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Effects of Press-Up Exercise on Body Mass Index, Levels of Oxidized LDL and Growth Differentiation Factor-15 in Male Students in Nnewi, Nigeria

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ABSTRACT

Background: Cardiovascular disease (CVD) is a leading cause of morbidity and mortality worldwide with a sedentary lifestyle, characterized by consistently low levels of physical activity. However, press-up exercise is a systemic exercise that engages all components of the body that could offer support around the shoulder joints and improve cardiovascular health. **Objective**: This study was designed to evaluate the effects of press-up exercise on cardiovascular health using Body mass index (BMI) and serum levels of oxidized LDL (Ox-LDL) and Growth differentiation factor-15 (GDF-15) as markers. **Materials and methods:** This cross-sectional study conveniently recruited 40 male students within the age range of 18 to 35 years. Ox-LDL and GDF-15 were determined using the double antibody Sandwich Enzyme-linked immunosorbent assay (ELISA) method. Statistical analysis was performed using Spearman's correlation. **Result**: There was a significant decrease in the median body mass index in post-press up (22.63) compared with pre-press up subjects (23.68). No significant decrease existed in the median serum levels of oxidized LDL and GDF-15 ($p>0.05$) in pre-compared with post-exercised participants. **Conclusion**: The significantly decreased body mass index (BMI) in post-press-up-exercise subjects suggests that fitness exercise such as press-up exercise can reduce and/or maintain body mass index without significant modification in Ox-LDL and GDF-15. However, the variation in duration and frequency of press-up exercises among volunteers were major limitations to the study; further study is recommended on similar markers and subjects with an extended duration and variation in press-up exercise.

Key words: Press-Up, Exercise, Body Mass Index, Oxidized LDL, Growth Differentiation Factor-15, Male Students, Nigeria.

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Introduction

Exercise is a subset of physical activity that has been defined as a "planned, structured, and repetitive bodily movement done to maintain or improve one or more components of physical fitness" [1]. Exercise is one of the most powerful non-pharmacological strategies which can affect nearly all cells and organs in the body. Changes in the behavior of adult stem cells have been shown to occur in response to exercise. Exercise may also act on the regenerative potential of tissues by altering the ability to generate new stem cells and differentiated cells that can carry out tissue-specific functions [2]. Press-up exercise which is an example of a systemic exercise engages the body from top to bottom and works up several muscle groups at once: the arms, chest, abdomen (core), hips, and legs. Press-ups can also be modified as needed, for instance by adjusting the speed, the angle of the body, and even hand placement, one can add more or less intensity, or focus on specific muscles [3]. Growth differentiation factor 15 (GDF15) has shown promise as a weight loss agent for obesity in animal studies. Also in healthy lean humans, fasting plasma GDF15 was observed to increase after acute exercise such as press-up [4]. Hu *et al* [4] also recorded that aerobic exercise increases GDF-15 levels in humans with obesity and that the elevation in plasma GDF-15 was associated with fat mass. Oxidized LDL (Ox-LDL) is a significant cardiovascular risk factor[5] and is also known to be associated with obesity[6] Linna *et al*.[7], had earlier found that the reduction of Ox-LDL lipids can be achieved through weight reduction which can be achieved by physical activity intervention such as press-up exercise [7]. An increase in GDF-15 level and reduction in the level of Ox-LDL following physical exercise such as press-up exercise may play a potential role in regulating an obesogenic metabolic phenotype in humans [4]

Oxidized LDL cholesterol (Ox-LDL) is considered one of the most important factors in initiating and accelerating vascular fat accumulation and sedimentation [8]. Studies have shown that Ox-LDL's atherogenic property is greater than low-density lipoprotein cholesterol (LDL-C). Low-density lipoprotein oxidation stimulates monocytes, followed by the accumulation of vascular macrophages, which are afflicted with arterial cramps [9]. The formation of Ox-LDL from LDL indicates a rise in oxidative stress that ultimately destroys endothelial tissue with the participation of free radicals, and together with the progression of atherosclerotic lesions, in particular, the precipitation of cholesterol, and the creation of plaque reduces the vascular function against inflammation. Reactive oxygen species (ROS) trigger the formation of Ox-LDL. ROS are a group of compounds endowed with high reactivity and short half-life based on their tendency to give or receive electrons to attain stability [10]. Regular physical exercise has many health benefits, but intense and prolonged exercise induces the excessive formation of ROS in various tissues, such as skeletal muscles and the liver, leading to a shift in redox balance in favor of oxidative stress. ROS are generally thought to cause deleterious oxidative damage to proteins, lipids, and DNA. Polyunsaturated fatty acid residues of lipids in LDL are oxidized by ROS-mediated lipid peroxidation, and the subsequent radical reactions result in the formation of both protein and lipid hydroperoxide on LDL. Research reports reveal contradictory findings, in which some researchers find that regular physical activity is effective in reducing oxidative stress, especially Ox-LDL levels, and consequently effective prevention of atherosclerosis [11].

