Academic Journal of International University of Erbil

Journal Homepage: https://ojs.cihanrtv.com/index.php/public

PRINT-ISSN: 2519-6928

Online-ISSN: 3080-7174

Evaluations of the impacts of Dietary supplements and hormonal usage on the physiological parameters of bodybuilders in Koya City

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DOI: https://doi.org/10.63841/iue23518

Received 30 March 2025; Accepted 19 April 2025; Available online 20 July 2025

ABSTRACT

Bodybuilders are more likely than other athletes to utilize hormonal (H), and non-hormonal (NH) supplements to improve physical performance and training. The study's objectives were to examine the impact of H and NH supplement on hematological and biochemical markers, as well as social and psychological factors pertinent to their misuse among young bodybuilders in Koya City, 51 adults (males and females) with a mean age of 27.12 ± 2.39 years were included in this study and separated into two main groups: bodybuilders= 31 , and control=20 , then subdivided into four Mini groups: supplemental bodybuilder group-I (SB group-I=12), supplemental bodybuilder group-II (SB group-I=19), non-athlete control group (NA control=10), and non-supplemental athlete control group (NSA control=10). 50.81% of the athletes showed using NH, versus 19.67% using H. Females are significantly less likely than males to participate in bodybuilding (OR 0.326 (95% CI 0.169-0.628), $p < 0.01$). High school or college graduates are less likely to take H and NH supplements (OR 0.199 (95% CI 0.088-0.449), $p < 0.001$). RBC, hematocrit, hemoglobin, MCV, ALT, AST, testosterone, creatinine, urea, and BUN levels were significantly higher in SB groups I and II than in NA and NSA controls. The findings highlight the need for evidence-based supplementation guidelines.

Keywords: Bodybuilding, Blood count, Dietary supplements, Testosterone, Kidney

1 INTRODUCTION

Dietary supplement (DS) utilization is increasing worldwide. Athletes who participate in gym require proper nourishment to be healthy. Supplements are essential for bodybuilding performance due to the link between bodybuilding, health, and nutrition [1]. For speedy results, young athletes have concentrated on various DS, which they believe to be safe and legal [2]. Studies have indicated that prolonged consumption of DS and energy drinks might result in physiological and biochemical issues, therefore frequently usage of these supplements is not beneficial for health [3][4]. Initially, exogenous hormone therapy such as growth hormone or anabolic steroids can disrupt the body's hormonal balance [5]. Research has associated anabolic steroid usage with adverse effects such as hepatic damage, cardiovascular issues (e.g., hypertension, myocardial infarction), and reproductive disorders, including testicular atrophy and infertility in males [6]. Prolonged administration of growth hormone may also induce insulin resistance, joint pain, and an increased risk of diabetes [7]. Secondly, excessive intake or use of supplements such as creatine, thermogenic agents, or high-dose vitamins without medical supervision may lead to physiological complications [8]. Thermogenic substances, such as

stimulants like ephedrine or synephrine, have been infrequently associated with stroke, sudden cardiac death, elevated blood pressure, and increased heart rate [9]. Athletes competing in bodybuilding are evaluated based on how muscular they appear. Seasons of hard work are typically required to prepare for a bodybuilding competition, after which the competitor embarks on a phase of intense body fat reduction to enhance muscle appearance [10]. The human body adapts remarkably to physical demands, with muscular function serving as the foundation for strength, speed, and endurance. Factors such as training intensity and muscle fibre composition influence strength and power production [11][12]. Bodybuilders are significant consumers of DS, which, when combined with a balanced diet, aim to improve well-being, enhance performance, support muscle growth, and reduce body fat. These practices, rooted in both evidence-based and anecdotal methods, commonly involve protein powders, creatine, amino acids, vitamins, and caffeine-based stimulants [13] [14]. Increasing the synthesis of muscle proteins, enhancing exercise metabolism, increasing muscular contractility, decreasing perceived exertion, improving attitude, and offering health benefits are just a few of the effects that sports supplements can have [15]. Athletes use supplements for reasons like improving physical and mental performance, maintaining health, and accelerating recovery [16] Bodybuilders often take performance-enhancing substances due to the desire for a competitive edge, the pursuit of an ideal physique, and societal beauty standards [17]. Athletes' usage of DS is a critical health concern that requires oversight from medical professionals [18]. Despite their widespread use, there is limited research on the specific effects of supplements on physiological parameters and body composition in bodybuilders [19]. The purpose of this study is to fill this gap by evaluating the impact of beverage consumption and both hormonal and non-hormonal supplements on hematological and biochemical parameters. The findings will contribute to evidence-based guidelines for optimizing athletic performance and promoting health.

2 MATERIALS AND METHODS

The purpose of the investigation is to compare two types of healthy control groups with bodybuilders to examine the effects of hormonal and non-hormonal supplements on physiological and biochemical indicators. Ethical approval was obtained from the Ethics Committee in the Faculty of science and Health, at Koya University, and informed written consent was secured from all participants. A total of 51 male adults, whose mean- age was 27.12 ± 2.39 years, were included and separated into four groups: non_ athletes (Control Group I, n=10), non _supplemental athletes (Control Group II, n=10), hormonal supplement users (SBG-I, n=12), and non-hormonal supplement users (SBG-II, n=19). Data on demographics, bodybuilding experience, dietary habits, supplement use, beverage consumption, and health factors were collected via a questionnaire. Samples were collected from gyms. Age was self-reported, and body mass index (BMI) was calculated using standard procedures based on WHO criteria, conventional approach was as follows: BMI = weight (in kg) / height2 (in m2) [20].

