Palestinian Medical and Pharmaceutical Journal

Assessment of Dairy Products and Protein Intake: Implications for Body Composition in Saudi Soccer Elite Athletes

Adam Tawfiq Amawi[1],Walaa Jumah Alkasasbeh[2,*] , Hassan AlSaoud[1], Ghareeb O. Alshuwaier[3], Abdulrahman I. Alaqil[4], Lana Alnimer[5], Faisal Alosaime[3], Jumana Shehadeh[6]

Received: 4th Sep. 2024, Accepted: 15th Nov. 2024, Published: ××××, DOI: https://doi.org/10.xxxx

Accepted Manuscript, In press

Abstract: Well-designed diets and proper nutrient intake are crucial factors that benefit health, enhance physical performance, and lead to better competitive results. In this study, our aim was to evaluate the associations between the consumption of dairy products and protein intake with body composition via body mass index (BMI) and fat percentage among Saudi soccer elite athletes. To achieve this, a cross-sectional, self-administered Saudi Food Frequency Questionnaire (FFQ) was completed by 81 elite Saudi soccer athletes aged between 18 and 25 years, with a mean age of 19 years, to assess their food intake. Body fat percentage was measured using skinfold thickness, and BMI was calculated for all participants, with a mean BMI of 22 (SD = 2). Our results revealed no statistically significant relationship between the consumption indexes of eggs, meat, chicken, fish, tuna, organ meat, milk, leben (fermented milk products), cream cheese, yoghurt, and labneh (Middle Eastern soft cheese) with fat percentage and BMI. The correlation coefficients were relatively low (r= 0.125, p-value= 0.547 and r=0.077, p-value= 0.882 respectively). Therefore, our findings suggest no association between protein and dairy product intake and BMI and fat percentage among Saudi soccer elite athletes. Thus, it's essential for soccer athletes and coaches to be mindful of making wise food choices to achieve better competitive results and maximize performance.

Keywords: Body Composition, Health Implications, Protein, Body mass index, Fat percentage

1 Department of Exercise Science and Kinesiology, School of Sport Science, The University of Jordan, Amman, Jordan
2 Department of Administration and Curriculum, Program of Sports Management and Training, Faculty of Arts and Educational Sciences, Middle East University, Jordan.
*Corresponding author email: walaakasasbeh1991@outlook.com
3 Department of Exercise Physiology, College of Sport Sciences and Physical Activity, King Saud University, Riyadh, Saudi Arabia
4 Department of Physical Education, College of Education, King Faisal University, Al-Ahsa, Saudi Arabia
5 Department of Nutrition and Food Technology /School of Agriculture .University of Jordan, Amman, Jordan
6 School of Nursing- The University of Jordan, Amman, Jordan

INTRODUCTION

Nutrition plays a fundamental role in the performance of athletes and their coaches, as proper nutrition is essential for enhancing athletic performance and physical fitness[1][2]. Many young athletes undergo rigorous training with the aim of pursuing a career in elite soccer [3] As part of this training regimen, careful attention is paid to their nutritional intake and dietary habits, recognizing their pivotal role in achieving peak performance and facilitating recovery from intense training sessions, given the demanding physical nature of their sports[4]. The implementation of well-structured diets and ensuring appropriate nutrient consumption stand as critical factors not only in promoting overall health but also in optimizing physical prowess[5] , ultimately translating into improved competitive outcomes[6], [7], [8]. Furthermore, various elements, such as the nature, intensity, and duration of their workouts, contribute significantly to the nutritional requirements and utilization of substrates among players[9] [10], [11]. It's no surprise that body composition plays a crucial role in athletic performance [12], typically delineated into fat mass and lean body mass. Generally, athletes exhibit lower body fat percentages compared to their non-athlete counterparts[13].Additionally, body composition stands out as a fundamental physical attribute among professional soccer players and represents a primary focus in cultivating competitive athletes [14], [15]. The interplay between body composition and anthropometric dimensions holds significant sway in shaping the trajectory of a soccer player's success. Furthermore, recognizing that distinct body types are requisite across various sports underscores the importance of body composition for athletes [15]. Nonetheless, athletes' overall fitness is frequently gauged through assessments of body composition [16], [17], [18]. within the realm of athletic nutrition, the significance of protein sources cannot be overstated, as they play a pivotal role [19], [20]. Proteins serve an anabolic function, crucial for optimizing body composition and fostering athletic performance[21], [22]Proteins and amino acids play a pivotal role in enhancing performance, particularly in the post-training period, where protein aids in stimulating regenerative processes within the body. Additionally, protein offers various benefits, including the inhibition of protein breakdown and the regulation of muscle protein synthesis[22][20].Among skeletal muscle proteins, three branched-chain amino acids—leucine, isoleucine, and valine—predominate, with leucine constituting approximately one-third of them[17]. Consequently, ensuring an adequate supply of leucine is vital for triggering muscle protein synthesis. This can be achieved primarily through the intake of high-quality proteins, with animal sources typically boasting a higher biological value[20][23]. Notably, protein sources such as milk, eggs, and most meats are considered high-quality proteins, as indexed in terms of protein digestibility corrected amino acid score. Thus, incorporating these protein sources into the diet proves beneficial in terms of providing the necessary leucine content. The guidelines of the International Society of Sports Nutrition recommend a protein intake ranging from 1.4 to 2.0 grams per kilogram of body mass per day for physically active individuals to optimize exercise training-induced adaptations[24] .This range exceeds the recommended dietary allowance (RDA) for protein consumption, which stands at 1.4 grams per kilogram of body mass per day [25]. Moreover, contemporary dietary guidelines advocate for the inclusion of dairy products as a cornerstone of a balanced diet due to their rich profile of essential micro and macronutrients. These products serve as valuable sources of high-quality protein, vital vitamins, minerals, and fatty acids, including short- and medium-chain saturated fatty acids, and trans fatty acids(Soltani and Vafa, 2017a) Notably, milk stands out as a nutrient-dense food, boasting an array of essential nutrients such as calcium, vitamin D, and protein (Sale and Elliott-Sale, 2019)Interestingly, milk shares similarities with many sports drinks in containing carbohydrates (CHO), comprising carbon, hydrogen, and oxygen[28]. Despite the importance of intensive athletic training for young soccer players in achieving success in professional sports, there is a lack of research exploring the relationship between dairy product and protein intake and body composition among these athletes. The significance of this study lies in filling this research gap and understanding how these dietary factors may influence the physical composition of elite Saudi soccer players. Given the pivotal role of dairy products and protein intake in promoting overall health, particularly among athletes, scant attention has been devoted to examining the correlation between dairy product consumption and body composition in this population. The aim of this study is to investigate the relationships between dairy product and protein intake and body composition among elite Saudi soccer athletes.

