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The Effects of a 12-Week Swimming Exercise Program on Body Composition and Physical Fitness in Obese Male Elementary Students: A Critically Appraised Paper

Nathaniel W Page, BS, David C Berry*

Department of Kinesiology, College of Health and Human Services, Saginaw Valley State University

dcberry@svsu.edu

***Corresponding Author:** David C. Berry, Department of Kinesiology, College of Health and Human Services Saginaw Valley State University, 7400 Bay Road, University Center, MI 48710.*

Abstract

***Context:** Obese patients, including adolescents, are at an increased risk for developing many health issues, including type-2 diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disease. Adolescents, in particular, suffering from obesity will likely continue to suffer from it in adulthood.*

***Objective:** Determine the effectiveness of aquatic exercise on body composition, physical fitness, and vascular compliance of obese elementary students.*

***Methods:** After selecting the Lee and Oh study, key evidence including study design, sample population, procedure, outcome measures, and results were summarized. Critical appraisal of the study's internal, external, and statistical validity followed.*

***Results:** Twenty obese elementary male students were split into two groups: swimming (n=10) and control group (n=10). Over 12-weeks, the swimming group exercised at an exercise intensity of 50-70% HRmax for 60-minutes, 3-days/wk. The control group did not participate in the swimming program.The swimming group showed significant changes in weight (P<0.05), body fat percentage (P<0.001) and fat-free mass (P<0.001). Posttest differences between groups revealed significant differences. Within the swimming group, differences in muscular endurance (P<0.05), flexibility (P<0.001), and cardiopulmonary endurance (P<0.001) were observed. Between-group differences were observed for muscular endurance (P<0.05), flexibility (P<0.05), and cardiopulmonary endurance (P<0.001). For vascular compliance, the right leg showed a significant difference within the swimming group (P<0.05).*

***Validity:** Internal validity was threatened due to no description of subjects being randomly allocated, therefore unable to ensures that (within the constraints provided by chance) treatment and control groups are comparable. External validity was compromised due to the study population being predominately males making it challenging to generalize between genders.*

***Conclusions:** Regular aquatic exercise for 60-minutes a day, 3-days/week at an exercise intensity of 50-70% HRmax may have a positive effect on body composition, physical fitness, muscular endurance, and flexibility within obese male elementary students.*

Keywords: *Obesity, swimming, adolescent, aquatic exercise.*

Introduction

Obese patients are at an increased risk for developing many health related issues, including insulin resistance and type-2 diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, stroke, sleep apnea, gallbladder disease, hyperuricemia and gout, and osteoarthritis [1]. In fact, chronic diseases and the associated co-morbidities (eg., obesity) account for more deaths in the United States (U.S.) and globally [2] and accounts for 80% of the U.S. health care costs [3].

Excess body weight is associated with substantial increases in mortality from all causes, in particular, cardiovascular disease [1]. Also, obesity is associated with job absenteeism, costing approximately $4.3 billion annually [4] and with lower productivity while at work, costing employers $506 per obese worker per year [5]. Adolescents suffering from obesity will likely continue to suffer from it in adulthood [6].

Reducing obesity, improving nutrition and increasing activity can lowers healthcare costs through fewer doctor's office visits, tests, prescription drugs, sick days, emergency room visits and admissions to the hospital and lowers the risk for a wide range of diseases [7]. Modern efforts to prevent disease, support people to lead healthier lives, and end health disparities must include focusing on not only traditional therapeutic interventions but innovative non-traditional interventional strategies.

Swimming is the fourth most popular sports activity in the U.S. and is considered an excellent intervention to engage in regular aerobic physical activity [8]. Just two and a half hours per week of aerobic physical activity, such as swimming, bicycling, or running, can decrease the risk of chronic illnesses [9,10]. In fact, researchers suggest that exercise training can reduce percentbody fat and enhance vascular compliance in obese male adolescents; changes that may reduce the risk for later development of cardiovascular disease [11]. The purpose of this review was to answer the following question.

Question

In obese adolescent students (P), what are the effects of regular aquatic exercise (I) on body composition, physical fitness, muscular endurance, and flexibility (O)?

Clinical Bottom Line

Regular aquatic exercise (i.e., swimming) for 60-minutes a day, 3-days/week at an exercise intensity of 50-70% HR maxcan have a positive effect on composition, muscular endurance, cardiovascular endurance, and flexibility in a groups of obese male elementary students.

Summary of Key Evidence

Study Design

Non-randomized clinical trial

Baseline	Swimming group	12-week follow-up
Baseline	Control group	12-week follow-up

Sample

N=24; 24 obese male elementary students were recruited for this study. Subjects were divided into two groups. The swimming group (n=12; age=11.45±2.87, height (cm)=127.46±5.37, weight (kg)=44.53±8.83; body fat (%)=34.45±32.24) and a control group (n=12; age=11.115±1.69, height (cm)=126.74±3.25, weight (kg)=46.73±8.86; body fat (%)=33.92±2.70). Four subjects; two from the swimming and two from the control group were excluded due to personal reasons and physical limitations; therefore, the final sample was 20 subjects.

