International Journal of Aquatic Research and Education

Volume 4 | Number 3 Article 10

8-1-2010

2010 International Aquatic Fitness Conference

Aquatic Exercise Association

Recommended Citation

Aquatic Exercise Association (2010) "2010 International Aquatic Fitness Conference," *International Journal of Aquatic Research and Education*: Vol. 4 : No. 3 , Article 10.
DOI: https://doi.org/10.25035/ijare.04.03.10
Available at: https://scholarworks.bgsu.edu/ijare/vol4/iss3/10

ABSTRACTS

International Journal of Aquatic Research and Education, 2010, 4, 328-351

2010 International Aquatic Fitness Conference

Aquatic Exercise Association (AEA)

Balance and Agility Performance Responses to a Water Exercise Program for Land Athletes

J. Whitehill Jr., N.L. Constantino, & M.E. Sanders

The responses to water fitness programs in terms of agility (speed, jumping, coordination) and balance performance is unclear. Water provides a unique environment for training but the specificity of training for land athletes is still unknown. The purpose of our study was to determine the effectiveness of a water-based exercise program on improving agility and balance for land-based competitive athletes during off-season training. Twenty-nine healthy, competitive athletes (ages 23.7 ± 6.5 years) were recruited to either a water exercise (WE, n = 14), or a control (C, n = 15) group. The WE group trained a minimum of 3 times per week, for 90 minutes each session, performing aquatic aerobic activities, resistance exercises, and stretching. WE activities included shallow, deep, and underwater running, jumping, cadence work, interval sets, and shallow-water cycling. The control group maintained land-based, off-season training and recorded all fitness activity. The duration of the program was 9 weeks. Agility and balance measurements were obtained at the beginning, middle, and at the end of the training period.

After 9 weeks of training, a two-sample independent *t* test revealed that all measures, moving both clockwise and counter clockwise, improved agility ($p < 0.001$) for the WE group compared to the C group. In addition, we found significant differences between groups on the compass drill moving clockwise (–1.51 ± 1.9 sec, vs –0.27 ± 0.7 sec), the compass drill moving counter clockwise (–1.45 ± 0.4 sec, vs –0.37 ± 0.1 sec), hexagon jumping clockwise (–3.50 ± 1.4 sec vs –0.57 ± 0.7 sec), and hexagon jumping counter clockwise (–3.22 ± 2.0 sec vs –0.64 ± 0.5 sec), respectively. Overall stability balance increased dramatically (13 ± 5.1 vs 1.5 ± 3.3) and balance in terms of maximal sway (1.09 ± 0.3 in vs 0.1 ± 0.3 in) were significantly higher ($p \le 0.01$) for the WE group compared to the control group, respectively.

No injuries were reported during the program. We concluded that this water exercise program conducted in the off-season resulted in improvements in body composition and cardiovascular fitness for a variety of competitive land-based athletes. Water exercise appeared to be a promising training option for healthy competitive athletes to safely and significantly improve fitness.

Assessment	Water Exercise Group		Control Group	
	Pre	Post	Pre	Post
Compass clock	7.66	6.15	7.28	7.01
Compass counter	7.56	6.11	7.41	7.05
Hexagon clock	12.89	9.39	11.74	11.16
Hexagon counter	12.47	9.25	11.64	11.00
Stability	75.00	88.0	76.60	78.07
Sway	2.02	0.94	1.85	1.75

* $p < 0.001$

Impact Forces During Land and Aquatic Plyometric Exercises

O. A. Donoghue, University of Edinburg; H. Shimojo and H. Takagi, University of Tsukuba, Japan

Buoyancy reduces impact forces during water based exercise making aquatic plyometrics a safer alternative to land-based plyometrics. This study quantified the reduction in impact forces during several jumping exercises using force plates positioned on land and in a swimming pool at a water depth of 1.3 m. Peak impact forces were reduced by 33-54% across the various exercises ($p < 0.001$). Single leg hops resulted in relatively higher impact forces compared to forces absorbed by each leg during double leg jumps on land; however, the impact forces were comparable during aquatic jumps. The results have implications for coaches and therapists who use aquatic plyometrics in training or rehabilitation.

Plyometric jumping exercises are commonly used by sportspeople to develop explosive speed, strength and power (Chu, 1992). Exercises can be single or repeated efforts, double or single leg, from a range of heights and aim for maximum height or distance. Despite these variations, they all require powerful muscle contractions and are associated with high impact forces on landing, which may lead to subsequent injury such as patellar tendinopathy (DePalma & Perkins, 2004). Aquatic plyometric programs have been found to improve performance to a similar level as land based training (Martel, Harmer, & Logan, 2005; Miller, Berry, & Buliard, 2002; Robinson, Devor, & Merrick, 2004); however, buoyancy reduces the impact forces experienced in water. One of the important factors in program design is the intensity or load placed on body tissues. Aquatic program design currently uses land-based guidelines as research has only recently reported impact forces for squat jump (Colado, Garcia-Masso, & González, 2010) and single leg hopping (Triplett, Colado, & Benavent, 2009) in the aquatic environment. Therefore, the aim of this study was to quantify the reduction in impact forces during a range of plyometric exercises when jumping in water compared to similar exercises on land.

Ethical approval was obtained from the institutional ethics committee prior to commencement of the study. Eighteen male swimmers (age, 23 ± 1.9 years; height, 1.76 ± 0.06 m; weight, 71.7 ± 6.9 kg; percent body fat, 20.8 ± 2.5 %) took part and wore swimming shorts and Rykä Hydro Step aqua shoes for the duration of testing. Participants performed ankle hops (AH), tuck jumps (TJ), counter-movement jump (CMJ), single leg hop in place with the dominant leg (SLH), and drop jump from a height of 30 cm (DJ) on land and in water (depth 1.30 m). Participants were instructed to keep hands on hips and jump for maximum height in each exercise. They landed from each jump on a force plate (Kistler 9253B11, Switzerland) operating at 2000 Hz. For the DJ, the second landing i.e. after the jump was analyzed. Normalized peak impact force was identified as the maximum force after landing on the plate divided by body weight (BW). In all exercises except SLH, impact forces were absorbed on both legs. A rough estimation of load absorbed on each individual leg (assuming equal distribution between legs) was obtained by dividing the impact force by two.

Statistical analyses were carried out using PASW Statistics v17. Differences between the means for each exercise in land and water conditions were analyzed using paired t-tests. The significance level was set at < 0.05. Cohen's d effect sizes were calculated using the formula: Effect size = $(\mu_1 - \mu_2) / SD_{pooled}$, where μ_1 and μ_2 represented the means in each condition and the SD_{pooled} was calculated as $\sqrt{[(SD_1^2 + SD_2^2)/2]}$. The interpretation of effect sizes was based on Hopkins (2010), where 0.2, 0.6, 1.2 and >2.0 represented small, medium, large and very large effect sizes respectively.

Peak impact forces for all exercises ranged from 4.32–6.77 BW during land based jumping and 1.99–4.05 BW when jumping in water (see Table 1). Average reductions in impact forces of 33-54% were observed depending on the exercise ($p < 0.001$, $d > 1.41$ for all exercises). When impact forces were adjusted to account for double leg landings, the estimated force absorbed on each leg was 2.50–4.32 BW on land and 1.84–1.97 BW in water. Impact forces during SLH were notably higher on land compared to other exercises, however similar forces were observed across most exercises in water (see Figure 1).

