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A Randomised Controlled Study on the Effects of Endurance Exercise Therapy on Antidepressant Drugs Induced Changes in Body Composition

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Abstract

Background: Weight gain is a common and well known adverse effect of short and long term antidepressant drug treatment. However, endurance exercise has been reported to be necessary for successful weight control and maintenance in all people but, there is paucity of scientific evidence about its effect on the body composition of patients receiving antidepressant drug therapy, hence, the need for this study.

Objective: To evaluate the effects of endurance exercise therapy on antidepressant drugs induced changes in body composition of patients receiving antidepressants.

Methods: A consecutive series of ninety patients with major depression receiving antidepressants from Neuro-psychiatric and University Teaching Hospital Lagos State, participated in this randomized controlled study. Patients were randomly assigned into Exercise Group (EG) or Control Group (CG). The EG went through relaxation exercises and a progressive endurance exercise programme three times per week for twelve weeks, while the CG carried out relaxation exercises twice per week for twelve weeks. Outcomes were Body Weight (BWT), Percent Body Fat (PBF), Waist-Hip-Ratio (WHR) and Body Mass Index (BMI). Both groups were assessed at baseline and at the end of 2nd, 4th, 6th, 8th, 10th and 12th week respectively.

Results: The post 12-week endurance exercise comparison of EG and CG showed statistically significant difference in the BWT (70.8 ± 14.4 VS 84.8 ± 12.9 kg), PBF (29.4 ± 8.2 VS 41.4 ± 8.1%) WHR (1.3 ± 0.7 VS 1.4 ± 0.2) and BMI (25.3 ± 5.1 VS 30.6 ± 4.3 kg/m^2) respectively.

Conclusion: The 12-week endurance exercise controlled body adiposity in patients receiving antidepressant drug treatment.

Keywords: Body composition; Antidepressants; Endurance exercise; Adiposity

Introduction

The increasing number of people diagnosed with major depression and the reliance on antidepressant drugs to manage this condition exposes patients to potentially harmful side effects, such as overweight, cardiovascular diseases, low self esteem and more depression [1]. Weight gain in a serious concern for patients starting or already taking an antidepressant drug, but weight gain is frequently overlooked because focus is on remission of depression [2,3]. On the other hand, reducing weight gain once it has occurred and the associated risks can be very difficult to manage. Overweight is defined as a body weight that exceeds the acceptable weight for a particular person based on the individual's age, height and / or frame size [4]. It is also defined as body mass index (BMI) of 25 – 29.9 kg/m^2; whereas obesity is defined as a BMI greater than or equal to 30 kg/m^2 [5,6]. Antidepressant drug treatment was found to be associated with a significant increase in body weight and body fat mass in six weeks [7]. Increased body fatness constitutes a significant public health problem in the developed world and increasing rapidly in several developing nations associated with high morbidity, mortality [6,8] and reduced quality of life. Controlling weight gain in patients on antidepressant drug treatment is the ideal strategy, which involves increased caloric expenditure through endurance exercise programme.

Moreover, growing evidence shows that participation in physical exercise has been reported to be necessary for successful weight control and maintenance in all people [9,10]. But there are special concerns for patients receiving antidepressant drug treatment because they present with antidepressant drugs induced changes in their body composition. However, there is paucity of scientific evidence about the effects of exercise intervention on the body composition of patients receiving antidepressant drug treatment, hence, the need for this study. This study evaluated the effects of a twelve-week endurance exercise therapy on the body weight (BW), percent body fat (PBF), waist-hip-ratio (WHR) and body mass index (BMI) in patients receiving antidepressant drug treatment.

Materials and Method

Participants for this study were consecutive series of ninety patients with major depressive disorder diagnosed by two psychiatrists (according to the Diagnostic and Statistical Manual of Mental disorders, 4th edition criteria [11]. The participants were recruited

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from the Federal Neuro-psychiatric Hospital (FNPH) Yaba and Lagos University Teaching Hospital (LUTH), Idi-Araba, Lagos State, Nigeria. They comprised of seventy two females and eighteen males. Below is a flow chart of trial for this study (Figure 1).

A calculation of the sample size using Cohen [12], showed that a minimum of 32 patients was required in each group to detect any difference at α- level of 5%. The inclusion criteria were patients with moderate to severe levels of major depressive disorder, their ages were 20 years and above, certified fit for exercise programme by psychiatrist, receiving antidepressant drug treatment for at least two weeks and able to walk independently. Those who met these criteria and were willing to participate were recruited for this study. Also, the exclusion criteria were participants that refused to volunteer and give consent, those with associated organic diseases and cardiovascular diseases were excluded from this study.

