How to Cite:
Mousa, A. A., & Ali, W. I. (2022). Impact of nutritional protein supplements on liver and kidney functions among athletes attending gym. *International Journal of Health Sciences*, *6*(S5), 6886–6898.
https://doi.org/10.53730/ijhs.v6nS5.10199

Impact of nutritional protein supplements on liver and kidney functions among athletes attending gym

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***Abstract*---**Whey protein is best recognized as a nutritional supplement that has been increasingly popular among gym users as the primary sports nutrition product used by athletes to improve exercise performance, body composition, and muscle growth. The types of supplements utilized can have a big impact on how athletes are treated medically. Two goals guide this work. To begin with, assess athletes' protein consumption. Second, we want to see if whey protein supplements alter the function of athletes' livers and kidneys. This is an analytical cross-sectional study conducted on 105 healthy male gym attendants in Al Nasiriyah city, Thi-Qar, Provence, south of Iraq, from June to November 2021. They were divided into two groups of athletes: group 1 (non-protein group) and group 2 (protein supplements group) with age of Mean ±SD of (27.56 ±8.31 years) and (29.26 ±7.35 years) respectively. The results indicate that athletes consume protein at a higher rate than the RDA for the general population, whether or not they utilize supplements. In terms of liver and renal function biomarkers, the results demonstrate no significant difference between the protein supplement group and the non-protein supplement group. To sum up, protein supplements had no influence on the liver and kidney functions of physically active male gym users or athletes.

***Keywords*---**gym users, athletes, whey protein supplements, kidney and liver function.

Introduction

Gyms have grown in popularity as a result of their ability to provide a variety of planned and scheduled activities to regulars, motivating both genders to look for

Manuscript submitted: 9 April 2022, Manuscript revised: 18 June 2022, Accepted for publication: 27 July 2022

exercises that modify their body composition [1]. Many Iraqis have recognized how crucial it is to maintain their new appearance in order to keep up with the rigors of daily life. As a result, plenty of well-known gyms and health food stores selling a variety of nutritional supplements have grown all over the country [2]. Although there appears to be a growing interest in the use of dietary supplements among individuals who exercise recreationally and wish to enhance body composition, there is little published data on gym-goers and dietary supplement use [3]. It is claimed that up to 90 percent of all athletes in the world use nutritional supplements to some degree, mostly because they are so readily available [4][5][6]. It is possible to purchase sports dietary supplements in public locations, including sports clubs. Despite the ambiguity surrounding their safety, some athletes frequently take them [7]. Dietary supplements are neither foods nor drugs. However, their purpose is to provide humans with necessary nutrients that are rarely obtained in conventional meals [8]. Because nutritional supplements are not regulated by the FDA (Food and Drug Administration), there is no guarantee that the ingredients mentioned on the label are actually present in the product [9]. Various nutritional supplements, which often come in various food forms, are commercially accessible and can be characterized as vitamins, proteins, and minerals in capsules or pills, and powder [10]. Protein is an important macronutrient necessary for growth and maintenance of the human body [11]. Dietary protein must be sufficient to supply the essential amino acids (EAAs) required for muscle protein synthesis and to prevent muscle protein breakdown [12]. Numerous supplements, including protein powders and different amino acid combinations, are sold for muscle gain [13]. Because of its high bioavailability and solubility, as well as a greater proportion of important amino acids, such as leucine, whey protein extract has been recommended as the best suitable form of protein for strength and endurance athletes, insulin secretion stimulation, and muscle protein oxidation prevention [14] [15][16].