Blood samples (10 ml) were collected via venipuncture, divided into EDTA tubes for CBC and glucose testing, and gel tubes for serum separation and biochemical analysis. The gel tubes were centrifuged at 4000 rpm for 10 minutes to obtain serum, which was then transferred to Hitachi cups. Fasting insulin, liver enzymes (AST, ALT, ALP), lipid profile, urea, creatinine, CRP and BUN were analyzed using the Mindray BS-230 analyzer, while hormonal assessments, including testosterone levels, were conducted with the Cobas e 411 analyzer. CBC parameters, such as RBC, WBC, platelets, hemoglobin, and hematocrit, MCV, MCH and MCHC were measured utilizing the Swelab Alfa analyzer. Fasting glucose levels were determined from EDTA samples using the On-Call device. A commonly used method for assessing insulin resistance is (HOMA-IR). It came from the following equation: HOMA-IR is equal to [fasting insulin] (µU/ml) × [fasting glucose] (mg/dl)/405 [21]. All procedures adhered to standardized protocols, with serum samples either analyzed immediately or stored at 4°C for subsequent analysis.

2.1 STATISTICAL ANALYSIS

All data is presented as the mean ± standard error of the mean. The data was analyzed using GraphPad Prism 8.0 and SPSS version 16.0 with a one-way ANOVA; a p-value of less than 0.05 was considered statistically significant.

3 RESULTS

Tables 1-5 and Figures 1-2 summarize the physiological parameter analysis that showed statistically significant differences among the groups in the present study. BMI, RBC, Hb, ALT, AST and Testosterone were significantly higher than control group., SB Group-l showed higher BMI, RBC, Hb., ALT, AST, and testosterone levels compared to the control groups, while kidney function parameters such as urea and creatinine also differed significantly.

SB Group-I had a significantly greater BMI than the other groups ($p = 0.009$). Age, weight, and height were among the other parameters that did not significantly differ across groups. Table.1.

Table 1. Mean ± SEM of control subjects' and bodybuilder athletes' body mass index (BMI), height (cm), weight (kg), and age (years).

Group	Mean ± SE				*p-value*
	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m^2)	
NA control (N=10)	25.2 ± 1.85472	72.3 ± 2.63	167.7 ± 3.23	25.4 ± 1.26795	0.54
NSA control (N=10)	28.3 ± 3.39951	70.7 ± 1.37	169.6 ± 2.41	24.2 ± 1.73291	0.91
SB group-I (N=12)	28.9 ± 2.74203	95.92 ± 3.42	178.9 ± 3.13	29.9 ± 0.79517 [b**]	0.009
SB group-II (N=19)	26.1 ± 1.59495	82.52 ± 2.77	174.7 ± 3.88	26.8 ± 0.88553	0.36

The values are shown to be substantially different by different alphabets; however, the same alphabets reveal that the values yield the same outcome. * = p < 0.05, ** = p < 0.01, *** = p < 0.001, [a] SB group-I VS NA control, [b] SB group-I VS NSA control, [c] SB group-II VS NA control, [d] SB group-II VS NSA control, [e] SB group-I VS SB group-II

The NA control and SB group-I exhibit higher cholesterol and LDL levels compared to NSA control and SB group-II. Triglyceride levels are highest in SB group-I, followed by SB group-II, with lower levels in both control groups. HDL levels show variation among the groups without a clear pattern. These results suggest that supplementation may influence lipid profiles differently across the groups, Figure.1.

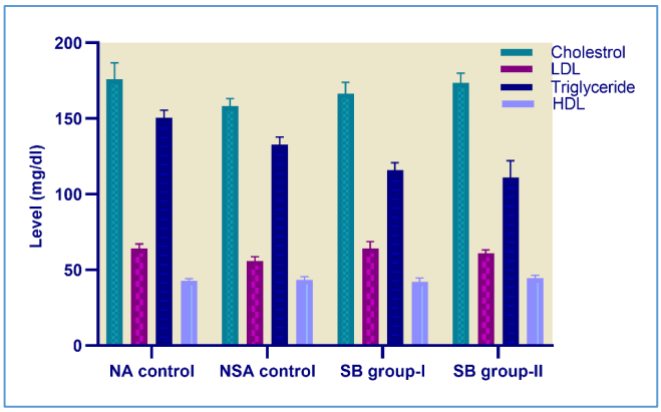

FIGURE 1. Comparison of lipid profile parameters (cholesterol, LDL, Triglycerides, HDL) Among control and supplement user groups.

There were no statistically significant differences in fasting glucose, fasting insulin, or HOMA index across the groups ($p > 0.05$). as shown in Table 2.

