Original Article

Effect of land and shallow water aerobic exercises on selected physiological and biochemical variables of obese adult

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Abstract:

We examined the Effect of land and shallow water aerobic exercise on selected physiological and biochemical variables of obese adult. This study was a two-centres, two-college, randomized controlled trial a total of 60 sedentary, obese men age 18–20 years were selected for this study. The 12- week -long exercise intervention included 60-min of moderate-to-vigorous aerobic exercise five times per week, the control group was not exposed to any of additional activity. The results reveal that the land and shallow water aerobic exercise interventions had an impact on the selected variables in all experimental groups, (SWAEG) showed a significant difference when compared to the (LAEG) with the $P < 0.01$ compared with baseline. Shallow water aerobic exercise group showed a significant difference Resting heart rate (0.89, $P < 0.001$) Maximum oxygen consumption (0.93, $P < 0.001$), Systolic blood pressure, (1.53, $P < 0.001$) diastolic blood pressure, (0.87, $P < 0.001$) High density lipoprotein, (1.24, $P < 0.001$) Low density lipoprotein (2.48, $P < 0.001$) and Triglycerides. (3.65, $P < 0.001$). land aerobic exercise group showed a significant difference Resting heart rate (1.20, $P < 0.01$) (VO2 max), (0.61, $P < 0.001$), Systolic blood pressure, (1.68, $P < 0.01$) diastolic blood pressure, (0.99, $P < 0.001$) High density lipoprotein, (1.41, $P < 0.001$) Low density lipoprotein (2.61, $P < 0.01$) and Triglycerides. (3.35, $P < 0.001$). control group did not any changes in all the variables. It was concluded that shallow water aerobic exercise resulted in a positive change in the selected variables.

Key words: shallow water aerobic exercise, land aerobic exercise.

Introduction

Physical exercise in water is a viable option to increase physical and mental health of obese persons while reducing the risk of injuries. Aerobic activities in water have been found to be

effective in improving aerobic fitness [Reilly, 2003], and have comparable effects on body composition when equated to weight bearing aerobic exercise on land [Gappmaier, 2006]. There are a wide variety of aquatic aerobic techniques that have been proven to positively affect various parameters of physiological function (Katsura et al., 2010; Cancela Carral & Ayan, 2007; Assis et al., 2006; Colado, Triplett, Tella, Saucedo, & Abellan, 2009; Colado, Tella, Triplett, & Gonzalez, 2009). One such type is deep water running (DWR), otherwise known as aqua jogging, which consists of simulated running in deep water. DWR is utilized for a variety of populations including the elderly, obese individuals, individuals with orthopaedic injuries, athletes, healthy individuals, as well as many persons with various clinical conditions (Subburaj et al., 2012; Killgore, 2012; Cuesta-Vargas et al., 2012; Azevedo, Lambert, Zogaib, & Barros Neto, 2010; Kaneda, Sato, Wakabayashi, Hanai, & Nomura, 2008; Broman, Quintana, Lindberg, Jansson, & Kaijser, 2006). Aqua jogging is used as low-impact training modality for individuals with compromised joints, during rehabilitation, weight bearing restriction, or when land exercise is not tolerated. Aqua aerobic exercise has been applied as a joint sparing intervention in rheumatologic diseases such as osteoarthritis, in the pre and postoperative management of musculoskeletal diseases, and as endurance and power training in cardio respiratory disease [Cider, 2003, Reilly, Dowzer, & Cable, 2003]. Exacerbating existing joint conditions during weight bearing exercise is counterproductive and can result in lasting damage to the joint structure (Gappmaier, Lake, Nelson, & Fisher, 2006; Wallace, 2003). Because obese individuals have a higher occurrence of joint pain, impact forces experienced during exercise are of great concern when discussing this population (Cohen, Cohen, & Banthin, 2009). The aquatic environment possesses many characteristics that can assist in reduction of impact forces while providing appropriate stimulus for improvements in cardiovascular fitness and muscular strength. The buoyancy of water supports the submerged body and counteracts the downward pull of gravity, providing reduction in body weight (Wilder & Brennan, 2004). Benefits of this buoyant effect include less stress and pressure on bones, muscles and connective tissues, while the viscosity and drag force of water provides a resistance proportional to the exerted effort (Wilder & Brennan, 2004). When the velocity of

movement doubles, the drag force produced by water quadruples, providing a resistance training stimulus (Tsourlou, Benik, Dipla, Zafeiridis, & Kellis, 2006; Colado et al., 2009; Colado et al., 2009). The qualities that the aquatic medium possesses create an optimal exercise environment for overweight and obese individuals, as impact and stress on joints is reduced while ability to attain an appropriate training stimulus is supported (Gappmaier et al., 2006).

