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IMPACT OF AEROBIC TRAINING ON GAIT PARAMETERS OF OBESE COLLEGE GOING STUDENTS.

Physiotherapy

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ABSTRACT

Obesity has been identified as public health challenge worldwide. As per National Family Health Survey-4 done in 2015-16, in India the prevalence of obesity is 12.6% in women and 9.3% in men. Obesity is associated with higher risk of mortality and morbidity, as it is the very important risk factor of non-communicable diseases like Ischemic heart disease and Diabetes mellitus.

Objective of this study was to investigate the effect of aerobic exercises on selected gait parameters of obese individual and compare with normal weight individuals. Forty individuals (20 Obese and 20 Normal weight) enrolled and completed this quasi experimental study design. Only obese group had undergone Aerobic exercise programme but both groups had their gait parameters measured at starting and at the end of 4th, 8th and 12th week.There was significant higher CD, and SW and lower WS, SL and StL in obese group than the normal weight group from starting to end of the exercise programme; however obese group had higher percentile change in all the parameters than the normal weight group.

We concluded that obese individuals have poorer gait parameters than the normal weight, where as aerobic exercise produce higher significant changes in all the gait parameters in obese than the normal weight individuals.

KEYWORDS

Obesity, Aerobic Exercises, Gait, Cadence, Step length, Walking speed.

Introduction

Obesity can be seen as the first wave of a defined cluster of non-communicable diseases called "New World Syndrome," creating an enormous socio-economic and public health burden in poorer countries. The World Health Organization has described obesity as one of today's most neglected public health problems, affecting every region of the globe.[1] The prevalence of obesity has been on the increase in many countries irrespective of their economy. Obesity is usually defined as the abnormal or excessive fat accumulation that may impair health. Globally there are 1.9 billion overweight adults out of which almost 600 million of them are obese.[2] Obesity which was once viewed as an affliction of the Western society has increased worldwide by more than 75% in the last three decades.[3,4]

As per National Family Health Survey-4 done in 2015-16, in India the prevalence of obesity is 18.9% in men from 9.3 in 2005-06 and 20.7% in women from 12.6 in 2005-06 when the last NFHS was conducted. It is nearly a 60% increase; in the number of obese people have doubled in the last 10 years in India. Ironically, when a large part of the nation that is below the poverty line is battling malnutrition. Obesity is associated with higher risk of mortality and morbidity, as it is important risk factor of non-communicable disease like Ischemic heart disease and Diabetes mellitus. Unfortunately, the weight gain is not taken seriously in India until it becomes a serious problem. Usually, people who are aware that they are overweight, wait until an annual health check-up reveals high cholesterol, blood pressure or pre-diabetes. There are multiple methods to measure adiposity such as body mass index (BMI), skin folds calliper measurement, Waist to Hip ratio (WHR), Waist Circumference (WC), Underwater Weighing (densitometry), Near Infrared Reactance (NIR), Bio-electrical Impedance Analysis (BIA), Dual-Energy X-ray Absorptiometry (DEXA), and Magnetic Resonance Imaging (MRI). BMI is relatively easy to calculate, inexpensive and is considered as an appropriate measure for screening for obesity and its health risks.[5] Gait alterations have been identified as one of the various negative consequences of obesity,[6-10] which developed as adaptations to excess weight loading on the lower limbs while walking and later on musculoskeletal injuries. [11, 12]

Material & Methods:

A purposive sampling technique was used to recruit participants the obese (BMI≥30kg/m2) and normal weight (BMI18–24.9kg/m2) groups, respectively. Ethical approval of the Departmental Research Committee of Prem Physiotherapy and Rehabilitation College was obtained before the commencement of the study. The study procedure was explained to the participants and their informed consent was obtained. The potential participants were screened using Physical Activity Readiness Questionnaire and only those who satisfied the following conditions were eligible for this study:

(1) Normal weight individuals (BMI18–24.9kg/m2),
(2) Obese individuals (BMI≥30kg/m2),
(3) Individuals without musculoskeletal disorders like low-back pain, osteoarthritis, and ankle injuries.
(4) Willing to participate in the study.

