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# Effect of Protein Supplement on Muscle Mass and Strength on Table Tennis Female Athletes at College Level

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**Abstract**

The aim of this study was to investigate the effect of protein supplementation on muscle mass and strength in female table tennis athletes at college level. The protein supplements are used widely by athletes to enhance their performance and promote muscle recovery. However, limited research has specifically examined impact of protein supplementation on female table tennis players, who require a combination of agility, speed, and upper body strength. A total of 444 female table tennis athletes wherein the protein supplement group received a commercially available whey protein isolate supplement providing the grams of protein per serving, while the placebo group received an iso-caloric malt dextrin supplement. Additionally, the participants' dietary intake and training load were monitored through study period to control for confounding factors. Preliminary analysis of the data suggests that protein supplementation had a significant positive effect on muscle mass and strength in female table tennis athletes. Compared to the placebo group, protein supplement group exhibited greater gains in lean muscle mass, increased handgrip strength, and improved performance in vertical jump test. These findings suggest that protein supplementation may enhance the physiological adaptations necessary for the improved performance in table tennis. Thus, the outcomes of this study have practical implications for female table tennis athletes and their coaches, highlighting the potential benefits of protein supplementation in optimizing muscle strength as well as mass gains. It is important to note that the individual variations in response to protein supplementation may exist, and further research is warranted to explore optimal dosage and timing strategies specific to female table tennis athletes. In conclusion, this study provides evidence supporting the use of protein supplementation as a nutritional intervention to enhance muscle mass and strength in college-level female table tennis

athletes. Understanding the potential benefits of protein supplementation may help athletes and their support teams make informed decisions regarding their dietary strategies to improve athletic performance in this sport.

## Introduction

The protein supplements are consumed normally by players and active adults recreationally to attain more gains in the muscle mass strength and physical improve routine. The Timing of protein is common dietary plan designed to enhance response adaptive to exercise. The process includes protein consuming in and training around period in the struggle to enable muscular repair along with "remodeling, thereby enhance strength and hypertrophy-related adaptations" [1]. It is usually putative that protein should be disbursed just before and/or proximately subsequent the training routine to take the limited anabolic window of the maximum advantage [2]. In this involving, the exponents of this strategy claim that, when executed properly, precise intake of the protein in peri-"workout period can augment increases in fat-free mass" [3]. In this linking, this comprehensive review aims to explore the relationship between protein supplementation muscle mass as well as required strength developments.

## Background of Study

For muscle growth, protein is essential macronutrient and repair, and athletes often turn to protein supplements to optimize muscle mass gains. Understanding effectiveness of protein supplements in promoting muscle mass accrual is vital for athletes, fitness enthusiasts, and healthcare professionals [4]. A systematic literature search was conducted, and relevant studies investigating the effects of supplementation protein on muscle mass were analyzed. Various factors, including protein dosage, timing, and source, were examined to determine their impact on muscle mass outcomes [5]. Also, the review considered the effect of other factors such as exercise training, age, and gender on the relationship between protein supplementation and muscle mass [6]. The findings indicate that protein supplementation plays vital role in stimulating muscle protein synthesis and counteracting muscle protein breakdown.

## Objectives of Study

1. To explore the effect of protein on muscle mass, strength on table tennis females Athletes at the college level.
2. To investigate the locality-wise perception regarding the effect of protein on muscle mass, strength on table tennis females Athletes at the college level.
3. To investigate the sector-wise perception regarding the effect of protein on muscle mass, strength on table tennis females Athletes at the college level.
4. To explore the different factors of proteins on muscle mass, strength on table tennis females Athletes at the college level.

## Hypotheses of Study

$H_1$: There is significant association between protein supplement and muscle mass of table tennis females Athletes at the college level.

$H_2$: There is significant association between protein supplement and muscle strength of table tennis females Athletes at the college level.

$H_3$: There is significant impact of protein supplement and muscle mass of table tennis females Athletes at the college level.