The growth differentiation factor 15 (GDF15) is a stress-sensitive circulating factor that regulates systemic energy balance [12]. Growth differentiation factor 15 (GDF15) has emerged as a potential anti-obesity agent. It circulates as a 25-kDa homodimer and is a member of the transforming growth factor- b (TGF-b) superfamily. Originally, identified in 1997 as a factor that inhibits macrophage activation [13] a role for GDF15 in the regulation of energy balance was established in 2007, when it was demonstrated that GDF15 suppresses food intake [14]. Subsequent pharmacological and genetic studies confirmed that GDF15 administration lowers body weight, largely by decreasing appetite [15,16,17]. Some studies have also suggested that GDF15 can directly increase thermogenesis and improve insulin sensitivity [18,19]. Recently, the GDNF family receptor a-like (GFRAL), located in the area of the hindbrain, was identified as the receptor that mediates the anorexic effects of GDF15 [17, 20]. Some risk factors contribute to increased risk of CVD, including hyperlipidemia, aging, hypertension, and diabetes [21]. GDF-15 has cardioprotective functions, and OxLDL level, not LDL-cholesterol, has also been found to be predictive of incidents of Type 2 Diabetes. In this work, the levels of BMI, Ox-LDL, and GDF-15 were comparatively evaluated in press-up-engaged male students in the Nnewi campus to establish the impact of press-up exercise on these markers.

Methods

Study participants

Sample size

The sample size was calculated using Taro Yamane (1973) formula as described by [22]

n = N divided by [(1) + N(e)]

Where:

n=sample size.

e =level of significance (0.05)

1=unity(constant)

Applying the method,

47/ [(1) +48(0.05)]

n =40

This was a cross-sectional study designed to evaluate the effect of press-up exercise on BMI using Ox-LDL and GDF-15 as markers. It was carried out at Nnamdi Azikiwe University, College of Health Sciences, Nnewi Campus, Anambra state, Nigeria involving a total of 40 aapparently healthy male students within the age range of 18 to 35years. Male individuals who were not alcoholics and not into drugs capable of affecting or modifying cholesterol level were recruited for this study. Male individuals outside the age range of 18-35. Male individuals suffering from cardiac diseases or any debilitating organ disease were excluded. The ethical approval for the research was obtained from the ethics committee of Faculty of Health Sciences, Nnamdi Azikiwe University Nnewi Anambra State, Nigeria ERC/FHST/NAU/2019/02151. Informed consent was sought and obtained from subjects prior to study. The participants were engaged in ten press –ups exercise on Mondays, Wednesdays and Fridays weekly for four weeks. Their systolic and diastolic blood pressures, height and weight were measured, recorded before and immediately after press-ups. 12hrs fast after four weeks press-ups exercise. Their body mass index (kg/m^2) before and after four weeks press –ups exercise was calculated using the information obtained. Similarly, five milliliters (5mL) of venous blood was collected aseptically from each participant twice, through venipuncture, and the blood dispensed into a plain container. The blood was centrifuged at 4000rpm for 5mins. The serum was extracted and used for the estimation of Ox-LDL and GDF-15. Ffive milliliters (5mL) of venous blood was collected aseptically from each participant twice, firstly before the commencement of the press up exercise(baseline sample as control) and immediately after overnight fast after four weeks press-ups exercise.Oxidized LDL was evaluated using the method described by [23]. GDF-15 was determined using the method as described by[24].

Statistical analysis

The sample data failed normality test so non parametric tools as stated below were used as suitable for the statistical analysis. The statistical analysis was performed using student's Wilcoxon signed rank test. Values were deemed significant if $p<0.05$. Correlation of the parameters with exercise was performed using the Spearman's correlation coefficient.

RESULTS

Table 1: There was a significant decrease in the median body mass index ($p<0.05$) in post press up compared with pre press up exercised participants.

Table 1: Body mass index in pre and post press up exercise subjects (Median)

Parameters	Pre Press-up	Post Press-up	Wilcoxon signed rank	P-value
BMI	23.680	22.630	-4.940	<0.001

Table 2: No significant decrease existed in the median serum levels of oxidized LDL and GDF-15 ($p>0.05$) in pre compared with post exercised participants.