Amateur athletes, in particular, frequently consume whey protein on their own prescription, which they usually purchase directly from dealers or via websites, neglecting the potential hazards related to chronic and high intake of a specific nutrient, such as proteins [17]. A healthy adult population requires 0.8 g of protein per kilogram of body weight per day, according to a worldwide consensus. This will suffice to meet the needs of 97–98% of the population [18]. In conjunction with physical exercise, the American College of Sports Medicine (ACSM) (2011) recommends 1.2 to 1.7 g/kg of protein per day for frequent bodybuilders and athletes training for cycling and running events [19]. Physically active people may have higher requirements, ranging from 1.2 to 2 g/kg of body weight [20]. In fact, numerous athletes ingest more than 2.0 g/kg/day of protein on a daily basis [21]. The International Society of Sports Nutrition claims that the ingestion of 1.4 to 2.0 g/kg/day of protein by physically active people is not only safe, but may even enhance training adaptations to exercise [22]. This level is also within the Institute of Medicine's Acceptable Macronutrient Distribution Range (AMDR) of 10–35 percent protein [23] For optimal anabolic impact, 0.4 g/kg/meal should be taken over a total of 4 meals to reach 1.6 g/kg/day (with a maximum daily consumption of 2.2 g/kg/day)[24]. Some studies show that a daily intake of whey protein of between 20 and 25 grams is sufficient to produce the promised advantages, but amounts beyond 40 grams may have harmful effects on the body [25].

Numerous studies have established a link between a high-protein diet and the development of renal diseases [26]. Supplementing with whey protein may have some deleterious consequences, particularly on kidney and liver function [27]. Protein-restricted diets are evidently beneficial for those with renal failure. [28]. There is limited research on protein intake as a risk factor for the start or progression of renal disease [29]. Brenner postulated that high dietary protein affects kidney function by increasing glomerular pressure and renal hyperfiltration [30]. On the other hand, results from individuals who experienced compensated hyperfiltration throughout pregnancy and following unilateral nephrectomy suggest different outcomes [31]. Unless the patient has pre-existing renal disease, no studies have shown that high-protein diets harm the kidneys [32][33]. The analysis of kidney and liver indicators in healthy gym attendants revealed that those who ingested nutritional supplements had minimal changes in the AST enzyme [34]. In his paper, A. A. Ali discovered that the prevalence of renal disease within Kurdistan Iraqi body builders was not significantly different from the overall population when examined by age-specific incidence rates [35].

Furthermore, N. Santesso argues in his article that high-protein diets have no substantial link to unfavorable kidney consequences but do show benefits in terms of weight loss, BMI, and waist circumference [36]. Several studies have shown that taking whey protein in an uneducated and unexercised manner can have negative effects on the liver by raising apoptotic signals in the short term and inflammatory markers and hepatotoxicity in the long run [37] The rate at which muscles use amino acids and the rate at which the liver breaks them down, as well as the amount of urea the body makes, have an opposite relationship [38]. In a rat model of fatty liver, oral ingestion of whey proteins reduced ALT and AST levels. This beneficial effect on ALT and AST could explain why the liver histology has improved and there is reduced fatty infiltration in hepatocytes [39][40]. The study's principal goals are twofold. The first step is to calculate how much protein athletes ingest. The second purpose is to investigate and determine the effect of whey protein supplements on liver and renal function in regularly gym-using individuals.

Methodology

This is an analytical cross-sectional study conducted in Al Nasiriyah city, Thi-Qar, Provence, south of Iraq, in the period of June–November 2021, In this study, the participants were gym attendants from three separate gyms located in various parts of the city. They were asked to respond to a questionnaire utilized in a direct interview. The first inquiries concerned protein supplements, followed by the performance of biochemical tests in the laboratory by qualified personnel.

Participants

To be included in the study, the participant had to be a male between the ages of 18 and 50 who frequented the gym; all participants in both groups had to train for at least 6 hours per week, with an average of 1.5 hours per day.

Exclusion criteria: Females, professionals, coaches, athletes who use hormone supplements, and athletes suffering from liver, renal, diabetes, or other chronic diseases are all excluded.

Participants' verbal agreement was obtained prior to the commencement of the investigation. The participants were divided into two groups: the first, which consisted of 71 people who did not take any protein supplements; and the second, which consisted of everyone who used daily protein supplements. The protein supplements refer to the amount of whey protein consumed on a daily basis.

