ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(7): 866-871
www.allresearchjournal.com
Received: 14-05-2016
Accepted: 15-06-2016

Mequanent Shikabaw Chekol
Sport Science Department,
Hawassa University
Hawassa, SNNPRS, Ethiopia

Correspondence
Mequanent Shikabaw Chekol
Sport Science Department,
Hawassa University
Hawassa, SNNPRS, Ethiopia

Efficiency of land and aquatic based exercises on the reduction of abnormal body weight among Haramaya university gymnasium and swimming pool users

Mequanent Shikabaw Chekol

Abstract
A study was conducted to investigate the comparative efficiency of land and aquatic based exercises on the reduction of body weight, with equal demand of intensity, duration, frequency, and types of exercise. Both overweight (BMI between 25 and 29.9 kg/m^2) and obese (BMI ≥ 30.00 kg/m^2) individuals were involved in the study and the evaluation lasted twelve consecutive weeks. Individuals used for the study were Haramaya University Gymnasium and Swimming Pool users, aged twenty up to thirty five years old and free from any impairment or chronic diseases. Purposive sampling technique was used to select the study participants. Twenty five overweight and obese individuals, men (n = 8) and women (n=17) were recruited for the study and randomly assigned to land based (n=12) and aquatic exercise groups (n=13) with matched mode of exercise. Assessments to measure progress made after the exercise program were conducted in terms of reduction made. Descriptive statistics and ANOVA (using SPSS version 16 software) were used to analyze the data collected and test the significance of the aquatic and land based exercises. The study confirmed that water or aquatic exercise resulted in higher reduction of body weight, for overweighed and obese individuals than land based exercise. Thus, overweighed and obese individuals are advised to use water based exercise than land based exercise to bring about significant reduction in body weight, and to promote good bodily appearance and optimal health.

Keywords: Obesity, overweight, body weight, BMI, and WHR

1. Introduction
Body composition is an important aspect of health for individuals from all age, gender, and ethnic groups.
Body composition adverts to the relative amount of various constituents in the body (e.g. fat, water, mineral, cells, bone and proteins), and estimates of body composition typically divide the body into fat and fat-free (water, mineral, cells, bone and protein) components [10].
Obesity and overweight among adults are generally defined as the abnormal or excessive accumulation of fat in adipose tissue to the extent that health may be impaired [30]. Adults with a body mass index (BMI) of 25 kg/m^2 and more as overweight and those with a BMI of 30 kg/m^2 and more as obese [31].
Now a days, in most Ethiopian urban areas people tend to use technological outlets (devices and transportations), and this makes them physically inactive or remain with less physical exertion in their daily activities. As a result, there happens an imbalance between people energy consumption (calories intake) and their energy expenditure.
When a greater number of calories are consumed in the diet, and fewer of the same are expended, the body stores the extra calories, i.e. gain in body weight (accumulation of body fat) [28].
An excessive amount of body fat leads to health problems [14]. Obesity is an established risk factor for chronic disease and premature death, but losing weight and keeping it off is necessary but difficult. The most costly chronic diseases which are consequences from obesity are: hypertension, cardiovascular disease, arthritis, stroke, musculoskeletal problem, mental retardation, type 2 diabetes, cancer, and general public health challenges.

From the above it can be noted that obesity and overweight problems need remediation to prevent or treatment. Substantial evidences show that physical activity can protect the development of chronic disease and increase longevity either for healthy individuals or obese and overweight individuals.

Aerobic exercise can be an important component of weight loss intervention, and therefore is commonly included in a comprehensive weight management program [19].

Because of contradictory results reported to date, the impacts of aerobic exercise intensity on body fat storage in overweight person was unclear and were not focused on comparing aquatic and land based exercises for the best of body weight reduction. Thus, the purpose of the study was to investigate the comparative efficiency of land and aquatic based exercises in reducing body weight, among Haramaya University Gymnasium and Swimming Pool Users with equal intensity, duration, frequency, and types of exercises.

