induces feelings of exhilaration [24]. While individuals with LBP submerged in water, buoyancy assists in supporting their weight, subsequently the amount of joint stress reduced and they can perform the exercise with little effort and less pain sensation[1, 29].

Meanwhile, since the water density is approximately 800 times more than air, combining the buoyancy and viscosity of water can interestingly provide a supreme source of resistance to improve muscle strength without bearing weight [30].

On the other hand, hydrostatic pressure utilizes forces perpendicular to the surface of the body, which results in reducing swelling, expanding joint position awareness and improving proprioception sense during aquatic exercise[29, 31]. Thus, the various benefits of aquatic exercise could provide favorable support for individuals with obese LBP who need more assistance to improve their quality of life. It is worth noting that body pain, physical functioning, and vitality of aquatic exercising groups were noticeable to the researcher after week 4 of the program while the subjects enthusiastically participated in the rest exercise session. However, it is essential to note that in this study, a 12-week aquatic exercise program was designed to promote relaxation, flexibility, stability, and muscle strength improvement. Improvement might have been more profound if weight loss had been promoted as part of the program design. Although LBP can affect QOL, other individual factors such as employment status, education level, and family matters cannot be ignored as they also influence QOL. Further research is needed to examine the effectiveness of aquatic exercise versus other low-back pain treatments among the obese population and the effect of a

weight-loss variable as well.

## CONCLUSION

As a conclusion, the findings of this study reveal that a 12-week aquatic exercise program can significantly improve all domains of quality of life in obese women who suffer from non-significant LBP. Therefore, aquatic exercise can be an effective intervention program to assist obese women with LBP to combat mobility limitations as well as social, emotional, and mental health issues. A dedicated aquatic fitness program can also increase vitality and reduce bodily pain. Even though obese people with LBP cannot avoid weight load on their spines in most forms of exercise, they are typically able to exercise in the water with minimal difficulty. Further research is needed to explore the effects of aquatic exercise on other groups of individuals who suffer from LBP, specifically among different populations and genders.

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## REFERENCES

- [1] Waller, B., J. Lambeck, and D. Daly, *Therapeutic Aquatic Exercise in the Treatment of Low Back Pain: A Systematic Review*. Clinical Rehabilitation. 2009; 23(1): 3-14.
- [2] Lonik, E.A.T., et al., *Prevalence of Low-Back Pain among Public Ambulance Workers in Kelantan, Malaysia*. Malaysian Journal of Public Health Medicine 2017. 2017. 17(1): 126-135.
- [3] Freburger, J.K., et al., *The Rising Prevalence of Chronic Low Back Pain*. Archives of internal medicine. 2009. 169(3); 251-258.
- [4] Bener, A., et al., *Obesity and Low Back Pain*. Collegium antropologicum. 2003; 27(1):95-104.
- [5] Shiri, R., et al., *The Association Between Obesity and Low Back Pain: A Meta-Analysis*. American Journal of Epidemiology. 2010; 171(2): 135-154.
- [6] Wong, T., N. Teo, and M. Kyaw, *Prevalence and Risk Factors Associated with Low Back Among Health Care Providers in a District Hospital*. Malaysian Orthopaedic Journal. 2010; 4(2): 23-28.
- [7] Punnett, L., et al., *Estimating the Global Burden of Low Back Pain Attributable to Combined Occupational Exposures*. American Journal of Industrial Medicine. 2005; 48(6): 459-469.
- [8] Lemmon, R., E.J. Roseen, and D. Rakel, *Chronic Low Back Pain*, in *Integrative Medicine*. Elsevier. 2018; 4<sup>th</sup> edition: 662-675.e3.
- [9] Mottola, M.F., *Exercise Prescription for Overweight and Obese Women: Pregnancy and Postpartum*. Obstetrics