Sampling

Three out of the 10 gyms in the city were chosen at random as the ones to study. Participants were chosen using a systematic random sampling method, and the time it took them to fill out the questionnaire was the time between their choices. The questionnaire asked about the trainee's age (in years), training habits (length of exercise per day and per week), supplement use, and supplement consumption duration (equal or less than 6 months, more than 6 months). Height, weight, waist, and hip circumferences were all taken into consideration when filling out the questionnaire.

Anthropometric and Biochemical analysis

Total protein consumption was determined using a 24-hour recall survey and a food exchange list. Body mass index (BMI) was calculated using the BMI equation (Wt. Kg / Ht. m2).Samples of 5 mL of blood were taken during blood collection, and the blood was centrifuged in the lab to obtain 3 mL of serum, which was then analyzed biochemically using a spectrophotometer. The enzymes ALT, AST, and alkaline phosphatase were tested for hepatic markers, while serum creatinine and urea were tested for renal markers. The reference normal values for kidney and liver indicators, according to the manufacturer's recommendations, were up to 20 U/l for ALT, 20 U/l for AST, 30 to 85 U/l for alkaline phosphatase, 0.7 to 1.4 mg/dl for creatinine, and 20 to 45 mg/dl for urea.

Statistical analysis

The Statistical Package for the Social Sciences (spss) version 25.0 was used to analyze the data (IBM). The chi square test was used to compare categorical variables. The continuous variables ALT, AST, ALP, creatinine, and urea were employed as dependent variables, and the t test was performed to compare them. A P value of less than 0.05 was considered significant.

Results

This is an analytical cross-sectional study of two groups of athletes that composed of 71and 34 participant in the first group and second group respectively. Age, height, weight, and other anthropometric measures are shown, and there was no statistically significant difference between the two groups. (Table 1).

Table 1: Comparison of mean age and anthropometric measurements between study group and control group

Characteristic	Non-Supplements *n* = 71	Supplements *n* = 34	*p*
Age (years)			
Mean ±SD	27.56 ±8.31	29.26 ±7.35	0.311 I NS
Height (cm)			
Mean ±SD	173.03 ±6.36	173.15 ±4.94	0.924 I NS
Weight (kg)			
Mean ±SD	76.41 ±13.26	78.71 ±10.54	0.379 I NS
Waist circumference (cm)			
Mean ±SD	82.77 ±10.05	83.03 ±7.29	0.895 I NS
Hip circumference (cm)			
Mean ±SD	95.86 ±7.82	94.53 ±6.66	0.395 I NS
Waist / hip ratio			
Mean ±SD	0.86 ±0.07	0.88 ±0.07	0.253 I NS
BMI (kg/m^2)			
Mean ±SD	25.50 ±4.07	26.21 ±3.00	0.364 I NS

n: number of cases; **SD**: standard deviation; **BMI**: body mass index; **I:** independent samples student *t*- test; **NS**: not significant

As shown in table 2, the biochemical parameters of the two groups do not differ significantly.

Table 2: Comparison of biochemical investigation between study (supplements) group and control (non-supplements) group

Characteristic	Non-Supplements *n* = 71	Supplements *n* = 34	*p*
Blood urea (mg/dl)			
Mean ±SD	32.04 ±6.49	31.79 ±6.03	0.852
Serum creatinine (mg/dl)			
Mean ±SD	0.77 ±0.14	0.79 ±0.14	0.619
Serum (AST) (IU/L)			
Mean ±SD	12.11 ±10.21	12.85 ±10.43	0.731
Serum (ALT) (IU/L)			
Mean ±SD	7.10 ±4.82	6.68 ±5.01	0.679
Serum ALP (IU/L)			
Mean ±SD	83.54 ±7.35	85.41 ±7.88	0.234

n: number of cases; **SD**: standard deviation; **AST** : serum aspartate aminotransferase; **ALT**: Alanine aminotransferase; **ALP**: serum alkaline phosphatase; **I:** independent samples student *t*- test; **NS**: not significant; *: significant at $p \leq 0.05$

The second group (supplements) had a higher daily protein intake than the first group (non-supplements), with a significant difference in protein (p = 0.001)., as shown in table 3., and the total energy gained from protein was also higher in the second group, with a significant difference, as shown in the same table.