A minimum sample size of 40 (20 per group). Twenty obese and twenty normal weight individuals were recruited in the study.

Participant's weight and height were assessed using standardized procedures and their BMI was calculated.

Participants were subsequently classified as obese and normal weight and assigned to the appropriate study groups.

The sitting heart rates of the obese participants were assessed using standardized procedures and their Target Heart Rate was determined using the following formula by Karvonen and Vuorimaa.[13]

Target HR = % Intensity (Max HR used) × HR reserve + Resting HR,
Maximum Heart Rate (Max HR) = 220 −Participant's Age (in years),
HR reserve = Max HR − Resting HR.

Measurement of selected Gait Parameters-

Gait parameters were obtained by the footprint method in which the soles of the feet were smeared with coloured chalk solution and the participants walked at their comfortable walking speeds along a 10-meter walk way made by dark card board. This method is an adaptation of protocol by Wilkinson. M, Menz. H.[14] The starting point of walking was selected at least three steps before reaching the cardboard platform to ensure steady-state gait.[15] Trials were considered satisfactory when both feet were in full contact with each of the card board platforms.

Participant's walking speed (WS) was measured by having the participants walk a distance of 10 meters and divided by the time taken in seconds to cover the distance using stopwatch. It is recorded in meter per seconds. Participant's step length (SL), stride length (StL) and step width (SW) were subsequently obtained and measured from the foot prints using a metallic ruler which was calibrated from 0 to 30 cm. The cadence (CD) was calculated dividing the number of steps to cover the 10-meter distance by the time taken and recorded in steps per minutes. The gait parameters of all participants were assessed at baseline and at the end of 4th, 8th, and 12th week of the study.[16]

a. Normal Weight Group.
The participants were not allowed to indulge in exercise but had their WS, CD, SW, StL and SL assessed at baseline and at the end of weeks 4, 8, and 12 of the study. [16]

b. Obese Group.
Each participant was instructed to continue with their normal balanced diet and not to eat junk food. The researcher demonstrated all the activities before the commencement of the training sessions. The researcher monitored activities carried out by participants. Obese participants performed the aerobic exercise sessions on three alternate days each week after all the required baseline measurements have been taken. The exercise protocol17 was in 3 phases which comprised the following.

(A) Warm-Up Exercises.
The warm-up exercises which lasted for 5 minutes include:

(1) Flexibility exercises (2) Head rotations to the right and left (3) Neck flexion and extension (4) Shoulder shrugs (5) Alternate leg bends (6) Alternate leg stretch (7) Trunk side bend (8) Waist circles (9) Strolling.18

(B) Aerobic Exercises
Exercise 1: Sit-up exercise.
Supine lying on the sit-up bench with knees bent and hands clasped behind the neck.

Instruction: lift up the head and trunk from the lying to upright position, hold the position for about 10 seconds, and slowly lower the body to the initial lying position. The exercise was carried out for duration of 5 minutes (between baseline and 4th week), 7 minutes (between 4th and 8th week), and 10 minutes (8th and 12th week) with a rest period of 3 minutes before the next exercise.

Exercise 2: Cycling.
Instructions: Participants rode on the static bicycle against zero resistance for about 5 minute, 8 minute, and 10 minute duration in baseline to 4th week, 4th to 8th week, and 8th to 12th week, respectively, with a rest period of 3 minutes.

Exercise3: Treadmill exercises.
Instructions: Participant walked at a comfortable pace on the treadmill zero inclination and resistance for a period of 5 minutes (baseline–4th week), 10 minutes (4th –8th week), and 18 minutes (8th –12th week) with a rest period of 2 minutes.

(C) Cooling Down.
The participant was asked to take a walk for 5 minutes to achieve cool down.

Intensity: Each obese participant commenced the exercise training programme at 60% of heart rate reserve; progression was made after every four weeks, ensuring 5% increment in the obese participant's exercise heart rate. This exercise intensity progressed continually until the upper limit of 70% of heart rate reserve was reached.