Procedures

All subjects participated in baseline data testing for body composition, physical fitness, and vascular compliance. The swimming group completed a 12-week aquatic exercise program that called for three-60 min training sessions per week. The swimming program included: 10 min warm up (RPE 7-9) that consisted of stretching for relaxing muscle and joint intensity. Followed by 40 min of aquatic exercise (1-6 weeks 50-60% HRmax, RPE 13-15), (7-12 weeks 60-70% HRmax RPE 13-15). Following the main exercise portion of the program was a 10 min cooldown consisting of walking and stretching in the water (RPE 7-9). The control group did not participate in a swimming program.

Outcome Measures

Body composition included: (1) weight, (2) body fat percentage (%) and (3) fat-free mass (measured using InBody 430 [Biospace, Koria]). Physical fitness included: (1) muscular strength ie., grip strength, measured via a digital dynamometer (TKK-5401, Japan), (2) muscular endurance (sit-ups), (3) flexibility (sitting trunk flexion measurement instrument [DW-704, Japan]) and (4) cardiopulmonary endurance (20-meters shuttle run). Vascular compliance was measured using PMV 3.0 (KM-Tec, Korea).

Results

A significant difference within the swimming group and between the groups was noted for weight (P<0.05), body fat percentage (P<0.001), fat-free mass (P<0.001). Within the swimming group, there was a significant difference in muscular endurance (P<0.05), flexibility (P<0.001), cardiopulmonary endurance (P<0.001). Between the groups, there was a significant difference in muscular endurance (P<0.05), flexibility (P<0.05) and cardiopulmonary endurance (P<0.001). A significant difference within the swimming group and between groups was found for vascular compliance right leg ((P<0.05) and (P<0.001), respectively.

Critical Appraisal

Internal Validity

Threats

1. Allocation was not concealed, the decision about whether or not to include a person in a trial could be influenced by knowledge of whether the subject was to receive treatment or not. Lack of allocation could produce systematic biases in an otherwise random allocation.
2. No description whether subjects were randomly allocated to groups, therefore unable to ensures that (within the constraints provided by chance) treatment and control groups are comparable.
3. Practitioner, participants, and assessor were not masked to groups, which could create bias, affecting reliability.
4. Inclusion and exclusion criteria were not stated which could increase participant variability and affect the reliability of outcomes.
5. Unable to determine if target heart rate was adjusted for the aquatic environment using the Kruel Aquatic Heart Rate Deduction.
6. The instruments used to measure grip strength, flexibility, and vascular compliance are not well identified, did not provide any reliability or validity data and, may not be available outside the study's country.
7. No control over outside activities could have affected participants' performance during post-testing on the outcomes measures.
8. Experience with the aquatic activity (i.e., swimming) could affect performance on the outcome measures.
9. Age of the participant could affect the ability to understand how to maintain the desired exercise intensity as well as complete physical fitness tests.
10. Outcomes measures were not obtained from more than 85% of the subjects allocated to the groups, subjects not followed-up may differ systematically from those whose are, and this potentially introduces bias.

Strengths

1. A detailed exercise protocol ensures that the experiment can be replicated.
2. The groups were similar at baseline, which creates a homogenous grouping.
3. All experimental subjects underwent an identical training protocol, eliminating a potential source of bias.
4. Drop out rates were reported.

External Validity

Threats

1. The study only examined obese elementary males, which makes generalization problematic to a larger population.
2. The study was conducted on obese adolescent males with likely fewer co-morbidities compared to the obese adults with a high number of co-morbidities; thus, the impact of the intervention could be limited to the younger population.
3. A sample size of 20 might not apply to the population under investigation or the general public.

Strengths

1. Description of intervention parameters allows for smooth reproduction of treatment.

2. Obesity in elementary school children is prevalent, making the study readily applicable to this population.

Statistical Validity

Threats

1. The study did not state the test assumptions and whether they were met which threatens the validity of the results.
2. The sample size was not calculated to have an appropriate study power of 80%.
3. Small sample size.
4. Multiple paired t-test were calculated, but no multiple comparison correct procedures were utilized, increasing the risk of erroneous inferences.
5. The effect size was not calculated.
6. The researchers did not state if an intention-to-treat analysis was conducted which could affect the validity of the results.

Strengths

1. Groups were assessed for similarity at baseline on the most important outcome measures.
2. Between-group statistical comparisons are reported for at least one critical outcome.
3. Data provides point measures and measures of variability for at least one critical outcome.
4. Data provides enough detail to calculate effect size and mean differences in the context of a meta-analysis.
5. P values were stated for all analyses, which indicates significance and which values were due to chance.

Conclusion

Regular aquatic exercise for 60 minutes a day, three days a week with an exercise intensity of 50-70% HR max may have a positive effect on composition, physical fitness, muscular endurance, and flexibility in adolescent obese males. The utilization of technology and a "Western" lifestyle has encouraged sedentary habits and the consumption of unhealthy calories. These poor lifestyle decisions are a just some of the contributing factors to obesity and the associated co-morbidities and risk of injury. Aerobic exercise has traditionally been prescribed as a means to combat obesity. However, obese individuals also deal with painful, swollen, and stiff joints. Painful, swollen, and stiff joints make aerobic activates such as land running quite painful and, in some cases, embarrassing. The aquatic swimming program examined in the Lee and Oh study could potentially be used as a regular means of aerobic exercise training when prescribed to an appropriate population such as obese individuals or those of chronic joint inflammation or other chronic disease conditions.

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