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# Psychological and Behavioral Effects Due To Targeted Bodybuilding Training on Overweight College Students

**Wei Chen[1], Syahrul Ridhwan Morazuki[2] , Lei Yang[3]**

[1]School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310 Skudai, Johor

[2]Shaanxi Railway Institute, Physical Education Department, Weinan714000, Peoples R China

[3]School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310 Skudai, Johor

[4]School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310 Skudai, Johor

wei-1991@graduate.utm.my, p-syahrul@utm.my, lei.y-1991@graduate.utm.my

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## *ABSTRACT*

***Background:*** *There is an increasing prevalence of obesity and overweight among college students. It is a concerning condition as these conditions are related to various diseases. Various existing studies established that bodybuilding comprises of various movements which could aid in decreasing body weight. Despite the robust studies, there was a lack of studies focused on college students. Therefore, this study aimed i) to measure psycho-behavioral changes after physical fitness routine among college students, ii) To investigate the effectiveness of the bodybuilding such as Perceived Physical Fitness among college overweight students, and, iii) to develop a body-building protocol specific to college students.*

***Method:*** *The study included a post-test and pre-test experimental design. It involved an intervention for six months whereby participants were involved in high-resistance exercise at a specific time. The study included 150 participants, a survey was undertaken before the intervention while another survey was undertaken after six months. The results were analyzed with SPSS.*

***Findings and Conclusions:*** *The study found that college students showed positive outcomes following the intervention. Additionally, the study also found that specific exercises focused on the pectoralis major and the deltoid could lead to positive outcomes. However, the findings of the study could be limited due to self-report and lack of actual measurement. Future studies should undertake studies implementing actual measurements for studies focused on college students.*

***Keywords****: bodybuilding, pectoralis major, deltoid, Psyche-Behavioural, Physical Fitness*

## 1. Introduction

There has been a notable increase in the prevalence of overweight/obesity among college students. A recent study of Chinese college students found that 29% of males and 53% of females were overweight or obese (Wang et al., 2022). This pattern is especially troubling considering obesity has been linked to various poor health outcomes, including an increased risk for chronic diseases such as diabetes, cardiovascular disease (CVD), and some cancers (Bendor et al., 2020). Therefore it is becoming an important public health problem. Subsequently, bodybuilding and physical fitness may be used to manage weight among this generation, not only for aesthetic reasons. That is, it helps to maintain a lower proportion of body fat while growing lean muscle mass, which results in increased metabolic output (Barakat et al., 2020). It cannot be overemphasized that weight management requires targeted muscle training.

Subsequently, the bodybuilding approach allows for the optimal stimulation of muscle growth and development, gradually, producing a better metabolically active body (Barakat et al., 2020). Moreover, the lifestyle of college students often contributes to the overweight (Carpenter et al., 2021). Thus, a designed protocol could be effective due to their proficiency with digital communication strategies to motivate behaviour change towards achieving specific goals, this approach might be particularly effective. Bodybuilding is an exercise regimen that involves the gradual increase of resistance to build and sculpt muscles aimed at improving body appearance by gaining muscle size and leanness while simultaneously reducing fat (Carnio et al., 2014). It differs from other resistance training such as weightlifting specifically designed to deliver enhanced performance and allow you to lift more weights over time. This intense sport requires an individual to train by lifting weights; fit cardiovascular activity capacity and improve their muscles via nutrition.

Participation needs to be active for all and emphasise empirical evidence on the benefits of an actively maintained level amount about health maintenance. In China, overweight is defined as a BMI more than 24 $kg/m^2$ and obesity as a BMI more than $28kg/m^2$. A targeted training and fitness protocol could potentially aid in reducing weight and building strong muscles. Numerous studies have analyzed the beneficial effects of targeted training protocols. For instance, Jitwil et al., (2019) found that high-intensity interval resistance training (HIIRT) produces significant improvements in body composition and cardiovascular fitness in overweight populations. Similarly, combined aerobic and resistance training helped reduce body fat percentage and increase muscular strength in overweight or obese adolescents (Sigal et al., 2014). However, more research is needed to address the unique challenges and needs of overweight college students. Therefore, developing bodybuilding-specific protocols that include targeted training movements for college students is required.

Subsequently, the study aimed to understand psychological and behavioral effects due to targeted bodybuilding training on overweight college students. That is the study followed the following objectives.

**RO1:** To measure psycho-behavioral changes after physical fitness routine among college students.

**RO2:** To investigate the effectiveness of the bodybuilding such as Perceived Physical Fitness among college overweight students.

**RO3:** To develop a body-building protocol specific to college students.

This study is significant as it could address the epidemic of obesity affecting college students. On the other hand, a targeted bodybuilding protocol would provide an adequate, time-efficient solution to weight management and physical fitness improvement. Most importantly, contrary to earlier research focusing on the general population, this study entailed focusing on college students specifically. This study has the potential to counter conventional weight loss tactics dismissing the importance of enhancing lean body mass for long-term metabolic health due to an emphasis on resistance training and increasing muscle size. Thus, the findings of this study could have benefits in health, academic, and quality of life outcomes for the college population.

## 2. Literature Review

### 2.1. Past Research On Bodybuilding's Impact on Weight Loss and Health

Recent studies have highlighted the incredible power of bodybuilding and muscle resistance workouts for fat loss and general health promotion. Schoenfeld et al. (2016) conducted a meta-analysis of 25 studies and found that resistance training-induced a significantly greater reduction in body fat percentage and increase in lean body mass in overweight and obese adults. The study aimed to investigate whether changes in duration in repetition could amplify the hypertrophic response to RT. Additionally, another study through a meta-analysis aimed to investigate eccentric muscle contractions on vertical jump, muscle strength, power production and soreness (Mike et al., 2017). The score was administered over four weeks using the Smith squat exercise with eccentric contractions of 2, 4, and 6 seconds to 30 college-aged men. The study found that longer eccentric contractions reduce vertical performance increase and soreness reduction. The results indicated that all participants recorded improvements in strength and power. Resistance training is appropriate for weight loss. The importance of soreness management cannot thus be undermined. Moreover, eccentric training duration can increase strength and hypertrophy while short durations could increase power. Additionally, hypertrophy training improved mental resilience.