The instruments used for the data collected were Body Composition Monitor (BF511) by Omron Healthcare [13], to assess Body Weight, Percent Body Fat and BMI; Tape-measure (non-elastic) to assess waist and hip girth used to calculate Waist-Hip-Ratio; and Height-meter (SECA-Model 220) to assess the height of the participants. Others were stationary Bicycle-Ergometer (Dynamix E-100) for bicycle exercise programme, Digital Automatic Blood Pressure Monitor (MOTECH Truescan) to assess blood pressure and heart rate of the participants, Exercise-Mats for mat-exercises, Stopwatch (Professional Quartz Timer) was used for timing during assessment and exercise session, Stationary Stairway for stair climbing exercises and Digital Music box (Sony) to provide background music for participants during exercise sessions. Also, Hamilton Rating Scale for Depression -17 (HRSD-17) and Beck Depression Inventory (BD1-II) were used by the psychiatrists to assess severity of depression of the participants. This study was conducted in the gymnasium of Federal Neuro-psychiatric Hospital, Yaba Lagos State, Nigeria.

Procedure for data collection

Ethical approvals were sought and obtained from the Federal Neuro-psychiatric Hospital, Lagos University Teaching Hospital and University of Ibadan/ University College Hospital Research Ethics Committee. Informed consent was sought and obtained from each participant and two cases of proxy informed consent by the relatives of participants were recorded, after the objectives and procedure of the study were clearly explained to each of them. Furthermore, their confidentiality was assured and safety ensured.

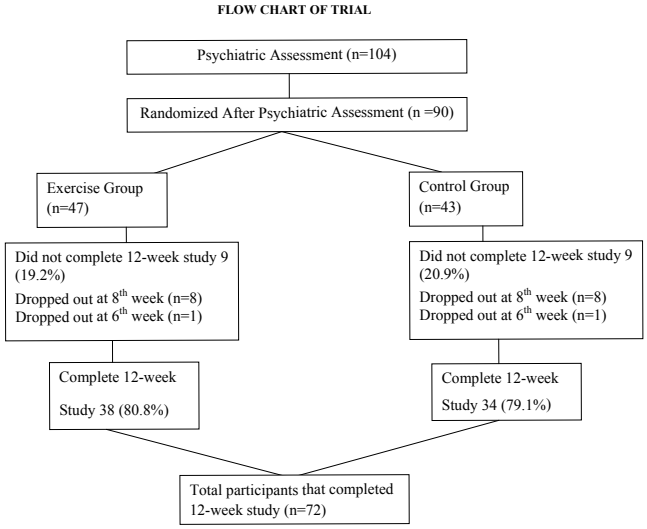

Figure 1: Flow chart of trail.

After psychiatric assessment, each participant was randomly allocated to either of the two parallel groups; Exercise group (EG) or Control group (CG), using a simple random technique, where only the first participant picked from the randomization box to determine the group of the next participation in order of patient's referral and applying concealment of allocation between the psychiatrist and physiotherapist (Principal investigator). Demographic and baseline data of participants in the two group were recorded as were being registered for the study. Participants in the CG carried out relaxation exercises twice in a week for twelve weeks. The relaxation exercises comprised of deep breathing, while at the same time tensing and relaxing different muscle groups of the upper limbs, abdomen and lower limbs in supine lying lasting for 20-30 minutes. The body weight (BWT), percent body fat (PBF), waist-hip-ratio (WHR), and body mass index (BMI) were assessed at the baseline, 2^{nd}, 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} week respectively. However, participants in EG carried-out endurance exercise programme and relaxation exercises for twelve weeks. Preceding the endurance programme exercise was a familiarization session held with participants where demonstration of the entire endurance and relaxation exercises protocol was shown to the participants by the researcher.

Endurance exercise programme

The endurance exercise programme was a circuit training pattern consisting of five stations, usually preceded by a warm-up session comprising of gentle-walk, shoulder-lifts, side-bends, leg-swings and head turns lasting five minutes and also a cool down session of brisk walking and breathing exercise lasting for 5-10 minutes.

Circuit station 1: This is the station of bicycle ergometry and the intensity was determined by calculating 60% of the maximal heart rate (220-age years). The participants sat on the stationary bicycle, seat adjusted with participant's knee slightly flexed (5°–10° degrees) from full extension and pedaled the bicycle freely for six minutes.

Circuit station 2: In this station, the participants carried-out aerobic dance including trunk movement exercises. They stood with both feet slightly apart with their hands on their hips, leaned forward, backward, sideways and rotated the trunk and waist in rhythm with background music. Each of this movement was repeated 5-10 repetitions.