METHODS

Study Design

This research employed a cross-sectional design to investigate the relationships between dietary protein consumption and body composition, specifically focusing on BMI and fat percentage, among young professional soccer players in Riyadh, Saudi Arabia.

A sample of soccer players was recruited from various clubs in Riyadh. Participants completed a structured Food Frequency Questionnaire (FFQ) to assess their dietary protein intake. In addition to the dietary assessment, anthropometric measurements, including BMI and skinfold thickness, were collected to evaluate body composition.

Participants

This age range between 17 and 21 years was chosen to ensure a focus on young adult athletes with relatively stable dietary habits and body composition. Players were selected to participate based on specific inclusion and exclusion criteria to ensure a homogenous sample and control for potential confounding variables. The inclusion criteria required participants to be aged between 17 and 21 years, actively engaged in daily training sessions, and regularly participating in professional soccer matches once or twice a week. Exclusion criteria included being outside the specified age range, irregular attendance in training or matches, having a history of major injuries or medical conditions that could affect dietary habits or body composition, and the inability to provide accurate dietary intake information or comply with the study's procedures.The sample size of 81 was determined through power analysis, ensuring that it was sufficient to detect meaningful relationships between dietary protein intake and body composition, such as BMI and body fat percentage. This calculation took into account an expected effect size based on similar studies, a significance level of 0.05, and a desired power of 0.80. Furthermore, a 10-15% increase in the calculated sample size was applied to accommodate potential dropouts, ensuring the robustness and generalizability of the findings across the target population of young Saudi soccer players.

Anthropometric Measurements

All subjects' body weights were measured prior to the commencement of the study using a digital scale accurate to the nearest 0.1 kg (Seca 813, Germany), while height was measured with precision to the nearest 0.01 cm (Seca 213, Germany). Siri's equation (1961) [(495/body density) - 450] was utilized to convert body density to the percentage of body fat[29]. Body fat percentage was assessed via skinfold thickness at seven anatomical sites: subscapular, triceps, chest, midaxillary, suprailiac, abdomen, and thigh, employing a Holtain skinfold caliper (Holtain Ltd., Crymych, UK). These skinfold measurements were meticulously collected by a skilled expert. The total body fat percentage was derived from the sum of the aforementioned skinfold measurements, calculated using the following equation: body density = 1.112 - (0.00043499 x sum of skinfolds) + (0.00000055 x square of the sum of skinfold sites) - (0.00028826 x age) (Jackson and Pollock, 1978).

Arabic Food Frequency Questionnaire

The Saudi FFQ was employed to evaluate participants' intake of dairy products and protein[31]. Prior to its use, the validity and reliability of this questionnaire were verified, as it was presented to a panel of experts specialized in nutrition and public health. The experts reviewed each item of the questionnaire to ensure its appropriateness and accuracy in alignment with the cultural context of the participants in Saudi Arabia. This process allowed the researchers to confirm that the Arabic version of the questionnaire is reliable and accurate in measuring the dietary habits of the participants.This questionnaire comprises 14 categories, encompassing dairy products, fruits, vegetables, meat, fish, eggs, mixed dishes, sandwiches and snacks, bread, cereal, and starches, beverages, juices and drinks, sweets, seeds and nuts, fast and non-fast food, artificial sweeteners, as well as vitamins and minerals, and fats, oils, and sugar. To align with the study's objectives, only data pertaining to the consumption of dairy products and protein were considered in the analysis.

Statistical Analysis

The variables were analyzed using central tendency measures, including frequency, percentages, means, and medians, as well as dispersion measures such as standard deviation and ranges. Total scores for each food group (dairy products, meat, fish, and eggs) were computed to establish the food index for each group. A Pearson correlation test was employed to investigate any correlations between the selected anthropometric variables (years of soccer playing experience, weight, BMI, and fat percentage) and each food group index (dairy products, meat, fish, and eggs). Furthermore, multiple linear regression was utilized to assess the extent to which the variables could predict BMI and fat percentage based on the food group indexes (dairy products, meat, fish, and eggs). The significance level (alpha) was set at .05 for a two-tailed test, with a power of .80 being utilized.

RESULTS

The study included 81 young Saudi soccer players aged between 17 and 21 years, recruited from various professional soccer clubs in Riyadh, Saudi Arabia, during the 2020–2021 Saudi League season.