Table 2: Levels of oxidized LDL and GDF-15 in pre and post press up exercise participant (median).

Parameters	Pre Press-up	Post Press-up	Wilcoxon Signed-rank	P-value
Ox-LDL	7.400	6.500	-1.570	0.116
GDF-15	23.680	15.200	-0.440	0.660

Table 3: There was no correlation between BMI and the levels of Oxidized LDL ($r= -0.007$, $p=0.966$) and no correlation was observed between BMI and GDF-15 ($r=0.003$, $p=0.985$).

Table 3: Correlation of the levels of OX-LDL and GDF-15 with BMI

Parameters	N	R	P-value
BMI vs OX-LDL	40	-0.007	0.966
BMI vs GDF-15	40	0.003	0.985

DISCUSSION

A planned, controlled, and repeated physical movement is referred to be a press-up workout when it is done to maintain or enhance one or more physical fitness components [1]. This study assessed how press-up exercise affected BMI, levels of oxidized LDL, and GDF-15. In comparison to the pre-press-up exercise, the median body mass index (BMI) considerably decreased ($p< 0.05$) after the press-up activity. This could be explained by the anaerobic exercise associated with the catabolism of adipose tissue, which includes weightlifting and other resistance workouts like press-ups or stomach crunches [25].

The body may burn calories more effectively throughout the day thanks to moderate physical exercise, which lowers body mass index by improving metabolism and causing the body to burn calories. This demonstrates that moderate exercise reduces body mass index by improving metabolism and burning calories, which allows the body to burn calories more effectively throughout the day. Exercise is the most significant discretionary factor in daily energy expenditure and can therefore have an impact on the energy balance. In a few longitudinal studies, it was demonstrated. For instance, a prospective study [26] with 20 years of follow-up showed that sustaining a high level of PA considerably reduces weight gain, especially in women. According to that study, people who were constantly active gained less weight over the subsequent period than people who were regularly sedentary. The Finnish Twin Cohort can be viewed as a natural experimental method to research produced similar findings [27]. Exercise causes weight reduction, and the weight loss is significantly larger when combined with energy restriction, according to some reviews [28], including a Cochrane Review (which is regarded as the gold standard in evaluating evidence). Thus, the programs designed to help people lose weight must include both nutrition and activity. As a result, there is a widespread belief, especially among laypeople, that very few people are successful in maintaining their weight loss over the long term. However, maintaining a weight decrease over the long run depends on behavioral consistency. Studies have unequivocally demonstrated that maintaining a diet and exercise strategies is associated with long-term success [29].

In pre-and post-press-up exercised participants, there were non-significant negative and positive relationships between BMI and the median serum levels of oxidized LDL and GDF-15, respectively. This implies that the modification of Ox-LDL and GDF-15 as revealed by the substantial associations may not be due to the oxidative alteration of BMI, which is demonstrated by the considerable elevation of median BMI in post-exercise individuals compared to pre-exercise subjects.

Despite having little impact on Ox-LDL levels, exercise training can enhance LDL metabolism by enhancing LDL elimination from plasma and lipoprotein turnover, according to [30].

This result contradicts studies [31,32] that found a positive relationship between Ox-LDL and inflammation and obesity. Additionally, among people with high abdominal fat, the impact of oxidative stress on the risk of cardiovascular disease (CVD) was significantly stronger 33,34]. It is widely acknowledged that exercise causes the release of many cytokines into the bloodstream, which regulates a sufficient metabolic response [35]. The release of IL-6 by muscles, which has been demonstrated to drive hepatic glucose release to offset the increased glucose absorption by skeletal muscle during exercise, is one of the best-recognized and best-understood examples [36]. The duration and variance of the press-up activity among the chosen subjects may be a contributing factor to the opposite observation. It is generally established that Ox-LDL levels in healthy, able-bodied subjects correlate with body mass index (BMI) and are higher in obese and overweight people. Chronic Spinal Cord Injury (SCI) patients have greater Ox-LDL levels than physically active SCI patients and able-bodied individuals, and Ox-LDL is also known to be related to physical activity in SCI patients. Meanwhile, GDF15 is being intensively investigated as a clinical biomarker, for example, to predict the likelihood of developing a chronic SCI [37].

CONCLUSSION

The significantly decreased body mass index (BMI) in post-press-up-exercise subjects suggests that fitness exercises such as press-up exercise can reduce and/or maintain body mass index without significant modification in Ox-LDL and GDF-15. However, the variation in duration and frequency of press-up exercises among volunteers was a major limitation of the study; further study is recommended on similar markers and subjects with an extended duration and variation in press-up exercise.

Conflict of interest: None declared

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