Past research has also shed light on the impact of bodybuilding through preferred reporting items. Salse-Batán et al. (2022) conducted a study to analyze the effect physical exercise may have on obesity-related parameters in individuals with intellectual disabilities (ID). The study utilized a systematic review and meta-analysis. The study found that multicomponent interventions including changes to diet, levels and types of physical activity and behavior change are more effective. Additionally, decreasing body weight and per cent body fat by a few percentage points may not be practically necessary or achievable for obesity prevention in the general population. Adding to the insights from the earlier studies, this study asserted that a whole-body prescription, combining different exercise programs and lifestyle interventions would be an effective tool to manage the weight loss process and health benefits in specific populations. However, the authors stated that it is necessary to compare different exercises associated with the framework of a multicomponent weight management intervention.

Past researches highlight that exercises targeting cardiac metabolic health could be essential interventions for overweight. For instance, Migueles et al. (2023) conducted a study on the effect of a 20-week exercise program in overweight or obese children on their cardiometabolic health and psychological well-being. The study included 92 children aged between eight and eleven years and was conducted in Granada, Spain. The intervention was 3 to 5 sessions of aerobic and resistance training each week, according to the control group uninterrupted with usual routines. It found that exercise significantly improves cardiac metabolic health in these children, primarily through observed improvements in lipid levels, reductions in overall and visceral fat content, and increased cardiorespiratory fitness indices. It increased cardiorespiratory fitness. These understandings imply the potential advantages that combined aerobic and resistance training may provide for improved physical health.

The loss of weight is also brought about due to increased demands in the body due to stimulation. In this context, the chapter on Physiology Exercise found that exercise activates the sympathetic nervous system and causes a complete reaction from the body (Patel & Zwibel, 2024). This, in turn, acts to maintain optimal levels of internal homeostasis to meet the increased requirements of physiological, metabolic, respiratory, and cardiovascular processes. Thus, previous studies established that bodybuilding can be applied as an intervention for obesity. Therefore, it is essential to evaluate the exercises that are used in building which are effective for weight reduction.

### 2.2. Evaluation Of Various Exercises Used In Bodybuilding

Evaluation of various exercises requires considering exercise physiology and human physiology. While exercise

physiology entails scientifically established training protocols, human physiology is the study of the normal human body focusing on its responses to exercise and ability to adjust to changes. To understand the effects of exercise, one needs to look at the specific changes that occur in the cardiovascular, musculoskeletal, and neuroendocrine systems. Faigenbaum et al. (2016) conducted a study involving the substantiality of resistance training programs. It fully illustrates the Olympic motto 'Citius, Altius, Fortius' because the purpose of the program is that young athletes perform faster, jump higher, and be stronger. Athletic potential is improved through integrative training combining resistance training with activities that develop the motor skills that reduce injury risk.

Moreover, the study by Faigenbaum et al. (2016) found that persistent participation in a well-organised and age-appropriate resistance training programme for young people can result in notable improvements in their health, fitness, and athletic performance. In the era when modern young athletes start specializing in their primary sport from an early age often neglect their general physical fitness and athlete abilities thus, such training is essential. The findings of the study found when prescribed safely and appropriately, the resistance exercise provides significant health and athletic performance advantages. Thus, qualified instruction and progressive, technique-driven activities produce optimal athleticism. Thereby, it would increase basal metabolic rate, lowering body fat, improving blood lipid levels and preserving long-term independence and functional ability.

In this context, further insights were drawn from a review by Bauer et al. (2023). This review aimed to measure the composition of the body among the bodybuilders taking part in competitions. Following PROSPERO guidelines, a comprehensive search identified 16 studies, with 6 providing detailed longitudinal data. Following the analysis, body fat levels were 15.3%-25.2% in females and 9.6%-16.3% in males. Body fat reductions ranged significantly from 30%-60% on average, while lean mass was largely maintained. These decreased significantly toward competition to 8.1%-18.3% and 5.8%-10.7%, respectively. Additionally, bodybuilders increased aerobic training and performed high volumes of resistance training during competition preparation. They emphasised the need to research training methods, dietary techniques, psychological circumstances, and other relevant elements. As a result, the scientific aspect of the training approach is quite important. In this context, the study highlighted that further research should investigate training programs, nutritional cues, and psychosocial aspects in greater detail.

Another study by Alves et al. (2020) aimed to study training programs for muscle hypertrophy. Bodybuilders are a separate cohort of athletes who use varied nutritional and training techniques to meet competition norms and requirements across multiple disciplines, ultimately achieving commensurate physiological changes. The study divided the training into four phases, namely, pre-contest, peak week, and post-contest. The review highlights the importance of structured, progressive, and periodized training protocols for maximizing muscle hypertrophy with minimized body-fat gain. When there are closer competitions, fat is recalibrated to smaller body levels and frequently increases aerobic activity and reworks resistance training volume. These changes in training goals are thought to have repercussions for athletes competing in various contests and disciplines, each with its own set of restrictions, objectives, and muscle hypertrophy needs. Most importantly, the study highlights that individual methods may vary. Thus, the context of this study is developed persistent training programs, nutritional cues can aid in bringing about expected physiological changes and subsequent decrease in weight.

### 2.3. Effectiveness In Targeting Specific Muscle Groups And Promoting Overall Fitness

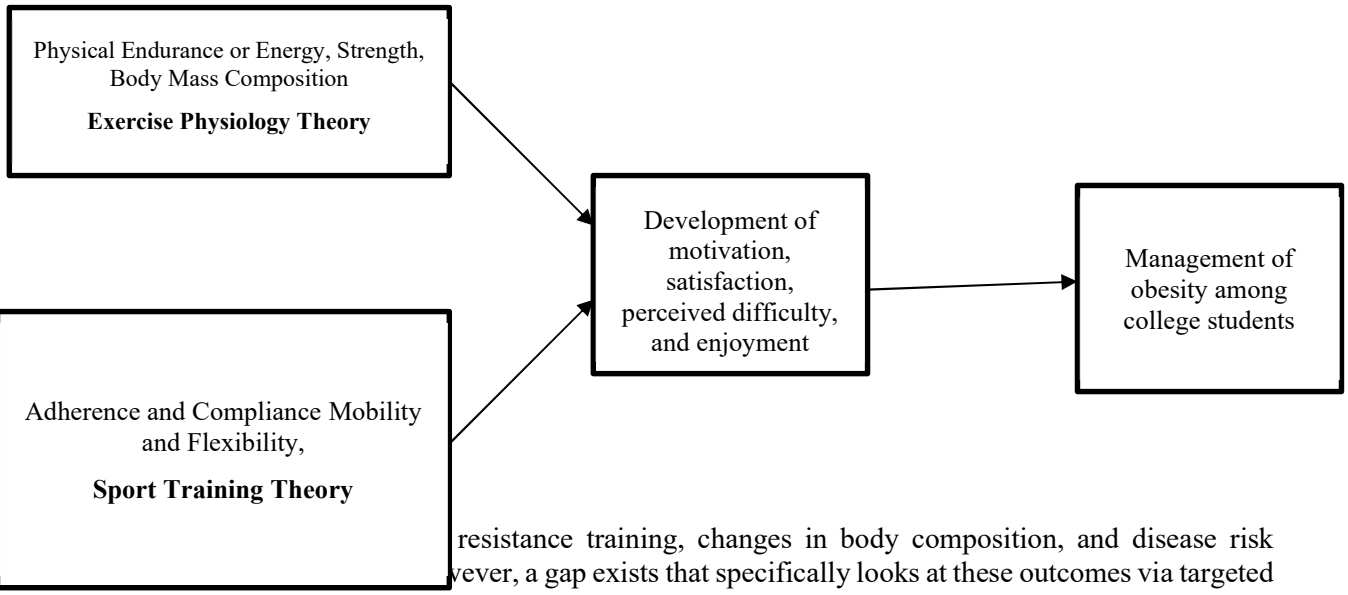
While resistance training was found to be very effective in the earlier sections, it was also essential to observe targeted muscle groups and promote overall fitness. Ogasawara et al. (2013) studied 14 young men to compare periodic resistance training (PTR) against continuous resistance training (CTR) on muscle size and function. The study found that there was an initial similarity in the amount of muscle cross-sectional area (CSA). Both groups performed bench press exercises at high intensity twice a week over this period for twenty-four weeks. Additionally, it was found that changes in function were significantly greater for children who received PTR compared to CTR. It highlighted the effectiveness of PTR in inducing key aspects of muscle mass and