As expected, normalized impact forces were significantly reduced when jumping in water compared to on land. The 54% decrease observed for SLH was similar to the 44.8% reduction observed by Triplett et al. (2009). Impact forces during SLH on land were much greater than the estimated forces absorbed by each leg during the other exercises. However, when jumping in water, the impact forces were slightly less than the estimated forces absorbed during CMJ and DJ. While SLH is a particularly high impact exercise on land, requiring sufficient lower limb

Table 1 Mean Peak Impact Force (Normalized to BW) During Landing From Each Exercise in Land and Water Conditions

	Impact Force/BW Land (Mean ± SD)	Impact Force/BW Water (Mean ± SD)	% Difference
AH	5.50 ± 0.94	3.68 ± 0.58	↓ 33
TJ	5.00 ± 1.06	2.47 ± 0.59	↓ 51
CMJ	6.77 ± 1.40	4.04 ± 1.52	↓ 40
SLH	4.32 ± 0.55	1.99 ± 0.54	↓ 54
DJ	6.57 ± 1.40	4.05 ± 1.02	↓ 38

SD, standard deviation

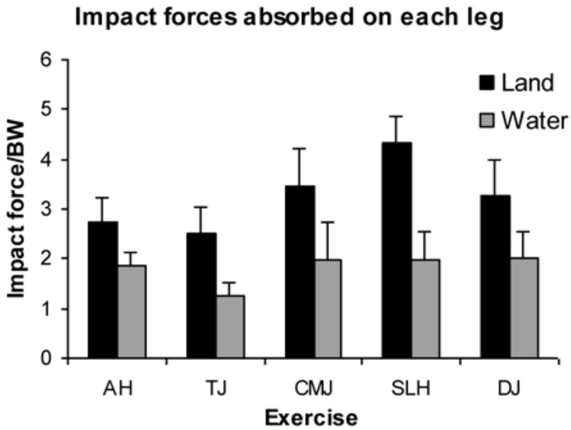

Figure 1 — Normalized peak impact force absorbed on each leg (mean with standard deviation bars) during landing from each exercise in land and water conditions.

strength, it appears to be of similar intensity to other exercises when performed in water. This suggests that it could possibly be introduced into a water training program earlier than in a land-based equivalent.

There are two main implications of these results. First, decreasing impact forces reduces joint loading thus helping to reduce the risk of injury (Dufek, & Bates, 1991). Aquatic plyometrics provide an alternative mode of training which results in similar performance benefits but in a less stressful environment. This may be useful for individuals who take part in a lot of impact or jump related training (e.g., volleyball, basketball). The second potential use is in rehabilitation from injury. Land running (although speed dependent) typically involves peak forces of 2-3 BW absorbed on a single leg (Cavanagh & Lafortune, 1980), which is comparable to forces observed in these water based exercises. Therefore, aquatic plyometrics represent a logical progression that can be used prior to re-introducing full effort land-based plyometrics. This would allow the appropriate movement patterns to be re-established while utilizing the cushioning properties of water and reducing the risk of aggravating the injury.

Important considerations include water depth, participant height, body composition, and landing technique, all of which influence the impact forces observed. Waist deep water has been recommended to ensure aquatic plyometrics are performed most effectively (Miller, Berry, & Gilders, 2001); however, most users will be restricted by fixed pool depths. The current study used a depth of 1.3 m which is standard in many swimming pools. This corresponded to an average water level of just below the xiphoid process in these participants. At this water depth, taller individuals are likely to exhibit greater impact forces on landing whereas smaller individuals may have lower impact forces but find it difficult to perform the jump effectively. Appropriate landing strategies are important to reduce the risk of injury. Stiff landings typically have little joint flexion and high impact forces. Soft landings are characterized by greater hip and knee flexion which allows energy to be absorbed over a longer period of time thus reducing impact forces.

Impact forces we observed were reduced by up to 54% during a range of plyometric exercises performed in water compared to on land, which supports the use of aquatic exercise in training and rehabilitation. Therapists and coaches can use this information when designing aquatic plyometric programs as an alternative to land based training, to allow athletes be gradually re-introduced to the demands of plyometric exercises after injury or for specific populations where low impact exercise is recommended.

The project was funded by the Carnegie Trust and the Daiwa Anglo-Japanese Foundation. The authors would also like to thank Dr Tsuyoshi Takeda, University of Tsukuba for his technical assistance during the study; the MSc and PhD students in the Swimming Biomechanics group at the University of Tsukuba for their support and assistance during data collection and the participants from the University of Tsukuba swimming club.

References

Cavanagh, P.R., & Lafortune, M.A. (1980). Ground reaction forces in distance running. *Journal of Biomechanics, 13*(5):397-406.

Chu, D. (1992). *Jumping into Plyometrics*. Champaign, IL: Human Kinetics.

Colado, J.C., Garcia-Masso, X., & González, L-M, et al. (2010). Two-leg squat jumps in water: An effective alternative to dry land jumps *International Journal of Sports Medicine, 31*(2):118-122.

DePalma, M.J., & Perkins, R.H. (2004). Patellar tendinosis: Acute patellar tendon rupture and jumper's knee. *The Physician and Sportsmedicine. 32*(5).

Dufek, J., & Bates, B. (1991). Biomechanical factors associated with injury during landing in jump sports. *Sports Medicine, 12*(5):326-327.

Hopkins, W.G. (2010). *A scale of magnitudes for effect statistics*. Retrieved from: newstats.org/effectmag.html.

Martel, G.F., Harmer, M.L., & Logan, J.M., et al. (2005). Aquatic plyometric training increases vertical jump in female volleyball players. *Medicine and Science in Sports & Exercise, 37*(10):1814-1819.

Miller, M., Berry, D., & Buliard, S., et al. (2002). Comparisons of land-based and aquatic-based plyometric programs during an 8-week training period. *Sport Rehabilitation, 11*:268-283.

Miller, M.G., Berry, D.C., & Gilders, R., et al. (2001). Recommendations for implementing an aquatic plyometric program. *Strength and Conditioning Journal, 23*(6):28-35.

Robinson, L.E., Devor, S.T., & Merrick, M.A., et al. (2004). The effects of land vs. aquatic plyometrics on power, torque, velocity, and muscle soreness in women. *Journal of Strength and Conditioning Research, 18*(1):84-91.

Triplett, N.T., Colado, J.C., & Benavent, J., et al. (2009). Concentric and impact forces of single-leg jumps in an aquatic environment versus on land. *Medicine and Science in Sports & Exercise, 41*(9):1790-1796.

Comparative Study of the Effects of Aquatic Versus Land-Based Lumbar Stabilization Exercises and Improving Function in Patients With Unstable Spine

Jason Adames, DPT and Robert Bayley, DPT, Wheeling Jesuit University

The purpose of this investigation was to report two participants' response to either a land-based lumbar stabilization program or the Aquatic Lumbopelvic Stabilization

Protocol in regards to pre- and post-pain ratings, objective measures and functional findings using the Oswestry Disability Index. The design of this research is a convenience sample case study of two participants. Participant #1 was a 45-year-old female with a diagnosis of chronic low back pain and fibromyalgia limiting ability to sleep, perform household chores, and family activities. Participant #2 was a 48-year-old female with a diagnosis of chronic low back pain limiting ability to perform a home exercise program, sit for prolonged periods, and perform job related functions. The methods consists of a physical therapy evaluation involving measurements in AROM, strength, flexibility, joint biomechanics, joint mobility, special tests for lumbar spine instability, and the Oswestry Disability Index Questionnaire. Subject #1 was placed into the land-based lumbar stabilization program and subject #2 is placed into the Aquatic Lumbopelvic Stabilization Protocol. A discharge summary was taken after the completion of each program which included the same measurements as the evaluation. The results for Subject #1 show improvements in lumbar spine AROM, core muscle strength, and joint biomechanics, but remain unchanged in flexibility, joint mobility and spinal instability special testing. Subject #1's Oswestry results were 26% prior to the program and 4% after the completion of the program. The results for Subject #2 showed improvements in lumbar spine AROM, core muscle strength, joint biomechanics, flexibility, joint mobility, and all instability special tests were negative. The Oswestry results were 52% prior to the protocol and 20% after completion of the protocol. Based on these results, both the land-based and aquatics-based lumbar stabilization programs appeared to be effective in aiding in decreasing low back pain perception and improving function in patients with the medical diagnosis of chronic low back pain and a secondary physical therapy diagnosis of an unstable spine. Both the Land-Based Program and ALSP can be used as a treatment guide for future Physical Therapists treating patients with the diagnosis of chronic low back pain secondary to lumbar spine instability and core muscle weakness.

Effects of Hydrogymnastic With Physical Activity in Physiological Variables in Women With Abdominal Circumference Over 80 cm

Felipe Monnerat and Luis Jorge da Conceição Jr, Espaço Stella Torreão and Rede Abodytech – RJ – Brazil; Paula Roquetti Fernandes, Center of Excellence in Physical Evaluation – RJ– LABIMH – Brazil; and José Fernandes Filho, Prof Dr Rio de Janeiro Federal University – LABIMH – Brazil.

Physical activity has shown efficacy for reducing and maintaining bodyweight. It also promotes health in acute and chronic ways (Brum, et al., 2004), being fundamental to control of glycemia (blood sugar levels) in individuals with Type 1 and 2 diabetes. It also increases HDL cholesterol, reduces LDL cholesterol and triglycerides (Brum, et al., 2004; Cambrie, et al., 2007; Ramos, 2006; Zabaglia, et al., 2009). When performed in an aquatic environment, it can be also aggregated with the benefits promoted by the physical characteristics of the water (Caromano, et al., 2003; Moraes, et al., 2007). The objective of the present study was to verify the acute effect of a hydrogymnastic program over the physiologic markers in women over 50 years old with an abdominal circumference over 80 cm.