1. *Sample Characteristics of soccer players*

The table presents the characteristics of 81 soccer players, including their age, years of experience, weight, height, body mass index (BMI), and body fat percentage. The mean age of the players was 19 years, with a standard deviation (SD) of 1, ranging from 17 to 21 years. Their average experience in soccer was 6 years, with a standard deviation of 3, ranging from 1 to 14 years. The players' mean weight was 66 kg, with a standard deviation of 8, ranging from 52 to 85 kg. On average, the players stood at 174 cm tall, with a standard deviation of 6, varying from 157 to 187 cm. Their mean BMI was 22 kg/m², with a standard deviation of 2, spanning from 17 to 31 kg/m². The average body fat percentage was 9%, with a standard deviation of 3, ranging from 4% to 17%.

Table (1): Characteristics of soccer players (n = 81)

Variables	*M ± SD	*MIN	*MAX
Age (year)	19 ± 1	17	21
Training Experience (year)	6 ± 3	1	14
Weight (kg)	66 ± 8	52	85
Height (cm)	1.74 ± 0.06	1.57	1.87
Body mass index (BMI) (kg/m2)	22± 2	17	31
Body fat percent (%)	9 ± 3	4	17

*M: Mean, SD: Standard deviation, Min: Minimum, Max: Maximum

2. *Dairy Product Consumption Patterns among Elite Saudi Soccer Athletes*

The table (2) presented the consumption patterns of dairy products among elite Saudi soccer athletes (n=81), analyzing the frequency of intake for various dairy items, including full-fat milk, low-fat milk, skimmed milk, yogurt, labneh, cream, and cheese. The results indicated that 19.4% of athletes consumed full-fat milk 2-4 times per week, while 50.9% preferred low-fat milk less than once a month. Additionally, 70.8% of athletes consumed skimmed labneh less than once a month .The data also showed that 40.7% of athletes consumed cheese and ice cream less than once a month. Overall, the table demonstrated that full-fat dairy products were the most preferred among the athletes.

Table (2): Dairy Product Consumption Patterns among Elite Saudi Soccer Athletes (n= 81)

Item		<1/month	1-3 /month	1/ wk.	2-4/ wk.	5-6/ wk.	1/day	2-3/day	4-5/day	> 6/day
		*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)
Full fat	Milk	10 (13.9)	8 (11.1)	7 (9.7)	14 (19.4)	2 (2.8)	11 (15.3)	13(18.1)	4 (5.6)	3 (4.2)
	Leben	13 (18.3)	12 (16.9)	8(11.3)	10 (14.1)	4 (5.6)	13 (18.3)	8 (11.3)	0 (0)	3 (4.2)
	Yogurt	17 (24.6)	13 (18.8)	9 (13)	8 (11.6)	3 (4.3)	7 (10.1)	5 (7.2)	4 (5.8)	3 (4.3)
	Labneh	27 (39.1)	13 (18.8)	7(10.1)	5 (7.2)	2 (2.9)	8 (11.6)	2 (2.9)	1 (1.4)	4 (5.8)
	Cream	22(32.4)	3 (4.4)	0 (0)	12 (17.6)	3 (4.4)	8 (11.8)	5 (7.4)	13 (19.1)	2 (2.9)
Low fat	Milk	28 (50.9)	3 (5.5)	4 (7.3)	2 (3.6)	1 (1.8)	10 (18.2)	5 (9.1)	2 (3.6)	0 (0)
	Leben	26 (49.1)	5 (9.4)	2 (3.8)	5 (9.4)	1 (1.9)	4 (7.5)	6 (11.3)	2 (3.8)	2 (3.8)
	Yogurt	27 (46.6)	7 (12.1)	5 (8.6)	4 (6.9)	3 (5.2)	5 (8.6)	1 (1.7)	3 (5.2)	3 (5.2)
	Labneh	31 (59.6)	9 (17.3)	2 (3.8)	1 (1.9)	1 (1.9)	6 (11.5)	1 (1.9)	0 (0)	1 (1.9)
	Cream	31 (54.4)	1 (1.8)	0 (0)	9 (15.8)	4 (7)	1 (1.8)	4 (7)	6 (10.5)	1 (1.8)
Skimmed	Milk	29 (65.9)	7 (15.9)	0 (0)	1 (2.3)	1 (2.3)	3 (6.8)	2 (4.5)	1 (2.3)	0 (0)
	Leben	34 (70.8)	4 (8.3)	1 (2.1)	5 (10.4)	0 (0)	2 (4.2)	1 (2.1)	1 (2.1)	0 (0)
	Yogurt	34 (69.4)	6 (12.2)	2 (4.1)	0 (0)	0 (0)	4 (8.2)	2 (4.1)	0 (0)	1 (2)
Ice-cream	Labneh	22 (40.7)	10 (18.5)	5 (9.3)	6 (11.1)	2 (3.7)	3 (5.6)	4 (7.4)	1 (1.9)	1 (1.9)
cream		26 (51)	9 (17.6)	5 (9.8)	3 (5.9)	2 (3.9)	3 (5.9)	0 (0)	1 (2)	2 (3.9)
White	Cream	26 (47.3)	0 (0)	0 (0)	8 (14.5)	10(18.2)	3 (5.5)	3 (5.5)	4 (7.3)	1 (1.8)
Cheddar		22 (40.7)	1 (1.9)	0 (0)	10 (18.5)	11(20.4)	5 (9.3)	0 (0)	2 (3.7)	3 (5.6)

* N: Number of participants, %: Percentage of participants

3. Consumption of Meats, Fish, and Eggs Among Athletes

Table (3) provides an overview of the frequency of consumption of various types of meat, fish, and eggs among the participants. The least consumed items were fried fish and meat, with 86.4% of participants (n = 70) reporting non-consumption, followed by chicken, meat 6, meat 8, and meat 15, with 87.7% of participants (n = 71) reporting non-consumption. Conversely, "meat 4" was the most consumed item, with 96.3% of participants (n = 78) reporting consumption, followed by meat 6, with 92.5% of participants (n = 75) reporting consumption.