With the above in mind, the research was designed to answer the following research questions:-

- Which types of exercises were best and easy to attain normal body weight and BMI?
- How much an obese or overweighed individual could reduce his/her body mass through land and aquatic based exercises?
- Which types of the selected land and aquatic based exercises were best to prevent and reduce the accumulation of fat in waist, hip and abdominal body part?

The general objective of the study was to investigate and compare the efficiency of land and aquatic based exercises on the reduction of body weight in HU Gymnasium and Swimming Pool Users.

2. Material and Methods

The study was conducted at Haramaya University Gymnasium and Swimming Pool which is found on Haramaya University campus, Ethiopia. The place is located 09º 24' N latitudes and 42º 02' E longitudes. The elevation of the place premises is 2013 - 2085 meters above sea level. The mean maximum and minimum temperature, where the University is located at 24.4 ^{0}C and 8.25 ^{0}C, respectively [2].

About the source of the study data, the primary data was obtained from the experimental investigation on the basis of the parameters selected for the study. Secondary data was obtained from different documents, journals, books, internet sources, and unpublished booklets.

2.1 Study sample

Participants of this study were HU Gymnasium and Swimming Pool users, who fulfilled the requirements for the study, BMI $\geq$ 25.0 kg/m^2, aged 20-35 years, free from any impairment or chronic diseases, and volunteer in response to the desired study. Thus, purposive sampling technique was used to select the study participants.

Participant information sheet or consent form and questionnaire was developed and administered to enable the acquisition of information on past and present health status, sex, age, type of food commonly consumed, and resting or idling time of potential candidates for the study.

Medical checkups for pregnancy and chronic disease (heart problem, hypertension, stroke, diabetes, cancer, and etc.) were made in the University Clinic before deciding up on the individuals for the study. The presence of pregnancy or any chronic diseases such hypertension, heart problem, stroke, diabetes, cancer, and etc. were used as the exclusion criteria.

Twenty nine individuals was filled the questionnaire and took medical checkup; among them, four (one female and three males) had heart problem, kidney surgery, and diabetic family history. Experimental measurement were also took for selecting the study participants i.e. Weight, height, waist grid, hip grid, thigh, dorsum-breast and upper arm circumference measurements were made using clinical balance (calibrated digital balance) with provision for weight-height measurement and an ordinary measuring tape made out of cloth for body circumference measurement, which purchased from local market. Using the measured values body mass index (BMI) had been calculated as ratio of body mass (kg) to height in meter square (m^2) and compare with the standard values.

Waist and hip circumference measurement was to estimate fat accumulation around abdomen and waist. This waist circumference measurement were made midway between the lower rib margin and iliac crest; hip circumference also measured with a steel tape at the widest part of the trochanters at position with feet kept 20-30cm apart. Arm, dorsum-breast, and thigh circumference measurement were made at mid-point of upper arm, dorsum-breast, and thigh using measuring tape with relaxation of standing position.

Based on the medical report, measurements made, and an index calculated values, twenty five participants (fifteen females and ten males) were selected for the study in total. The criteria for the selection were willingness to participate in the study, health as recommended by physicians, age between 20 and 35 years, and BMI ($\geq$ 25 kg/m^2). The sample size was decided up on the basis of availability of willing participants, cost and convenience of handling and managing the study, potential and prospect of small sample size for detailed and thorough investigation, and ease of control over the participants with regard to the sport activities.

These experimental measurements were made three times throughout the study period i.e. (pre exercise measurement, during exercise/starting after six weeks measurement and after exercise/starting after twelve weeks measurement. The only medical checkup for chronic disease was made for the first recruitment purpose only.

2.2 Tools of data collection

Cloth-plastic tape for regional body circumference measurements, calibrated balanced beam scale for weight-height measurements, and thermometer for measuring the temperature of the water in the pool were utilized during the study. Haramaya University Swimming Pool for aquatic exercise program and the Gymnasium for land based group exercise were used.