Hydrogymnastic practitioners who participated in this study were 17 women age 50 years and older with an abdominal circumference over 80 cm divided in two random groups on different days. All of them passed through pre-requirements, answered the PAR-Q test, and received a written orientation about the test which they were to receive and signed an informed consent. They were instructed not to ingest any food after one hour before the test.

Physiologic markers were diastolic and systolic arterial pressure, heart rate, oygen saturation, and blood sugar measured 5 minutes before and 1 minute after the activity. Arterial pressure was measured through the ausculatory method by the same evaluator in all participants, with the same measuring device in all tests, using the right arm as the standard arm. A sphygmomanometer calibrated by INNMETRO was used together with a stethoscope. For the oxygen saturation and heart rate a Contec oximeter was used and the values were collected 20 seconds after the device was put on the index finger. The blood sample was collected in the left index finger by another evaluator utilizing an Accure Check glycosimeter, Active model.

The workout session used was aerobic training with variable intensity without equipment. The exercises worked all segments comprehensively. The workout total time was 30 minutes in a 32ºC, in a 1.5 meter deep heated swimming pool. In the first and last 5 minutes the participants performed only a run in the water and at the end, were left in a group of three for collecting purposes while the rest of the group remained running in the water. The same procedure was adopted at the beginning of the activity to standardize the same workout time for all the participants. As a statistic method, the descriptive (means and standard deviations) and paired t tests were utilized, and the results before and after the workout were observed.

The following table contains the descriptive physiologic markers including diastolic and systolic arterial pressure, heart rate, oxygen saturation and blood sugar levels in women pre- and post-aquatic activity. Contrary to our expectations, the exercise prescription for patients with Type I and II diabetes was much more complex than anticipated.

Significant statistical differences were found ($p \leq 0.05$) only in the comparison of pre- and post-blood sugar tests ($p < 0.0001$) and systolic arterial pressure ($p < 0.0001$).

	Age	Ab	Glycemia		AP				HR		SAT	
			Pre	Post	Pre		Post		Pre	Pre	Pre	Post
N	17	17	17	17	17	17	17	17	17	17	17	17
Mean	73,6	98,3	132	96	122	74	133	76	80,6	82,4	97,1	97,4
DP	8,2	11,1	33	13	8,3	6,4	13,7	8,8	15,8	14,7	1,2	0,9

References

Brum, P.C. et al. (2004). Adaptações agudas e crônicas do exercício físico no sistema cardiovascular. *Revista Paulista de Educação física, 18*, 21-31.

Cambrie, L.T. et al. (2007). Efeito agudo e crônico do exercício físico no perfil glicêmico e lipídico em diabéticos tipo 2. *Revista Motriz, 13*(4), 238-248.

Caromano, F.A. et al. (2003). Efeitos fisiológicos da imersão e do exercício na água. *Revista Fisioterapia Brasil, 4*(1), 1-5.

Moraes, C.F. et al. (2007). Variação da freqüência cardíaca, pressão arterial sistêmica, glicemia e duplo produto no ciclismo aquático e indoor. *Revista Brasileira de Prescrição e Fisiologia do Exercício, 1(*6), 77-85.

Ramos, S.S. (2006). Prevenção Primária da Coronariopatia pela Atividade Física. *Revista da Sociedade de Cardiologia do Rio Grande do Sul, 15(*9), 1-4.

Zabaglia, R. et al. (2009). Efeito dos exercícios resistivos em portadores de diabetes mellitos. *Revista Brasileira de Prescrição e Fisiologia do Exercício, 3*(18), 547-558.

The Effect of Aquatic Exercise on Body Composition, Lumbar Function and Pain Scale in Elderly Women With Low Back Pain

Kang Sung-sun and Kim Woo-Won, Korean Aquatic Exercise Association

The purpose of this study was to investigate the effect of an aquatic exercise program for elderly women with low back pain for more than 6 months on body composition, lumbar function and pain scale. 24 elderly women were involved in this study. They were divided in two groups: an aquatic exercise group had twelve people (mean age: 61.42±5.11), and a control group had twelve people (mean age: 62.08 ± 7.56). All subjects were tested pre and post for body composition, isokinetic muscle function, and pain scale after 12 weeks of aquatic training.

Weight, lean body mass, % body fat, WHR, BMI were measured with an Inbody 3.0 (Biospace, Korea) for determining body composition. Peak torque, average power, and total work were measured with a Biodex System III (U.S.A) for measuring lumbar function. VAS was measured with a pain scale questionnaire. All data collected were analyzed using SPSS PC + 14.0 statistics package and all variables measured were expressed by mean and standard deviation. The statistical comparisons were made using one way repeated measured ANOVA. Statistical significance was considered at $p < .05$.

First, body composition was significantly changed indicating weight ($p < .01$), lean body mass ($p < .001$), and BMI ($p < .01$) differences between groups. Percentage body fat and WHR was not significantly different in the measurement period. Second, isokinetic muscle function was significantly different for peak torque ($p < .05$) in the measurement period, but between groups the interaction effect was not significant. Average power ($p < .01$) was significantly different in the measurement period but not between groups. Total work was significant in lumbar extensor ($p < .01$) and flexor ($p < .01$) muscles for the measurement period but not between groups. Finally, significant differences on the pain scale were observed on back pain, stiffness, walk freedom, walking discomfort, standing still, twisting pain, hard chair, soft chair, handicap, work modification ($p < .05$) in the measurement period. Twisting pain ($p < .001$) was significant between groups. Back pain, standing still, handicap, work modification ($p < .05$) all produced significant interactions.

Although aquatic exercise is known to have a positive effect on energy consumption, because the subjects were older it was difficult to elicit a desired intensity for exercise. They also preferred not to put their heads in the water. These factors may have impaired percent body fat changes over the twelve week period. Deep water is believed to have a positive effect on lumbar flexor and extensor strength and stabilization. Improvements were seen for the group even though they had previously participated in aquatic exercise. The Vas survey showed significant differences. This may be due to the reduced impact and nerve pressure experienced in deep water aiding in the increase of functional movement.

Several limitations existed for the study. The participants previously practiced aquatic exercise. We did not fully control for additional exercise, genetics, eating habits, drug taking habits, physical conditioning, and philosophical factors.

The 12 week deep water exercise program had a positive effect on body composition parameters, lumbar function, and reduction of lumbar and associated pain. Additional research should be conducted to affirm the benefits of deep water exercise for different populations and age groups for relief of low back pain and increase in lumbar function.

Objective and Subjective Evaluation of Load in Various Environments

Jana Labudová and Yvetta Macejková, Faculty of Physical Education and Sport, Comenius University, Bratislava, Slovakia

Physical activities in the water environment have specific features compared to physical activities on land (Aquatic Exercise Association, 2006; Dargatz, & Kochová, 2003; Labudová-Ďurechová, 2005). The features come from the effects of the environment on the human organism. For all the various activities in water there is a common feature of intensity level for a health zone, which is 50–70% of HR_{max} (Dargatz, & Kochová, 2003; Hamar, & Lipková, 2001) and for a health-aerobic zone 50–85% VO_{2max} (AEA, 2006; Labudová-Ďurechová, 2005). The aim of our research was to compare internal load of organisms in terms of heart rate curve with the subjective evaluation of perceived exertion according to the Borg scale. In the research we used basic human locomotion – walking. It is a motion in water which is not affected by swimming technique or the level of swimming skills. The empirical research was supported by a national grant VEGA 1/0674/08 "A study of human motorics in water environment."

Participants included men aged 22.5 ± 2 years (n = 10), all of them were students specializing in sport sciences. For objective conditions in water and on land we used a walking speed of 3 km/hour, which is a slow walk of 70-90 steps/min. The length of the average step was 0.75m taken at a time frequency interval of 0.8s. The length of steps was restricted by a belt and the time interval was given by a sound signal coming out of a CD player. All participants were tested in breast water depth. Heart rate data were collected with a heart rate monitor (POLAR 610) recording at 5 second intervals representing an objective method of recording heart rate. The interpretation of HR zones according to the intensity of load was determined by the Karvonen formula normalized according to the basal heart rate (Wilmore, & Costill, 1999; Kirkpatrick, & Birnbaum, 1997). The participants specified their ratings of perceived exertion of the performance exertion by means of a modified Borg Scale during the test after 25m. We used the modified Borg scale (Borg, 2004) from 0 to 10, where 1 presents a very low intensity and 10 is an extremely high intensity.