Total scores were computed for each food group, with a higher mean indicating a better food index score. The total milk index scores ranged from 0 to 20, with a mean of 8.06 (SD = 4.34). Three-quarters of the sample exhibited low milk index scores according to the quartile equation. Similarly, the total leben index scores ranged from 0 to 23, with a mean of 8.48 (SD = 4.03), with 75% of the sample demonstrating low leben index scores.

Moreover, the total cream cheese index scores ranged from 0 to 26, with a mean of 14.48 (SD = 8.04). Fifty percent of the sample had moderate cream cheese index scores based on the quartile equation. Additionally, the total yoghurt index scores ranged from 0 to 25, with a mean of 6.51 (SD = 5.22), and 25% of the sample exhibited high yoghurt index scores according to the quartile equation.

Concerning the meat, chicken, and egg food groups, the total egg index scores ranged from 0 to 18, with a mean of 8.78 (SD = 4.22). Half of the sample displayed low to moderate egg index scores according to the quartile equation. Furthermore, the total chicken index scores ranged from 0 to 9, with a mean of 5.17 (SD = 2.85), with 75% of the sample having high chicken index scores.

Moreover, the total meat index scores ranged from 0 to 46, with a mean of 22.05 (SD = 8.92), and three-quarters of the sample exhibited low to moderate meat index scores based on the quartile equation. Similarly, the total fish index scores ranged from 0 to 18, with a mean of 4.22 (SD = 4.20), indicating low fish index scores among the sample.

Furthermore, the total tuna index scores ranged from 0 to 9, with a mean of 2.58 (SD = 2.19), indicating a moderate tuna index among the sample. Likewise, the total cream cheese index scores ranged from 0 to 24, with a mean of 12.93 (SD = 4.59), with 75% of the sample displaying moderate organ meat index scores according to the quartile equation.

Table (3): Consumption of Meats, Fish, and Eggs Among Athletes n (%)

Item	<1/month	1-3 / month	1/ wk.	2-4/ wk.	5-6/ wk.	1/day	2-3/day	4-5/day	> 6/day
	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)	*N (%)
Egg boiled	6 (8)	8 (10.7)	4 (5.3)	14 (18.7)	5 (6.7)	20 (26.7)	9 (12)	2 (2.7)	7 (9.3)
Egg fried	4 (5.6)	4 (5.6)	1 (1.4)	6 (8.5)	10(14.1)	20 (28.2)	11 (15.5)	2 (2.8)	13 (18.3)
Chicken	9 (11.5)	5 (6.4)	11 (14.1)	19 (24.4)	2 (2.6)	17 (21.8)	5 (6.4)	3 (3.8)	7 (9.0)
Lamb grilled meat	15 (20.3)	15 (20.3)	16 (21.6)	8 (10.8)	1 (1.4)	6 (8.1)	6 (8.1)	2 (2.7)	5 (6.8)
Gravy lamb meat	20 (28.2)	11 (15.5)	10 (14.1)	8 (11.3)	2 (2.8)	9 (12.7)	7 (9.9)	1 (1.4)	3 (4.2)
Buffalo meat	27 (37.5)	11 (15.3)	12 (16.7)	4 (5.6)	1 (1.4)	9 (12.5)	3 (4.2)	3 (4.2)	2 (2.8)
Camel meat	27 (38)	16 (22.5)	8 (11.3)	6 (8.5)	0 (0)	7 (9.9)	3 (4.2)	2 (2.8)	2 (2.8)
Burgers	15 (20.5)	11 (15.1)	11 (15.1)	16 (21.9)	1 (1.4)	8 (11.0)	6 (8.2)	4 (5.5)	1 (1.4)
Fried fish	27 (38.6)	13 (18.6)	12 (17.1)	4 (5.7)	1 (1.4)	6 (8.6)	4 (5.7)	1 (1.4)	2 (2.9)
Grilled fish	34 (47.2)	10 (13.9)	13 (18.1)	3 (4.2)	2 (2.8)	6 (8.3)	2 (2.8)	1 (1.4)	1 (1.4)
Tuna fish	29 (40.3)	8 (11.1)	11 (15.3)	10 (13.9)	0 (0)	10 (13.9)	2 (2.8)	1 (1.4)	1 (1.4)
Shrimp	36 (49.3)	11 (15.1)	12 (16.4)	4 (5.5)	1 (1.4)	3 (4.1)	2 (2.7)	2 (2.7)	2 (2.7)
Sea fruit	47 (67.1)	9 (12.9)	4 (5.7)	2 (2.9)	0 (0)	3 (4.3)	2 (2.9)	2 (2.9)	1 (1.4)
Organ meats	33 (46.5)	14 (19.7)	5 (7.0)	8 (11.3)	1 (1.4)	5 (7.0)	2 (2.8)	2 (2.8)	1 (1.4)