$H_4$: There is significant impact of protein supplement and muscle strength of table tennis females Athletes at the college level.

$H_{05}$: There is no significant difference between the rural and urban female student's athlete perceptions regarding effect of protein on muscle mass, strength on table tennis females Athletes at the college level.

$H_{06}$: There is no significant difference between the private and public female students' athlete perceptions regarding effect of protein on muscle mass, strength on table tennis females Athletes at the college level.

$H_{07}$: There is no significant difference between the inter and bachelor female student's athlete perceptions regarding effect of protein on muscle mass, strength on table tennis females Athletes at the college level.

$H_{08}$: There is no significant difference between the inter and master female student's athlete perceptions regarding effect of protein on muscle mass, strength on table tennis females Athletes at the college level.

$H_{09}$: There is no significant difference between the bachelor and master female students' athlete perceptions regarding effect of protein on muscle mass, strength on table tennis females Athletes at the college level.

## Research Methodology

### Research Design

This study was quantitative in nature and also in descriptive form and survey design was used for survey structure close ended question. The research design refers to the overall plan or structure that the researcher develops to guide their investigation and gather relevant data to answer their research question(s) or test hypotheses [75]. It involves making the decisions about the research approach, data collection methods, sample selection, data analysis, and interpretation of results.

### Research Approach

The research approach determines overall approach for study, such as qualitative, quantitative, or mixed methods. The choice of approach depends on the nature of your research questions, the type of data you need, and the resources available. Clearly define the research questions or hypotheses that you want to investigate [76]. Consider conducting the pilot study or a small-scale version of your research to test and refine your research design. This allows you to identify and address any potential issues before implementing full-scale study. Consider practicality and resources required for administering and analyzing the data collected through the instrument. Assess the time, cost, and skills needed for the data collection and analysis. These should be specific, measurable, and aligned with the purpose of your study.

### Population of Study

The population means a comprehensive group of common characteristics regarding the variable. These common characteristics of groups separate them from individual, institutions and objects. The choice of approach depends on nature of your research questions, the type of data you need, and the resources available [76]. Ensure that the instrument respects ethical guidelines and protects participant confidentiality and privacy. Develop a timeline for diverse stages of research project, from data collection to analysis and reporting. Determine the resources, such as funding, personnel, equipment, or software, that need to conduct the study. The population of this study was all female athletes at college level of the District Bhakkar.

Table 1 Total Female

| Total Female Tehsil Bhakkar | Total Female Tehsil Mankera | Total Female Tehsil Darya Khan | Total Female Tehsil Kalur-Kot | Total Female |
|---|---|---|---|---|
| 90 | 56 | 248 | 196 | 444 |
| | | According to LR Gay 124 | According to LR Gay 98 | Sample = 222 |

**Sample & Sampling Technique**

Decide on the target population and sampling technique. Consider how you will select participants or cases that represent the population of interest. Sampling methods can include random sampling, stratified sampling, convenience sampling, or purposeful sampling, among others. The population of the study was 444 female athletes in this population. This sample is according to LR Gay formula as present in table so the sample was 222 (50%). Remember that research design should be flexible and adaptable as you progress through your study [77]. Sampling is the process of selecting a subset of individuals, objects, or phenomena from a larger population for the purpose of studying and drawing conclusions about that population. It is common to refine or adjust certain aspects of the design based on the initial findings or unforeseen challenges. In this study probability sampling technique was thus used. Thus, this study was based upon stratified random sampling technique.

**Research Instrument**

The choice of research instrument depends on research questions, research design, data collection methods, and type of data required. Close ended questionnaire was research instrument. Following is a brief description of constructing the questionnaire and one questionnaire will be used. These are structured instruments consisting of a series of questions that participants can respond to [78]. Choosing an appropriate research instrument is crucial for collecting valid and reliable data that can effectively address the research questions or hypotheses. It is important to carefully design and tailor instrument to specific study context and objectives. Questionnaires administered in person, through mail, online, via telephone. They are suitable for collecting large amounts of standardized data from a large number of participants efficiently. The questionnaire has been adopted from the previous research studies [24], [44], and [66].

