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Effects of Pre and Post Workout Nutrition on Muscle Growth in Adults with Resistance Training

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Abstract:
Background & Aim: There is a debate regarding pre and post workout meal impact on muscle building. The objective of this research study was to find best nutrient timing to get the maximum lean muscle mass and lose fat mass in adult males with same type of resistance training.
Methodology: The sample size was 20 male adults aged 18 to 55 who perform resistance training from selected fitness centers in Lahore. The participants were divided into 2 groups i.e. Group a (control group): who consume balance diet throughout the day, Group B (experimental group): who consume balance diet but focus on pre and post workout meal. A self-structured questionnaire was used for the comparative study, which included questions about age, weight, height, analysis of body fat and analysis of skeletal muscle strength.
Results: Participants of both groups have nearly same reduction in body fat percentage but when in strength analysis the participant of control group have 19% improvement in 1 RPM while participants in experimental group have 40% improvement in 1RPM.
Conclusion: The pre and post workout meal showed better effect on increase in skeletal muscle mass through resistance training as the results indicated that the experimental group have more increase in 1RPM strength than the control group.
Keywords: Pre and post workout, Nutrition, Muscle growth, Adults, Training

INTRODUCTION

In recent years gym and fitness industry is flourishing around the globe. Now people start caring about their health and fitness by having regular exercise and following healthy diet plan. Like during covid-19 in China people started doing home base exercises and eating healthy diet. The aim behind this is first to stronger the immunity and next is to divert the attention also. In a web based platform, a sample of 449 Chinese participants was selected through the implementation of a questionnaire methodology. The survey encompassed various scales to assess health awareness, health-oriented life objectives, perceived control over behaviors, and engagement in domestic exercise routines. To facilitate comparative analysis, a T-test was employed. The outcomes divulged notable disparities in home-based physical activity contingent on factors such as gender, age, and marital status. Notably, health consciousness was found to substantially enhance participation in home workouts. A mediating role was identified between health consciousness and at-home exercise, with perceived behavioral control serving as an intermediary. The inclination

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toward domestic exercise, it was observed, could be attributed to the influence of health consciousness, mediated through the avenue of perceived control. This shift in behavior was notably spurred by healthcare experts who have increasingly advocated for adopting healthy lifestyles to mitigate disease risks. This heightened awareness within the broader populace has significantly propelled the prevalence of fitness centers in various societies. Many individuals have embraced gym memberships, primarily motivated by a desire to attain improved health, while others seek to attain more favorable body shapes. This surge in health and fitness orientation has transcended geographical boundaries, not merely thriving in Western regions such as America and Europe but also witnessing rapid growth in the Asian context (Jain, 2017).

Social media's capacity to serve as an exceptional wellspring of motivation showcased its profound worth within the realm of health and fitness. Individuals who have embarked on weight loss endeavors or sought to enact positive transformations upon their physique commonly pinpoint the maintenance of motivation as the most arduous aspect of the journey. Yet, for those seeking a catalyst to reinvigorate their progress, social media emerges as a remarkably effective motivational tool. The platform proves invaluable in kindling inspiration, offering the option to view invigorating exercise videos. A considerable avenue through which social media extend its advantages to those striving for wholesome bodily and mental alterations is by furnishing a virtual support network online. Embracing a health-conscious lifestyle poses challenges, especially when navigating uncharted territories. It is precisely in such instances that the presence of a support network assumes immense significance. In moments of despondency, waning determination, or even when the question of the endeavor's rationale arises, a virtual support network on social media can prove pivotal. The availability of round-the-clock assistance within an online support network is a prime asset. Denizens of social media can supply encouraging words, dispense guidance, recount their personal tales of triumph, caution against specific products and approaches, and provide psychological upliftment during times of utmost need.

Fitness influencers, actors and models also play a role in promoting gym culture as people are influenced by them and follow their lifestyles. The advantages of social media in promoting physical activity and dietary interventions were firmly rooted in its extensive outreach and cost effective avenues for interaction, access to information, and entertainment. Social media also played a pivotal role in cultivating awareness regarding unhealthy lifestyles and their repercussions, consequently motivating individuals to embrace healthier ways of living. Concluding our discussion, we will now delve into the less favorable aspects of social media concerning fitness and well-being. While the merits generally outweighed the demerits by a substantial margin, it remains prudent to carefully evaluate all facets. The subsequent are some limitations associated with utilizing social media for matters of health and fitness. Regrettably, misinformation has permeated social media, encompassing what the media, in an ironic twist, terms as "false information." In essence, social media gives users the ability to instantly share information with others without first verifying its accuracy. People may present ideas as facts, and tragically, some people take information they see online as gospel when it is demonstrably false. People may argue, for instance, that covering your body in shrink wrap before bed can help you sleep better at night (Goodyear *et al*., 2021).