Table 2. Mean ± SEM of control subjects' and bodybuilder athletes' Fasting glucose (FG), Fasting insulin (FI), HOMA index

Group	**Mean ± SE**			*P. value*
	Fasting glucose (mg/dl)	**Fasting insulin (µU/mL)**	**HOMA index**	
NA control	93.5 ± 5.38774	16.8 ± 0.59576	3.8 ± 0.19070	0.75
NSA control	81.2 ± 4.89172	17.4 ± 0.60744	3.4 ± 0.20179	0.99
SB group-I	79.1 ± 2.89528	18.4 ± 0.52264	3.5 ± 0.09332	0.86
SB group-II	86.5 ± 11.48998	17.7 ± 1.25871	3.3 ± 0.29200	0.54

The values are shown to be substantially different by different alphabets; however, the same alphabets reveal that the values yield the same outcome. * = p < 0.05, ** = p < 0.01, *** = p < 0.001, [a] SB group-I VS NA control, [b] SB group-I VS NSA control, [c] SB group-II VS NA control, [d] SB group-II VS NSA control, [e] SB group-I VS SB group-II

The indices of RBC ($p = 0.003$), Hb ($p = 0.004$), Hct ($p = 0.002$), and MCV ($p = 0.04$) were showed significant differences, with SB group-I exhibiting the highest values for RBC, Hb, and Hct. No significant differences were noted in WBC, PLT, MCH, and MCHC, shown in Table 3.

Table 3. Mean ± SEM of red blood cell count (RBC), white blood cell count (WBC), hemoglobin concentration (HB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet count (PLT)

Parameters	Mean ± SE				*p. value*
	Control group		Bodybuilder athletes		
	NA Control	NSA Control	SB group-I	SB group-II	
RBC (10^{12}/l)	5.1 ± 0.17664	4.9 ± 0.16218	5.7 ± 0.08359 ^{b**}	5.3 ± 0.16510	0.003
WBC (10^{9}/l)	7.5 ± 0.68255	7.5 ± 0.37274	9.5 ±1.43587	7.2 ± 0.35786	0.39
PLT (10^{9}/l)	232.7 ± 18.69703	245.7 ± 21.18125	268.5 ± 22.66778	260.2 ± 16.77065	0.76
Hb (g/dl)	13.9 ± 0.56243	13.8 ± 0.70692	16.2 ± 0.16774 ^{b**}	14.8 ± 0.37419	0.004
Hct (%)	42.2 ± 1.71577	41.3 ± 1.97822	49.4 ± 0.73305 ^{b**}	44.2 ± 1.14670	0.002
MCH (pg)	27 ± 0.93458	28.2 ± 1.23031	28.1 ± 0.41639	27.9 ± 0.79851	0.86
MCV (fl)	76.78 ± 2.24	80.36 ± 1.21	85.47 ± 1.32 ^{a*}	84.19 ± 1.67	0.04
MCHC (g/dl)	32.9 ± 0.23058	33.3 ± 0.25493	33 ± 0.30327	33.6 ± 0.26557	0.27

The values are shown to be substantially different by different alphabets; however, the same alphabets reveal that the values yield the same outcome. * = p < 0.05, ** = p < 0.01, *** = p < 0.001, a SB group-I vs NA control, b SB group-I vs NSA control, c SB group-II vs NA control, d SB group-II vs NSA control, e SB group-I vs SB group-II

Alanine transaminase levels were significantly elevated in SB Group-l (38.8 ± 9.54U/L) compared to the other groups (p=0.021), indicating potential liver stress or metabolic changes. Similarly, AST levels were significantly higher in SB Group-l (29.3 ± 4.55 U/L) compared to the other groups (p=0.011), suggesting increased hepatic enzyme activity. However, ALP levels showed no significant differences across the groups (p=0.87), and CRP levels also remained comparable among the groups, with no statistical significance (p=0.268). These results show that SB Group-l experienced notable alterations in specific liver enzymes, possibly to their supplementation or activity patterns, while inflammation levels (CRP) were unaffected, as shown in Table 4.

Table 4. Mean ± SEM of control subjects and bodybuilder athletes' ALT, ALP, AST, and CRP

Parameter	Mean ± SE				*p-value*
	Control group		Bodybuilder athletes		
	NA- control	NSA-control	SB group-I	SB group-II	
ALT (U/L)	13.9 ± 1.0350	15.1 ± 2.1731	38.8 ± 9.5484 ^{b*}	21.4 ± 3.4194	0.021
ALP (U/L)	75 ± 5.7133	69.7 ± 4.0755	68.9 ± 4.8546	74.2 ± 5.1804	0.857
AST (U/L)	14.5 ± 1.8088	18.4 ± 3.4419	29.3 ± 4.5452 ^{b*}	20.1 ± 1.7634	0.011
CRP (mg/dl)	3.4 ± .8665	2.9 ± .4027	4.8 ± .9803	3.6 ± .3621	0.268

The values are shown to be substantially different by different alphabets; however, the same alphabets reveal that the values yield the same outcome. * = p < 0.05, ** = p < 0.01, *** = p < 0.001, ^{a} SB group-I VS NA control, ^{b} SB group-I VS NSA control, ^{c} SB group-II VS NA control, ^{d} SB group-II VS NSA control, ^{e} SB group-I VS SB group-II

Significant variations in kidney parameters were noted between the groups, as seen in Table 5. Blood urea nitrogen (BUN) levels were significantly elevated in SB Group-l (18.7 ± 1.91 mg/dl) compared to the control groups (p=0.006), Creatinine levels were significantly higher in SB Group-l (1.12 ± 0.07 mg/dl) compared to the other groups (p=0.001), suggesting increased muscle breakdown or potential renal stress. Urea levels showed a notable increase in SB Group-l (34.3 ± 3.10) compared to the control groups (p=0.043), further indicating metabolic changes.