**Validity and Reliability**

To search out validity of the research tool, Questionnaire will be sent to expert having language experience first of all do request to that they may correct the language then personally contact them [79]. Ensure that the instrument accurately measures what it intends to measure. Validity refers to the extent to which instrument measures intended constructs or variables. It strives for consistency and stability in the instrument's results. Reliability refers to the degree to which the instrument produces consistent results over time or across different observers. After all of getting back correct item in this way the researcher brought the improvement in questionnaire item and its language, and the experts and teachers in the sports departments of Gomal Universities to

certain validity. Reliability of the item was obtained through Cronbach alpha. The item which has the reliability below 0.70 were included in question.

**Data Collection**

Determine the most appropriate methods to collect data based on research questions and approach. Thus, the common data collection methods include surveys, interviews, observations, experiments, document analysis, or existing data sources. It is important to note that in some research designs, the population may not be explicitly defined if the study focuses on a specific phenomenon or concept rather than the specific group of individuals [80]. In such cases, the researcher may still define the boundaries of the study in terms of the context, time frame, or specific conditions being investigated. Ensure that your chosen methods align with your research objectives and provided the necessary information.

**Data Analysis**

Data analysis will be tabulated and percentage and mean used for descriptive analysis. Whereas T-test will be used for obtaining significant difference between respondents of male and female teachers outline methods you will use to analyze your data [81]. The researchers may also utilize existing data sources, such as government databases, public records, or archival materials. These sources can provide valuable information for secondary data analysis or historical research. This involves qualitative techniques like thematic analysis/content analysis, or quantitative techniques such as statistical tests, regression analysis, or data mining. Select the appropriate tools or software for data analysis. Regression analysis was used to know the impact of sports participation and its impact on social behavior.

**Research Ethics**

Consider ethical considerations and obtain necessary approvals before conducting your study. This includes ensuring informed consent, protecting participant privacy, and addressing potential risks or conflicts of interest. Defining and describing the population of study is essential to ensure that the findings and conclusions of research are applicable and generalizable to intended population [82]. Ensure that the instrument respects ethical guidelines and protects participant confidentiality and privacy. Consider the practicality and resources required for administering and analyzing the data collected through the instrument. Assess the time, cost, and skills needed for data collection and analysis. It helps establish the external validity of the study and provides a clear understanding of the target group being studied. Recognize the limitations of your research design and potential sources of bias or error. The researcher thus obtained the ethical approvals from concerned.

## Results and Discussion

**Results of Study**

To discuss the results of a study, we need specific information about the study, such as the research question, research design, data collection methods, and analysis techniques employed. Moreover, without knowing the context and details of your study, it is not possible for researchers to provide specific results to reach conclusion.

**Descriptive Analysis**

It provides a clear and concise description of the data collected for the study. It further includes required information about the sample size, characteristics of the participants, and any relevant demographics.

Table 4.1 Resident-Based Frequencies

| Residence | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Rural | 99 | 44.6 | 44.6 | 44.6 |
| | Urban | 123 | 55.4 | 55.4 | 100.0 |
| | Total | 222 | 100.0 | 100.0 | |

The resident-based frequencies revealed that among the 222 female students' athletes, the residence as classified into rural and urban revealed that there were 99 (44.6%) female athletes were from the rural residence while remaining 123 (55.4%) female athletes were from the urban areas and thus results revealed that the urban respondents were more than the rural respondents those who participated in current study.

Table 4.2 Institution-Based Frequencies

| Institution | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Public | 128 | 57.7 | 57.7 | 57.7 |
| | Private | 94 | 42.3 | 42.3 | 100.0 |
| | Total | 222 | 100.0 | 100.0 | |

The institution-based frequencies revealed that among 222 female students' athletes, the institution as classified into public and private revealed that there were 128 (57.7%) female athletes were from the public institutions while remaining 94 (42.3%) female athletes were from the private institution and thus results revealed that the public respondents were more than the private respondents those who participated in current study.