2.3 Exercise training protocol

Twenty five eligible individuals with the same number of sex, age, and BMI (with two interval approximation) were randomly divided in to two groups. The first group was assigned in aquatic exercise program, which was conducted in swimming pool and others in gymnasium. The water in the pool had 25-27 ^{0}C which was normal temperature. The exercise modality in the study was low intensity exercise (40-50 HRmax) in the first six weeks, and moderate intensity (50-60% HRmax) in the last six weeks, for both groups.

Applications of the exercise in a session were performed in three phases, namely: warm-up and simple stretching phase, main exercise phase, and cool down phase. Frequency and

duration of exercise for both groups were 3 days per week and 60 minutes per session. After 6 weeks of training, the progress of the training program was ensured by increasing & adjusted the amount of sets, the number of repetitions, and the speed of the exercises for each groups accordingly. Most of participants were students and office workers.

Descriptive statistics was used to analyze data. The mean and standard deviations (mean ± SD) were calculated using the established equations. Data collected from land and aquatic based exercises were compared with changes in body weight, and the effect of the exercises on above was analyzed. Analysis of Variance (ANOVA) was made using SPSS version 16.

3. Results and Discussion

3.1 Baseline information of participants

There was no significance difference between two groups due to age and sex deference. From land based exercise group, six participants were female and four male. Similarly, in aquatic exercise group eight participants were females and three male. There were no significant differences in any of these ages (23.90±2.95 and 23.82±2.60 of land and aquatic exercise groups, respectively) and characteristics measured between the two groups.

Table 1: Baseline data of the Subjects

Parameters	LBE (m ± sd)	ABE (m ± sd)
Age	23.90±2.95	23.82±2.60
Weight (cm)	71.41 ± 6.07	73.04 ± 7.71
Height (cm)	1.60 ± 0.07	1.63 ± 0.06
BMI (kg/m^2)	27.68 ± 2.51	27.37 ± 1.77
Waist Circumference (cm)	95.20 ± 7.58	93.55 ± 6.15
Hip Circumference (cm)	104.60 ± 7.75	102.18 ± 6.63
WHR Circumference	0.91 ± 0.04	0.92 ± 0.06
Thigh Circumference (cm)	60.10 ± 4.84	60.36 ± 2.54
Arm Circumference (cm)	30.80 ± 1.87	32.09 ± 1.51
Dorsum Breast Circumference (cm)	97.30 ± 3.34	99.64 ± 3.72
Blood cholesterol (mg/dl)	195.54 ± 17.34	201.69 ± 28.91
Blood Triglycerides (mg/dl)	181.21 ± 16.03	193.59 ± 21.94
HDL (mg/dl)	41.03 ± 6.07	35.43 ± 7.87
LDL (mg/dl)	127.35 ± 30.80	155.25 ± 30.44

LBE= land based exercise, ABE= aquatic based exercise, and m ± sd= mean and standard deviation

3.2 Interventions

All the training programs were well tolerated; there was no significance difference between attendance (session interruption) rates in all 36 attainable sessions for both exercise groups. And no serious injuries or related problems occurred during land based exercise sessions.

3.3 Postoperative measurements output

Postoperative measurements were taken at the end of the exercise program (end of 12th week). All characters of the participant considered during the first and the second phases of measurement were included.

Table 2: Mean values and standard deviation of postoperative body characteristics

LBE				ABE		
Parameters	M ± Sd	M.d-lp	P-value lp	M ± Sd	M.d-Ap	P-value Ap
Weight (kg)	68.53 ± 5.52	2.38	0.04**	68.29 ± 7.01	4.74	0.02**
Height (cm)	1.60 ± 0.07	0.00	1.00NS	1.63 ± 0.06	0.00	1.00NS
BMI (kg/m^2)	26.90 ± 2.49	0.78	0.05**	25.60 ± 1.70	1.76	0.02**
Waist Circumference (cm)	91.00 ± 6.90	4.20	0.02**	88.27 ± 5.33	5.27	0.04**
Hip Circumference (cm)	103.30 ± 7.39	1.30	0.07*	100.09 ± 6.12	2.09	0.04**
WHR Circumference	0.88 ± 0.05	0.03	0.07*	0.88 ± 0.07	0.03	0.02**
Thigh Circumference (cm)	59.30 ± 4.55	0.80	0.07*	58.18 ± 2.89	2.18	0.07*
Arm Circumference (cm)	30.60 ± 2.12	0.20	0.08*	30.91 ± 1.64	1.18	0.08*
Dorsum Breast Circumference (cm)	96.60 ± 2.76	0.70	0.06*	97.18 ± 2.99	2.45	0.09*
Blood cholesterol (mg/dl)	133.53 ± 25.79	62.01	0.01***	123.95 ± 14.97	77.74	0.01***
Blood Triglycerides (mg/dl)	105.64 ± 44.51	75.57	0.01***	90.35 ± 37.26	103.25	0.01***
HDL (mg/dl)	60.91 ± 10.59	-19.88	0.01***	63.88 ± 10.14	-28.46	0.01***
LDL (mg/dl)	64.02 ± 10.24	63.33	0.04**	72.39 ± 11.74	82.86	0.01***