Table 5. Mean ± SEM of bodybuilder BUN (mg/dl), Creatinine (mg/dl), Urea (mg/dl)

Parameter	Mean ± SE				*p-value*
	Control group		Bodybuilder athletes		
	NA control	NSA control	SB group-I	SB group-II	
BUN (mg/dl)	14.4 ± 1.18424	15.3 ± .69029	18.7 ± 0.9159 ^{ab**}	16.6 ± .5725 ^{c*}	0.006
Creatinine(mg/dl)	0.67 ± 0.02998	0.70 ± 0.06229	1.12 ± 0.0738 ^{ab**}	0.92 ± 0.0581 ^{c*}	0.001
Urea (mg/dl)	26.9 ± 1.80367	25 ± 1.96891	34.3 ± 3.1026 ^{b*}	31.7 ± 1.7645 ^{c*}	0.043

The values are shown to be substantially different by different alphabets; however, the same alphabets reveal that the values yield the same outcome. * = p < 0.05, ** = p < 0.01, *** = p < 0.001, a SB group-I vs NA control, b SB group-I vs NSA control, c SB group-II vs NA control, d SB group-II vs NSA control, e SB group-I vs SB group-II

The box plot shows the distribution of testosterone levels across all groups. SB group-l demonstrated significantly higher testosterone levels compared to the groups ($p < 0.01$), as indicated by the asterisks (**). As seen in Figure.2.

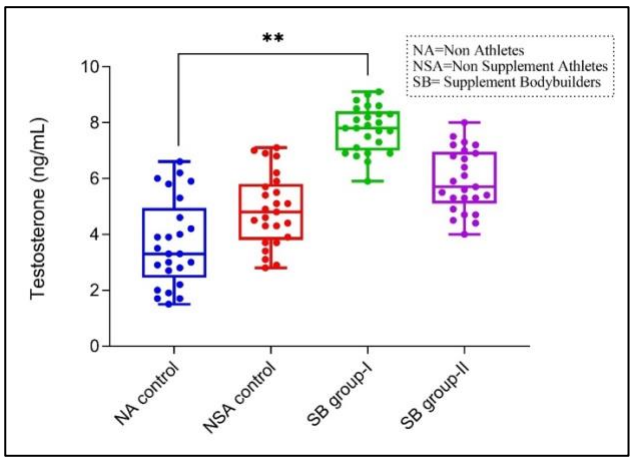

FIGURE.2 Box plot shows testosterone levels (ng/ml) among controls and supplement groups. NA: Non-athlete control, NSA: Non-supplemental athlete control, SB group-l: supplemental (hormonal) bodybuilder group-1, SB group-II: supplemental (non-hormonal) bodybuilder group-ll.

Hemoglobin and SB Group-I: A positive correlation was observed, indicating that individuals in Group I experienced an increase in hemoglobin levels as the supplementary index. Hemoglobin and SB Group-II: A positive with different level of significance was observed as compared to Group I, suggesting that non-hormonal supplements may also have an effect, but to a lesser degree as shown in Figure 3. A&B.

Table 6. Compare significant parameters among bodybuilders based on hormonal and non-hormonal usage.

Compared Parameters	Bodybuilders Group	
	R	P- value
SB group-I (Hormone users) and Hb (g/dl)	0.349	0.0242
SB group-II (Non-Hormone users) and Hb (g/dl)	0.326	0.0173
SB group-I (Hormone users) and Creatinine (mg/dl)	0.525	0.0812
SB group-II (Non-Hormone users) and Creatinine (mg/dl)	0.188	0.442
SB group-I (Hormone users) and ALT (U/L)	0.454	0.236
SB group-II (Non-Hormone users) and ALT (U/L)	0.011	0.331