In young adult males getting muscular body is priority of about 90% gym goers and for this purpose they need good muscle mass. Muscle growth is needed to get muscular body and micro tears in the muscles through resistance training or any sort of training. After that adequate nutrition is provided to recover these micro tears in skeletal muscles and leads to muscle hypertrophy.The newly

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recovered muscle cell is bigger and stronger than original muscle cell (Schoenfeld & Brad, 2010).
Accumulating evidence has indicated a potential correlation between the quality of nutrition and muscular well-being. The present study unearthed a noteworthy link between specific dietary patterns and muscular health over a span of 15 years. Notably, the "Traditional" food regimen was linked to an increase in muscle mass, while an anti-inflammatory diet exhibited a twofold effect by promoting enhanced muscle mass and improved muscular functionality. These findings underscore the paramount importance of optimizing dietary practices to facilitate healthy aging. Across the 15-year timeframe, an anti-inflammatory diet characterized by an abundant inclusion of vegetables, fruits, and wholegrain cereals was observed to correlate with amplified skeletal muscle mass and heightened muscle performance. In contrast, the conventional dietary pattern, characterized by elevated consumption of vegetables, wholegrain cereals, and animal-derived protein, presented an alternative picture. (Davis *et* al., 2021).
Meal timming is also an important factor which we consider for nutritional intake. Different people have different believes in fitness industry regards the meal timing. Some believe that consuming correct amount of nutrients in throughout the day is important and rather than giving nutrient during the anabolic window. But others consider the intake of right nutrients within 3060 minutes after workout is most important to correct body composition. Still others believe pre and post workout meals are important (Alan Albert Aragon & Brad Jon Schoenfeld, 2013).
There is an increasing trend of fitness and gym going in Pakistan. The main aim of mostly gyme goers is muscle growth which can be achieve through proper nutrition with resistance training. When we talk about nutrition then nutrient timming plays a very important role but there are many different concepts regarding if pre and post workout meal works or not. So to find out the best nutrient timming I done that study.
Pre & post workout nutrition help to increase muscle mass in adult males with resistance training.
The objective of this research study was:
i. To find best nutrient timming to get the maximum lean muscle mass and lose fat mass in adult males with same type of resistance training.

LITERATURE REVIEW

A qualitative study was published on nutrient timing effect on muscle building with resistance training. The main purpose of that research is that the strategically consumption of nutrients pre and post workout help to enhance muscle building. To verify that they took 2 groups of males which do same type of resistance training, but they provide nutrient strategically pre & post workout to group 1 and nutrient in all over the day to group 2. The results shows that the group which got nutrients pre-post workout have significant increase in lean body mass and 1 Rep max than other group in 10 weeks (Cribb, P. J., & Hayes, A, 2006).
In 2009 another study was published on the effect of protein supplement timing on the strength and body composition of males which do resistance training in 10 weeks. In that research they took 33 males and make 3 groups to all groups they gave protein supplement on different timings. They gave protein supplement in morning and evening on random timing to group 1, pre& post workout to group 2 and 3rd group was controlled group. They observe all the groups strength through 1 rep max of compound exercises and lean mass with their body shapes and after 10 weeks they did not observe any significant effect of protein timing on strength and lean mass of candidates (Hoffman *et* al., 2009).
Another study was published to find was pre or post workout nutrition which is better to improve

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muscle growth. To check that they use essential amino acid & carbohydrate supplement solution (EAC) and gave them to candidates pre and post workout and results indicate that those which took EAC pre workout have more anabolic effect and more muscle protein synthesis instead of those who got EAC immediately after resistance training (Tipton *et* al., 2001).