Note: ***, **, and *; significant at 1%, 5%, and 10% probability level respectively. LBE= land based exercise, ABE= aquatic based exercise, M ± Sd= mean and standard deviation, NS= Not significant, M.d-lp= Mean difference between baseline and postoperative data of land based exercise, M.d-Ap= Mean difference between baseline and postoperative data of aquatic based exercise, P-value lp= significance value of land based exercise between postoperative data, and P-value Ap= significance value aquatic based exercise between postoperative data.

Source: own experimental result, 2012.

3.4 Weight and BMI at postoperative exercise

Comparisons of body weight and BMI of land and aquatic based exercise groups between baseline and postoperative exercise output are indicated below in Figure 1.

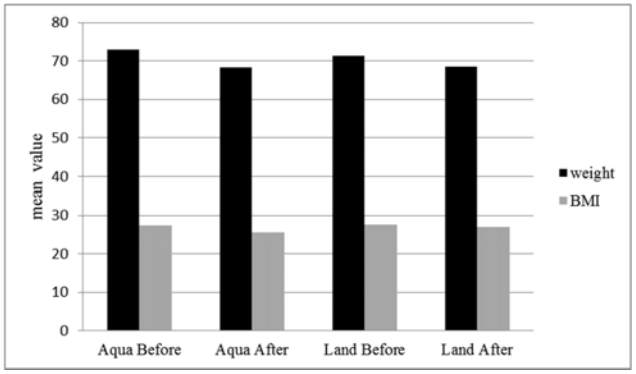

Fig 1: Comparisons of aquatic and land based exercise groups body weight and BMI between baseline data versus postoperative measurement results.

As can be seen from Figure 1 and Table 2, the reduction in body weight and BMI were significant at p= 0.04 and 0.05, for land based groups, respectively and aquatic based groups significant at 0.02 of both body weight and BMI. Body weight reduced the mean value from 71.41±6.07 kg to 68.53±5.52 kg and 73.04±7.71 kg to 68.29±7.01 kg for land and aquatic based exercise, respectively. BMI is also reduced the mean value from 27.68±2.51 to 26.90 ± 2.49 kg/m^2 and 27.37±1.77 to 25.61±1.70 kg/m^2 in case of land and aquatic based exercise, respectively.

At the end of the study, land based exercise indicate the mean difference of body weight by 1.43 kg and BMI by 0.56 kg/m^2. Aquatic exercise groups also made the mean difference of body weight by 2.63 kg and BMI by 0.99 kg/m^2 as compared with the first six weeks training measurement data. Likewise comparisons between postoperative versus baseline data in both exercise groups also shows the mean difference of body weight by 2.38 kg and 4.75 kg, and BMI by 0.78 and 1.77 kg/m^2 for land and aquatic based exercise groups, respectively.