Method

The objective of the study was to investigate the effect of land and shallow water aerobic exercise on physiological and biochemical changes. Resting heart rate, Maximum oxygen consumption (VO₂ max), Systolic blood pressure, diastolic blood pressure, High density lipoprotein, Low density lipoprotein and Triglycerides were selected as variables for this investigation. Sixty physically active, male, undergraduate engineering college students between 18 and 20 years of age volunteered as participants. Participants were randomly categorized into three groups of 20 each: Group I was not exposed to any specific training/conditioning program (CG), group II was involved in land aerobic exercise group (LAEG) and group III was given shallow water aerobic exercise group (SWAEG). The land aerobic exercise and shallow water aerobic exercise programmes were designed by the investigators and was administered for a period of 12 weeks, 5 days a week. It was specifically designed to improve the fitness levels of obese adults. Participants attended one, 60 minute session Monday thru Friday. Both experimental groups underwent their respective experimental treatment.

Measurements

Invitation letters were sent to participant for consent to participate in the study; only those who declined participation were required to return a signed reply form. Student participation was entirely voluntary. The madras medical college Institutional Review Board approved the research design and consent procedures and currently has it on file. Height and weight of participants were measured barefoot and in light clothing by a researcher, following the National Health and Nutrition Examination Survey protocol [National Center for Health Statistics; 2000]. The equipment used for measurement (electronic scales and wall mount tapes) was validated against a calibrated Seca stadiometer (Model 844) and Seca electronic scale (Model 214). Body mass index (BMI) was computed [weight (kg)/height squared (m²)] to classify participants into overweight and obese groups using the International Obesity Task Force age- and sex-specific BMI cut-offs equivalent to BMI values (kg/m²) of 25 and 30, respectively, at age 18 [Cole TJ, 2000]. Resting heart rate test was calculated by beats per minute by stopwatch. Maximum oxygen consumption (VO₂ max) was calculated based on the raw scores obtained for cardio respiratory endurance by using the following formula: VO₂ max = (Distance covered in meters -504.9) / 44.73. The values are recorded in ml.kg⁻¹.min⁻¹ (Cooke et al., 2010). Systolic blood pressure and diastolic blood pressure was calculated by sphygmomanometer and stethoscope. High density lipoprotein, Low density lipoprotein and Triglycerides, in the blood sample of each subject who was recorded in mg/dl.

Statistical Analysis

Statistical analyses were performed using SPSS 15 for Windows. The pre and post-test were conducted 1 day before and after the experimental treatment. Descriptive statistics, analysis of co-variance was used to analyze the collected data. Scheffe's test was used as a post-hoc test to determine level of significance. All data are presented as means ± standard error, and the level of significance was set at P<0.01 for all analyses.

Results

Table 1. Physiological variables in the SWAEG, LAEG and CG before and after interventions

Groups	Pre	Post	Change
Heart Rate (nos)			
SWAEG	77.30 ± 0.89***	75.80 ± 1.52	1.50 ± 0.70
LAEG	76.60 ± 1.64	75.17 ± 1.20**	1.43 ± 0.67
CG	77.50 ± 1.44	77.10 ± 1.21	0.40 ± 0.57
Vo ₂ Max (ml/min/kg)			
SWAEG	18.98 ± 0.94	20.89 ± 0.93***	1.91 ± 0.07
LAEG	17.45 ± 0.64	19.15 ± 0.61***	1.70 ± 0.09
CG	17.31 ± 0.57	17.24 ± 0.57	0.07 ± 0.13
Systolic Blood Pressure (mm/hg)			
SWAEG	124.50 ± 1.78	119.30 ± 1.53***	5.20 ± 0.58
LAEG	122.10 ± 1.87	119.20 ± 1.68**	2.90 ± 0.65
CG	123.30 ± 1.08	124.90 ± 1.06	1.60 ± 0.44
Diastolic Blood Pressure (mm/hg)			
SWAEG	83.20 ± 1.12	79.60 ± 0.87***	3.60 ± 0.46
LAEG	82.90 ± 1.18	80.30 ± 0.99***	2.60 ± 0.41
CG	82.10 ± 1.15	81.70 ± 1.06	0.40 ± 0.51

All data are means ± s.e. **P<0.01, ***P<0.001 compared with baseline.