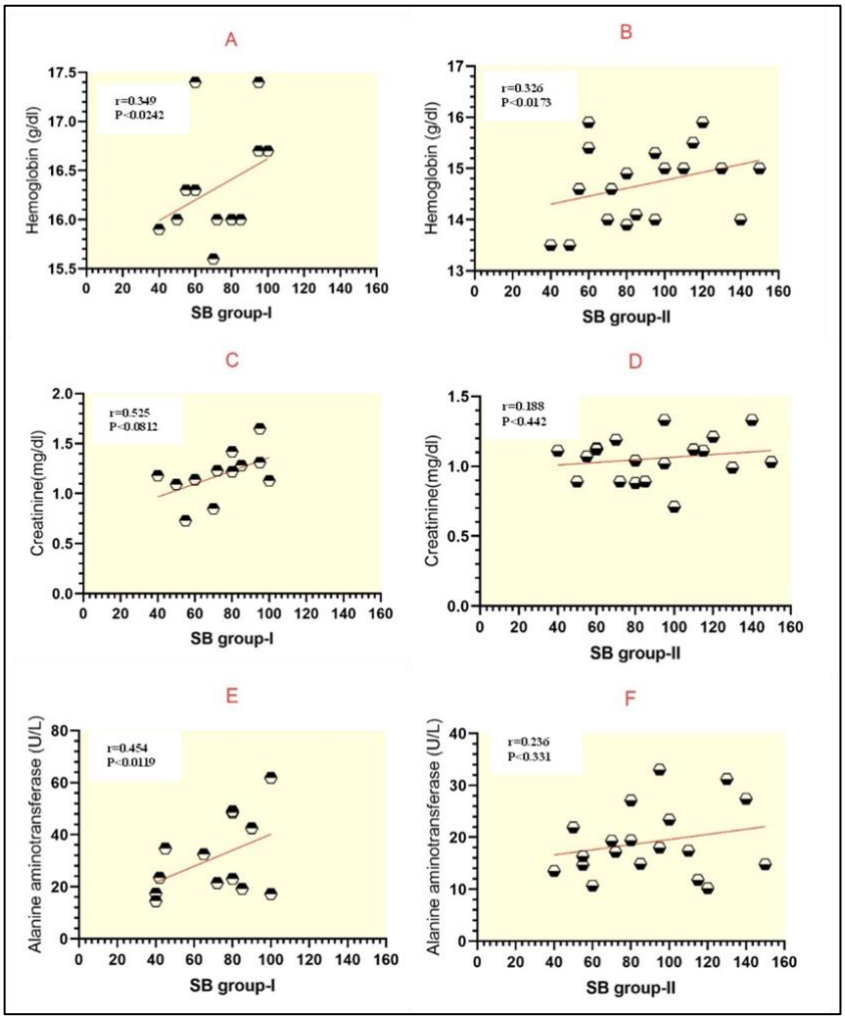

FIGURE 3. Pearson correlation analysis between selected physiological parameters and supplement users in bodybuilders. This figure shows six positive association in SB Group-I and SB Group-II: A. Hemoglobin and SB Group-I (r=0.349, p<0.02), B. Hemoglobin and SB Group-II (r=0.326, p<0.01), C. Creatinine and SB Group-I (r=0.525, p<0.08), D. Creatinine and SB Group-II (r=0.188, p<0.44), E. ALT and SB Group-I (r=0.454, p<0.01), F. ALT and SB Group-II (r=0.236, p<0.33). statistical analysis performed using Pearson's correlation coefficient (r).

The association between testosterone as a dependent variable and various independent study variables has attracted significant attention in creatinine, Hct, and ALT. As shown in table 7.

Table 7. Multivariate analysis demonstrating the dependence of testosterone on a variety of independent variables.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-5.972	1.220		-4.895	.000
	Creatine	12.052	1.320	.791	9.130	.000
2	(Constant)	-13.496	2.827		-4.773	.000
	Creatine	9.415	1.530	.618	6.155	.000
	Hct	.221	.076	.292	2.907	.005
3	(Constant)	-12.222	2.797		-4.369	.000
	Creatine	8.699	1.516	.571	5.738	.000
	Hct	.188	.075	.248	2.497	.016
	ALT	.037	.017	.184	2.116	.040

a. Dependent Variable: Testosterone

4 DISCUSSION

This study investigated the effects of hormonal and non-hormonal dietary supplements on hematological and biochemical parameters in bodybuilders, focusing on glucose metabolism, lipid profiles, liver and kidney function, and hematological

markers. Significant differences were observed between the study groups. Hormonal supplement users (SBG-I) displayed higher BMI, testosterone levels, RBC count, hemoglobin, hematocrit, ALT, AST, and kidney function markers (BUN, creatinine, and urea) compared to non-hormonal supplement users (SBG-II). These findings suggest that hormonal supplementation profoundly impacts metabolic, hepatic, and hematological profiles [22]. In contrast, non-hormonal supplement users showed milder alterations in these parameters, with no significant effect on glucose metabolism markers including fasting glucose, fasting insulin, or HOMA-IR.

BMI was significantly higher in SBG-I (hormonal supplement users, $p = 0.009$), reflecting anabolic effects potentially linked to hormonal supplement use, consistent with findings by [23][24]. Increased lean body mass through muscle fiber hypertrophy, characterized by an enlargement of the cross-sectional area of individual muscle fibers, elucidates the elevated body mass index (BMI) [25]. Mechanical overload and resistance training primarily stimulate this process by activating signaling pathways such as the phosphatidylinositol 3-kinase (PI3K)/Akt/mTOR pathway, hence enhancing protein synthesis and muscle growth. In these conditions, type II muscle fibers, which are more responsive to hypertrophic stimuli, exhibit more development than type I fibers [19]. Additionally, satellite cells, a type of myogenic progenitor cell, are activated, proliferate, and fuse with existing muscle fibers, thereby supplying nuclei that enhance protein synthesis and muscle growth. Increased muscle mass, without a corresponding rise in fat, elevates overall body weight and consequently BMI. This highlights a limitation of BMI as the sole health metric, as individuals with considerable muscle hypertrophy may be inaccurately categorized as obese or overweight despite possessing low fat levels [26]. Beyond anthropometric changes, biochemical alterations such as lipid profile shifts also reflect the systemic impact of supplementation. Lipid profile analysis revealed higher cholesterol and LDL levels in SBG-I, raising cardiovascular risk concerns [21][27]. The utilization of anabolic-androgenic steroids (AAS) is among the various risk factors influencing the intricate pathological process termed atherogenesis, which involves the formation of atherosclerotic plaques within arterial walls. Synthetic testosterone derivatives, namely steroid supplements, have been connected with the acceleration of atherogenic processes through many mechanisms affecting lipid metabolism, vascular endothelial function, oxidative stress, and inflammation [28]. The alteration in lipid profiles is one of the most extensively examined effects of anabolic steroid usage [29]. While correlation analysis did not show a strong direct relationship, the elevated LDL levels in SBG-l may reflect the cumulative effect of steroid-related metabolic alteration. Interestingly, glucose metabolism markers showed no significant differences across groups ($p > 0.05$), diverging from studies suggesting metabolic disturbances [8].