Several earlier investigations encountered limitations such as limited participant groups, imprecise gauges of muscle dimensions and potency, and the absence of prior control over exercise routines or protein consumption. This led to ambiguity regarding whether heightened protein intake contributes to the enhancements in muscle size and strength observed subsequent to resistance training . Our objective was to ascertain whether the intake of protein nutrients exerted an influence on the alterations induced by RT in the size and potency of the elbow flexor muscles when combined with resistance training. A cohort of 33 previously untrained and healthy young males was methodically allocated to either the protein or placebo cohorts, following a meticulous pairing based on their customary protein intake and strength response following a 3-week RT phase devoid of nutritional supplementation (which was then succeeded by a 6-week training hiatus). Subsequently, the participants underwent elbow flexor RT sessions thrice a week for a duration of twelve weeks. Preceding and concluding the 12-week RT regimen, evaluations were conducted to gauge the dimensions and potency of the elbow flexor muscles (unilateral 1-RPM) MRI. Post collating and scrutinizing the outcomes, the deductions drawn indicated that the immediate intake of protein subsequent to a workout did not manifest a notable impact on the process of muscle development. (Erskine, R. M. *et* al., 2012).

A research endeavor was undertaken to ascertain whether the consumption of after-workout nutrition could serve as a deterrent against muscle loss in the elderly population while simultaneously facilitating the augmentation of muscle mass. To explore this, a cohort of 13 senior men was selected, and they were administered liquid oral protein (comprising 10 g protein, 7 g carbohydrate, and 3 g fat) either immediately after their exercise session or with a two-hour delay following each training session. This intervention was conducted over a span of 12 weeks, during which the participants engaged in a strength training regimen encompassing three sessions per week. Evaluations encompassed assessments of muscle strength through assesment, while muscle hypertrophy was gauged using MRI and muscle biopsies. DEXA was employed to analyze body composition, and dietary records spanning a four-day period were amassed for analysis. Notably, Group 1, which received after-workout meal immediately, exhibited a greater quadriceps size than the other group. Consequently, the deduction drawn from this investigation underscores the role of immediate post-workout nutrition in fostering an increase in muscle mass among the elderly population. (Esmarck, B. *et* al , 2001).

The absence of prospective, randomized trials that specifically target this subject and meticulously control all relevant variables posed challenges in determining whether elevated dietary protein intake could yield enhanced health outcomes. Consequently, our approach to addressing this query was necessarily deductive, relying on evidence supporting the notion that an augmented intake of dietary protein produces favorable effects. The focal point of our examination pertained to the aging population, particularly the elderly. Over time, there is a decline in both muscle mass and functionality, and by the age of 60, a considerable number of individuals experience a compromising decline in function. Noteworthy is the correlation observed between notable reductions in muscle mass and strength and the manifestation of adverse health outcomes.Within this discourse, we delve into the body of evidence that substantiates the notion of positive impacts associated with heightened protein consumption in the diet. The ingestion of dietary protein triggers

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the stimulation of muscle protein synthesis, subsequently leading to an augmented availability of plasma amino acids. This cascade ultimately culminates in heightened muscle mass, potency, and functionality, provided that all other variables remain stable. Improved health outcomes in relation to age are inherently connected with elevated levels of muscle mass, potency, and functionality.In light of these insights, a reasonable assumption can be drawn that an optimal protein intake for the elderly exceeds the recommended dietary allowance. Notably, no adverse repercussions have been documented from marginal increments in protein consumption exceeding the established RDA range of 0.8 g protein/kg/day (Wolfe, 2012).

In the year 2011, a study was published that validated the concept of consuming protein quickly before participating in resistance training, leading to an amplification in muscle growth. Moreover, it is firmly established that relying solely on energy intake, such as carbohydrates, does not optimize muscle protein synthesis, consequently impacting anabolism and overall muscle protein accrual. Recent investigations have illuminated the efficacy of specific protein types, particularly those that are rapidly digested and rich in leucine content (e.g., whey protein), in fostering heightened muscle protein synthesis. Regular post-workout consumption of these varieties of proteins appears to potentially contribute to increased hypertrophy.Upon analyzing a multitude of training experiments, comprehensive assessments have revealed that whey protein, especially, along with dairy-based proteins in general, exhibit a competitive advantage over isoenergetic carbohydrate and soy protein in eliciting hypertrophic responses. For the purpose of augmenting muscle protein synthesis, net muscle protein accrual, and ultimately promoting hypertrophy, embracing the practice of consuming whey protein or dairy-derived protein in the early post-exercise phase could prove to be a beneficial strategy (Phillip S., 2011).