When we compared walking on land to walking in water, all participants achieved higher heart rate values during the 500 yard water test than during walking on land. The increase of HR average values in water in comparison to average values measured during walking on land varied individually in the group of observed men. The increase of HR of six men was from 26% to 37%, the other four observed men had an increase of 43%–75%. Despite the fact that we expected higher HR during walking in water, we found the increase to be relatively high, especially since this was a group of young sportsmen.

We found significantly higher ratings of perceived exertion in water in comparison to those for walking on land. All participants specified walking on land on the Borg scale with a rating of 1, which is a very low intensity. The intensity in the water was evaluated by the subjects to be between 3 and 5 on the Borg scale (medium or high intensity). One participant who played football reported a rating of 7 on the Borg scale which is a very high intensity. To illustrate our results, we present an example of a 22 year old participant, whose basal heart rate was 64 bpm. During the walking test in water he achieved maximal HR of 143 bpm. The intensity during the tests was in a moderately aerobic zone. When we compared the heart rate curves of the two tests, the intensity was 37% higher in the water environment as compared to land (Figure 1).

The subjective evaluation of the intensity performed during the same test in various environments of participant I.M. showed an increased intensity load in water reaching a value of 6 or high intensity (Figure 2).

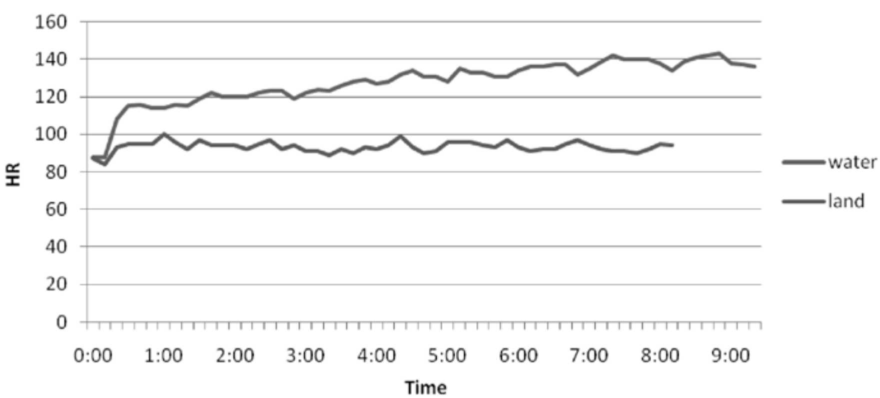

Figure 1 — The heart rate curve of I.M. during walking in various environments.

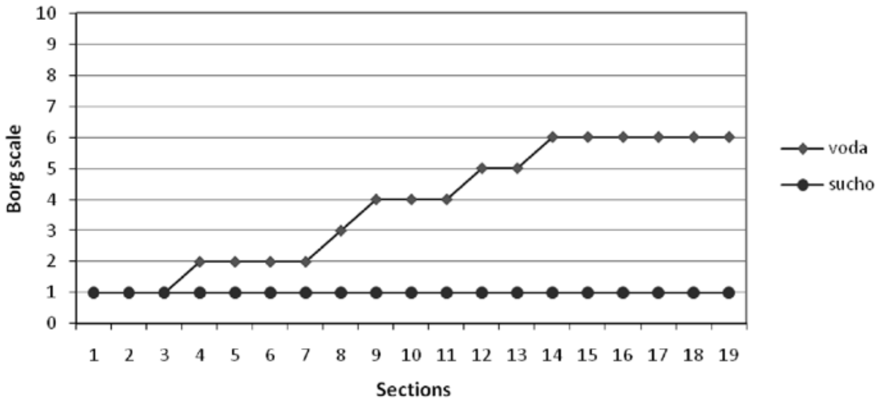

Figure 2 — Ratings of perceived exertion of participant I.M. during walking in various environments.

Evaluating the uniqueness of exercise workload under field conditions is a concrete directive for understanding content of physical activities in various environments [Čechovská, Novotná, & Milerová, 2003; Macejková, et al., 2008]. The perceived and physiological difficulty of exercise performed in water is supported by its features (i.e., resistance, pressure, buoyancy) and the overall physical condition of participants. Ratings of perceived exertion can provide valuable information for exercise performed in water.

References

Aquatic Exercise Association (AEA). (2006). *Aquatic Fitness Professional Manual* (5th ed.). Champaign, IL: Human Kinetics.

Borg, G. (2004). *The Borg CR10 Scale® Folder*. A method for measuring intensity of experience. Hasselby, Švédsko. Borg Perception.

Čechovská, I., Novotná, V., & Milerová, H. (2003). *Aqua-fitness*. Praha: Grada Publishing.

Dargatz, T., & Kochová, A. (2003). *Bodytrainer akvafitnes*. Praha: Ivo Železný.

Hamar, D., & Lipková, J. (2001). *Fyziológia telesných* vičení (1st Ed.). Bratislava: FTVŠ UK.

Labudová-Ďurechová, J. (2005). *Aquafitness* (1st Ed.). Bratislava: PEEM.

Macejková, Y., et al. (2005). Swimming lessons and their effectiveness. In: *Educación Física : Reflexión, Acción y Propuestas* (pp. 437-440), Cáceres : Imprenta Provincial.

Macejková, Y., et al. (2008). Proporcionalidade da carga durante aulas de natacáo de adultos. *Fitness & Performance Journal, 7*(3), 180-184.

Rodriguez -Adami, M. (2005). *Aqua-fitness*. Praha: Ikar.

Sedlácek, J., et al. (2003). *Kondičná atletická príprava a rekreačná atletika*. Bratislava: FTVŠ UK.

Wilmore, J. H., & Costill, D. L. (1999). *Physiology of sport and exercise.* Champaign,IL: Human Kinetics.

Kirkpatrick, B., & Birnbaum, B. (1997). *Lessons from the heart. Individualizing physical education with heart rate monitors*.

The Influence of Ai Chi on Balance and Fear of Falling in Older Adults: A Randomized Clinical Trial

R. Teixeira, Hospital Privado da Trofa, Porto, Portugal; L. Pérez, Hospital du Jura Bernois, Saint Imier, Switzerland; J. Lambeck, Faculty of Kinesiology and Rehabilitation Sciences, K.U.Leuven, Belgium; and F. Neto, FisioNeto-Fisioterapia e Bem-Estar, Póvoa de Varzim, Portugal.

Falls are a major problem in older adults, leading not only to an increase of incapacity but also to an increase of morbidity and mortality. Complications of falls include fractures, dependence and fear of falling (FOF), among others. When training balance on land, an individual's performance may be diminished by a lack of confidence or a fear of falling. In an aquatic environment, water's inherent viscosity serves like a postural support, promoting confidence and reducing the fear of falls. Aquatic therapy has the capacity to prevent deterioration in and increase the quality of life within the elderly community as well as promote their independence. Many studies investigate the efficacy of exercises programs in the aquatic environment.

Recently, Sova and Konno described a variant of Tai Chi, carried out in the aquatic environment named Ai Chi. Ai Chi is a technique of aquatic active relaxation related to T'ai Chi and Chi Gong, created by Dr. Jun Konno, in Japan. It consists of a progression of simple and slow exercises of the arms, legs and torso, with gradual narrowing of the basis of support, combined with deep breathing. It has been suggested that it has positive effects in older adults with coordination and balance deficits. However, to our knowledge, experimental evidence is very scarce to support those claims. Currently, only one study on Ai Chi has been published, showing the effects of Ai Chi in chronic stroke patients. Therefore, the aim of this study was to examine the effect of an Ai Chi program on balance and fear of falling among older adults.

Thirty older adults were randomly allocated to either an experimental or a control group. The presence of exclusion or inclusion criteria was established using both a structured interview and physical assessment. The inclusion criteria were aged 77–88 years and had either a high or a medium risk of falling (POMA score between 0 and 24). Exclusion criteria were any physiotherapy treatment or participation in physical activity during the study and standard contraindications to hydrotherapy as well as an absence from the Ai Chi sessions for more than 4 sessions.