performance significant improvements in muscle hypertrophy and strength adaptations.

On the other hand, resistance training can be a feasible alternative to aerobic exercise, with moderate-intensity resistance training, for instance, 50-85% 1RM, having a greater impact on lipid profiles (Mann et al., 2014). This degree of exercise intensity was also consistent with the training needs for muscular growth in bodybuilding. By using progressive resistance training strategies to enhance muscle development, calories and body fat can be burnt and reduced effectively. Similarly, Hussain et al. (2021) found that engaging in long, repetitive activities and performing technical motions poorly is extremely likely to result in exercise-related injuries. Thus, periodic resistance training with a feasible alternative to aerobic exercise can lead to muscle growth.

### 2.4. Theoretical Framework

This study is based on the theory of exercise physiology theory and the theory of sports training. Exercise physiology theory explains how the body responds to physical activity and the environmental conditions associated with the activity (Powers et al., 2007). For instance, resistance training results in muscle hypertrophy via intracellular physiological responses such as mechanical tension, metabolic stress, and muscle damage. The theory provides a framework that can be used to identify the body's response patterns and adaptive responses during exercise. The exercise physiology theory explains the metabolic adaptation associated with resistance training due to the increase in resting metabolic rate and the enhancement of insulin sensitivity. On the other hand, sportsperson training provides a basic and scientific principle that can be used to develop a training pattern or program that an individual can undertake to build muscles(Bompa & Buzzichelli, 2019). Progressive overload also ensures that a person keeps on growing through training, while periodization ensures that a person does not over-train while expecting to gain weight. Therefore, it also aligns to establish an evidence-based bodybuilding protocol effectiveness in an overweight college student.

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T resistance training, changes in body composition, and disease risk as vever, a gap exists that specifically looks at these outcomes via targeted bodybuilding protocols for overweight college students. Additionally, as discussed earlier, various literatures are providing the benefits of resistance training on weight management (Faigenbaum et al., 2016; Schoenfeld et al., 2016). As overweight and obesity become epidemic among college students, research must fill these gaps enabling the development of bodybuilding interventions tailored to meet specific needs in a way effective at maintenance by this high-risk group.

## 3. Methodology

### 3.1. Research Design

This study adopted a pre-test and post-test experimental design to compare the targeted bodybuilding training program's impact on overweight college students. The pre-test and post-test designs are commonly utilized to ascertain the differences that an intervention would make on a study subject by comparing pre-intervention and post-intervention states (Dimitrov & Rumrill, 2003). The study was undertaken in a period of six months, whereby, an initial survey was undertaken among the college students. The students were asked to participate in gym constituting high resistance exercises for six months. Following the six months, the survey was undertaken among the students again to identify the changes. Contrary to a randomized control experiment, this research methodology facilitated the comparison of the pre-intervention and post-intervention outcomes. Additionally, the span of intervention was six months as it was optimal to investigate the impact of a life cycle of six months for physiological adaptations from resistance training as conducted in the study by (Westcott, n.d.). It was also instrumental in understanding the viability of the bodybuilding program, including compliance and long-term results of bodybuilding among college students.

### 3.2. Participant Selection

College students aged 18-25 years with overweight (BMI $\geq$ 25 kg/m$^2$) were recruited using convenience sampling. Shadish et al. argues that random assignment to groups can account for lurking variables and enhance the research's internal validity (Cook & Campbell, n.d.). Subsequently, to ensure that the results are not generalizable, a total of 150 surveys were conducted from the Chinese College.

### 3.3. Data Collection and Analysis

The data was collected over an open online platform consisting of survey questions designed using a Likert scale. It is a scale utilized for measuring attitudes and behaviours (Sullivan & Artino, 2013). Additionally, the online platform was chosen to ensure the convenience of participants. Following the data collection, the data was analyzed using SPSS software. Here the independent variables included the exercises of high resistance such as hamstring exercise, triceps exercise, bicep exercise and others. On the other hand, the dependent variable included Psychological Aspects: motivation, satisfaction, perceived difficulty, and enjoyment, Behavioural aspects: Adherence and Compliance, Perceived Physical Fitness: Mobility and Flexibility, Physical Endurance or Energy, Strength, Body Mass Composition. Finally, during the data collection, participants were given research information and they were also informed that they could withdraw at any moment. Data confidentiality by anonymous coding and securely storing the collected records were also ensured.

## Chapter 4: Findings

### 4.1 Reliability and Validity

The exploratory factor analysis has been done for each set of instruments used for the analysis process. However, the validity reliability of only the pre-test questionnaire for Psycho-Behavioural Aspects, and Physical Fitness have been tested. For the Bodybuilding Routine, only a post-test questionnaire has been used.