ISSN nutrient timming priciples:

1. Nutrient timing encompassed the meticulous orchestration of planning, incorporating whole foods, enriched edibles, and dietary enhancements. This practice was instrumental in optimizing recovery and tissue restoration, heightening muscle protein synthesis (MPS), and elevating emotional well-being post high-intensity or rigorous workouts.
2. The adoption of a high-carbohydrate regimen (ranging from 8 to 12 g of carbohydrates per kilogram per day [g/kg/day]) proved instrumental in maximizing the reservoirs of endogenous glycogen, which endured considerable depletion during vigorous physical activity.
3. During exercise sessions extending beyond 70 minutes, maintaining a consistent carbohydrate intake rate of 30-60 g/h within a 6-8% carbohydrate-electrolyte solution (equivalent to 6-12 fluid ounces) emerged as crucial. This practice effectively addressed the challenges posed by extended bouts (> 60 minutes) of high-intensity activity (> 70% VO2max), safeguarding fuel supply and fluid equilibrium. In scenarios where carbohydrate delivery fell short, the inclusion of protein showcased potential to enhance performance, mitigate muscle damage, promote euglycemia, and expedite glycogen synthesis.
4. Substantial evidence underscored the benefits of carbohydrate consumption during resistance training regimens (e.g., 3-6 sets of 8-12 repetition maximum [RM], involving a variety of exercises targeting major muscle groups). This strategy fostered euglycemia and augmented glycogen reserves. Carbohydrates, when consumed either in isolation or alongside protein during resistance exercise, exhibited the capacity to bolster muscle glycogen stores, diminish muscle damage, and yield improved acute and prolonged training responses.
5. Scientific inquiry affirmed that the ingestion of essential amino acids (EAA), at an approximate dose of 10 g, whether in unbound form or as part of a protein bolus comprising around

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20-40 g, served as an optimal catalyst for stimulating the synthesis of fresh muscle protein.

6. Pre-sleep consumption of casein protein (approximately 30-40 g) yielded acute enhancements in muscle protein synthesis (MPS) and nocturnal metabolic rate, without exerting influence upon lipolysis. This strategic consumption of casein protein before slumber demonstrated its potential for positively impacting nighttime physiological processes. (Kerksick *et* al., 2017)

International sports science acadmey after a lot of researches give some principle which are following:

1. To optimize the replenishment of endogenous glycogen stores, the most effective approach entailed adhering to a high-glycemic, high-carbohydrate (CHO) diet, amounting to 600-1000 grams per day or 8-10 g/kg/d. Concurrently, to stimulate protein synthesis to its maximum potential, the consumption of free amino acids and protein (PRO) either in isolation or in conjunction with CHO, prior to engaging in resistance training, emerged as the optimal course of action.
2. During the act of exercising, the recommended practice involved the ingestion of CHO every 10 to 15 minutes, within a 6 to 8% CHO solution (equivalent to 8 to 16 fluid ounces), at a rate of 30 to 60 grams per hour. For the purpose of optimizing glycogen re-synthesis in the aftermath of both immediate and subsequent endurance exercise sessions, the addition of PRO, achieving a CHO:PRO ratio ranging from 3 to 4:1, proved advantageous.
3. In the post-exercise phase (within a 30-minute window), empirical evidence substantiated that substantial doses of CHO (8-10 g/kg/day) significantly promoted muscle glycogen repletion. When combined, PRO (0.2-0.5 g/kg/day) was incorporated alongside CHO, maintaining a 3-4:1 ratio, to further bolster this restorative process.
4. Following brief or protracted periods of resistance training supplementation, the incorporation of CHO, either in isolation or alongside PRO, during resistance exercise sessions yielded noteworthy benefits. These encompassed enhanced muscle glycogen levels, mitigation of muscle injury, and the facilitation of more substantial training adaptations.
5. Scientific investigation has convincingly demonstrated that the consumption of amino acids, particularly essential ones, within three hours post-exercise, elicited marked increments in muscle protein synthesis. The concurrent inclusion of CHO exhibited the potential to augment protein synthesis. Moreover, the pre-workout consumption of a CHO + PRO supplement potentially resulted in peak levels of protein synthesis.