The groups had a baseline similarity regarding age (Mann-Whitney $U = 82.0$,$p = 0.202$), sex, fear of falling (Mann-Whitney $U = 75.0$, $p = 0.119$) and balance (total: Mann-Whitney $U = 66.0$, $p = 0.053$; static: Mann-Whitney $U = 69.5$, $p = 0.073$; dynamic: Mann-Whitney $U = 68.5$, $p = 0.066$). All participants were assessed with the Tinetti Performance-Oriented Mobility Assessment (POMA) to measure balance capabilities and the Falls Efficacy Scale (FES) to measure fear of falling at 0 and 6 weeks. The organization did not allow for a follow up measurement.

Individuals assigned to the experimental group received 16 Ai Chi sessions, according to the sequence suggested by Sova and Konno. The exercises were undertaken in a 6 week period. The program was completed at a community aquatic centre being conducted by a physiotherapist, certified as an instructor of Ai Chi by "Aqua Dynamics Institute."

The control group did not receive any instructions and were not encouraged to change their physical activity, ADLs or social habits during the study. Before the intervention was carried out, 2 sessions to allow for the mental adjustment of the elderly to the aquatic environment were performed, since many of the participants had never experienced aquatic therapy or had a significant fear of falls.

The experimental group had a statistically significant increase in balance (Wilcoxon Z = –3,289; p = 0.001) but not in fear of falling (Wilcoxon Z = –1,024; p = 0,306), whereas the control group showed no significant change in balance (Wilcoxon Z = –1,140; p = 0,254) and a significant increase in fear of falling (Wilcoxon Z = –2,528; p = 0,011). Clinically significant effects sizes for balance of 1.3 for the tPOMA, with 1.1 and 1.4 for bPOMA and gPOMA was shown, respectively. A clinical significant ES for the FES was also reached (1.5), but depended on the fact that fear of falling increased in the control group.

This investigation's findings suggest that an Ai Chi program leads to a clinical relevant increase of both static and dynamic balance in older people. There is a tendency to decrease fear of falling, although statistical significance has not been reached. But since fear of falling increased in the control group, a clinical relevant difference could be shown.

References

Noh D.K., Lim H.I., & Paik N.J. (2008). The effect of aquatic therapy on postural balance and muscle strength in stroke survivors – a randomized controlled pilot trial. *Clinical Rehabilitation, 22*: 966-76

Sova R., & Konno J. (2003). *Ai Chi balance, harmony & healing* (2nd ed.). Washington: DSL Ltd.

Comparison of Rate-Pressure Product in Stationary Cycling on Land and in Water

Danielle de Jesus Lourenço Vieira, Carla Helena de Mello Alves, Renata Portinho Vlasak, Andrea Cristina Ferreira, Ana Cristina Lopes Barreto, and Roxana Macedo Brasil

Some studies demonstrate differences in the acute hemodynamic responses between exercises performed in water and on land. The aim of this study was to compare the acute responses of Rate-Pressure Product (RPP) of the subjects for indoor cycling (land and water). Heart rate (HR) and blood pressure (BP) in 15 men (23.30 ± 3.01 years; 1.75 ± 0.05 m; 78.20 ± 5.96 kg; 13.04 ± 5.81% G; 25.48 ± 1.84 IMC; 38.10 ± 5.43 VO2máx) were monitored during both protocols. An interval protocol of cycling of 35 minutes, divided into warm up and five more stages of training with different intensities was performed on land and in the water. The RPP was measured every 5 minutes and calculated throughout the product of HR and Systolic Blood pressure (SBP). After confirmation of the normality of the data (Shapiro-Wilks test), an applied variance analysis (ANOVA) *two way* was used to verify the effect

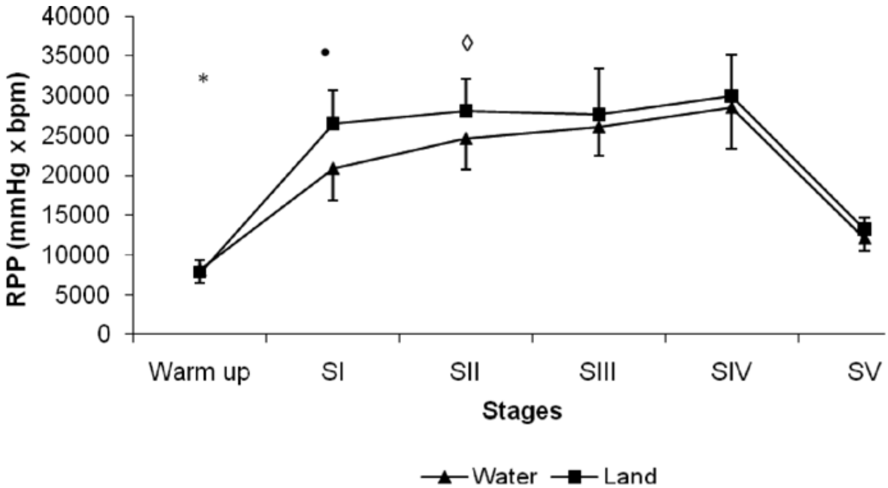

Figure 1— Average responses of rate-pressure product.

*** =** significant difference between the beginning of the exercise and the stages in cycling in the water and on land ($p < 0.05$).

• = significant difference on SI between cycling in the water and on land ($p < 0.05$).

◊ = significant difference on SII between cycling in the water and on land ($p < 0.05$).

of the hemodynamic responses in the protocols. The post-hoc test of Bonferroni was used to discriminate the possible differences between the variables. Significantly lesser values ($\alpha < 0.05$) of RPP in Stage I (SI) are registered for aquatic cycling (20890.00 ± 3986.00 mmHg × bpm) when compared with land cycling (26504.87 ± 3687.04 mmHg × bpm). This result was also found between the values of Stage II (SII) (24614.27 ± 3841.14 mmHg x bpm; 28086.80 ± 4086.59 mmHg × bpm, respectively) ($P < 0,05$). The conclusion is that in aquatic cycling there is a tendency to have a lower RPP when compare to land for the same intensity.

Main Reasons for Doing Water Exercises in Slovak Women

Monika Urbanova and Jana Labudova, Slovak Medical University in Bratislava, Slovakia and Faculty of Physical Education and Sport, Comenius University in Bratislava, Slovakia

Quality of life depends on fulfillment of social needs, cultural needs, the quality of general wellbeing, our attitudes and beliefs, and our efforts and motivation to improve all these components getting them in balance and harmony. Many different motivational indicators and reasons exist for the desire to make our life better.

Slowing down the process of involuntary, physical, and functional wear is possible by achieving a significant impact with appropriate mental and physi-

https://scholarworks.bgsu.edu/ijare/vol4/iss3/10
DOI: https://doi.org/10.25035/ijare.04.03.10

cal activity along with good nutrition (Čechovská, Novotná, & Milerová, 2003; Labudová-Ďurechová, 2005). Everyone desires to live as long as possible. The quality of such long life is a very important issue. The consequence of our stressful lifestyle is low physical and related mental performance, and poor health with higher incidence of diseases. Women very often feel the need to recover and regenerate mental and physical powers.

Water exercise significantly reduces the risk of life threatening diseases, improves mobility and overall functional ability of joints, as well as reduces pain. Finally, aquatic programs increase metabolism, help to maintain long-term optimal weight, improve neuropsychiatric problems, sleep quality, and help eliminate depression and coping with chronic pain. Physical activities in the water environment have specific features in comparison to physical activities on land (Aquatic Excercise Association, 2006; Dargatz & Kochová, 2003; Rodriguez -Adami, 2005). We cannot forget the benefits of regular exercises as well as healthy nutrition and their importance in the prevention of life threatening diseases.

The purpose of the study was to determine the main motives for doing water exercise in Slovak women, to compare indicators of quality and quantity, and to look at how the beliefs and attitudes differ between the two groups of women. The objective was to specify the behavior that motivates women to initiate and maintain regular water exercise, evaluate contribution of aqua fitness on the life quality and overall health of the study group, as well as evaluate the quality of the classes by knowing the women's opinion.

The subjects participating in our research were composed of 37 women from the city of Bratislava who do water exercises on a regular basis, generally twice a week. The sample was actually composed of two groups and assessed by different characteristics: age, level of experience (beginners and advanced) and location of the aquatic centre. The women were divided by age into four groups (15–30, 31–45, 46–60 and 60 and elder). Women took part in lessons in two different places and pools; one pool was located at the Faculty of Physical Education and Sports (n =19) and the other one was located in a fitness centre (n =18). The majority of the women spent their time at work in a sitting or passive position and responded that they were able to swim by using at least three swimming styles.