- and gynecology clinics of North America. 2009; 36(2): p. 301-316.
- [10] Cifu, D.X. and H.L. Lew, *Braddom's Rehabilitation Care: A Clinical Handbook E-Book*. 2017: Elsevier Health Sciences.
- [11] Lahiri, S., J. Gold, and C. Levenstein, *Estimation of Net-Costs for Prevention of Occupational Low Back Pain: Three Case Studies from the US*. American Journal of Industrial Medicine. 2005; 48(6): 530-541.
- [12] Taheri, M. and K. Irandoust, *The Effects of Aquatic Exercise on Body Composition and Nonspecific Low Back Pain in Elderly Males*. Journal of physical therapy science. 2015; 27(2): 433-435.
- [13] Bender, T., et al., *Hydrotherapy, Balneotherapy, and Spa Treatment in Pain Management*. Rheumatology international. 2005; 25(3): 220-224.
- [14] Louw, A. et al., *Know Pain, Know Gain? A Perspective on Pain Neuroscience Education in Physical Therapy*. journal of orthopaedic & sports physical therapy. 2016; 46(3): 131-134.
- [15] Delevatti, R., E. Marson, and L. Fernando Kruehl, *Effect of Aquatic Exercise Training on Lipids Profile and Glycaemia: A Systematic Review*. Revista Andaluza de Medicina del Deporte. 2015; 8(4): 163-170.
- [16] Hossein Abadi, F., et al., *Effects of Aqua-Aerobic Exercise on the Cardiovascular Fitness and Weight Loss among Obese Students*. International Journal of Physiotherapy. 2017; 4(5): 278-283.
- [17] Piotrowska-Calka, E., *Effects of A 24-Week Deep Water Aerobic Training Program on Cardiovascular Fitness*. Biol Sport. 2010; 27: 95-98.
- [18] Netchanok, S., M. Wendy, and C. Marie, *The Effectiveness of Swedish Massage and Traditional Thai Massage in Treating Chronic Low Back Pain: A Review of the Literature*. Complementary Therapies in Clinical Practice. 2012; 18(4): 227-234.
- [19] Ionescu, D.D., A.M. Ionescu, and E. Jaba, *The Investments in Education and Quality of Life*. Journal of Knowledge Management, Economics and Information Technology. 2013; 3(6): 1-12.
- [20] Sararaks, S., et al., *Validity and reliability of the SF-36: the Malaysian context*. Medical Journal of Malaysia. 2005; 60(2): 163.
- [21] Davidson, M. and J.L. Keating, *Validity and Reliability of the SF-36: the Malaysian Context*. Physical therapy. 2002; 82(1): 8-24.
- [22] Mooney, A., *Quality of Life: Questionnaires and Questions*. Journal of health communication. 2006; 11(3): 327-341.
- [23] Alhaji, M.M., et al., *Psychometric Evaluation of the Brunei-Malay SF-36 version 2 Health Survey*. Asian Pacific journal of cancer prevention: APJCP. 2018; 19(7): 1859.
- [24] Olson, D.A., et al., *Aquatic Exercise for Treatment of Low-Back Pain: A Systematic Review of Randomized Controlled Trials*. American Journal of Lifestyle Medicine. 2013; 7(2): 154-160.
- [25] Rewald, S., et al., *Effect of Aqua-Cycling on Pain and Physical Functioning Compared with Usual Care in Patients with Knee Osteoarthritis: Study Protocol of A Randomised Controlled Trial*. BMC musculoskeletal disorders. 2016; 17(1): 88.
- [26] Fiskens, A., et al., *Perceived Benefits, Motives, and Barriers to Aqua-Based Exercise among Older Adults With and Without Osteoarthritis*. Journal of Applied Gerontology. 2015; 34(3): 377-396.
- [27] Fiskens, A.L., et al., *Comparative Effects of 2 Aqua Exercise Programs on Physical Function, Balance, and Perceived Quality of Life in Older Adults With Osteoarthritis*. Journal of Geriatric Physical Therapy. 2015; 38(1): 17-27.
- [28] Intveld, E., S. Cooper, and G. van Kessel, *The Effect of Aquatic Physiotherapy on Low Back Pain in Pregnant Women*. International Journal of Aquatic Research and Education. 2010; 4(2): 5.
- [29] Ariyoshi, M., et al., *Efficacy of Aquatic Exercises for Patients with Low-Back Pain*. The Kurume medical journal. 1999; 46(2): 91-96.
- [30] Hossein Abadi, F., et al., *A Comparative Study of Water and Land Based Exercises Training Program on Stability and Range of Motion*. International Journal of Engineering & Technology. 2018; 7(4.42): 68-72.
- [31] Dunder, U., et al., *Clinical Effectiveness of Aquatic Exercise to Treat Chronic Low Back Pain: A Randomized Controlled Trial*. Spine. 2009; 34(14): 1436-1440.