Table 3 comparison between daily protein intake in the first and second group

protein	Characteristic	Non-Supplements *n* = 71	Supplements *n* = 34	*p*
	Daily intake (gm)			
	Mean ±SD	109.01 ±45.97	144.50 ±57.12	0.001
	Daily intake (gm/kg)			
	Mean ±SD	1.50 ±0.70	1.85 ±0.73	0.019
	Total energy (kcal%)			
	Mean ±SD	0.14 ±0.06	0.18 ±0.07	0.003

There is a significant difference (p value = 0.013) between the 24 hr. recall energy of the 2 groups, as seen in table 4, in which we can see that the mean and SD of the second group were higher than the first.

Table 4: 24 hr. recall energy of two groups.

Characteristic	Non-Supplements *n* = 71	Supplements *n* = 34	*p*
24 hr. recall total energy (kcal)			
Mean ±SD	2583.00 ±952.72	3102.00 ±1047.45	0.013

Table (5) demonstrates that more than half of the second group consumes more protein than the RDA for a healthy adult population, while only 25.4% of the first group consumes more. The difference between the two readings was significant.

Table 5 : Comparison of the amount of daily protein intake between the study group and the control group

Amount of daily Protein intake	Non-Supplements n = 71	Supplements n = 33	p
	n (%)	n (%)	
Higher than RDA	18 (25.4 %)	21 (60.6 %)	< 0.001 **
Within RDA	53 (74.6 %)	13 (39.4 %)	

Discussion

Dietary supplements are becoming more popular among gym attendants, and they are frequently ingested without the supervision of a health expert. Furthermore, uncontrolled supplement use may have negative health consequences, such as alterations in liver and renal function [1]. Protein intakes ranging from as little as the RDA to very substantial quantities can be used to increase muscle mass and strength[41]. A link between protein supplements and renal function has been shown in numerous studies. Brenner argued that excessive dietary protein consumption has a harmful effect on kidney function by causing a persistent increase in glomerular pressure and renal hyperfiltration[30]. (Xie et al.2021) found that high protein intakes were linked to higher blood urea and creatinine levels in obese people. [18]. (D. S. Schlickmann et al.2021) and (P. C. Galati 2017) reveals that gym users who take nutritional supplements may have minor kidney (urea) function changes. [1][34]. According to Omar et al. (2016), there is a high correlation between protein powder consumption and serum creatinine levels in athletes who take protein supplements [42]. Furthermore, G. M. Kirsztajn et al. (2014) state that changes in renal indicators have been observed in those who take a high-protein diet, which could have long-term negative effects on renal function [43]. These findings contradicted the results in table (2), which showed that there was no significant change in biomarkers for renal function between athletes who use protein supplements and those who do not. where Blood urea (mg/dl) Mean ±SD (32.04 ±6.49) and (31.79 ±6.03) for non-supplements and supplements group respectively with p value of (0.852) and so the result for Serum creatinine (mg/dl) were Mean ±SD (0.77 ±0.14) and (0.79 ±0.14) with p value of(0.619).

In contrast, the current study's findings are consistent with those of Eisenstein et al., who found limited evidence of adverse effects of high-protein diets on renal function in individuals without established renal disease [44]. According to the findings of Xie et al. 2021, diets high in protein did not have a detrimental impact on renal outcomes in healthy people [18]. (F. B. Nerbass et al.2019) argue that, regarding renal function, the main issue is a probable overload of the kidneys due to an increase in glomerular filtration pressure and rate from a high protein diet as urea, the main result of protein metabolism, is expelled by this organ. [26]. However, according to a systematic review by Martin et al. (2005), renal hyperfiltration can be an adaptive process and so would not harm the organisms of healthy individuals [29]. According to recent World Health Organization publications, there isn't enough evidence to link a high-protein diet to kidney disease [45]. (M. A. Gawad et al.) demonstrate that consuming a high protein diet promotes exercise training adaptations while producing no harm as long as renal function is normal [46]. According to W. F. Martin and J. R. Poortmans, greater protein intake by competitive athletes and active people does not indicate kidney injury or impairment [29][47]. The work of A. A. Ali et al. Kidney disease rates were not significantly different between bodybuilders and the general population [35].