6. The synergistic effect of a CHO + PRO supplement enriched with creatine (Cr) (at a dosage of 0.1 g Cr/kg/day) appeared to evoke even greater adaptations in response to resistance training.
7. The concept of nutrient timing encompassed a comprehensive approach that extended beyond meticulous planning, encompassing the consumption of whole foods, nutrients derived from food sources, and those obtained from alternate origins. When juxtaposed with unsystematic or conventional patterns of nutrient intake, the strategic alignment of energy consumption and the optimal balance of specific macronutrients emerged as influential variables. These factors were shown to contribute to augmented recovery and tissue repair subsequent to high-volume exercise, heightened muscle protein synthesis, and improved emotional states.
8. Rigorous examination of various dosages of post-exercise CHO + PRO supplements against control or placebo conditions consistently revealed tangible enhancements in both strength

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and body composition within the framework of regular, sustained resistance training regimens.
In 2020, a research study centered on nutrient timing emerged, likening it to a gateway of opportunity that enhances athletes' performance. The study expounded that nutrient timing involves the strategic manipulation of nutrient intake during specific timeframes surrounding exercise sessions, all in pursuit of bolstering performance, recovery, and adaptation. Initially confined to eating during exercise, this paradigm broadened to encompass pre- and posttraining nourishment. Throughout the research progression, the focus remained on scrutinizing the consequences and outcomes of nutrient consumption within distinct temporal windows.Furthermore, discernible improvements in muscle hypertrophy and strength were apparent. The interplay between energy availability and macronutrient content emerged as a pivotal consideration when calibrating the timing of supplementary nutrient intake during both training and competitive endeavors. This imperative arises due to the multifaceted nature of nutrient consumption across various periods throughout the day. The endeavor to circumscribe the definition of "nutrient timing" to an exclusive, singular moment in time is compounded by these complexities, thereby posing challenges (Arent *et* al., 2020).

METHODOLOGY:

The study design was Interventional study. The data was collected from selected fitness centers (ABS Gym, Shapes, Charm Body) in Lahore. The study was target male adults who was performing resistance training for muscle growth in selected fitness centers. The duration of that study was 4 months. The purposive sampling techniqe was used to collect data and the sample size was 20 participants. Male adults performing resistance training (age 18-55 years). Participants who were not continue the resistance training.
A self-designed questionnare who was be used to collect the arthoprometric measurements and body fat percentages.

Treatment Plan:

Group A (Control group)	**Group B (Treatment Group)**
○ Male between 18-55 years ○ Resistance Training (High intensity & moderate frequency) ○ Nutrients will be distributed throughout the day.	○ Male between 18-55 years. ○ Resistance training (High intensity & moderate frequency) ○ Specified nutrients will be given which include 30 gram of carbs, 20 gram of protein and 10 gram of fats in preworkout meal and in post 30 grams of carbohydrates and 25 grams of protein.

RESULTS AND DISCUSSION

This study aims to discuss the impact of pre and post workout meal on body composition with resistance training. In this study we collect data from different fitness centers in Lahore. The questionnaire contains the questions regarding demographics, anthropometric, body fat analysis and 1 strength analysis.