Table 2. Biochemical variables in the SWAEG, LAEG and Control groups before and after interventions

Groups	Pre	Post	Change
HDL			
SWAEG	56.13 ± 1.22	58.98 ± 1.24***	2.84 ± 0.26
LAEG	54.35 ± 1.51	56.82 ± 1.41***	2.46 ± 0.36
CG	51.57 ± 1.32	51.21 ± 1.26	0.36 ± 0.19
LDL			
SWAEG	130.02 ± 2.75	122.29 ± 2.48***	7.73 ± 0.52
LAEG	133.79 ± 2.71	127.49 ± 2.61**	6.29 ± 0.67
CG	135.80 ± 2.69	137.96 ± 2.79	2.16 ± 0.61
Triglycerides			
SWAEG	147.39 ± 3.86	136.50 ± 3.65***	10.89 ± 0.65
LAEG	153.38 ± 3.87	142.69 ± 3.35***	10.69 ± 1.02
CG	150.39 ± 4.27	152.96 ± 4.34	2.56 ± 0.67

HDL= High Density Lipo-protein, LDL-Low Density Lipo-protein

All data are means ± s.e. **P<0.01, ***P<0.001 compared with baseline.

It was observed that the mean gains and losses of LAEG and SWAEG made from pre to post test were shown significant difference on physiological variables of heart rate (1.50, 1.70, p<0.05), Vo2 max (1.70, 1.91, p<0.05), systolic blood pressure (2.90, 5.20, p<0.05) and diastolic blood pressure (4.60, 4.60, p<0.05) respectively.

It was observed that the mean gains and losses of CG made from pre to post test were shown insignificant differences on the physiological variables of heart rate (1.10, p>0.05), Vo2 max (0.07, 1.91, p>0.05), systolic blood pressure (1.60, p>0.05) and diastolic blood pressure (1.60, p>0.05).

It was observed that the mean gains and losses of LAEG and SWAEG made from pre to post test were shown significant difference on bio-chemical variables of HDL (2.46, 2.84, p<0.05), LDL (6.29, 7.73 p<0.05) and triglycerides (10.69, 10.89, p<0.05) respectively.

It was observed that the mean gains and losses of CG made from pre to post test were shown insignificant differences on the bio-chemical variables of HDL (0.36, p>0.05), LDL (2.16, 1.91, p>0.05) and triglycerides (2.56, p>0.05).

Table 3I: Primary Outcomes of the Study

Variables	N	F Value	P
Heart Rate	60	7.83	0.01
Vo2 Max	60	12.45	0.001
Systolic Blood Pressure	60	9.34	0.01
Diastolic Blood Pressure	60	8.92	0.01
HDL	60	24.67	0.01
LDL	60	34.49	0.001
Triglycerides	60	17.89	0.01

The SWAEG and LAEG significantly increased the vo2 max, HDL and decreased heart rate, systolic blood pressure, diastolic blood pressure, LDL and triglycerides from pre test to post test. The obtained F values of SWAEG, LAEG and CG of heart rate (7.83), vo2 max (12.45), systolic blood pressure (9.34), diastolic blood pressure (8.92), HDL (24.67), LDL (34.49) and triglycerides (17.89). There was a significant difference on all physiological and biochemical variables from pre test to post test on two experimental groups with no changes in control group.

The present study demonstrated that physiological and biochemical variables have shown significant difference among the experimental groups. The SWAEG have shown better result in heart rate, vo2 max, systolic blood pressure, diastolic blood pressure, LDL, HDL and triglycerides than the LAEG and CG.

Discussion

After a 12 weeks effect of land and shallow water aerobic exercise dietary restriction in obese people, improvements were found on all the selected variables. Our study observed a significant reduction. The results of our intervention in obese people suggest that promising health effects can be expected from shallow water aerobic exercise.

Aquatic exercise has been proved beneficial in patients with conditions who are at risk when performing strenuous exercise such as osteoarthritis [Foley, 2003, Wyatt, 2001. Wang, 2007], fibromyalgia [Assis, 2004], and sports injuries [Zenhausen, 1997]. The aquatic environment is also highly beneficial to individuals that are overweight or obese. It should be considered to be the physical exercise intervention of choice due to the ability of

obese individuals to perform exercise more effectively without joint strain, high impact, injury risk, and the overall discomfort associated with land exercise for this population [Wadden, 2006; Finkelstein, 2007]. In our study, no participants experienced any injury suggesting that land and shallow water aerobic exercise provides a safer medium for exercising in obese populations.

Conclusion

The results reveal that the land and shallow water aerobic exercise interventions had an impact on the selected variables in all experimental groups, Resting heart rate, Maximum oxygen consumption, (VO₂ max), Systolic blood pressure, diastolic blood pressure, High density lipoprotein, Low density lipoprotein and Triglycerides. Shallow water aerobic exercise group (SWAEG) showed a significant difference when compared to the land aerobic exercise group (LAEG) with the $P < 0.01$ compared with baseline. It was concluded that shallow water aerobic exercise resulted in a positive change in the selected variables.

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