In studies on the effect of protein supplements on liver function (Kaneko et al. 2008) and (Nunes et al. 2013), excessive whey protein consumption without exercise was linked to liver problems, with elevated alanine aminotransferase (ALT) and aspartate aminotransferase (AST), enzymes linked to liver injury[48][49]. (D. S. Schlickmann et al.2021) found a link between liver function markers and the usage of dietary supplements, with a higher likelihood of having slight liver changes (AST enzyme) [1]. According to (A. K. Abbas 2017), the increase in the levels of AST, ALT, and ALP in the whey protein group implies a defect in liver metabolism [50]. (K. N. Whitt) indicates a case of acute cholestatic liver damage related to whey protein and creatine supplementation [51]. The results of this study show that there is no significant difference in liver function biomarkers between the protein supplement group and the control group. in which Serum AST (IU/L) Mean ±SD are (12.11 ±10.21) and (12.85 ±10.43) for first (non-supplements) and second group(supplements) respectively with p value of (0.731), while for Serum ALT (IU/L) Mean ±SD are (7.10 ±4.82) and (6.68 ±5.01) for first and second group respectively with p value of (0.679) and for Serum ALP (IU/L) there is no significant difference between two groups where (Mean ±SD 83.54 ±7.35) for first group and (85.41 ±7.88) for supplements group with p value of (0.234). And this result is consistent with many studies, like in a study by R. Nunes et al., the expression of liver damage markers decreased in a group that exercised and consumed whey protein [49]. In contrast, Manninen et al. (2004) argue that there is no scientific evidence that a high-protein diet has any negative consequences on liver function [33]. E. M. Hamad and colleagues Whey protein products enhanced the outcomes of histological liver evaluations; serum ALT and AST levels improved in all whey protein groups [39]. Increased protein consumption by competitive athletes and physically active individuals does not indicate liver injury or impairment [29][47][52]. Protein intakes ranging from as little as the RDA to very substantial quantities can be used to increase muscle mass and strength[41].

In this study, the dietary protein intake was estimated by reporting food intake via a 24-h dietary recall in which mean ±SD was(1.50 ±0.70 gm/kg/day) and (1.85 ±0.73 gm/kg/day) for non-supplements and supplements group respectively in which there is a significant difference (p = 0.019) . This is congruent with the findings of I. Delimaris et al., who discovered that both groups refer to a high-protein diet that exceeds the RDA for protein in adults [11]. In a series of original studies, Antonio and colleagues prescribed exceptionally high protein doses, ranging from 3.4 to 4.4 g/kg/day, and they consistently reported that there were no adverse effects. This indicates that there was no impact on the kidney or liver function of the participants [53][54]. A series of controlled studies lasting up to one year and utilizing protein intakes of 2.5 to 3.3 g/kg/day in healthy resistance-trained athelets with protein consumption of approximately 2.5 to 3.3 g/kg/day revealed that increasing protein intakes had no negative effect on kidney and liver function markers [55]. With a protein consumption of up to 2.8

g/kg, no negative effects on liver markers were seen [47][56]. Individuals who exercise regularly and take supplements have a lower risk of developing alterations in liver and kidney indicators [53][57][58][59].

Conclusion

This work presented an analytical cross-sectional study to highlight the impact of protein supplements on renal and liver function in renal and hepatic disease-free athletes who used the gym in Nasiriyah City, Thi-Qar Provence, Southern Iraq.
We discovered that:

1. Athletes consume more protein than the RDA for the general population, regardless of whether they use supplements or not.
2. There is no significant difference in liver and kidney function between protein supplement users and non-users.

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