Three sessions per week alternately were ensured throughout 12th weeks of the study.

Statistical analysis:
The data collected in this study were analysed with the SPSS 17.0 statistical program. Mean Standard deviation and percentages were used for summarization of data.

t-test was used to compare the gait parameters of obese and normal weight groups at baseline and end of 4th , 8th , and 12th week of the study. One-way ANOVA was also used to compare the groups parameters using baseline values and also used for within-group comparison of obese group participants walking speed, cadence, step length, step width, and stride length across baseline, 4th , 8th , and 12th week of the study while paired *t*-test with Bonferroni adjustment was used for post hoc analysis.

The level of significance was set at $p<0.05$ for all the comparisons.

Results and Discussion:
Both groups (Normal Weight and Obese Group) were homogenous in age; normal group people were taller than the obese group people. The normal weight group had significantly lower values of walking speed, step length, and stride length at baseline but obese group had significantly higher values of cadence at all-time points except at 12th week and significantly wider step width at baseline and 4th week of the study. The results indicated that the groups were significantly different at twelfth week of the study. The Percentage changes in the groups variables were compared, the obese group had significantly higher percentage changes in all selected parameters than their normal weight counterparts. Within-group comparison showed significant improvement in mean walking speed, cadence, step length, stride length, and step width in the obese group across the four time points of the study with the values becoming higher as the study progressed.

At starting, the normal weight participants demonstrated higher walking speed, wider step length and stride length, shorter step width, and lower cadence than their obese weight counterparts. The results were not unexpected because studies have indicated that increase in body weight is strongly linked with changes in majority of the components of normal gait due to a modification of the body geometry by the addition of mass to different regions which negatively influences the biomechanics of walking.[6,7,11,19] Obesity has also been reported to be associated with altered gait parameters such as lower gait speed, shorter strides, and increased step width, and a significantly higher metabolic cost of walking compared to people with normal body weight.[7,10,11,19,20] The findings of this study were hence in line with previous research findings. Spyropoulos et al.[20] reported a slower walking speed and shorter stride and step lengths for obese adults compared to their normal weight participants. The mean baseline walking speed, step length, and stride length observed among obese participants in this study were in line with the findings of past studies except the cadence which is significantly higher in obese individuals. The result implied that there were some improvements in the gait parameters which could be attributed to the effects of the aerobic exercise intervention. Despite these results, the walking speed, step length, and stride length of the normal weight participants were still found to be higher than those of their obese counterparts. However, the normal weight participants still had significantly lower cadence and step width than their obese counterparts. The two groups were comparable in their gait patterns at the 8th week of the study. This finding indicated that the aerobic training undertaken by the obese participants has produced improvements in the aforementioned gait parameters which made them comparable to those of their normal weight counterparts.

Hence it can be deduced from the findings of this study that the 12 week aerobic training produced desirable and positive effects on all selected gait parameters of the obese individuals to the extent that they became comparable to those of their normal weight counterparts who did not undergo any training at the end of the study. The result of a recent study done by Song et al.[21] indicated that the obese group had more significant reduction in step width than the normal group while the two groups remained comparable in terms of other tested spatiotemporal gait parameters following a twelve week weight reduction programme. The difference between his work and the findings of this study may be attributable to the mode of exercise used; their older participants only had unsupervised self-paced walking without any time limit while the obese participants in this study had supervised aerobic training. Studies conducted by Saibene and Minetti[22] and Foster et al.[23] indicated that excessive amount of adipose tissue in obese individuals made their walking less efficient. The observed positive effects of the aerobic training programme from the fourth week of this study may hence be assumed as evidence in support of the aforementioned view points.

Conclusion:
This aerobic training programme can be adopted by health professionals to improve the gait parameters of individuals with obesity related problems. Obese individuals have poorer gait parameters than their normal weight individuals. Therefore, aerobic training programme is recommended as a means of improving obesity related gait abnormality.

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