* N: Number of participants, %: Percentage of participants

4. *Relationships between Food Group Consumption and Anthropometric Variables*

To explore the associations between selected food group consumption and anthropometric variables (years of soccer experience, weight, BMI, and fat percentage), a Pearson correlation test was conducted, with the significance level set at $p < 0.05$. Analysis revealed no significant relationships between BMI and consumption of milk, leben, cream cheese, yoghurt, and labneh (r = -0.017, p = 0.882; r = 0.089, p = 0.431; r = 0.094, p = 0.402; r = 0.180, p = 0.109; r = 0.094, p = 0.405, respectively). Similarly, no significant relationships were found between BMI and egg, chicken, meat, fish, tuna, and organ meat consumption (r = 0.080, p = 0.476; r = 0.041, p = 0.716; r = 0.040, p = 0.724; r = 0.019, p = 0.868; r = -0.055, p = 0.626; r = 0.046, p = 0.681, respectively). Moreover, fat percentage showed no significant correlations with milk, leben, cream cheese, yoghurt, labneh (r = -0.038, p = 0.737; r = 0.032, p = 0.775; r = 0.116, p = 0.302; r = 0.061, p = 0.588; r = 0.046, p = 0.685, respectively), nor with egg, chicken, meat, fish, tuna, and organ meat consumption (r = -0.048, p = 0.671; r = 0.204, p = 0.068; r = -0.031, p = 0.781; r = 0.054, p = 0.635; r = -0.062, p = 0.582; r = -0.013, p = 0.912, respectively), see Table (4).

5. *Body Mass Index Predictors*

To identify the significant predictors of BMI, a forward stepwise linear regression was employed, with an alpha threshold of $p < 0.05$. Despite considering 11 potential predictors (consumption of milk, leben, cream cheese, yoghurt, labneh, egg, chicken, meat, fish, tuna, and organ meat), none of these variables emerged as significant predictors of BMI: F (11, 69) = (0.522, p = 0.882), with an R2 of 0.077, see Table (4).

6. *Fat Percentage Predictors*

Similarly, to identify significant predictors of fat percentage, a forward stepwise linear regression was conducted, with an alpha level set at $p < 0.05$. Despite considering the same 11 potential predictors, none of them emerged as significant predictors of fat percentage: F (11, 69) = (0.898, p = 0.547), with an R2 of 0.125, see Table (4).

Table(4): Relationships between Food Group Consumption and Anthropometric Variables

Item	*M ±	Expected range	MIN	MAX	Variables	Training Experience	Weight	BMI	FAT
Milk	8.06 ± 4.34	0 - 27	10	20	*r^2	.029	-.054	-.017	-.038
					*p	.796	.633	.882	.737
Leben	8.48 ± 4.03	0 - 27	0	23	*r^2	.039	.008	.089	-.032
					*p	.727	.942	.431	.775
Cream cheese	14.48 ± 8.04	0 - 36	0	26	*r^2	.116	-.050	.094	-.116
					*p	.303	.657	.402	.302

Yogurt	6.51 ± 5.22	0 - 27	0	25	*r^2	-.065	.072	.180	.061
					*p	.567	.524	.109	.588
Labneh	13.35 ± 8.43	0 - 36	0	25	*r^2	.042	.073	.094	.046
					*p	.710	.517	.405	.685
Egg	8.78 ± 4.22	0 – 18	0	18	*r^2	.022	.061	.080	-.048
					*p	.845	.586	.476	.671
Chicken	5.17 ± 2.85	0 - 9	0	9	*r^2	.117	-.100	.041	-.204
					*p	.300	.375	.716	.068
Meat	22.05 ± 8.92	0 – 54	0	46	*r^2	-.023	-.004	.040	-.031
					*p	.840	.969	.724	.781
Fish	4.72 ± 4.20	0 – 18	0	18	*r^2	-.204	.022	.019	.054
					*p	.068	.843	.868	.635
Tuna	2.58 ± 2.19	0 – 9	0	9	*r^2	.018	-.061	-.055	-.062
					*p	.874	.586	.626	.582
Organ meat	12.93 ± 4.59	0 - 27	0	24	*r^2	-.046	.006	.046	-.013
					*p	.682	.959	.681	.912

*M ± SD: Mean ± Standard Deviation,r^2: Coefficient of determination (explains variance) ,p-value: Significance level

DISCUSSION

The study aimed to explore the consumption patterns of animal proteins, specifically dairy products, meat, fish, and eggs, among young male Saudi elite soccer players and assess their association with selected anthropometric variables, namely BMI and fat percentage. Our findings revealed a preference among the participants for full-fat variants of milk, leben, cream cheese, yoghurt, and labneh, with average consumption rates of 88.9%, 87.7%, 84%, 85.2%, and 88.9%, respectively, compared to skimmed and low-fat alternatives. This aligns with the observations made by Soltani and Vafa (2017), indicating that the intake of dairy fat typically does not correlate with elevated risks of weight gain, cardiovascular disease (CVD), or type II diabetes.

Furthermore, our study indicated relatively low average consumption of milk and leben, with total index scores ranging from 0 to 20 and 0 to 23, respectively. In contrast, moderate consumption was observed for cream cheese and labneh, with total index scores ranging from 0 to 26 and 0 to 25, respectively. Notably, yoghurt consumption was found to be high, with total index scores ranging from 0 to 25.

In terms of meat, chicken, and egg consumption, the average intake of eggs and meat was assessed to be low to moderate, with total index scores ranging from 0 to 18 and 0 to 46, respectively. Conversely, chicken consumption appeared relatively high, with the total index score ranging from 0 to 9. However, fish intake was relatively low, with total index scores ranging from 0 to 18, while tuna and organ meat intakes were moderate, with total scores ranging from 0 to 9 and 0 to 24, respectively. Petri et al. (2016)

[28]noted that the consumption of milk, fish, and eggs among Italian athletes was notably below international guidelines. This low milk intake could be attributed to potential gastrointestinal discomfort experienced by some players, potentially impacting their exercise performance. Similarly, -Gutiérrez et al. (2005) observed that players from a Spanish First Division Soccer League club had low intake of polyunsaturated fatty acids (PUFA)[9], correlating with a low daily fish intake, which accounted for only 2% of total energy intake, compared to a higher consumption of meat, poultry, and meat derivatives, constituting 12% of total energy intake. The finding that milk and dairy products were consumed sparingly by less than 5% of the participants aligns with the results of our current study.