**Table 1. Reliability and Viability**

*Reliability and Validity of the Data Collection Instrument for Psycho-Behavioural Aspects, Physical Fitness and Bodybuilding Routine*

| | Extraction | AVE | CR | KMO SA | Bartlett's Test |
|---|---|---|---|---|---|
| Motivation T1 | 0.813 | 0.538 | 0.850 | 0.668 | 193.718** |

| | | | | | |
|---|---|---|---|---|---|
| Satisfaction T1 | 0.79 | | | | |
| Perceived Difficulty T1 | 0.805 | | | | |
| Enjoyment T1 | 0.714 | | | | |
| Adherence Compliance T1 | 0.496 | | | | |
| Mobility Flexibility T1 | 0.828 | | | | |
| Endurance Energy T1 | 0.743 | 0.599 | 0.856 | 0.687 | 93.338** |
| Strength Power T1 | 0.676 | | | | |
| Body Mass Composition T1 | 0.763 | | | | |
| Pectoralis major Monday | 0.713 | | | | |
| Triceps Monday | 0.681 | | | | |
| Abdominals Monday | 0.93 | | | | |
| Latissimus dorsi Wednesday | 0.622 | | | | |
| Biceps Wednesday | 0.798 | 0.621 | 0.936 | 0.897 | 114.357** |
| Abdominals Wednesday | 0.862 | | | | |
| Quadriceps Friday | 0.783 | | | | |
| Hamstrings Friday | 0.822 | | | | |
| Deltoid Friday | 0.835 | | | | |

Correlation is significant at the 0.05 level (2-tailed).

Correlation is significant at the 0.01 level (2-tailed).

As per Table 1, the extraction values of all Psycho-Behavioural Factors are higher than 0.6, except the Adherence and Compliance. It indicates that adherence and compliance do not fit properly with the other psychological aspects used in this study. The Validity of this scale is comparatively lower than another scale (AVE = 0.538), however the composite reliability is high (CR = 0.85). The KMO coefficients of Psycho-Behavioural Factors are higher than 0.6, which indicates that the sample size is adequately valid and the significance of Bartlett's test shows the significant validity of the scale ($p < 0.05$). The physical fitness scale has all items with moderate to high initial loading where the validity is at the threshold level (AVE = 0.599). The Composite Reliability of this scale is high, whereas the highest composite reliability can be found in the scale of Bodybuilding Routine (CR = 0.936). Both of these scales show higher KMO coefficients than 0.6 which indicates adequate sample size with a valid dataset as per Bartlett's significance ($p < 0.05$).

### 4.2 Pre-Test Post-Test Comparison of Psycho-Behavioural Factor

The average age of the participants is 20.76 years, whereas most of the participants are 18 years old (Figure 1). The age of participants ranged from 18 to 25 years.

**Figure 1. Age Distribution of Participants**

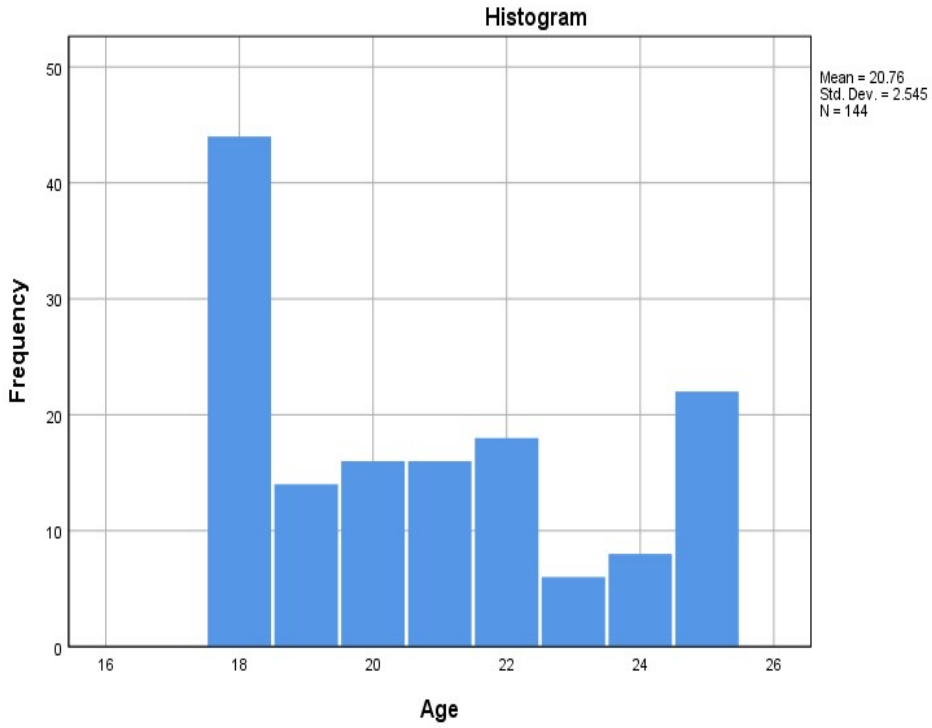



**Table 2. Descriptive Statistics of Pre-Test Post-Test Comparison of Psycho-Behavioural Factor**

| | | | | | | | | Percentiles | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Skewness | Kurtosis | Min | Max | 25 | 75 |
| Motivation T1 | 3.32 | 3 | 1.838 | 0.477 | -0.488 | 1 | 8 | 2 | 4.75 |
| Satisfaction T1 | 3.15 | 3 | 1.735 | 0.543 | -0.335 | 1 | 8 | 2 | 4 |
| Perceived Difficulty T1 | 7.85 | 8 | 1.845 | -0.45 | -0.624 | 3 | 10 | 7 | 10 |
| Enjoyment T1 | 4.58 | 4 | 2.026 | 0.062 | -0.676 | 1 | 9 | 3 | 6 |
| Adherence Compliance T1 | 3.99 | 4 | 1.896 | 0.42 | -0.025 | 1 | 10 | 3 | 5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Motivation T2 | 6.81 | 7 | 1.806 | -0.059 | -0.792 | 3 | 10 | 5 | 8 |
| Satisfaction T2 | 5.81 | 6 | 1.697 | 0.159 | -0.361 | 2 | 10 | 5 | 7 |
| Perceived Difficulty T2 | 5.42 | 6 | 2.685 | -0.091 | -0.741 | 0 | 10 | 4 | 7 |
| Enjoyment T2 | 6.72 | 7 | 2.16 | -0.242 | -0.939 | 2 | 10 | 5 | 8 |
| Adherence Compliance T2 | 5.14 | 5 | 2.054 | 0.125 | -0.282 | 1 | 10 | 4 | 6 |

As per Table 2, both T-test and post-test measures have low Skewness and Kurtosis Values. Besides, the means and medians for almost all measures are equal. It shows that the measures are normally distributed. Furthermore, the average motivation (6.81 ± 1.8), satisfaction (5.81 ± 1.7), enjoyment (6.72 ± 2.16) and Adherence Compliance (5.14 ± 2.05) are higher in the post-test compared to the pre-test. However, perceived difficulty (5.42 ± 2.68) in the post-test is lower than in the pre-test. Considering normal distribution, a parametric paired T-test is used in the following section.