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4.1 Demographics

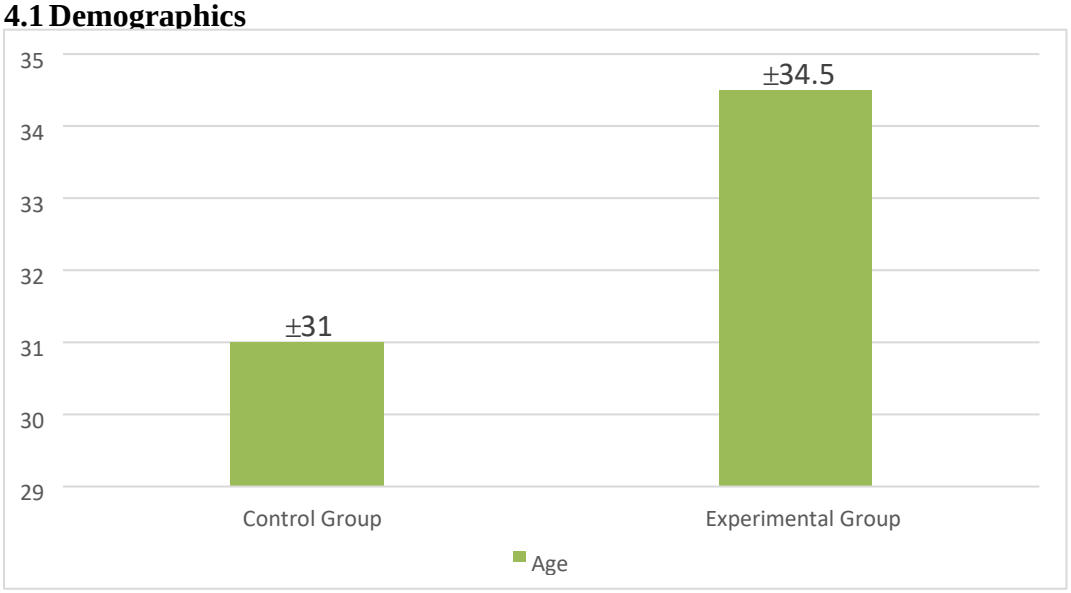

Figure 4.1 Age of Participants

Figure 4.1 shows that the average age of participants of both groups lies in 30's because in 30's people are more likely to go to fitness centers because mostly people in 30's are somehow financially stable and now they start caring about their health.

4.2 Anthropometric Measurements

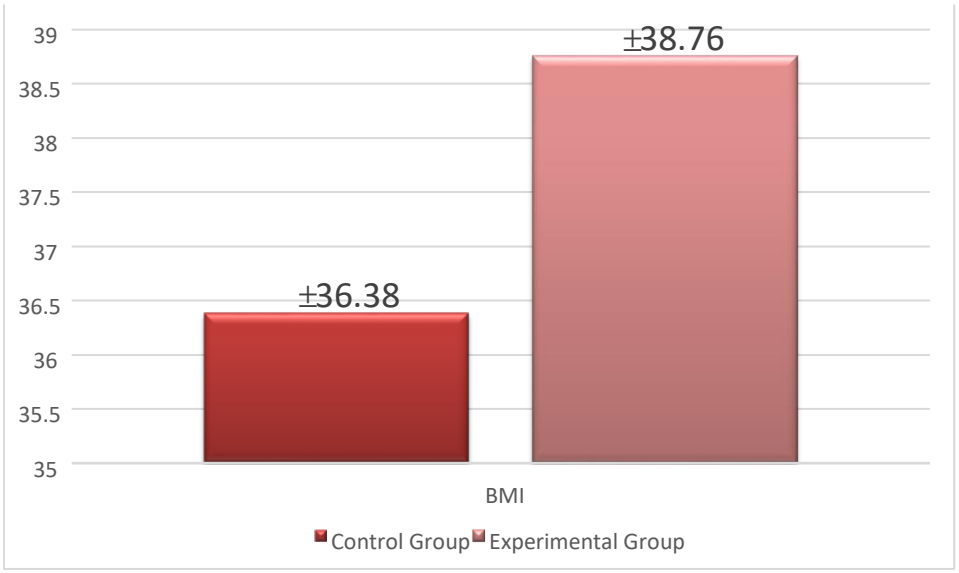

Figure 4.2 Comparisons between BMI

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Figure 4.2 shows the comparison between the BMI's of both control and experimental group. Both groups lie in grade 2 obese category. The main aim of taking obese people in both groups is to observe the effect of pre and post workout nutrition. And another thing is to check the body re-composition in both groups and it's easier to observe that in obese people.

4.3. Body Fat Analysis

There is the comparison of the body fat percentages of both (control & experimental group) from two different methods. My first method is from body fat caliper (Silveira, 2020) in which body fat caliper instrument is used to measure the body fat manually. 2nd method is AS formula which is most advanced calculation method in which we put information in the specified formula (Body fat % = (1.39 * BMI) + (0.16 * Age) - (10.34 * gender) – 9) (Jackson, 2002) and get the results. The purpose to use 2 different methods to make my calculations more authentic because in Pakistan the other automatic high quality body fat measuring equipment are not available.