However, a study conducted by Hidalgo et al. (2015) on athletes revealed that the intake of meat, poultry, fish, and eggs accounted for 30% of the total daily energy intake[8]. Additionally, the protein intake of the four teams included in the study ranged from 1.9 to 2.2 g/kg BM, exceeding the recommendations for adolescent male soccer players.

One concern associated with a high dietary protein intake is the elevation of plasma levels of albumin, uric acid, and cholesterol [32]. Iglesias-Gutiérrez et al. (2005) found that the relative protein contribution of milk and dairy products accounted for 20% of the total protein intake[9], while 15% of the total energy intake was derived from daily consumption of meat, fish, and eggs (comprising 16% of total energy and 43% of total protein intake), surpassing the Recommended Dietary Allowance (RDA) for protein. Therefore, athletes would benefit from focusing on consuming high-quality protein sources such as dairy protein, eggs, and lean meat, as protein quality plays a significant role in maximizing muscle accretion.As reported by Hector et al. (2017), protein derived from animal sources such as dairy, eggs, and meat provides essential amino acids, along with vital nutrients like vitamin B12, iron, zinc, calcium, and vitamin D [33]. This contributes to meeting nutritional needs while managing energy intake effectively. Nevertheless, our study did not identify any statistically significant relationship between the indexes of milk, leben, cream cheese, yoghurt, and labneh, as well as egg, meat, chicken, fish, tuna, and organ meat, and BMI. The R-squared (R2) values indicated a relatively weak association (0.077), and the probability of an increase in the consumption of these food groups being linked to a decrease in BMI was weak, with a non-significant relationship ($p=0.882$).

Additionally, Antropométricas (2019) conducted a study comparing the anthropometric characteristics of 381 Kosovo elite athletes, including 130 basketball players, 133 handball players, and 118 football players[34]. The study suggested that soccer athletes had significantly lower BMI compared to handball and basketball players. Moreover, Makhafola et al. (2022) investigated the association between energy, macronutrients, and BMI among 60 non-competitive soccer athletes, finding no significant relationship between BMI and protein intake ($p=0.179$)[35].

Furthermore, our study found no statistically significant relationship between fat percentage and the indexes of egg, meat, chicken, fish, tuna, organ meat, milk, leben, cream cheese, yoghurt, and labneh, with a relatively weak R-squared value (0.125). The probability that an increase in the consumption of these food groups is related to a decrease in fat percentage was non-significant ($p=0.547$). Similarly, Hector et al. (2017) reported that in the energy balance of young male novice weightlifters, consuming skimmed milk following resistance exercise for 12 weeks led to greater gains in lean body mass (LBM) and greater reduction in fat mass compared to the consumption of soy protein[33]. However, a study suggested that during hypoenergetic periods, diets characterized by lower carbohydrate intake (less than 40% of total energy intake) and higher protein intake (> 1.05 g·kg–1·d–1) result in increased fat-mass loss and lean-mass preservation compared to diets higher in carbohydrate and lower in protein[36].

In summary, our study represents a significant contribution to the understanding of dietary patterns and their impact on body composition among Saudi soccer elite athletes. While previous research has explored athletic nutrition, our study stands out as the first and most recent endeavor to specifically evaluate the relationship between protein and dairy product consumption and body composition parameters, including BMI and fat percentage, within this population. Despite the absence of significant associations observed in our findings, the importance of informed dietary choices remains paramount for optimizing athletic performance and overall health. Therefore, further research is warranted to delve deeper into the complexities of dietary patterns and their effects on body composition among elite athletes, facilitating the development of tailored nutritional strategies[37] to enhance performance outcomes.

CONCLUSION

In conclusion, our study examining the relationship between protein intake and body composition in elite Saudi soccer players did not reveal significant correlations between the consumption of protein-rich foods, particularly dairy products, and body mass index (BMI) or fat percentage. However, the prevalence of full-fat dairy consumption among participants suggests areas for potential dietary optimization. Comparisons with previous research highlight common trends in dietary habits among elite athletes, emphasizing the need for personalized nutritional strategies. While no direct link was found between protein intake and body composition in this study, it underscores the importance of continued research to better understand the complex relationship between diet and athletic performance. These findings emphasize the need for tailored nutritional interventions to optimize athletes' performance and overall health.

Limitations of the Study

While this study provides valuable insights into the dietary habits and their relationship with body composition among elite Saudi soccer players, several limitations should be acknowledged. Firstly, the study was limited to a relatively small sample of elite male soccer players, which may affect the generalizability of the findings to other athletic populations or to female athletes. A larger sample size might yield more statistically significant results. Secondly, the cross-sectional design of the study limits the ability to infer causality; therefore, longitudinal studies are needed to better understand the long-term effects of dietary protein intake on body composition. Additionally, the data on food consumption were self-reported by the participants, which could lead to inaccuracies due to recall bias, underreporting, or overreporting of dietary intake. Furthermore, the study focused solely on Saudi elite soccer players, whose dietary habits may be influenced by cultural and regional factors, making it challenging to apply these findings to athletes from different backgrounds. Future research should aim to include a larger, more diverse sample size, incorporate longitudinal data collection, and account for additional variables to build a more comprehensive understanding of the relationship between dietary intake and body composition in athletic populations understanding of the relationship between dietary patterns and body composition in elite athletes.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Ethical Committee of King Saud University (E-21-5659). All procedures were conducted in accordance with the guidelines of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their involvement in the study.