A survey was used as the main method for collecting and examining the data. The questionnaire contained 16 questions. For the evaluation of quality we concentrated on reasons, goals and benefits (Q: 9, 10, 13, 14). Quantity was set by age, the length of time for taking part in lessons, and the place where the lessons were held. We gained data and information regarding their opinion and judgments about the content of the lessons (Q 15) helping indicate the main reasons for doing and maintaining the water exercises.

Discovering the causes allow us to specify the main motivation indicators of Slovak women. From the results, we were able to see the motivation indicators. For an example of the results of this study, we show and comment on illustrating the goals, benefits, and changing of goals (Figures 1, 2, 3).

Women from both groups have the same or very similar reasons and goals for initiating and maintaining water exercise. The main goals of their participation as Figure 1 indicates were maintaining or improving personal physical fitness, a desire to do something for oneself (FPES b, c) and maintaining or improving personal physical fitness and stress reduction (BF b, e). Women reported mostly the same

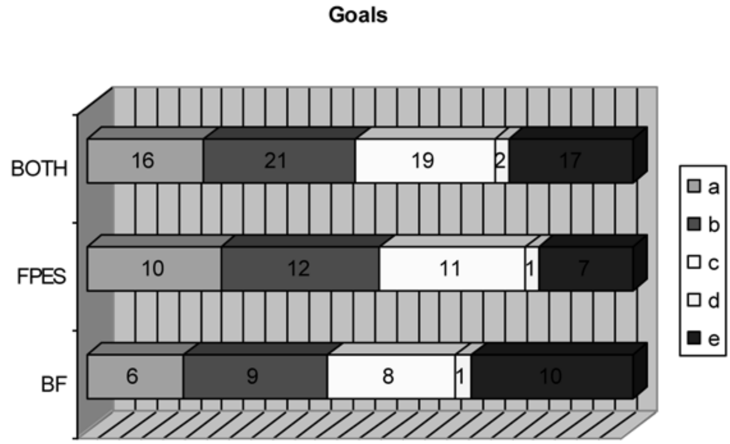

Figure 1

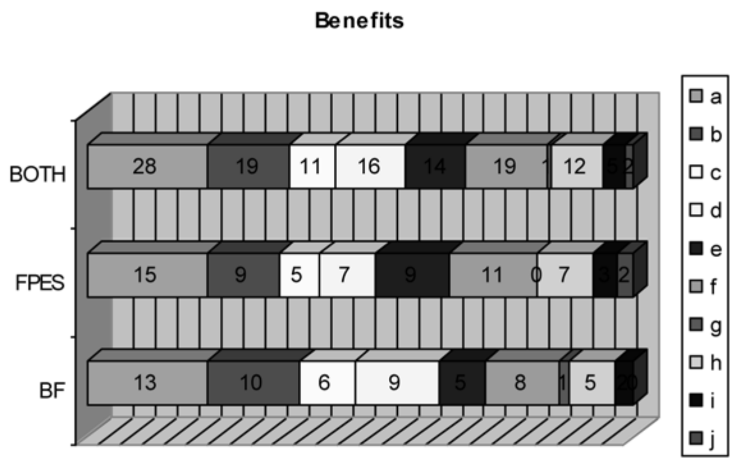

Figure 2

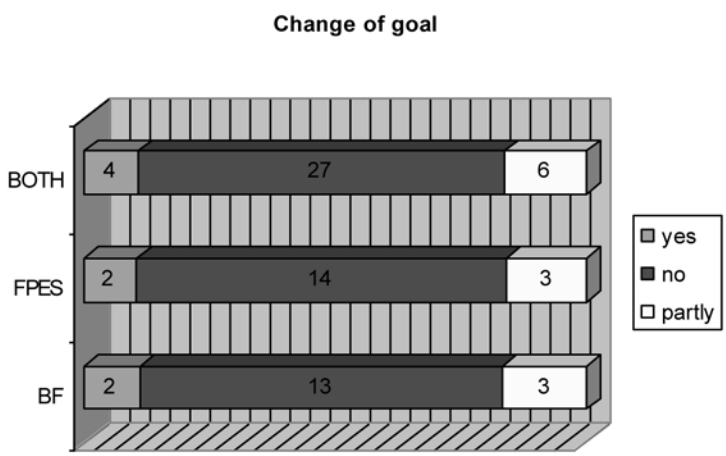

Figure 3

https://scholarworks.bgsu.edu/ijare/vol4/iss3/10
DOI: https://doi.org/10.25035/ijare.04.03.10

benefits of taking part in our aquatic lessons as shown in Figure 2. The biggest benefits for Slovak women were improving physical fitness, better flexibility, pain release, better health state, and weight loss. According to desired goals and achieved benefits only four women in general reported a change in their goals during taking part in water exercise. Women from both groups reported feeling less tired and more fulfilled at an emotional level.

Women from our study regardless of age seemed to be very active and motivated. In addition to water exercise, they usually took part in many different physical activities several times per week. Women from the FPES pool were older than women from the BF fitness center. The age difference and the differences between both facilities (water depth, sound system level, settings etc.) were shown as no issue regarding the motivation, beliefs and attitudes in both groups. Women in both groups seemed to have the same or very similar reasons and goals for doing water exercise. The tendency to initiate exercise was primarily determined by beliefs and attitudes and maintenance of exercise were mostly determined by benefits. Women from both groups reported primarily the same benefits for taking part in our aquatic lessons. The majority had taken part in the aquatic program for more than one year and 12 women had been involved for more than two years. All of them reported being very satisfied with the content of the lessons and the training quality, and that they wanted to continue in water exercise and aquatic activities.

References

Aquatic Exercise Association (AEA). (2006). *Aquatic fitness professional manual* (5th ed.). Champaign, IL: Human Kinetics.

Čechovská, I., Novotná, V., & Milerová, H. (2003). *Aqua-Fitness*. Praha: Grada Publishing.

Dargatz, T., & Kochová, A. (2003). *Bodytrainer Akvafitnes*. Praha: Ivo Železný.

Labudová-Ďurechová, J. (2005). Aquafitness (1st ed.). Bratislava: Peem.

Rodriguez -Adami, M. (2005). *Aqua-fitness*. Praha: Ikar.

The Effects of Land and Water Exercise Programs on Functional Balance in Older Adults

Elizabeth Fishback and Robyn Anderson, Department of Exercise and Health Science, Alma College, Alma Michigan

The purpose of this study was to compare the effectiveness of land and water exercise programs on improving balance in older adults, as measured by functional balance tests. Twelve subjects (age range 57–80 years) participated in either water (WA) or land (LA) based exercise that consisted of a standard class format (warm-up, cardio, muscle strength/endurance, flexibility and cool-down) and the addition of balance specific training. Both classes exercised for 60 minutes, 3 times a week, for a total of 8 weeks. Balance tests were administered prior and after the intervention programs and included Functional Reach, Tandem Gait, Timed Up and Go, The Step Test, One Leg Stance and The Six Minute Walk Test. A repeated measures ANOVA ($p < .05$) was used to analyze the data. The results showed that subjects of both groups improved significantly in Functional Reach: WA pre 9.45 ± 2.18

inches, post 12.68 ± 3.04 inches; LA pre 8.61 ± 3.26 inches, post 10.80 ± 2.37 inches; Timed Up and Go: WA pre 9.99 ± 5.76 seconds, post 7.26 ± 4.24 seconds; LA pre 6.92 ± 0.49 seconds, post 6.11 ± 0.56 seconds; Step Test Right Leg: WA pre 16.23 ± 7.05, post 21.33 ± 6.85 steps; LA pre 16 ± 0.55 steps, post 22.39 ± 3.03 steps; Step Test Left Leg: WA pre 15.57 ± 7.01 steps, post 20.33 ± 6.53 steps,; LA pre 15.8 ± 4.92 steps, post 22.6 ± 2.35 steps; The Six Minute Walk: WA pre 501.43 ± 108.56 meters, post 552.48 ± 106.46 meters; LA pre 429.05 ± 44.03 meters, post 494.14 ± 62.69 meters. No significant gains were found in Tandem Gait or the One Leg Stance. These results suggest that when both water and land-based exercise programs focus on balance specific training, the mode of exercise is less important than the specificity of the intervention. This study concluded that water-based programs are an important mode of exercise to consider for improving functional balance in older adults due to the less demanding nature and the safe exercise environment of the water and the equitable balance gains found during water training compared to those realized during land training.