Hematological parameters such as RBC, hemoglobin, and hematocrit were significantly higher in SBG-I ($p < 0.01$), Elevated RBC count and polycythemia in bodybuilders arise from both natural physiological responses to intense exercise and the utilization of performance-enhancing substances. Mild erythrocytosis may enhance oxygen transport and endurance; nevertheless, pathological polycythemia presents significant health risks and warrants medical evaluation, particularly when produced by exogenous substances. Mitigating adverse effects in athletes relies on monitoring hematological indicators [30][31]. However, other markers, including WBC and CRP, remained unchanged, suggesting limited systemic inflammation [32]. Raised ALT ($p = 0.021$) and AST ($p = 0.011$) levels in SBG-I suggest hepatic stress, aligning with [33][34], who reported increased liver enzyme activity due to metabolic demands of supplementation [35]. Many studies, particularly those involving high-protein intake, performance-enhancing medications, or herbal components, have indicated increased liver enzyme activity associated with the metabolic demands of dietary supplements.

According to Rolfes, Pinna, and Whitney (2018) in their textbook Understanding Normal and Clinical Nutrition [36], excessive consumption of certain supplements, such as protein powders and fat-soluble vitamins, can raise liver enzymes as a result of increased hepatic metabolism and possible hepatotoxicity [37]. The correlation analysis supports this interpretation. A positive correlation between ALT and SBG-l indicates that hormonal supplements may contribute to increased liver enzyme activity, reflecting liver stress or altered metabolism. Similarly, a positive trend observed in SBG-II suggests that non-hormonal supplements may also influence liver enzymes, though to a lesser extent as shown in Figure 3E & 3F.

These findings underscore the importance of liver function monitoring in individuals consuming performance-related supplements, especially those with hormonal content. The significant increase in kidney function markers, including creatinine and urea, in SBG-I ($p < 0.05$), suggests a physiological alteration related to renal stress or increased muscle catabolism. Creatinine, a byproduct of creatine phosphate metabolism in muscle, is commonly employed as a surrogate for glomerular filtration rate (GFR). It usually indicates either lower renal clearance or increased muscle breakdown. Similarly, urea, a waste product of protein metabolism excreted by the kidneys, frequently increases in illnesses associated with renal failure or enhanced protein catabolism. The statistically significant increase in these markers in SBG-I indicates that the group may have experienced lower renal excretory capacity, increased metabolic stress, or both. Correlation analysis revealed a moderate positive correlation between creatinine and SBG-I, suggesting that hormonal supplements may influence kidney function markers, likely due to elevated muscle metabolism or renal load. In SBG-II, a positive trend-albeit less pronounced, also suggests a minor influence of non-hormonal supplements on renal function as shown in Figure 3C & 3D. These findings support the hypothesis that both supplementation and intense physical

activity can affect kidney biomarkers, particularly in those using hormonal substances. To determine the specific cause of the observed elevations, greater research into contributing factors such as hydration level, physical activity, dietary protein consumption, or underlying renal pathology is recommended [5][38]. The observed elevation in testosterone levels among SBG-I may be attributed to the direct influence of exogenous hormone intake. Additionally, the physical demands associated with intense bodybuilding training may also contribute to altered testosterone regulation. This finding support previous evidence that anabolic steroid use can modulate endogenous hormone levels [39].

The overall correlation patterns suggest that both hormonal and non-hormonal supplements impact biochemical and hematological markers, especially hemoglobin, creatinine, and ALT with stronger correlations observed in Group-I. These results emphasize the need for medical oversight when using supplements, particularly hormonal ones, to manage potential risks to liver, kidney, and cardiovascular health [40]. Limitations of the study include its small sample size, reliance on self-reported data, and cross-sectional design, which restrict causal interpretations [41]. Future research should investigate long-term effects, include female athletes, and explore molecular mechanisms underlying supplementation impacts.

CONCLUSION

This study, conducted for the first time in Koya City.This study demonstrates that the use of hormonal and non-hormonal supplements among young bodybuilders in Koya City is associated with significant alterations in hematological and biochemical markers, indicating potential health risks. The higher prevalence of supplement use among males and individuals with lower educational attainment underscores the influence of sociodemographic factors in supplement misuse. The elevated levels of parameters such as RBC, hemoglobin, liver enzymes, and kidney function indicators in supplement users further suggest physiological strain associated with these substances. These findings call for the development and implementation of evidence-based guidelines and targeted educational interventions to promote safe supplement practices and mitigate health risks within the bodybuilding community.

ETHICAL APPROVAL

The local ethical committee at Koya University, Faculty of Health & Science, approved the undertaking. The initiative has also been approved by the coach of the bodybuilding center gyms. Participants were requested to give their informed consent. Data anonymity was maintained throughout the entire data processing procedure.