Circuit station 3: Mat exercises such as alternate straight leg raising, head and shoulder lifts and bilateral leg raise were carried-out in this station. Participants carried-out these movements in supine lying in rhythm with background music provided by the music box. Each of this movement was done 5-10 repetitions.

Circuit station 4: In standing position, participants climbed up and down 5-10 times on a stationary wooden stairway with rungs of heights, the movement up and down the stairs was guided by the tempo of the background music.

Circuit station 5: In this station, participants carried-out a self paced walking exercise guided by the tempo of the background music. Participants walked the full length of the gymnasium (9.3 m) to and fro for 25 times (232.5 m). The entire duration of the endurance exercise per session lasted 50-75 minutes.

Progression of exercise

There was an upward review of the initial 60% of HR_{max} to 65% and 70% at 5th and 9th week, while one minute was added to the duration of exercise in each circuit station at the beginning of 4th, 7th and 10th week respectively, except in circuit station 5. In circuit station 5, there was an upward review of initial 25 times (232.5 m) of to and fro covered distance of the gymnasium to 30(279 m), 35(323.5 m), 40(372 m), 45(418.5 m) and 50(465 m) times at 3rd, 5th, 7th, 9th and 11th week respectively. All the participants tolerated the intervention without complications.

Data analysis

The analysis of this study was based on intention-to-treat analysis which includes all participants in the groups to which they were randomly assigned regardless of the intervention they received and withdrawal from intervention during the study. Descriptive statistics of mean and standard deviation, tables and graphs were used to present data, and inferential statistics of Independent t-test, Repeated measure ANOVA and post-hoc analysis with Bonferroni correction were used with alpha level set at 0.05.

Results

A total of ninety participants were involved in this study, comprising seventy two females and eighteen males aged between 20 and 70 years. The mean age was 38.9 ± 10.97 years as shown on table 1. Table 2 shows the baseline comparison of body weight (BWT), percent body fat (PBF), waist-hip-ratio (WHR) and body mass index (BMI) between the exercise group (EG) and Control group (CG). Moreover, table 3 and figure 2 indicate mean changes and pattern of curve in exercise group BWT, PBF, WHR and BMI across the 12-week assessment period using repeated measure ANOVA. While table 4 and figure 3 show the mean changes in control group BWT, PBF, WHR and BMI across the 12 week assessment period using repeated measure ANOVA. The post 12-week endurance exercise comparison of the BWT, PBF, WHR and BMI between the EG and CG using independent t-test is shown on table 5, whereas the Bonferroni post-hoc analysis revealed significant difference between the baseline and 8th, 10th and 12th week of assessment period for all the body composition indices.

Variables	N(%) X ± SD	X ± SD
Sex		
Male	18(20)	
Female	72(80)	
Age		38.9 ± 10.97
Height		1.66 ± 0.71

Table 1: Biodata of Participants.

Variables	EG n=47 X ± SD	CG n=43 X ± SD	t-value	p-value
AGE (Yrs)	38.73 ± 11.12	39.09 ± 10.94	0.15	0.88*
HT (m)	1.67 ± 0.06	1.66 ± 0.08	0.25	0.80*
BWT (kg)	76.75 ± 15.89	76.62 ± 13.27	0.04	0.97*
PBF (%)	36.68 ± 9.88	34.09 ± 10.45	1.21	0.23*
WHR	1.37 ± 0.14	1.39 ± 0.21	0.41	0.68*
BMI(kg/m²)	28.49 ± 5.91	27.78 ± 4.5	0.64	0.52*

Alpha level = 0.05

Table 2: Comparison of Baseline Body Composition Indices Between the ERG and CRG using Independent t-test.

Variables	BSL X ± SD	WK2 X ± SD	WK4 X ± SD	WK6 X ± SD	WK8 X ± SD	WK10 X ± SD	WK12 X ± SD	F-ratio	P-value
BWT(kg)	79.30 ± 16.75	74.89 ±16.82	76.16 ± 15.67	74.63 ± 15.39	72.98 ± 14.95	71.65 ± 14.64	70.85 ± 14.3	7.77	0.007*
PBF (%)	37.39 ± 10.57	35.68 ±1031	34.4 ± 9.85	33.15 ± 9.38	31.67 ± 8.93	30.31 ± 8.36	29.45 ± 8.23	159.95	0.000*
WHR	1.41 ± 0.14	1.39 ± 0.11	1.39 ± 0.11	1.37 ± 0.12	1.34 ± 0.12	1.34 ± 0.12	1.34 ± 0.12	9.81	0.001*
BMI(kg/m²)	29.12 ± 6.37	27.78 ± 5.64	27.27 ± 5.41	27.25 ± 5.60	26.11 ± 5.19	25.65 ± 5.15	25.35 ± 5.06	45.38	0.000*

Alpha level= 0.05

Table 3: Mean Body Composition Indices in EG Across the 12-WK Assessment Period Using Repeated Measure ANOVA with (n=47).