Determination of Maximal Cardiorespiratory Responses and Ventilatory Thresholds for Three Water Exercises in Young Women

Cristine Lima Alberton, Amanda Haberland Antunes, Débora Dutra Beilke, Stephanie Santana Pinto, Ana Carolina Kanitz, Marcus Peikriszwili Tartaruga, and Luiz Fernando Martins Kruel

The aim of this study was to assess maximal cardiorespiratory responses and ventilatory threshold (VT) for treadmill running (TR) and water-based stationary running (SR), jumping jack (JJ) and front kick (FK), and to compare the ratings of perceived exertion (RPE) corresponding to the 1st and 2nd VT. The sample included nine young women who participated in four maximal test sessions (TR, SR, JJ and FK). A Polar S610™ was used for heart rate (HR) measurement, a MedicGraphics VO2000 gas analyser, for oxygen uptake (VO_2) and ventilation (Ve), and a Borg scale (from 6 to 20), for RPE. Repeated-measures ANOVA with post-hoc Bonferroni test was performed, with an $\alpha = 0.05$. The analyses showed that peak VO_2 ($p < 0.001$), maximal HR ($p = 0.016$) and VO_2 corresponding to VT ($p < 0.001$) yielded significantly higher responses for TR, followed by SR and FK, and lower responses for JJ. The percentage values of peak VO_2 in the thresholds were not significantly different among the exercises. RPE also did not differ among exercises in the 1st and 2nd VT. Regardless of the exercise (TR, SR, JJ or FK), the intensity will be the same if it is prescribed based on the percentage values obtained for VT or RPE.

Effects of Water-Based Exercise on Body Balance of Elderly Women Performing Different Types of Training

Natália Amélia da Silva Azenha, Cristine Lima Alberton, Ana Carolina Kanitz, Flávia Gomes Martinez, Ronei Silveira Pinto, Eduardo Lusa Cadore, Marcus Peikriszwili Tartaruga and Luiz Fernando Martins Kruel

Physical activity for older adults is important because of improvement in quality of life. The aim of this study was to analyze the body balance in elderly women subjected to water-based exercise training. The sample consisted of 10 healthy active women (61.0 + 0.5 years) engaged in water for at least 12 months and that there were at least 3 months without physical exercise. The subjects were divided into 3 groups: balance (n = 3), strength (n = 4) and aerobic (n = 4). The 12-week training was conducted at the Swimming Center of the Physical Education School on the Universidade Federal do Rio Grande do Sul (EsEF / UFRGS). Evaluation sessions were held, pre-and post-training, to assess body balance, where it was measured on an AMTI Brand force platform, with eyes closed and with eyes open. Data was collected on center of plantar pressure variables anteroposterior (COPx), plantar pressure center lateromedial (COPy), moment of force anteroposterior (Mx) and moment of force lateromedial (My). Data analysis used descriptive statistics and data are presented as mean and standard deviation. As a result, there was a trend for improvement in lateromedial balance in the aerobic group through the values of My with eyes open (0.08 ± 0.06 0.03 ± 0.03 pre and post) as well as in the strength group in the variables My and COPy (0.04 ± 0.02 0.02 ± 0.01 pre and post, 0.07 ± 0.09 0.04 ± 0.06 pre and post, respectively) and without My with closed eyes (0.03 ± 0.02 before and 0.02 ± 0.01 post). In the balance group, we found a trend of improvement in balance when considering the values of COPy with open eyes (0.06 ± 0.02 before and 0.02 ± 0.02 post). We conclude that the applied training improved some components of postural balance post-training, and this improvement was present regardless of whether the class applied balance, muscle strength, or cardiorespiratory fitness.

The Influence of Aquatic Exercise in the Preoperative and Postoperative Treatment of Lumbar Arthrodesis

Marcos Gomes de Bitencourt and Flávia Gomes Martinez, Grupo de Pesquisa em Atividades Aquáticas e Terrestres, Escola de Educação Física Universidade Federal do Rio Grande do Sul. Porto Alegre, Rio Grande do Sul, Brasil

This research presented a literature review on the influence of aquatic exercise in the preoperative and postoperative treatment of lumbar arthrodesis (the surgical fixation of a joint which is intended to result in bone fusion). This research used scientific and review articles, master's dissertations, and quotes extracted from books to seek answers to the question: "Should aquatic exercise be used as a method for the preoperative and postoperative treatment of lumbar arthrodesis?" In this theoretical reference review, concepts and information were considered for aquatic exercise, the lumbar spine, arthrodesis, and exercises. Aquatic activity, in this case aquatic exercise, appeared to provide the following body adaptations for participants: reduction of body weight, improvement of functioning blood circulation, generating an improvement in attitude, and providing a sense of comfort. In conclusion, the literature review was inconclusive and there was a need for more research on this topic and the development of methods to achieve the most efficient treatment in the preoperative and postoperative treatment of lumbar arthrodesis using aquatic exercise.

The 100 Step Water Test

Mary O. Wykle, PhD, with Teresa Triche, MS, and Marty Biondi, PT

The 100 Step Water Test was designed to track the cardiorespiratory improvement and fitness of wounded Soldiers. The initial test design was extremely simple and did not measure with any reliability. As now defined, the test is appropriate not only for Soldiers recovering from injuries, but for any injured athlete or active aquatic participant desiring to monitor their fitness level. It is a natural component of deep water cadence training.

After trial and error, the current administration of the test was in deep water with adequate floatation to maintain correct buoyancy. The test requires the subject to take 100 steps – or as many as their ability permits. The steps are counted as the non-dominant leg steps down. Knee flexion is to 45˚ and less than 90˚. Bent arm swing is emphasized. The subject counts steps aloud, emphasizing each ten steps (10, 20, 30, etc.). If unable to continue counting aloud, the test administrator assumes the counting.

There is no time limit to the test. The total time to complete the 100 steps is recorded on the data sheet. To closely monitor the alignment, knee lift, and step count, the subject is tethered to the edge of the pool.

Resting heart rate and ending heart rate are recorded. Heart rate readings are achieved using a Heart Rate Monitor with chest strap. The one being used in the pilot study currently being conducted is the Polar RS300X. The Insta-wand was tested, but accurate readings were not achieved. It was extremely important to quickly obtain accurate ending heart rate immediately upon ending the 100 steps while in the water.

Preparing to take the test required practicing the correct stepping form while tethered. Subjects were taught the correct form the week before the first test was administered. It was also requested that the subject not do a high intensity workout the day prior to the test. Exercise at moderate intensity was permitted the day prior to the test.

Tests were at scheduled appointment times. The subject arrived early to warm-up prior to the test with shallow water walking. Ten minutes prior to taking the resting heart rate, subject moved to a bench at the deep end of the pool and sat quietly with feet on the deck for approximately ten minutes, put on a heart rate monitor, and test administrator recorded the resting heart rate. Participants then put on the floatation belt with tether attached and entered the water by using the ladder or sliding in. The free end of the tether was attached to a secure object such as the diving block and the subject began slowly jogging to establish a rhythm. Using a stopwatch, the test administrator gave the commands to begin jogging and to start counting.

The test administrator was responsible for ensuring correct execution of the steps, counting of steps, time, and motivation for the subject. The desired rating of perceived exertion (RPE) was 4/5 using the Brennan Scale. An RPE of less than 4 resulted in inaccurate data.

Participants who were not medically appropriate for full exertion were tested in a modified form and data were recorded but not analyzed with the others. In cases where full exertion was contraindicated or precautionary, completing the 100 steps at a moderate (RPE 3) level was tracked to record personal progress. An example was a subject who had been cleared for aquatic exercise, but who suffered from chest pains upon full exertion. This was an example of personal tracking of time and RPE with a drop in the time to take the 100 steps showing success. The heart rate monitor was vital in this instance to also record heart rate or show irregular heartbeats to use as referral to medical care for follow up.

Data from the first round of testing were currently being received. Data were collected monthly and analyzed. This was a one year pilot study at three Army installations with the focus on musculoskeletal injuries. The hypothesis was to see ending heart rates drop along with the time required to take 100 steps in deep water. At the completion of this phase, it was anticipated that total step time will drop along with resting to ending heart rate ratios. This is currently being conducted with Soldiers still in the process of healing.

It was important to emphasize that this was currently a performance improvement case study and not empirical research. The Aquatic Rehabilitation Program and Aquatic Warrior Exercise Program were under the U.S. Army Office of the Surgeon General and specifically the Proponency Office for Rehabilitation and Reintegration. This was a pilot study being conducted at three Army installations this year. The goal was to standardize these programs throughout the Army.