Postoperative measurement outputs of body weight and BMI for both land and aquatic based exercise participants indicated the greater significant reduction as compared with the baseline and second phase measurement data. But, as presented in Figure 1, the reduction of body weight and BMI are more significant in aquatic exercise program as compared as land based exercise program, this is due to the nature of the water, in which water is denser than air and provides greater resistance to movement. The resistance of the water is a major factor in determining caloric expenditure; however, there are several factors that require consideration when discussing resistance in the water. For example, in water the resistance can be altered by the speed of the movements that affect drag and resistance force, the limb length and surface area, and the amount of force applied against the water's resistance. Resistance from viscosity is proportional to the velocity of movement through liquid [4]. These reduce body weight, which assist people to move limbs through the full range of motion and the more calories was expend.

3.5 Waist-hip ratio (WHR), thigh, arm, and dorsum-breast circumference at postoperative measurements

Based on the baseline and postoperative measurement, the comparisons of waist, hip, WHR, thigh, arm, and dorsum-breast circumference between land and aquatic based exercise are indicated below in Figure 2.

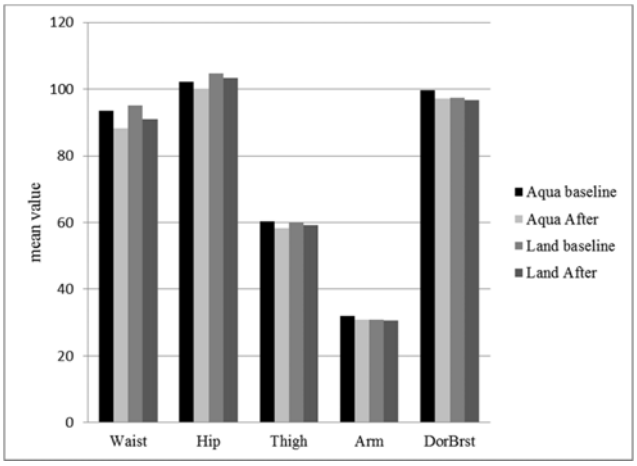

Fig 2: Comparisons of aquatic and land based exercise groups' waist, hip, WHR, thigh, arm, and dorsum-breast circumference between baselines versus postoperative results.

As the data indicated in Figure 2 and Table 2, waist circumference reduced the mean value from 95.20±7.58 cm to 91.00±6.90 cm and 93.55±6.15 cm ± 88.27±5.33 cm for land and aquatic based exercise, respectively. Hip circumference reduced the mean value from 104.60 ± 7.75 cm to 103.30/7.39 cm and 102.18±6.63 cm to 100.09±6.12 cm for land and aquatic based exercise, respectively. WHR also reduced the mean value from 0.91±0.04 to 0.88±0.03 and 0.92±0.06 to 0.88±0.07 for land and aquatic based exercise, respectively. Thigh circumference also reduced the mean value from 60.10±4.84 cm to 59.30±4.55cm and 60.36±2.54 cm to 58.18±2.89 cm for land and aquatic based exercise, respectively. Arm circumference reduced the mean value from 30.80±1.87 cm to 30.60±2.12 cm and 32.09±1.51 cm to 30.91±1.64 cm for land and aquatic based exercise, respectively; and dorsum-breast circumference too reduced the mean value from 97.30±3.34 cm to 96.60 ± 2.76 cm and 99.64±3.72 cm to 97.18±2.99 cm for land and aquatic based exercise, respectively.

The reductions in land and aquatic based groups were statically significant at p= 0.02 and 0.04, 0.07 and 0.04, 0.07 and 0.07, 0.07 and 0.07, 0.08 and 0.08, and 0.06 and 0.09 of waist, hip, WHR, thigh, and arm circumference, respectively (see Table 2).

At the end of the study, both exercise groups significantly reduced mean differences of waist circumference by 2.40 cm and 3.00 cm, hip circumference by 0.60 cm and 2.09 cm, and WHR by 0.02 and 0.04 for land and aquatic exercise respectively as compared as the first six weeks training outputs. Similarly there were reduced thigh circumference by 0.30 cm and 1.27 cm, arm circumference by -0.10 cm and 0.55 cm, and dorsum-breast circumference by 0.40 cm and 1.00 cm for land and aquatic based exercise programs respectively as compared as the first six weeks training outputs. Waist circumference also reduced by 4.20 cm and 5.27 cm, hip circumference by 1.30 cm and 2.09 cm, WHR by 0.30 and 0.04, thigh circumference by 0.80 cm and 2.18 cm, arm circumference by 0.20 cm and 1.18 cm, and dorsum-breast circumference by 0.70 cm and 2.46 cm for land and aquatic based exercise groups respectively as compared as the baseline data.