ACKNOWLEDGEMENT

My first and greatest thanks to all the Koya City gym centers for their assistance and cooperation throughout this investigation. Opening your doors and sharing your experiences made this study feasible. We thank the committed coaches and trainers who generously gave their time, knowledge, and insights. Your dedication to client health, fitness, and personal growth is inspirational. Your insights deepened and improved this research. I also appreciate the Koya City bodybuilders that participated in this study. You brought a fresh perspective on fitness and bodybuilding with your passion, discipline, and willingness to share your struggles. This research would not have been possible without the Koya fitness community's support. Your help is much appreciated.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

[1] E. S. Chauhan, M. Chaudhary, and R. Singh, "Effects of ergogenic supplements and dietary supplements on young athletes' performance: A review," Scientific Journal of Sport Performance, vol. 1, no. 2, pp. 71-82, 2022.

[2] S. M. Seifert, J. L. Schaechter, E. R. Hershorin, and S. E. Lipshultz, "Health effects of energy drinks on children, adolescents, and young adults," Pediatrics, vol. 127, no. 3, pp. 511-528, 2011.

[3] L. Steinke, J. S. Kalus, V. Dhanapal, D. E. Lanfear, and H. D. Berlie, "'Energy drink" consumption causes increases in blood pressure and heart rate," ed: Am Heart Assoc, 2007.

[4] L. A. B. Persad, "Energy drinks and the neurophysiological impact of caffeine," Frontiers in neuroscience, vol. 5, p. 116, 2011.

[5] D. Davani-Davari, I. Karimzadeh, and H. Khalili, "The potential effects of anabolic-androgenic steroids and growth hormone as commonly used sport supplements on the kidney: a systematic review," BMC nephrology, vol. 20, pp. 1-12, 2019.

[6] F. Hartgens and H. Kuipers, "Effects of androgenic-anabolic steroids in athletes," Sports medicine, vol. 34, pp. 513-554, 2004.

[7] M. Heidet, A. A. Wahab, V. Ebadi, Y. Cogne, C. Chollet-Xemard, and M. Khellaf, "Severe hypoglycemia due to cryptic insulin use in a bodybuilder," Journal of Emergency Medicine, vol. 56, no. 3, pp. 279-281, 2019.

[8] C. G. Awuchi, V. S. Igwe, and I. Amagwula, "Nutritional diseases and nutrient toxicities: A systematic review of the diets and nutrition for prevention and treatment," International Journal of Advanced Academic Research, vol. 6, no. 1, pp. 1-46, 2020.

[9] A. J. Melhem Jr, A. C. Araújo, F. N. S. Figueiredo, and D. L. A. Figueiredo, "Acute myocardial infarction in a young bodybuilder: A case report and review of the literature," The American Journal of Case Reports, vol. 21, pp. e924796-1, 2020.

[10] P. Montuori et al., "Bodybuilding, dietary supplements and hormones use: behaviour and determinant analysis in young bodybuilders," BMC Sports Science, Medicine and Rehabilitation, vol. 13, pp. 1-11, 2021.

[11] E. Neupert, L. Gupta, T. Holder, and S. A. Jobson, "Athlete monitoring practices in elite sport in the United Kingdom," Journal of Sports Sciences, vol. 40, no. 13, pp. 1450-1457, 2022.

[12] T. J. Suchomel, S. Nimphius, C. R. Bellon, W. G. Hornsby, and M. H. Stone, "Training for muscular strength: Methods for monitoring and adjusting training intensity," Sports Medicine, vol. 51, no. 10, pp. 2051-2066, 2021.

[13] I. Garthe and R. J. Maughan, "Athletes and supplements: prevalence and perspectives," International journal of sport nutrition and exercise metabolism, vol. 28, no. 2, pp. 126-138, 2018.

[14] J. Li, T. B. Davies, and D. A. Hackett, "Self-reported training and supplementation practices between performance-enhancing drug-user bodybuilders compared with natural bodybuilders," The Journal of Strength & Conditioning Research, vol. 37, no. 5, pp. 1079-1088, 2023.

[15] C. M. Kerksick et al., "ISSN exercise & sports nutrition review update: research & recommendations," Journal of the international society of sports nutrition, vol. 15, pp. 1-57, 2018.

[16] G. Baltazar-Martins, D. Brito de Souza, M. Aguilar-Navarro, J. Muñoz-Guerra, M. d. M. Plata, and J. Del Coso, "Prevalence and patterns of dietary supplement use in elite Spanish athletes," Journal of the International Society of Sports Nutrition, vol. 16, pp. 1-9, 2019.

[17] A. S. R. Tavares, A. F. Rosado, J. Marôco, L. Calmeiro, and S. Serpa, "Determinants of the intention to use performance-enhancing substances among Portuguese gym users," Frontiers in psychology, vol. 10, p. 2881, 2020.

[18] F. Halabchi, S. Shab-Bidar, and M. Selk-Ghaffari, "Prevalence of supplement consumption in Iranian athletes: A systematic review and meta-analysis," International Journal of Preventive Medicine, vol. 12, 2021.

[19] P. Montuori et al., "Bodybuilding, dietary supplements and hormones use: behaviour and determinant analysis in young bodybuilders," BMC Sports Science, Medicine Rehabilitation, vol. 13, pp. 1-11, 2021.

[20] S. Strings, C. Wells, C. Bell, and A. Tomiyama, "The association of body mass index and odds of type 2 diabetes mellitus varies by race/ethnicity," Public Health, vol. 215, pp. 27-30, 2023.