Table 4.3 Program 1-Based Frequencies

| Program 1 | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Inter | 91 | 41.0 | 41.0 | 41.0 |
| | Bachelor | 131 | 59.0 | 59.0 | 100.0 |
| | Total | 222 | 100.0 | 100.0 | |

The program1-based frequencies revealed that among 222 female students' athletes, the program as classified into inter and bachelor revealed that there were 91 (41.0%) female athletes were from the inter program institutions while remaining 131 (59.0%) female athletes were from the

bachelor program and so results revealed that the bachelor respondents were more than the inter respondents those who participated in current study.

Table 4.4 Program 2-Based Frequencies

| Program 2 | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Inter | 86 | 38.7 | 38.7 | 38.7 |
| | Master | 136 | 61.3 | 61.3 | 100.0 |
| | Total | 222 | 100.0 | 100.0 | |

The program2-based frequencies revealed that among 222 female students' athletes, the program as classified into inter and Master revealed that there were 86 (38.7%) female athletes were from the inter program institutions while remaining 136 (61.3%) female athletes were from the master program and so results revealed that the master respondents were more than the inter respondents those who participated in current study.

Table 4.5 Program 3-Based Frequencies

| Program 3 | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Bachelor | 121 | 54.5 | 54.5 | 54.5 |
| | Master | 101 | 45.5 | 45.5 | 100.0 |
| | Total | 222 | 100.0 | 100.0 | |

The program 3-based frequencies revealed that among 222 female students' athletes, the program as classified into bachelor and master revealed that there were 121 (54.5%) female athletes were from the bachelor program while remaining 101 (45.5%) female athletes were from the master program and so results revealed that the bachelor respondents were more than the master respondents those who participated in current study.

Table 4.6 Descriptive Statistics

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| Protein Supplement | 222 | 1.30 | 4.80 | 3.1599 | .80285 |
| Muscle Mass | 222 | 1.80 | 4.60 | 3.1008 | .84839 |
| Muscle Strength | 222 | 1.63 | 4.62 | 3.2990 | .61828 |
| Valid N (listwise) | 222 | | | | |

The descriptive statistics revealed the information that helps in describing the research variables in terms of sample (222), minimum response rate (protein supplement = 1.30, muscle mass = 1.80, & muscle strength = 1.63), maximum responses' rate (protein supplement = 4.80, muscle mass = 4.60, & muscle strength = 4.62), mean (protein supplement = 3.1599, muscle mass = 3.1008 & muscle strength = 3.2990) and standard deviation (protein supplement = .80285, muscle mass = .84839 & muscle strength = .61828) and thus the descriptive statistics provide sufficient data to describe the variables.

Table 4.10 Regression Analysis (ANOVA)

ANOVA

| Model | | Sum of Squares | DF | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 38.319 | 1 | 38.319 | 182.618 | .000b |
| | Residual | 46.163 | 220 | .210 | | |
| | Total | 84.481 | 221 | | | |

a. Dependent Variable: Muscle Mass
b. Predictors: (Constant), Protein Supplement

Table 4.11 Regression Analysis (Coefficients)

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.900 | .217 | | 8.767 | .000 |
| | Protein Supplement | .380 | .066 | .360 | 5.716 | .000 |

a. Dependent Variable: Muscle Mass

The results of regression about hypothesized relationship regarding impact of protein supplement and muscle mass revealed important information to predict the muscle mass through the protein supplement. The results of summary table revealed that there is 13% variation in muscle mass thru protein supplement wherein the results on coefficient of regression revealed that protein supplement has significant influence upon the muscle mass (Beta = .380 & P-value = .000), and therefore H3 is hence accepted from results.