As the above description illustrated the predominant site of fat loss shows from trunk region. This data confirm the findings that waist girth was significantly reduced with training regardless of mode. More of the effects indicated on aquatic exercise groups. An evaluation of the upper and lower body exercises that were performed the illustration of possibilities for altered caloric expenditure during aquatic exercise. The upper and lower body exercises involved a movement pattern that included similar for both exercise groups. The energy cost of these motions performed on land was relative to gravity and the individual performing the movement. The energy cost in the water was relative to the amount of force that is applied with the movements, the drag forces created by the movement, the limbs of the individual performing the movements and the water depth. These factors exposed for additional energy (calorie) expenditure in addition to land based exercise group [4].

4. Conclusion and Recommendation

4.1 Conclusions

Based on the results obtained the following conclusions are made:

1. Postoperative measurement of body weight and BMI in both groups indicates significance reduction made in comparison with the baseline and the first six weeks exercise program. But, the reduction of body weight and BMI were more significant in aquatic exercise as compared with land based exercise, even if the exercise mode was similar.
2. Exercises, land and aquatic based, are appropriate to manage excess body weight. Nonetheless, aquatic based exercise resulted in higher caused reduction of body weight, for overweighed and obese individuals than land based exercise.
3. There was considerable reduction in waist and hip circumferences or WHR, thigh, arm, and dorsum-breast circumferences when aquatic based exercises were practiced.

4.2 Recommendations

Although the study indicated the importance of land and aquatic based exercises to control body weight, and to improve life, the research conducted had its own limitation due to lack of appropriate laboratory and field equipments. Hence, further studies using better instruments and equipment, and large number of samples, different age classes, life style and parameters or indicators, must be conducted. Continuous moderate physical activity combined with balanced dietary intake is needed to prevent weight regain after substantial weight loss program. In the area to generate information on intensity, duration and type of exercise, better method to reduce obesity and overweight effect and on importance of the aquatic based exercise in therapy and performance improvement.

5. Acknowledgments

Above all, loving, kindness and faithfulness of the almighty God in bestowing health, strength, patients, and protection throughout my life and the study period is highly appreciated. My genuine appreciation and heartfelt thanks go to all research participants (Dr. Molla Deyou, and Dr. Abebe Fanta (Advisor); my families, and friends), without them the study might not be possible.