**Table 3. Descriptive Statistics of Pre-Test Post-Test Comparison of Psycho-Behavioural Factor**

| | | Paired Differences | | | 95% CI | | | |
|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | SE | Lower | Upper | t | P-value |
| Pair 1 | Motivation T2 - Motivation T1 | 3.486 | 1.701 | 0.142 | 3.206 | 3.766 | 24.6 | 0.000 |
| Pair 2 | Satisfaction T2 - Satisfaction T1 | 2.66 | 1.478 | 0.123 | 2.416 | 2.903 | 21.6 | 0.000 |
| Pair 3 | Perceived Difficulty T2 - Perceived Difficulty T1 | -2.431 | 2.274 | 0.189 | -2.805 | -2.056 | -12.8 | 0.000 |
| Pair 4 | Enjoyment T2 - Enjoyment T1 | 2.132 | 1.775 | 0.148 | 1.84 | 2.424 | 14.4 | 0.000 |
| Pair 5 | Adherence Compliance T2 - Adherence Compliance T1 | 1.153 | 1.657 | 0.138 | 0.88 | 1.426 | 8.35 | 0.000 |

As per the p-values in Table 3, in all psycho-behavioural measures, significant differences have been found between pre-test and post-test ($p < 0.05$). However, the increment of Motivation in the post-test from the pre-test ($t = 24.6$, $p < 0.05$) is most significant followed by the incremental changes in Satisfaction ($t = 21.6$, $p < 0.05$) and Enjoyment ($t = 14.4$, $p < 0.05$). The changes between the pre-test and post-test in Perceived Difficulty ($t = 12.8$, $p < 0.05$) are also significant, however the changes in detrimental. The lowest level of change is found in Adherence and Compliance ($t = 8.35$, $p < 0.05$).

### 4.3 Pre-Test Post-Test Comparison of Physical Fitness

**Table 4. Descriptive Statistics of Pre-Test Post-Test Comparison of Physical Fitness Factor**

| | | | | | | | | Percentiles | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Skewness | Kurtosis | Min | Max | 25 | 75 |
| Mobility Flexibility T1 | 4.46 | 4 | 2.055 | 0.09 | -0.746 | 1 | 9 | 3 | 6 |
| Endurance Energy T1 | 3.22 | 3 | 1.938 | 0.897 | 1.157 | 1 | 10 | 1.25 | 5 |
| Strength Power T1 | 5.32 | 5 | 2.286 | -0.03 | -0.518 | 1 | 10 | 4 | 7 |
| Body Mass Composition T1 | 3.08 | 3 | 1.898 | 0.613 | -0.562 | 1 | 8 | 1 | 4 |
| Mobility Flexibility T2 | 7.38 | 8 | 2.308 | -0.641 | -0.473 | 2 | 10 | 6 | 9 |
| Endurance Energy T2 | 4.9 | 5 | 1.935 | 0.419 | 0.037 | 1 | 10 | 4 | 6 |
| Strength Power T2 | 8.1 | 8.5 | 2.005 | -0.753 | -0.354 | 3 | 10 | 6 | 10 |
| Body Mass Composition T2 | 6.47 | 6 | 2.184 | 0.05 | -0.902 | 2 | 10 | 5 | 8 |

As per Table 4, the T-test and post-test results of all fitness measures have low Skewness and Kurtosis Values. Additionally, the means and medians are almost equal for all measures. It shows that the measures are normally distributed. Furthermore, the average Mobility Flexibility (7.38 ± 2.3), Endurance or Energy (7.38 ± 1.93), strength or power (8.1 ± 2.01) and body mass composition (6.47 ± 2.18) are higher in the post-test compared to the pre-test.

**Table 5. Descriptive Statistics of Pre-Test Post-Test Comparison of Psyche-Behavioural Factor**

| | | Paired Differences | | | 95% CI | | | |
|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | SE | Lower | Upper | t | P-value |
| Pair 1 | Mobility Flexibility T2 - Mobility Flexibility T1 | 2.917 | 2.114 | 0.176 | 2.568 | 3.265 | 16.6 | 0.000 |
| Pair 2 | Endurance Energy T2 - Endurance Energy T1 | 1.674 | 1.761 | 0.147 | 1.383 | 1.964 | 11.4 | 0.000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pair 3 | Strength Power T2 - Strength Power T1 | 2.778 | 1.691 | 0.141 | 2.499 | 3.056 | 19.7 | 0.000 |
| Pair 4 | Body Mass Composition T2 - Body Mass Composition T1 | 3.382 | 2.024 | 0.169 | 3.048 | 3.715 | 20 | 0.000 |

According to Table 5, the p-values indicate that for all fitness measures, significant differences have been found between pre-test and post-test ($p < 0.05$). However, the increment Body Mass Composition in the post-test from the pre-test ($t = 20$, $p < 0.05$) is most significant followed by the incremental changes in Strength or Power ($t = 19.7$, $p < 0.05$) and Mobility and Flexibility ($t = 16.6$, $p < 0.05$). However, the lowest level of significant change is found in Endurance and Energy ($t = 11.4$, $p < 0.05$).

### 4.4 Effect of Targeted Body-Building on Pico-Behavioural Change

In each of the 5 psycho-behavioural factors namely Motivation, Satisfaction, Perceived Difficulty, Enjoyment and Adherence Compliance, the difference between pre-test and post-test is calculated. Then the mean of these 5 pre-test and post-test differences are calculated to find Psycho-Behavioural change.