Consent for publication

Not applicable.

Availability of data and materials

The data are available from the authors upon reasonable request.

Author's contribution

Study Design: Adam Amawi

Literature Review and Critical Revision of the Manuscript: Adam Amawi, Walaa Alkasasbeh, Lana Alnimer.

Writing - Reviewing & Editing: Adam Amawi, Walaa Alkasasbeh, Lana Alnimer.

Data Collection: Faisal Alosaime.

Data Analysis: Jumana Shehadeh.

Conceptualizing the Study: Adam Amawi, Ghareeb Alshuwaier, Abdulrahman Alaqil,Hassan AlSaoud.

Drafting the Manuscript: Adam Amawi, Walaa Alkasasbeh, Lana Alnimer.

Competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

None.

Acknowledgments

None.

REFERENCES

[1] A. T. Amawi, B. Abuawad, G. O. Alshuwaier, A. A. Alnuaim, A. K. Bursais, and A. I. Alaqil, "Understanding the Sport-Nutrition Knowledge and Practices among Jordanian Olympic Preparation Program's Athletes and Coaches for TOKYO2020 Olympic Games," International Journal of Human Movement and Sports Sciences, vol. 10, no. 3, pp. 567–573, 2022, doi: 10.13189/saj.2022.100325.

[2] A. T. Amawi et al., "Knowledge and Attitude of Dietary Supplements among Arab Olympic Athletes and Coaches in Preparation Program for Tokyo 2020 Olympic Games," International Journal of Human Movement and Sports Sciences, vol. 11, no. 2, pp. 368–377, 2023, doi: 10.13189/saj.2023.110214.

[3] R. Monteiro, D. Monteiro, M. Torregrossa, and B. Travassos, "Career Planning in Elite Soccer: The Mediating Role of Self-Efficacy, Career Goals, and Athletic Identity," Front Psychol, vol. 12, 2021, doi: 10.3389/fpsyg.2021.694868.

[4] M. Steffl, I. Kinkorova, J. Kokstejn, and M. Petr, "Macronutrient intake in soccer players–a meta-analysis," Nutrients, vol. 11, no. 6, 2019, doi: 10.3390/nu11061305.

[5] T. Alawamleh and W. AlKasasbeh, "Exploring the Landscape of eHealth in Promoting Physical Activity and Healthy Dietary Intake," Univers J Public Health, vol. 12, no. 1, pp. 120–127, 2024, doi: 10.13189/ujph.2024.120113.

[6] W. AlKasasbeh and S. Akroush, “Investigating the interrelationships among food habits, sports nutrition knowledge, and perceived barriers to healthy eating: a study of adolescent swimmers,” Front Nutr, vol. 11, 2024, doi: 10.3389/fnut.2024.1381801.

[7] W. J. Alkasasbeh, T. Alawamleh, and W. A. Alrahahleh, “Investigating Nutrition Literacy Levels among Adolescent Swimmers,” International Journal of Human Movement and Sports Sciences, vol. 12, no. 2, pp. 403–413, 2024, doi: 10.13189/saj.2024.120215.

[8] R. Hidalgo et al., “Nutritional intake and nutritional status in elite Mexican teenagers soccer players of different ages,” Nutr Hosp, vol. 32, no. 4, pp. 1735–1743, 2015.

[9] E. Iglesias-Gutiérrez, P. M. García-Rovés, C. Rodríguez, S. Braga, P. García-Zapico, and Á. M. Patterson, “Food habits and nutritional status assessment of adolescent soccer players. A necessary and accurate approach,” Canadian Journal of Applied Physiology, vol. 30, no. 1, pp. 18–32, 2005.

[10] A. Amawi et al., “Athletes’ nutritional demands: a narrative review of nutritional requirements,” Front Nutr, vol. 10, 2023, doi: 10.3389/fnut.2023.1331854.

[11] W. J. AlKasasbeh and A. T. Amawi, “Elevating Physical Education Teacher Through Technology Integration,” International Journal of Interactive Mobile Technologies, vol. 18, no. 2, pp. 16–26, 2024, doi: 10.3991/ijim.v18i02.43669.

[12] A. Amawi et al., “Exploring the Impact of Dietary Factors on Body Composition in Elite Saudi Soccer Players: A Focus on Added Sugars, Salt, and Oil Consumption,” International Journal of Human Movement and Sports Sciences, vol. 11, no. 6, pp. 1305–1312, 2023, doi: 10.13189/saj.2023.110614.

[13] P. Noormohammadpour, R. Mazaheri, M. Abarashi, F. Halabchi, T. Seif-Barghi, and Z. Alizadeh, “Body composition and dietary pattern of iranian male soccer players, a large national study,” Asian J Sports Med, vol. 10, no. 1, 2019, doi: 10.5812/asjsm.83684.

[14] H. A. Ghazzawi et al., “Correlation of Consumption Vegetables, Fruit, and Nuts with Body Mass Index and Fat Deposition in Saudi Elite Male Soccer Players,” International Journal of Human Movement and Sports Sciences, vol. 11, no. 2, pp. 350–359, 2023, doi: 10.13189/saj.2023.110212.

[15] E. Ludwig, “Fruit and Vegetable Consumption of Division I Collegiate Football and Volleyball Players Pre-and Post-Deregulation of Snacks by the Ncaa,” 2015.