6. References

1. Aggel-Leijssen V, Wagenmakers A, Van B. Effect of exercise training at different intensities on fat metabolism of obese men, Jour Appl Physiol. 2002; 92:1300-9.
2. Alemaya Agricultural Research Center (ALARC), 1997; Proceedings of the 13th Annual Research and Extension Review Meeting, 1996, 26-28.
3. Andrew PH, Neil AK, Nuala MB. Children, Obesity and Exercise Prevention, treatment and management of childhood and adolescent obesity. 2007, 185.
4. Anonymous, Caloric Expenditure: Does Water Exercise Make the Grade? 2007; Accessed on, 2012.
5. American College of Sports Medicine (ACSM) (no date). The Indoor Cycling Experience (I.C.E) report. Accessed, 2012.
6. Bjorntorp P. International Textbook of Obesity. Reporrt in Sahlgrenska Hospital, Go teborg, Sweden, 2001, 528.
7. Bruce EB. Aquatic Therapy: Scientific Foundations and Clinical Rehabilitation Applications. The American Academy of Physical Medicine and Rehabilitation. 2009; 1:859-872.
8. Bryner RW, Toffle RC, Ullrich IH, Yeater RA. The effects of exercise intensity on body composition, weight loss, and dietary composition in women. Am. J Clin Nutr. 1997; 16:68-73.
9. Carolyn K, Lynn AC. Therapeutic Exercise, Foundations and Techniques 5th ed. F. A. Davis Company, 2007, 1957.
10. Davies PSW, Cole TJ. Society for the Study of Human biology Symposium series: Body composition techniques in health and disease, MRC Dunn Nutritional Laboratory, Cambridge. 1995, 169.
11. Fujiishima K, Shimizu T, Ogaki T, Hotta N, Kanaya S, Shono T *et al.* Thermoregulatory Response to low-Intensity Prolonged Swimming in Water at Various Temperature and Treadmill walking on Land. Journal of physiological Anthropomotry and applied human science. 2000.
12. Gormley J, Hussey J. Exercise Therapy, prevention and treatment of disease Blackwell Publishing Ltd, 2005, 281.
13. James A, Jennifer M. The energy expenditure of using a walk-and-work desk for office workers with obesity, Br J Sports Med. 2007; 41:561-558.
14. Lee DC, Sui X, Blair SN. Does physical activity ameliorate the health hazards of obesity? Department of Exercise Science, University of South Carolina, Columbia, South Carolina, USA, 2008.
15. Leslie SS. Overweight and obesity. Reported on the Health status of Tiaga country, Pennsylvania. Report, 2005, 1(2).
16. Linda SP, Jaci LV. Physical activity mediates a healthier body weight in the presence of obesity, 2000.
17. Manton ND, Lipsett J, Moore DJ, Davidson GP, Bourne AJ, Couper RT. Non-alcoholic steatohepatitis in children and adolescents. Medical Journal of Australia. 2000; 173:476-9.
18. Marian M. (no date). (Why water aerobics?) Report. Accessed, 2012, 5.
19. Marra C, Bottaro M, Oliveira R, Novaes JS. Effect of moderate and high intensity aerobic exercise on the body composition of overweight men. Journal of exercise physiology online (JEP. Online). 2005; 8:7-4.
20. Meyer and Meyer Sports. Masters Swimming-A Manual. Sports publishers Association (WSPA), Oxford (UK) Ltd., 2006. ISBN-10:84126-185-8p.

21. Montgomery J, Chambers M. Mastering Swimming, your Guide for Fitness, Training, and Competition. Library of congress cataloguing-in-publication data, United States of America, 2009.
22. Nagle J. What Happens to your body, when you swim, 2010. Rosen Publishing Group, Inc. Newyork, NY 10010.
23. Ogle GD, Allen JR, Humphries IRJ, Briody JN, Morely K, Howman R *et al.* Body composition assessment by dual energy x-ray absorptiometry in subjects aged 4–26 years. American Journal of Clinical Nutrition. 1995. 747-61.
24. Philip AW. How Fat Works. Harvard University, Press Cambridge, Massachusetts London, England, 2006, 264.
25. Roger E, Thomas R. Kinanthropometry and Exercise Physiology Laboratory manual. Tests, procedures and data' 3rd Ed. Volume One: Anthropometry, 2009; 1:359.
26. Ronalds S. Nancy Group. Choose to lose weight-loss plan for men. Park Avenue south, Newyork, 2000, 10003.
27. Sheila B. Members of MSSNY's. Weight Management: Promotion of a Healthy Lifestyle. Rural and Preventive Medicine Committee, New York, white paper 2002, 25-11.
28. Shemelis Mekonnen. A Study of the Effects of Moderate Intensity and Duration of Exercise on Weight loss in Overweight Women. Phd unpublished Thesis, Andhra University, India, 2010.
29. Thomas C, Vangsness JR. Orthopedic Surgery Associates. USC, Accessed on, January, 2000.
30. Wieland, K, Claude M, Martin W. Obesity in Childhood and Adolescence Pediatric and Adolescent Medicine. 2004; 9:280.
31. World Health Organization (WHO). Obesity, Preventing and Managing the Global Epidemic: Report of the WHO Consultation of Obesity, Geneva, 1998.
32. Zwiauer K, Caroli M, Malecka E, Poskitt E. Clinical features, adverse effects and outcome, Child and Adolescent Obesity, Cambridge: Cambridge University Press. 2002, 131-53.