Variables	BSL X ± SD	WK2 X ± SD	WK4 X ± SD	WK6 X ± SD	WK8 X ± SD	WK10 X ± SD	WK12 X ± SD	F-ratio	P-value
WT(kg)	78.48 ± 13.14	77.41 ± 12.93	78.31 ±12.60	79.90 ±12.76	81.69 ± 12.71	84.63 ± 15.47	84.80 ± 12.90	49.25	0.000*
PBF (%)	33.34 ± 9.80	33.95 ± 9.51	34.64 ± 9.17	35.94 ± 8.66	37.43 ± 8.28	38.93 ± 8.26	41.40 ± 8.20	264.93	0.000*
WHR	1.40 ± 0.22	1.40 ± 0.22	1.41 ± 0.21	1.41 ± 0.21	1.42 ± 0.22	1.43 ± 0.21	1.44 ± 0.22	25.20	0.000*
BMI(kg/m²)	27.55 ± 4.40	27.86 ± 4.51	28.22 ± 4.35	28.99 ± 4.56	29.47 ± 4.33	29.91 ± 4.35	30.61 ± 4.36	110.88	0.000*

Alpha level= 0.05

Table 4: Mean Body Composition Indices in CG Across the 12-WK Assessment Period Using Repeated Measure ANOVA.

Variables	WK 12 ERG n=47 X ± SD	WK 12 CRG n=43 X ± SD	t-value	p-value
BWT (kg)	70.85 ± 14.34	84.84 ± 12.90	4.35	0.00*
PBF (%)	29.45 ± 8.23	41.40 ± 8.196	6.17	0.00*
WHR	1.34 ± 0.72	1.44 ± 0.22	2.45	0.02*
BMI (kg/m²)	25.35 ± 5.06	30.61 ± 4.36	4.72	0.00*

Alpha level = 0.05
KEY
BWT = Body Weight
PBF = Percent Body Fat
WHR = Waist-Hip-Ratio
BMI = Body Mass Index
KG = Kilogram
M2 = Metres Square
* = Significant difference at p<0.05

Table 5: Comparison of Post 12-WK Mean Body Composition Indices Between the EG and CG using Independent t-test.

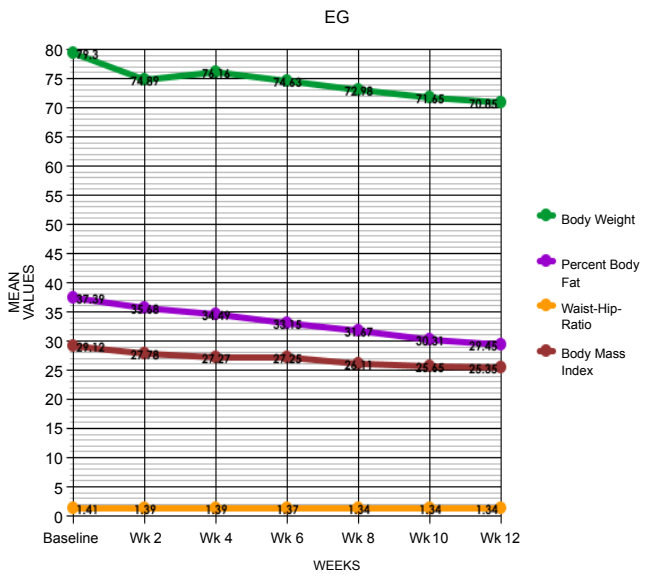

Figure 2: Mean BWT, PBF, WHR and BMI of Exercise group (EG) across the 12-week study period showing significant reduction after 12 weeks of endurance exercise programme.