**Table 6. Regression Model to Find Effect on Psyche-Behavioural Change**

**Model Summary**

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| 0.385 | 0.148 | 0.091 | 0.97194 |

**ANOVA**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 22.024 | 9 | 2.447 | 2.59 | 0.009 |
| Residual | 126.585 | 134 | 0.945 | | |
| Total | 148.609 | 143 | | | |

**Coefficients**

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | -0.336 | 0.724 | | -0.465 | 0.643 |

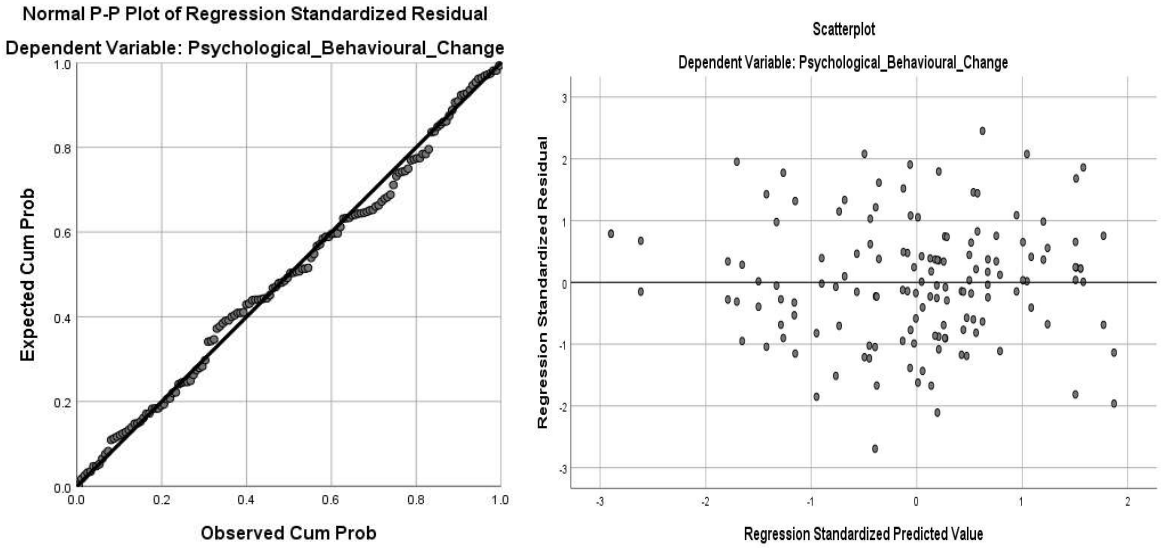
| | | | | | |
|---|---|---|---|---|---|
| Pectoralis major Monday | 0.18 | 0.069 | 0.22 | 2.599 | 0.01 |
| Triceps Monday | 0.076 | 0.065 | 0.101 | 1.177 | 0.241 |
| Abdominals Monday | -0.033 | 0.069 | -0.042 | -0.486 | 0.628 |
| Latissimus dorsi Wednesday | 0.14 | 0.086 | 0.138 | 1.634 | 0.105 |
| Biceps Wednesday | 0.063 | 0.063 | 0.085 | 0.992 | 0.323 |
| Abdominals Wednesday | 0.106 | 0.071 | 0.13 | 1.495 | 0.137 |
| Quadriceps Friday | -0.101 | 0.084 | -0.109 | -1.203 | 0.231 |
| Hamstrings Friday | 0.075 | 0.079 | 0.082 | 0.952 | 0.343 |
| Deltoid Friday | 0.285 | 0.11 | 0.228 | 2.589 | 0.011 |

a Dependent Variable: Psychological Behavioural Change

b Predictors: (Constant), Deltoid Friday, Hamstrings Friday, Pectoralis major Monday, Triceps Monday, Abdominals Wednesday, Latissimus dorsi Wednesday, Biceps Wednesday, Abdominals Monday, Quadriceps Friday

As per Table 6, the exercise routines can collectively predict only 14.8% (R-square = 0.148) of the Psycho-Behavioural Change. As per ANOVA results, collectively the exercise routines can significantly predict Psycho-Behavioural Change. However, the most independent and significant effect is found from the Deltoid exercise of Friday ($B = 0.285$, $p < 0.05$) along with the significant positive effect of the Pictorials major exercise of Monday ($B = 0.18$, $p < 0.05$) on Psycho-Behavioural Change. The effect of other exercises on Psycho-Behavioural Change is not significant.

**Figure 2. P-P Plot of Residual (Left) and Predicted vs Residual Plot for the Model of Psycho-Behavioural Change**




As per Figure 2, the P-P plot shows that the residuals follow the normal diagonal line. Therefore, the assumption of normality of residual is satisfied. As per the Predicted vs Residual plot, no trends and patterns are found in the points. It shows no risk of heteroscedasticity and the assumption of homoscedasticity is accepted. Therefore, the model of Psycho-Behavioural Change is robust.

### 4.5 Effect of Targeted Body-Building on Physical Fitness Change

In each of the 4 physical fitness factors namely Mobility, Endurance, Strength and Body Mass Composition, the difference between pre-test and post-test is calculated. Then the mean of these 4 pre-test and post-test differences are calculated to find total Physical Fitness change due to intervention.

**Table 7. Regression Model to Find Effect on Physical Fitness Change**

**Model Summary**

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| 0.415 | 0.172 | 0.117 | 1.16751 |

**ANOVA**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 38.036 | 9 | 4.226 | 3.1 | 0.002 |
| Residual | 182.652 | 134 | 1.363 | | |

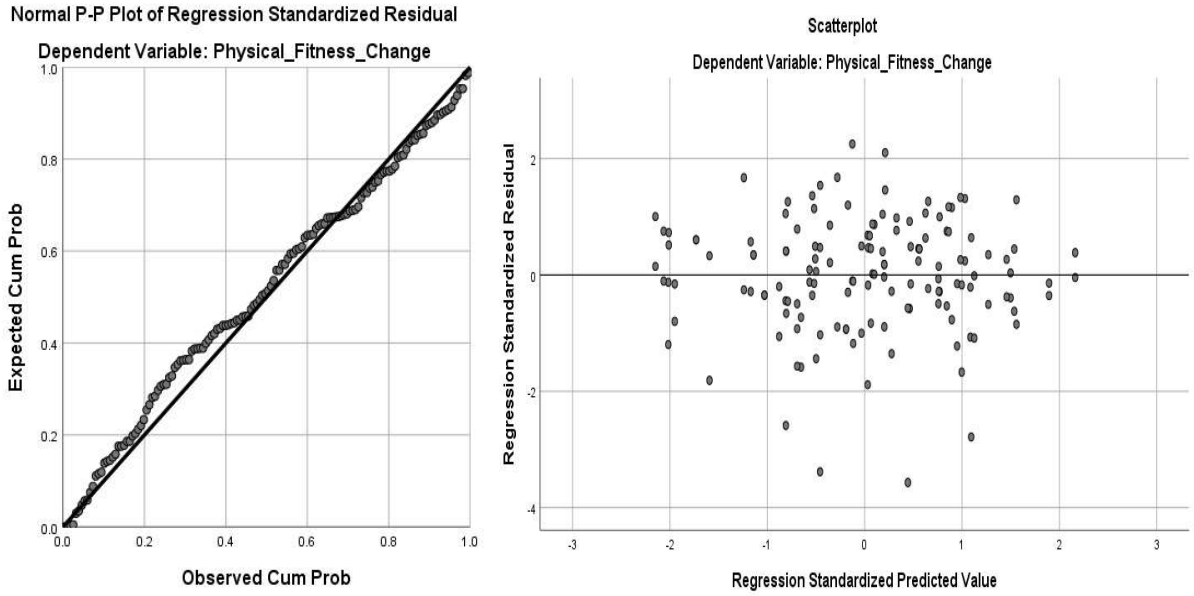
| | | | | | |
|---|---|---|---|---|---|
| Total | 220.687 | 143 | | | |
| **Coefficients** | | | | | |
| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | B | Std. Error | Beta | | |
| (Constant) | -0.238 | 0.869 | | -0.274 | 0.784 |
| Pectoralis major Monday | 0.223 | 0.083 | 0.224 | 2.673 | 0.008 |
| Triceps Monday | 0.153 | 0.078 | 0.165 | 1.961 | 0.052 |
| Abdominals Monday | -0.055 | 0.082 | -0.057 | -0.664 | 0.508 |
| Latissimus dorsi Wednesday | 0.193 | 0.103 | 0.156 | 1.875 | 0.063 |
| Biceps Wednesday | 0.09 | 0.076 | 0.1 | 1.192 | 0.235 |
| Abdominals Wednesday | -0.115 | 0.085 | -0.116 | -1.348 | 0.18 |
| Quadriceps Friday | -0.12 | 0.101 | -0.106 | -1.189 | 0.236 |
| Hamstrings Friday | 0.264 | 0.095 | 0.234 | 2.771 | 0.006 |
| Deltoid Friday | 0.242 | 0.132 | 0.159 | 1.833 | 0.069 |