[21] B. I. Abdullah and S. F. Salih, "Lipoprotein (a) Level Among Patients with Type 2 Diabetes Mellitus and Prediabetes in Comparison with Healthy Controls," Science Journal of University of Zakho, vol. 11, no. 1, pp. 30-36, 2023.

[22] A. S. R. Tavares, M. Vital, M. Cunha, M. M. Matos, and F. Tonin, "Impact of anabolic steroid consumption on biochemical and hematological parameters in bodybuilders: A systematic review and evidence gap mapping," Performance Enhancement Health, p. 100280, 2024.

[23] M. Paolo et al., "Bodybuilding, dietary supplements and hormones use: behaviour and determinant analysis in young bodybuilders," BMC Sports Science, Medicine and Rehabilitation (Web), vol. 13, no. 1, pp. 1-11, 2021.

[24] S. A. Alshammari, M. A. AlShowair, and A. AlRuhaim, "Use of hormones and nutritional supplements among gyms' attendees in Riyadh," Journal of Family and Community Medicine, vol. 24, no. 1, pp. 6-12, 2017.

[25] R. C. Alves et al., "Training programs designed for muscle hypertrophy in bodybuilders: a narrative review," Sports Medicine, vol. 8, no. 11, p. 149, 2020.

[26] J. Fink, B. J. Schoenfeld, and K. Nakazato, "The role of hormones in muscle hypertrophy," The Physician sportsmedicine, vol. 46, no. 1, pp. 129-134, 2018.

[27] M. Li and S. Rabkin, "Extremely low HDL cholesterol and increased LDL cholesterol induced by the use of anabolic steroids in a body builder: A case study," Int J Sports Exerc Med, vol. 4, no. 4, p. 109, 2018.

[28] H. Celik, M. Z. Tuysuz, Y. Aktas, M. A. Eren, and R. Demirbag, "Assessment of Paraoxonase 1 and Arylesterase Activities and Lipid Profile in Bodybuilders: A Comparative Study of Physical Activity and Anthropometry on Atherosclerosis," Medicina, vol. 60, no. 10, p. 1717, 2024.

[29] A. E. Rosca et al., "Lipid profile changes induced by chronic administration of anabolic androgenic steroids and taurine in rats," Medicina, vol. 55, no. 9, p. 540, 2019.

[30] R. Meamar, M. Maracy, S. Nematollahi, S. Yeroshalmi, A. Zamani-Moghaddam, and M. R. A. Ghazvini, "Effect of taking dietary supplement on hematological and biochemical parameters in male bodybuilders an equation model," Iranian journal of nursing and midwifery research, vol. 20, no. 6, pp. 681-688, 2015.

[31] E. Ammatuna and M. Nijziel, "Polycythemia and renal infarction in a bodybuilder," International Journal of Medicine, vol. 107, no. 8, pp. 661-662, 2014.

[32] S. Jahan et al., "Effects of dietary supplements on selected hematological and biochemical parameters of Pakistani athletes," BMC nutrition, vol. 4, pp. 1-8, 2018.

[33] S. Sulaiman, S. Hussein, K. Qurbani, K. Husen, S. Rasul, and A. Mustafa, "Effects of Dietary Supplements and Anabolic Hormones on Hematological and Biochemical Parameters among Young Bodybuilders in Kurdistan Region of Iraq," 2023.

[34] D. S. Schlickmann et al., "Liver and kidney function markers among gym users: the role of dietary supplement usage," British Journal of Nutrition, vol. 128, no. 4, pp. 704-711, 2022.

[35] P. Montuori et al., "Bodybuilding, dietary supplements and hormones use: behaviour and determinant analysis in young bodybuilders," (in eng), BMC Sports Sci Med Rehabil, vol. 13, no. 1, p. 147, Nov 24 2021.

[36] M. Jiyana, A. Nesamvuni, and L. Ncube, "Nutrient composition of planned adult patients' normal diet menus in selected public hospitals in Gauteng Province, South Africa," African Journal for Physical Activity Health Sciences, vol. 24, no. 3, pp. 245-261, 2018.

[37] E. Nash et al., "Drug-induced liver injury from selective androgen receptor modulators, anabolic-androgenic steroids and bodybuilding supplements in Australia," Alimentary Pharmacology Therapeutics, vol. 59, no. 8, pp. 953-961, 2024.

[38] S. Ozkurt, E. Ozakin, H. Gungor, and A. U. Yalcin, "Assessment of Renal Function of Bodybuilders Using Anabolic Androgenic Steroids and Diet Supplements," Cureus, vol. 15, no. 8, 2023.

[39] Z. Wenbo and Z. Yan, "The uses of anabolic androgenic steroids among athletes; its positive and negative aspects-a literature review," Journal of multidisciplinary healthcare, pp. 4293-4305, 2023.

[40] D. S. Schlickmann et al., "Liver and kidney function markers among gym users: the role of dietary supplement usage," (in eng), Br J Nutr, pp. 1-8, Sep 13 2021.

[41] S. Ozkurt, E. Ozakin, H. Gungor, and A. U. Yalcin, "Assessment of Renal Function of Bodybuilders Using Anabolic Androgenic Steroids and Diet Supplements," (in eng), Cureus, vol. 15, no. 8, p. e43058, Aug 2023.