Exercising in Deep Water vs. Dry Land: Effects on Body Composition

J.C. Colado, M. Pellicer, X. García-Massó, J. Benavent, E.H. Dantas, & J. Lizandra, University of Valencia (Spain)

There is a large amount of literature concerning the physiological and functional effects of deep-water (DW) endurance training on different population sectors. In recent years, some studies have evaluated integral programs for the physical conditioning (IPPC) in shallow-water (SW) finding improvements both in body composition (BC) as well as in functional capacity. There is still a lack of knowledge regarding IPPC in DW, so the aim of this study was to measure the effects of an IPPC in DW on BC.

Sixteen healthy, sedentary women participated in the study. The subjects were randomized divided in two groups (DW Group-G- n = 8, 38.12 ± 6.53 years old; DLG n = 8, 40.25 ± 8.66 years old; p = 0.59) that performed a 16 week IPPC consisting of 3 weekly sessions. The participants were instructed not to change their daily life activities or their eating habits. The DWG used flotation belts when performing the training as well as other materials such as Aqua Exercisers, Gloves, Hydro Boots and Aquafins (Thera-Band®). The DLG used elastic bands (Thera-Band®) and free-weights. Each session lasted 45 min. for both groups. The IPPC was planned following these periodization guidelines: (1) for endurance exercises: 1^{st} month working 55-60% of HRmax; 2^{nd}-3^{rd} month working 61–70% of HRmax; 4^{th} month working 71–75% of HRmax. (2) for resistance exercises: 1^{st} month working 5 in OMNI-RES; 2^{nd} month working 6-7 in OMNI-RES and 3^{rd}-4^{th} month working

7-8 OMNI-RES. An eight-polar bioelectrical impedance system (BC-418,Tanita Corp., Tokyo, Japan) was used to determine BC and the weight also was measured.

Similar changes in overall and segmental BC improvements were observed ($p > 0.05$). Overall changes were: (1) DLG Body Weight (BW) 0 Kg, p=1; % of Body Fat (%BF) –0.85, p = 0.005; Fat-free mass (FFM) + 0.725, p = 0.01. (2) DWG BW -0.125, p = 0.81; %BF –1.59, p = 0.02; FFM + 0.85, p = 0.01. The change in the FFM of the extremities was: Arm (DLG + 0.05, p = 0.03 vs. DWG + 0.038, p = 0.2); Leg (DLG + 0.025, p = 0.68 vs. DWG + 0.175, p = 0.04). The change of trunk BC was FFM: DLG + 0.425, p = 0.04 vs. DWG + 0.425, p = 0.02; and of the %BF: DLG –1.375, p = 0.004 vs. DWG –1.94, p = 0.03.

Training in the water may lead to muscle mass increases as well as to fat reduction in the abdominal area. The effects on BC appear to be the same for training in DW or in DL as long as the methodological guidelines used to apply the IPPC are similar. The control of intensity and volume of training as well as the level of adaptation and the use of specific materials for the aquatic environment will enhance the effectiveness of these aquatic programs.

Differences in the Muscular Activation in Resistance Exercises Performed in Water vs. Dry Land

J.C. Colado, M. Pellicer, X. García-Massó, P. Salvá, S. Borreani, and A.G. Lucas, University of Valencia (Spain)

It has not yet been conclusively demonstrated whether the degree of muscular activation that can be achieved by highly trained persons with aquatic exercises (AE) for strength training (ST) is comparable to that achieved with dry land exercise (DLE) equivalents. The aim of this study was to determine whether the level of activation achieved with AE for ST with trained subjects is comparable to that achieved with their DLE equivalents using an analysis of kinesiological electromyography.

Four healthy males (24.33 ± 0.58 years old; 80.27 ± 13 kg; 12.03 ± 2.22 %BF; minimum of 2 years experience with ST) participated in the study. A surface electromyograph (Mega model ME6000) was used to determine the muscular activity of the agonist muscles of the movement (pectoralis major -PM- and posterior deltoid -PD-) and selected muscles of the trunk (rectus abdominis -RA, erector spinae lumborum -ES-). The movements evaluated were those involved in both glenohumeral adduction (Ad) and abduction (Abd) on a horizontal plane and without the remaining body segments making any movements to help. Prior to the exercises, the maximal voluntary contraction of each of the muscle groups analysed was determined, as well as the resistance in kg that had to be used for the DLE, together with a pace of movement that allowed exercise to be carried out in water reproducing the same intensity carried out on dry land.

The activation of the agonist muscles by the exercises carried out in the aquatic medium was at least equal to that obtained on dry land: PM (DLE 43.21 ± 27.64 vs AE 49.24 ± 28.56; p = 0.36); PD (DEL 60.85 ± 16.8 vs AE 70.76 ± 15; p = 0.005). Activation of the ES with AE was greater, both with the horizontal Ad exercise and with the Abd: AE 42.7 ± 25.74 vs DLE Ad 16.4 ± 12.12, p=0; vs DLE Abd 24.31 ± 9.66, p = 0. In addition, we noted the greater activation of the ES when exercising in water with currents: 54.98 ± 29.75 vs without 42.7 ± 25.74, p = 0.001.

The muscular activation achieved for the agonist groups with AE for ST was at least the same as that obtained with their DLE equivalents. Activation was always at levels that allowed strength adaptation to be achieved, even when, as in this case, the subjects had excellent physical aptitude. In addition, despite the fact that the trunk group evaluated was not a primary stabilizer, it was significant that the activation of the ES was significantly greater in the aquatic medium.

AE for ST can achieve effective muscular activations to provoke beneficial adaptations as long as the materials used are of an appropriate size, the speed of execution is high and adapted to the goals of the person exercising, body stability is maintained and perceived exertion is adjusted to the required values of the number of repetitions initially set. In addition, given the significant participation of the retrosomatic musculature, this methodology should not be used with subjects who lack good exercise technique and whose stabilizing trunk musculature is not in excellent condition.

Squat Jump Forces in Water vs. Dry Land: A Comparative Study

J.C. Colado, M. Pellicer, V. Tella, L.M. González, and X. García-Massó, University of Valencia (Spain); N.T. Triplett, Appalachian State University, USA.

Although vertical jumps have different benefits such as improving muscle strength, mobility, increasing bone density etc, there are a number of risks associated with the impact forces produced during landing stages. Performing jumps in water may be an alternative that can help to reduce articular compression during these stages. In addition, some studies have shown that a program of jumps in water improves power, peak concentric torque, vertical jump height, and speed which leads us to believe that jumps in water may be an effective alternative to dry land jumps to produce adaptations and improvements to motor performance, with the additional advantage that they reduce the risk of injury. The aim of this study was measure squat jump forces in water versus on dry land.

Twelve junior female handball players (age: 16.0 ± 0.7 years; height: 170 ± 10 cm; weight: 64.4 ± 8.9 kg) competing at a national level participated in the study. Subjects completed a familiarization session and a testing session 24–48 hours later. The intensity and stress of the squat jump (maximum concentric force, peak impact force and impact force development) were examined under three conditions: on dry land, an aquatic jump and an aquatic jump using devices that increase the drag force. Before the test a standard warm up of 5 min was performed. During the testing session the subjects were encouraged to make the maximal effort. Three attempts were made for each condition and the best attempt was chosen for the analysis. The subjects were asked to keep their hands on their hips during the whole test, except in the case of the aquatic jump with devices the subjects kept their arms straight. The degree of flexion for the starting position of the jump was set at 90º.

The data analysis revealed that the maximum concentric force was greater when the jumps were performed in water than on dry land, $F(1, 11) = 15.7$, $p = 0.002$, $r = 0.77$, but there were no differences between aquatic jumps, although it was a trend to increase in a bigger manner the maximum concentric force if the devices that increasing drag force were used. The peak impact force was lower for the aquatic jumps than for dry land jumps, $F(1,11) = 44.21$, $p < 0.001$, $r = 0.89$, and no differences were observed between aquatic jumps although it was a trend to reduce more the peak impact force if the devices that increasing drag force were used. Differences in the impact force development were also found, $F(1, 11) = 24.16$, $p < 0.001$, $r = 0.83$, with the values for aquatic jumps being lower that the values in dry land.

It seemed to be evident that water was the optimum environment in which to perform jumps since variables associated with the intensity were boosted and the variables related to impact force were reduced.

The outcomes of this study may be useful in fields associated with sport performance as well as in rehabilitation and prevention as our study demonstrated that training jumps in water could have the same or greater benefits than training jumps on dry land with much less risk.

DOI: https://doi.org/10.25035/ijare.04.03.10