a Dependent Variable: Percieved physical fitness change

b Predictors: (Constant), Deltoid Friday, Hamstrings Friday, Pectoralis major Monday, Triceps Monday, Abdominals Wednesday, Latissimus dorsi Wednesday, Biceps Wednesday, Abdominals Monday, Quadriceps Friday

As per Table 7, the exercise routines can collectively predict only 17.2% (R-square = 0.172) of the Physical Fitness Change. As per ANOVA results, collectively the exercise routines can significantly predict Physical Fitness Change. A most, independent and significant positive effect is found from the Hamstrings Exercise of Friday ($B = 0.264$, $p < 0.05$) along with the significant positive effect of the Pictorials major exercise ($B = 0.223$, $p < 0.05$) on physical fitness change. The Triceps exercise on Monday ($B = 0.153$, $p < 0.1$) and Deltoid exercise on Friday ($B = 0.242$, $p < 0.1$) has a marginally significant positive effect on physical fitness. The effect of another exercise on Physical Fitness Change is not significant.

**Figure 3. P-P Plot of Residual (Left) and Predicted vs Residual Plot for the Model of Physical Fitness Change**




As per Figure 3, the P-P plot shows that the residuals follow the normal line. Hence, the assumption of normality of residual is satisfied. As per the Predicted vs. Residual plot, no trends and patterns are found in the points, which shows the assumption of homoscedasticity is accepted. Therefore, the model of Physical Fitness Change is robust.

### 4.6 Key Findings

- The Targeted Bodybuilding Exercise significantly improved the psycho-behavioural factors in the post-test from the pre-test.
- Only the Deltoid exercise on Friday and the Pictorials major exercise on Monday have a significant impact on the improvement of psycho-behavioural factors.
- The Targeted Bodybuilding Exercise significantly improved the physical fitness factors in the post-test from the pre-test.
- The effect of Targeted Bodybuilding exercises on physical fitness is stronger than the impact on psycho-behavioural improvement. Hamstring exercise on Friday and Pictorials major exercise on Monday has a significant impact on the improvement of physical fitness. The Triceps exercise on Monday and the Deltoid exercise on Friday have a marginally significant positive effect on the improvement of physical fitness.

## 5. Discussions

### 5.1. Training Movements That Stimulate Target Muscles

The results of this study revealed that specific bodybuilding training leads to a very high stimulation of the muscle, which promotes global fitness and confirms previous research in this area. The potential of high-resistance training such as squats, deadlifts, or bench presses was similar to the previously established studies such as (Schoenfeld et al., 2016). Thus, when appropriately trialled in an overweight university student population, significant gains were realized with muscle activation and endurance from such compound movements. Moreover, this interaction highlighted that the strength training type expressed as the CNS output to a muscle has clear effects on muscular size by influencing recruitment patterns since attributes of this exercise underpin hypertrophic mechanisms.

Most importantly, quadriceps, bench press for pectorals, and pulldowns were very effective at stimulating these major musculature when compared with others. It was found that the overweight college students we worked with not only gained added muscle mass but also built specific fitness goals because that correlates to overall improvements. The high-intensity training is associated with both body improvement and may influence reduction of chances of comorbidity (Kemmler et al., 2020). The present work may contribute to the field of bodybuilding and offers a technical route for creating highly robust muscle-building schemes which are uniquely adjustable towards the obese undergraduate.

### 5.2. Psycho-behavioral Changes after Targeted Gym Training Routine

The study found that the Targeted Bodybuilding Exercise significantly improved the physical fitness factors in the post-test from the pre-test. Self-Determination Theory (SDT) entails exercises that work on fostering autonomy, competence, and relatedness. Thereby, it can help boost intrinsic motivation and psychological well-being (Deci & Ryan, 2012). Similar improvements in psychological well-being were also found in different studies (Cunha et al., 2024). Thereby, resistance training was found to be associated with a decrease in anxiety and depression, contributing to an improvement in well-being. Obesity and overweight are often associated with anxiety and depression among college students. Thus, the obtained results reflect that the components of high-resistance exercise could not only be effective in reducing weight but can also aid in addressing healthy behavioural change.

There was a significant increase in strength, mobility, and flexibility according to the study, along with changes in body mass composition. The observed improvements in body mass, composition, and strength power per se are consistent with the principles of progressive overload and specificity fundamental to resistance training. The findings aligned with the fact that muscle hypertrophy and fat loss occur from resistance training (Bernárdez-Vázquez et al., 2022). Furthermore, regression analysis subsequently identified that those exercises having bench press and shoulder dive on Monday, pectoralis major or deltoid raise minor were the most influential antagonists for comprehensive well-being. Thus, it contributed to both the psycho-behavioural & physical fitness of an individual. Thereby, it could be implied that exercises should focus on the major muscle groups for greater overall improvements. Similarly, hamstring exercise had a favourable impact on physical fitness making it clear that individual muscle groups should not be left untouched for effective workouts.