after study measure through Body Fat Caliper

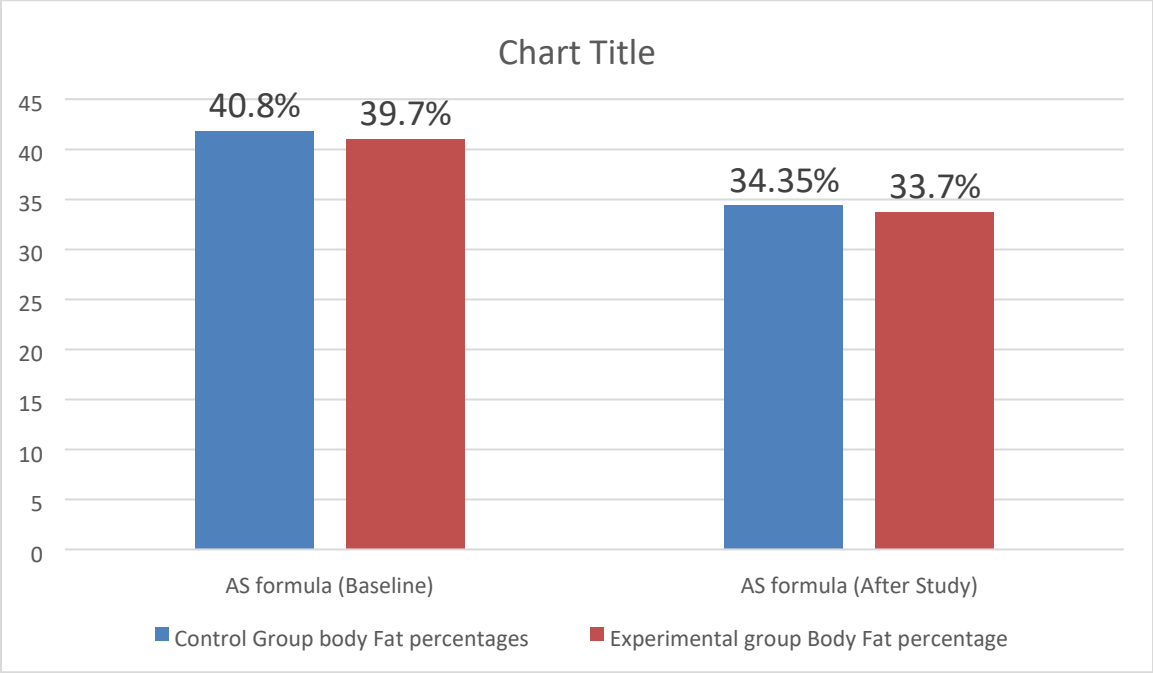

Figure 4.3b Comparison of body fat percentages in both group participants before nd after study measure through AS Formula

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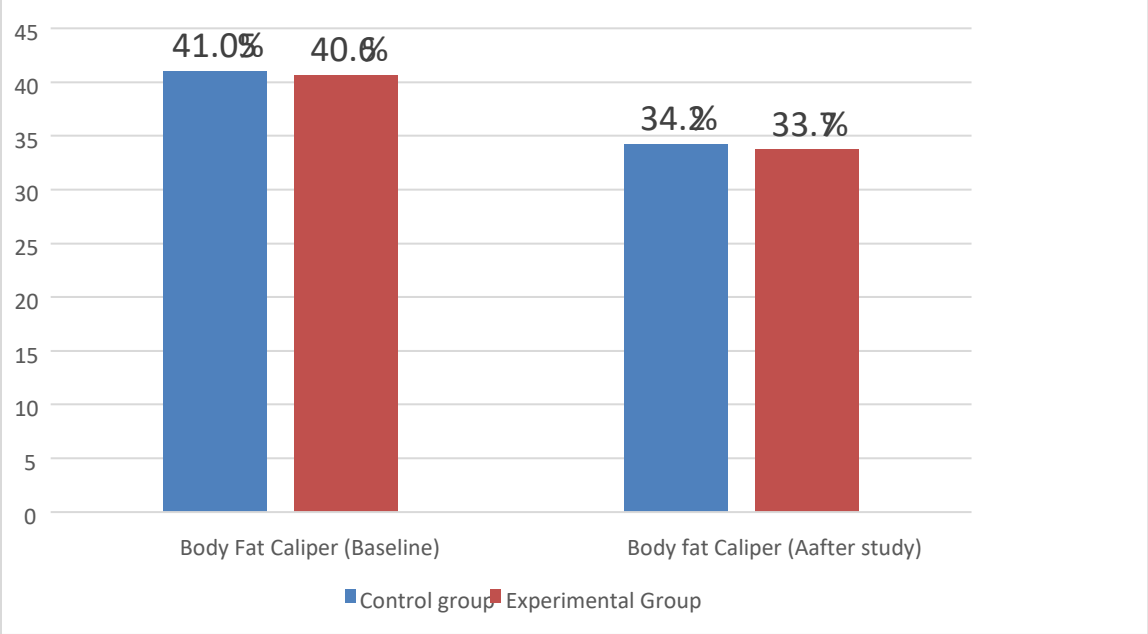

Figure 4.3a Comparison of body fat percentages in both group participants before

Figure 4.3a shows the comparison of body fat percentages through fat caliper while 4.3b shows the comparison of body fat percentages through AS Formula. And the results show that there is almost equal drop of body fat in both groups.