[16] T. Alawamleh and W. Alkasasbeh, “Exploring the Correlation between Physical Fitness and Kinematic Parameters in Butterfly Stroke among Physical Education Students,” International Journal of Human Movement and Sports Sciences, vol. 12, no. 2, pp. 302–308, 2024, doi: 10.13189/saj.2024.120204.

[17] M. N. Melvin, A. E. Smith-Ryan, H. L. Wingfield, E. D. Ryan, E. T. Trexler, and E. J. Roelofs, “Muscle characteristics and body composition of NCAA Division I football players,” J Strength Cond Res, vol. 28, no. 12, pp. 3320–3329, 2014, doi: 10.1519/JSC.0000000000000651.

[18] W. J. Alkasasbeh, "Evaluation of Plyometric Exercise, Strength Training on Physical Capabilities," International Journal of Human Movement and Sports Sciences, vol. 11, no. 1, pp. 37–43, 2023, doi: 10.13189/saj.2023.110105.

[19] W. J. Alkasasbeh and A. T. Amawi, "Impact of Eating Habits on the Psychological State of Jordanian Athletes: A Descriptive Study," Food Science and Technology (United States), vol. 11, no. 3, pp. 168–181, 2023, doi: 10.13189/fst.2023.110305.

[20] H. Dobrowolski, A. Karczemna, and D. Włodarek, "Nutrition for female soccer players—recommendations," Medicina (B Aires), vol. 56, no. 1, p. 28, 2020.

[21] G. O. Alshuwaier, H. A. Ghazzawi, A. I. Alaqil, Y. R. Alsharif, A. K. Bursais, and A. T. Amawi, "Different training sessions impact on serum protein profile of Saudi professional soccer players," Niger J Clin Pract, vol. 25, no. 8, pp. 1287–1294, 2022, doi: 10.4103/njcp.njcp_72_22.

[22] K. D. Tipton and R. R. Wolfe, "Protein and amino acids for athletes," Food, Nutrition and Sports Performance II, pp. 104–129, 2004.

[23] S. M. Phillips and L. J. C. Van Loon, "Dietary protein for athletes: from requirements to optimum adaptation," Food, Nutrition and Sports Performance III, pp. 29–38, 2013.

[24] R. Jäger et al., "International society of sports nutrition position stand: protein and exercise," J Int Soc Sports Nutr, vol. 14, pp. 1–25, 2017.

[25] N. Boisseau, M. Vermorel, M. Rance, P. Duché, and P. Patureau-Mirand, "Protein requirements in male adolescent soccer players," Eur J Appl Physiol, vol. 100, no. 1, pp. 27–33, 2007, doi: 10.1007/s00421-007-0400-4.

[26] S. Soltani and M. Vafa, "The dairy fat paradox: Whole dairy products may be healthier than we thought," Med J Islam Repub Iran, vol. 31, p. 110, 2017.

[27] C. Sale and K. J. Elliott-Sale, "Nutrition and athlete bone health," Sports Medicine, vol. 49, no. Suppl 2, pp. 139–151, 2019.

[28] C. Petri, G. Mascherini, L. Pengue, and G. Galanti, "Dietary habits in elite soccer players," Sport Sci Health, vol. 12, pp. 113–119, 2016.

[29] W. E. Siri, "Body composition from fluid spaces and density: analysis of methods," 1956.

[30] A. S. Jackson and M. L. Pollock, "Generalized equations for predicting body density of men," British journal of nutrition, vol. 40, no. 3, pp. 497–504, 1978.

[31] M. M. Alkhalaf, C. A. Edwards, and E. Combet, "Validation of a food frequency questionnaire specific for salt intake in Saudi Arabian adults using urinary biomarker and repeated multiple pass 24-hour dietary recall," Proceedings of the Nutrition Society, vol. 74, no. OCE5, p. E337, 2015.

[32] P. Ghadirian, B. Shatenstein, M. Verdy, and P. Hamet, "The influence of dairy products on plasma uric acid in women," Eur J Epidemiol, vol. 11, no. 3, pp. 275–281, 1995, doi: 10.1007/BF01719431.

[33] A. J. Hector and S. M. Phillips, “Protein recommendations for weight loss in elite athletes: A focus on body composition and performance,” Int J Sport Nutr Exerc Metab, vol. 28, no. 2, pp. 170–177, 2018, doi: 10.1123/ijsnem.2017-0273.

[34] A. Pireva, “Anthropometric and body composition differences among elite kosovo basketball, handball and soccer players | Diferencias antropométricas y de composición corporal entre jugadores de baloncesto, balonmano y fútbol de élite de kosovo,” International Journal of Morphology, vol. 37, no. 3, pp. 1067–1072, 2019, doi: 10.4067/S0717-95022019000301067.

[35] M. Makhafola, H. Makhubela, S. Masoga, and S. H. Makuse, “Fitness Soccer Athletes Training at the University of Limpopo, South Africa: Are the Macronutrients Intake and Anthropometric Status of These Athletes Optimal?,” Int J Environ Res Public Health, vol. 19, no. 19, 2022, doi: 10.3390/ijerph191912650.

[36] S. M. Phillips, D. R. Moore, and J. E. Tang, “A critical examination of dietary protein requirements, benefits, and excesses in athletes.,” Int J Sport Nutr Exerc Metab, vol. 17 Suppl, 2007, doi: 10.1123/ijsnem.17.s1.s58.

[37] W. J. AlKasasbeh and A. T. Amawi, “The Effectiveness of Using Mobile Learning Application on Undergraduates’ Intrinsic Motivation and Their General Nutrition Knowledge,” International Journal of Interactive Mobile Technologies, vol. 17, no. 17, pp. 19–37, 2023, doi: 10.3991/ijim.v17i17.40959.