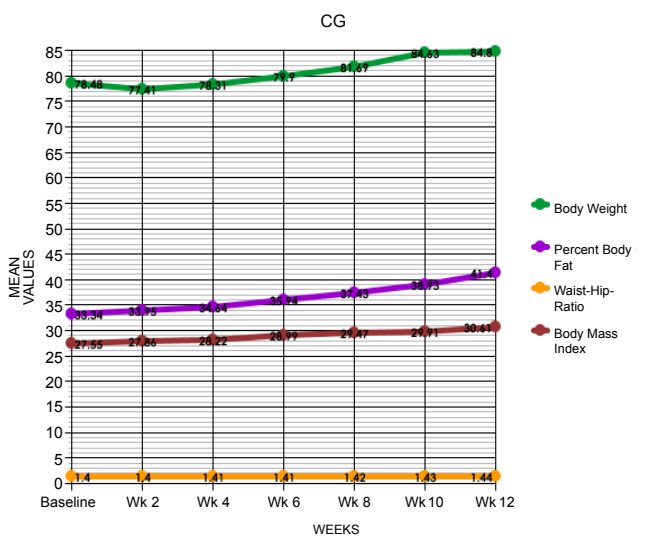

Figure 3: Mean BWT, PBF, WHR and BMI of Control group (CG) across the 12-week study period showing significantly higher values after 12 weeks of endurance exercise programme.

Discussion

The null hypothesis proposed for this study was that there would be no significant difference in the baseline and immediate post-twelve week endurance exercise body composition indices (BWT, PBF, WHR and BMI) between the EG and CG. According to the results obtained from this study, the hypothesis was hereby rejected. At baseline, comparison of mean values of age, height and body composition indices revealed that there were no significant differences between the EG and CG respectively (Table 2). The implication was changes observed thereafter could be attributed to the endurance exercise intervention. From the result in table 3 and figure 2, the body composition indices (BCI) of EG were significantly lower compared to the BCI of the CG which were significantly higher (Table 4 and Figure 3).

The Statistically significant reduction of BCI in EG could be explained by the effects of the supervised, monitored and carefully progressed endurance exercise on caloric expenditure, net loss of appetite, reduction of rate of gain in fat cell number (hyperplasia) and loss of more fat tissue. This statement was in agreement with previous findings in subjects on weight reduction and maintenance programme [10]. Another important explanation could be mobilization of fat from visceral adipose tissue resulting in an improved fat distribution as reported by Ross and Rissanen [14], especially when considering the effect of endurance exercise on WHR. Similarly, free fatty acids at moderate intensities of endurance exercise are mobilized from the periphery to provide the majority of the fuel used and help in the maintenance of fat balance [10]. It has also been shown that endurance exercise carried out for at least three times per week with intensities of about 55-70% HRmax and lasting for 30-40minutes expend 250-300 kcal per session [10,15,16].

On the other hand, the statistically significant higher BCI in the CG could be explained by the non-participation in the endurance exercise programme evidenced by the graph pattern (Figure 3) across the 12-week study period compared to the EG decreasing (Figure 2) across the study period. Also considering the fact that weight gain is a common and well known adverse effect of short and long term antidepressant drug treatment [2,3] was also a major contributing effect to the significantly higher BCI recorded in the CG. Though the mechanism is not clearly known, but previous studies had explained that serotonin helps regulate appetite and carbohydrate intake, and is the most often manipulated neurotransmitter in antidepressant drug treatment, which is associated with carbohydrate craving, low satiety rates and increased calorie intake treatment [2,3]. Another plausible mechanism is the high affinity antidepressant drugs have for blocking histaminergic receptors which have also been associated with excessive appetite and increase food intake [2,3].

The findings of this study showed that while antidepressant drug treatment is found to be associated with significant increase in body weight, endurance exercise has an independent effect on the composition of the weight. Weight gain occurs when there is a constant increase in caloric intake compared to energy expenditure (Change in Energy Stores = Energy intake – Energy Expenditure). Considering the above equation of energy stores and results from this study, exercise therapy can be an important modifying and mediative modality to prevent/control excessive weight and fatness in patients receiving antidepressant drug treatment. Early exercise intervention is a key to preventing weight gain and fat increase in patients on antidepressant drugs, based on the fact that weight gain is frequently overlooked because focus is on remission of depression and weight gain may be substantially greater after remission of depression is achieved.

The limitations of this study were absence of a true no-treatment control group due to ethical reasons and that patients were not stratified according to the types (Tricyclic, Selective Serotonin reuptake inhibitors, Monoamine Oxidase inhibitors and Atypical Antidepressants) of antidepressant drugs received. However, patients to be placed on antidepressant drugs should be assessed and planned for caloric expenditure through endurance exercise before medically significant antidepressant drugs induced body composition changes occur. Also, exercise therapy in patients on antidepressant drugs requires continuous motivation, encouragement and commitment.

Therefore, we concluded from this study that a twelve week endurance exercise programme controlled adiposity in patients receiving antidepressant drug treatment. Future studies can replicate this study to evaluate effects of endurance exercise on the body composition of patients on specific type of antidepressant drug treatment.

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