The current findings offer valuable insight to strength and conditioning professionals. Taken together, the impact of pectoralis major and deltoid routines on psychological outcomes parallels their physical influence and underscores the importance of individualized exercise programs. These findings highlight the value of resistance training for such programs and strategies to institute this kind of exercise in weight loss or fitness regimes among overweight college students.

### 5.3. Developing a Body-Building Protocol Specific to College Students.

The study aimed to develop a targeted bodybuilding intervention designed for overweight college students. It was found that significant improvement in both psycho-behavioural and physical fitness outcomes post-intervention was present. The results obtained in our study showed significant improvements in motivation, satisfaction, enjoyment, and adherence to the sessions performed by participants. These findings were evident

through existing studies such as (Granero-Jiménez et al., 2022). Furthermore, Collado-Mateo et al. (2021) identified adherence to physical activity such as goal setting, information and monitoring, adequate expectations, and characteristics of exercise program. Similarly, the study showed enhanced motivation and enjoyment in overweight college students completing bodybuilding exercises, indicative of greater adherence to weight-loss programs.

The results confirm that selective training protocols, especially on large muscle groups like the pectoralis major and hamstrings, can produce significant benefits in terms of fitness. Kemmler et al. (2020) highlighted that resistance training is an effective treatment for overweight individuals attempting to increase muscle strength and improve physical fitness. These changes in body mass composition support structured training, like those implemented by competitive groups on college campuses to help combat overweight and obesity among students. Such strong modifications of psycho-behavioural factors in response to deltoid exercise and physical fitness via hamstring exercise suggested that exercises could potentially be chosen for health benefits. Thus, the exercise protocol to be designed for college students could include muscle-quality-targeted exercises, which were successful at accomplishing psycho-behavioural and physical fitness gains.

Ramírez-Vélez & Izquierdo (2022) in their editorial highlighted that exercise specificity should be one of the primary components in developing successful fitness programs for diverse populations. Fitness professionals can achieve much more effective and enjoyable bodybuilding programs by concentrating on particular muscle groups while taking psycho-behavioural factors into account. The results of the study have implications for setting up fitness programs for overweight college students. It also provides greater integration of aerobic training with bodybuilding regimens. However, larger and longer-term treatment research is needed to better understand the potential for targeted interventions in this high-risk group.

## 6. Conclusion

The objective of the current study was to develop and evaluate a bodybuilding protocol specifically tailored for overweight college students, focusing on the psycho-behavioural and physical fitness impacts. This research has found significant insight that selective bodybuilding exercises are reasonably effective in improving psychological well-being and physical health among this demographic. The findings of the study highlighted the beneficial effects of targeted muscular exercises so that overweight college students experienced greater motivation, satisfaction, and pleasure during practice and better compliance to training. Furthermore, better parameters of physical fitness, such as strength, mobility, and flexibility, with changes in body mass composition, are coherent with what was previously described in the literature about resistance training. These enhancements both at the psycho and behavioral level closely match with Self-Determination Theory (SDT) suggesting that being autonomous while feeling competent in interactions leads to intrinsic motivation and positive psychological well-being.

The positive effects of targeted resistance training on general fitness were understood. The proven importance of such specific exercises as the pectoralis major and the deltoid was explained by the significant effect they have on both psycho-behavioural and physical fitness on specific days. This indicates a necessity to include the exercises where attention must be paid to major muscle groups. Furthermore, anxiety and depression were reduced due to resistance training. The improvement of psychological factors post-test was noteworthy. Thus, the authors conclude that a well-designed bodybuilding protocol is a successful intervention for improving mental rather than just physical health. It can contribute to reducing some of the negative effects.

Despite the findings of the study focused on college students who are overweight, the study could be lacking in several factors. The major limitation of the study was the self-reporting and lack of measures of the changes among the participants. This could contribute to the biases in the study along with misinformation. Thereby, future studies could be recommended to undertake experimental studies or longitudinal studies with a definite sample consisting of college students. Additionally, future studies could also undertake specific measures such

as assessing body composition, and instruments for evaluating physical fitness.

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*****Pre-test Questionnaire***

1. What is your gender?

2. What is your age group?

**Honestly rate the following psychological and behavioural factors, where 0 = Extremely How, 10 = Extremely High**

3. How motivated do you feel to do physical exercise or bodybuilding training?

4. How satisfied are you with your current fitness initiatives and routine and its effectiveness?

5. How difficult is maintaining a targeted bodybuilding training routine?

6. How much do you enjoy physical exercise or bodybuilding training?

7. How much do you strictly adhere to instructions by complying with the exercise routines and protocols?

**Honestly rate yourself from 0 to 10 as per the following physical fitness parameters, where 0 = Extremely**

**How, 10 = Extremely High**

8. Mobility and flexibility of the body including limbs, spine and others.

9. Physical endurance or energy that helps to endure physical stress without exhaustion

10. Strength or power in your muscle and bone that helps to apply pulling and pushing force

11. Healthy body mass composition that involves healthy weight as per height, body shape and fat distribution in your body.

*****Pre-test Questionnaire***

**Honestly rate from 0 to 5 how much correctly, thoroughly, effectively and efficiently with concentration you have executed the following exercise protocols, where 1 = with least focus and efficiency, 5 = with most focus and efficiency**

1. Pectoralis major or chest exercise on Monday

2. Triceps exercise on Monday

3. Abdominal exercise on Monday

4. Latissimus dorsi or "lats" exercise on Wednesday

5. Biceps exercise on Wednesday

6. Abdominal exercise on Wednesday

7. Quadriceps or front thigh exercise on Friday

8. Hamstrings or posterior thigh muscles between the hip and the knee exercise on Friday

9. Deltoid or solder muscles exercise on Friday

**Honestly rate from 0 to 10 the following psychological and behavioural factors, where 0 = Extremely How, 10 = Extremely High**

10. How much motivated do you feel to do physical exercise or bodybuilding training?

11. How satisfied are you with your current fitness initiatives and routine and its effectiveness?

12. How difficult is maintaining a targeted bodybuilding training routine?

13. How much do you enjoy physical exercise or bodybuilding training?

14. How much do you strictly adhere to instructions by complying with the exercise routines and protocols?

**Honestly rate yourself from 0 to 10 as per the following physical fitness parameters, where 0 = Extremely How, 10 = Extremely High**

15. Mobility and flexibility of the body including limbs, spine and others.

16. Physical endurance or energy that helps to endure physical stress without exhaustion

17. Strength or power in your muscle and bone that helps to apply pulling and pushing force

18. Healthy body mass composition that involves healthy weight as per height, body shape and fat distribution in your body.