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4.4 Strength Analysis

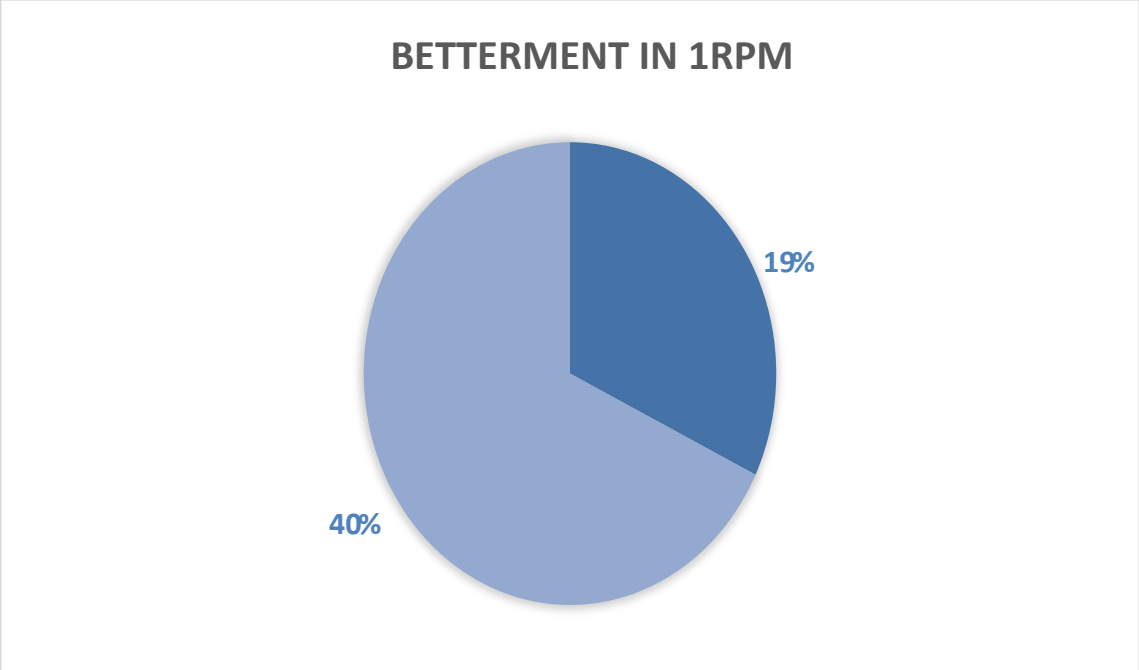

Figure 4.4 Betterment of 1 Rep Max in Both Groups.

Figure 4.4 shows the comparison of improvement in 1 rep Max of control and experimental group. Results show that the control groups which consume balance diet throughout the day without focusing on pre and post workout nutrition have fewer improvements in strength as compared to our experimental group. The research studies shows that the strength is directly proportional to lean body mass so more strength means more lean body mass (Harris, 1997) (Charlton *et* al., 2020). Other methods like DEXA were not used because of unavailability of equipment in Pakistan and also that method is very expensive.

CONCLUSION

The conclusion of research is that the pre and post workout meal shows effect on increase in muscle mass through resistance training because in my results the experimental group has more 1RPM strength then the control group.

RECOMMENDATIONS

The use of pre and post workout meal helps a person in increasing both strength and muscle mass. So the persons whose basic goal is to build more muscles and increase strength should use pre and post workout meal according to the needs.

LIMITATIONS

The study on the effects of pre and post-workout nutrition on muscle growth in adult males with resistance training had a few limitations. Firstly, the sample size was relatively small, which might

have limited the generalizability of the findings. Furthermore, the study might not have accounted for individual variations in metabolism and dietary preferences, potentially influencing the outcomes. Lastly, factors such as adherence to the prescribed nutrition plans and consistency in resistance training routines could have varied among participants, affecting the overall validity of the study's conclusions.

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