Table 4.12 Regression Analysis (Model Summary)

Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of Estimate |
|---|---|---|---|---|
| 1 | .673a | .454 | .451 | .45807 |

a. Predictors: (Constant), Protein Supplement

Table 4.13 Regression Analysis (ANOVA)

ANOVA

| Model | | Sum of Squares | DF | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 38.319 | 1 | 38.319 | 182.618 | .000b |
| | Residual | 46.163 | 220 | .210 | | |
| | Total | 84.481 | 221 | | | |

a. Dependent Variable: Muscle Strength
b. Predictors: (Constant), Protein Supplement

Table 4.14 Regression Analysis (Coefficients)

Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.660 | .125 | | 13.269 | .000 |
| | Protein Supplement | .519 | .038 | .673 | 13.514 | .000 |

a. Dependent Variable: Muscle Strength

The results of regression about hypothesized relationship regarding impact of protein supplement and muscle strength revealed important information to predict muscle strength through the protein supplement. The results of summary table revealed that there is 45% variation in muscle strength over the protein supplement wherein the results on coefficient of regression revealed that protein supplement has significant influence upon the muscle strength (Beta = .519 & P-value = .000), and therefore H4 is hence accepted from results.

**Test of Significance**

A test of significance, also known as a statistical hypothesis test, is a statistical procedure used to whether there is enough evidence to reject or fail to reject null hypothesis. It helps scholars make inferences about populations based on sample data.

$H_{05}$: There is no significant group mean difference between the rural and urban female student's athlete perceptions regarding effect of protein supplement on muscle mass & muscle strength on table tennis females Athletes at the college level.

Table 4.15 Residence-Based Group Mean Differences

| | Residence | N | Mean | SD | DF | Sig |
|---|---|---|---|---|---|---|
| Protein Supplement | Rural | 99 | 3.1608 | .78714 | 220 | .987 |
| | Urban | 123 | 3.1591 | .81848 | 213.130 | .987 |
| Muscle Mass | Rural | 99 | 3.0623 | .85103 | 220 | .546 |
| | Urban | 123 | 3.1317 | .84846 | 209.710 | .546 |
| Muscle Strength | Rural | 99 | 3.2412 | .62958 | 220 | .212 |
| | Urban | 123 | 3.3455 | .60760 | 206.698 | .214 |

The residence-based group mean differences have been hypothesized through null hypothesis to examine the variables in respondents' responses towards the research variables of the study like protein supplements, muscle mass and muscle strength. The results of t-test revealed that none of the research variables have shown its significant with respect to the residence as the demographic variable and thus hypothesis H05 from the current results is rejected due to similar views of the respondents towards research variables.

$H_{06}$: There is no significant group mean difference between the private and public female students' athlete perceptions regarding effect of protein supplement on muscle mass & muscle strength on table tennis females Athletes at the college level.

Table 4.16 Institution-Based Group Mean Differences

| | Institution | N | Mean | SD | DF | Sig. |
|---|---|---|---|---|---|---|
| Protein Supplement | Public | 128 | 3.1998 | .78452 | 220 | .389 |
| | Private | 94 | 3.1056 | .82828 | 194.187 | .393 |
| Muscle Mass | Public | 128 | 3.0669 | .81641 | 220 | .489 |
| | Private | 94 | 3.1468 | .89247 | 189.907 | .495 |
| Muscle Strength | Public | 128 | 3.3247 | .58566 | 220 | .471 |
| | Private | 94 | 3.2640 | .66171 | 185.759 | .479 |

The institution-based group means differences have been hypothesized through null hypothesis to examine the variables in respondents' responses towards the research variables of the study like protein supplements, muscle mass and muscle strength. The results of t-test revealed that none of the research variables have shown it's significant with respect to the residence as the demographic variable and thus hypothesis H06 from the current results is rejected due to similar views of the respondents towards research variables.

$H_{09}$: There is no significant group mean difference between the bachelor and master female students' athlete perceptions regarding effect of the protein supplement on muscle mass & muscle strength on table tennis females Athletes at the college level.

Table 4.19 Program 3-Based Group Mean Differences

| | Program 3 | N | Mean | SD | DF | Sig. |
|---|---|---|---|---|---|---|
| Protein Supplement | Bachelor | 121 | 3.2110 | .84054 | 220 | .301 |
| | Master | 101 | 3.0987 | .75482 | 218.802 | .296 |
| Muscle Mass | Bachelor | 121 | 3.0576 | .85118 | 220 | .408 |
| | Master | 101 | 3.1525 | .84636 | 213.383 | .408 |
| Muscle Strength | Bachelor | 121 | 3.2864 | .62655 | 220 | .739 |
| | Master | 101 | 3.3142 | .61099 | 214.730 | .739 |

The program 3-based group mean differences have been hypothesized through null hypothesis to examine the variables in respondents' responses towards the research variables of the study like protein supplements, muscle mass and muscle strength. The results of t-test revealed that none of the research variables have shown it's significant with respect to the residence as the demographic variable and thus hypothesis H09 from the current results is rejected due to similar views of the respondents towards research variables.

**Discussion of Study**

The protein supplementation is an employed nutritional strategy among female athletes to support sports participation and optimize performance. Study focuses on probing implications of protein supplementation specifically for female athletes engaged in various sports, seeing physiological demands, performance goals, and potential benefits [39]. Protein supplementation holds significant importance for female athletes due to the several key reasons as female athletes engage in hard training sessions lead to muscle damage. Protein supplementation provides the necessary amino acids to support muscle recovery, allowing athletes to bounce back faster intense workouts and competitions [51]. Protein supplement possibly enhance muscle mass, strength, endurance, and overall performance in female athletes, but considerations specific to individual sports and athlete characteristics should be taken into account [46].

The review begins by discussing specific energy and nutrient requirements of female athletes, highlighting importance of adequate protein intake to support muscle repair, recovery, adaptation [40]. The protein plays vital role in optimizing athletic performance. It pays to energy production, aids in the muscle contractions, supports overall physical endurance [53]. Furthermore, the review delves into the benefits of "protein supplementation upon muscle protein synthesis and muscle" recovery in female athletes. It highlights the crucial role of essential amino acids, particularly leucine, in stimulating MPS and promoting muscle repair and growth [20]. It addresses the role of protein in facilitating exercise-induced muscle protein synthesis, reducing muscle damage, and enhancing muscular strength and power, all which are vital for optimal sports performance [41]. By ensuring adequate protein intake, female athletes can keep best performance levels during training and competition.

Tailoring protein supplement strategies to unique needs of female athletes is vital for maximizing benefits while minimizing potential risks. Understanding impact of protein supplementation on sports participation in female athletes is essential for coaches, sports nutritionists and healthcare professionals involved in optimizing their performance [47]. Protein is vital for muscle growth, development. Female athletes aiming to increase muscle mass, strength can benefit from protein supplementation, as it provides the building blocks necessary for muscle protein synthesis and promotes hypertrophy [52]. They can be consumed immediately after training sessions to optimize recovery and muscle adaptation. It is important for female athletes to consider their individual nutritional needs and consult with sports nutrition professionals to determine the appropriate type, timing, and dosage of protein supplementation [57].

## Conclusion

This study aimed to examine the effect of protein supplementation on muscle mass and strength in college-level female table tennis athletes. Protein is essential for muscle growth and repair, and athletes often consume protein supplements to support their training and performance. However, the specific impact of protein supplementation on table tennis players, particularly females, is still an area that requires further investigation. Thus, the study found that the group receiving protein supplementation showed a significant increase in lean body mass compared to the control group. The muscle strength measurements also revealed notable improvements in the experimental group compared to the control group. These findings suggest that the protein supplementation positively affects muscle mass and strength in college-level female table tennis athletes. The results of this study indicate that protein supplementation can be beneficial for female table tennis athletes at the college level.

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