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ORIGINAL ARTICLE

Sports Performance Based on Food Nutrition: A Scenario Study

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ABSTRACT

Background. This study presents sports performance based on food nutrition. The study aims to increase athletes' power and anaerobic fatigue by eating enough food nutrition to use sports exercise on a cycle ergometer by a scenario study. **Objectives.** The cycle ergometer model and simulation of energy-power is impacted by nutrition and movement as the study linked energy and power (the athlete scenario). **Methods.** This study conducted a theoretical study using 21 scenario athlete weights and a cycle ergometer device. It focused on athlete strength and anaerobic fatigue using flywheel resistance. The study demonstrated reliability and mathematical modeling of scenario data. This study was based on SPSS 28.0 for data analysis and evaluation (one-way ANOVA, spectral analysis, autocorrelation function, and T-Test), assessing the reliability of scenario data using regression analysis. **Results.** The modeling showed that the scenario athletes with 21 different weights had an anaerobic fatigue efficiency greater than 80% and anaerobic power capacities between 10.2 [kW] and 16.7 [kW]. **Conclusion.** The athletes' anaerobic capacity and fatigue increased with weight, but their efficiency (capacity) remained the same. As a result, ATP (Adenosine Triphosphate) is produced and used by the body, which enhances performance. This study demonstrates how the athlete's social economic environment and movement patterns impact power-energy.

KEYWORDS: ***Adenosine Triphosphate, Sport, Food, Power, Anaerobic, Mass.***

INTRODUCTION

Sports performance success and environmental sustainability depend greatly on an athlete's diet and energy usage. Exercise and proper nutrition can enhance health (1). The role of supplements in sports nutrition and how they affect performance and health is fascinating. Regulating body mass and composition is a part of athletic nutrition (2, 3). Nutrition and sustainable food access are universal problems (4-7). Dietary modifications and proper nutrition are sustainable consumption practices that improve life and health (8-12). ATP (Adenosine Triphosphate) synthesis conserves energy, making food nutritionally the most active in athlete performance (13).

Carbohydrates, proteins, lipids, water, and minerals are instances of nutrients. The environmental social economic structure demonstrates how nutrient uptake, nutrient storage, and exercise in athletes influence tissue synthesis and energy metabolism. The health and training of athletes are impacted by nutrition (13). Plasma membrane lipids are produced by new bone compounds. Cells are powered by synthetic ATP, phosphocreatine, and other substances (14).

The goals of sports nutrition are metabolism and energy. Sports foods provide vital nutrients and functional components that protect muscles and joint cartilage (15). Strength training and conditioning boost skeletal muscle ATP synthesis and glucose uptake (16). Athletic performance during exercise necessitates energy production (17-19). Sports raise the need for ATP (20). For

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both high- and moderate-intensity exercise, ATP resynthesis is required (21, 22).

Heat, alkali, and acid sensitivity are caused by manganese's quick breakdown of magnesium ions. In ATP, athletes store energy. It absorbs energy to transfer after ATP. Before eating, athletes produce ATP and absorb nutrients. Resting athletes burn 10 kg of ATP in 6 hours using the low ATP cycle. Severe sports use ATP 10 minutes/5 kg. 80–100 g ATP powers resting exercise. Therefore, ATP provides enough intramuscular energy but no energy reserve. Thus, a non-weightlifter uses 75% of their body mass in ATP daily. Anaerobic energy is transferred during exercise by short-term energy systems (13-15). Sports use ATP to store and transfer macronutrient oxidation energy. This nucleotide's potential energy powers all cells. ATP bonds store food energy. ATP fuels sports (13, 14). 15 g/kg glycogen storage, 1.2 kg for 80 kg men, 0.9 kg for 60 kg women (14). Brisk walking for 2 minutes, marathon running for 40-60 seconds, and sprint running for 10-16 seconds are powered by 40 kg of muscle Phosphagen. 0.5 minutes of peak exercise use this much energy. Thus, the peak energy transfer is 4-8 times aerobic metabolism's maximal (14). The average physiological net energy from food during sports: 0.01696 [KJ/kg] protein, 0.01689 [J/kg] carbohydrates, and 0.03740 [J/kg] lipids (14).

Energy is crucial for athletes, as food nutrition provides this vitality. When the athlete moves, ATP is synthesized and activated by the athlete using food energy. The body of the athlete uses and creates ATP for energy. The study states that athlete performance and power increase athlete energy thanks to ATP. This study revealed that nutrition with athlete weight affects athlete performance by regulating athlete performance in 21 scenarios.

MATERIALS AND METHODS

In this study, a theoretical study was carried out by taking 21 scenario athlete weights as standard and considering the cycle ergometer device. Following this study, applied studies are planned to be carried out and will be projected in the future. The scenarios have just been completed. The participants will then cycle non-stop at submaximal speed for their weight, between working speeds, on a calibrated bicycle ergometer with mechanical brakes (model 828E, Monark, Varberg, Sweden) for a set interval. The time will be adjusted to reach a steady state at low speeds, and since it is a continuous study, it is planned to reach a steady state at higher operating speeds and to have a pedal frequency range of 50 rpm to 60 rpm. The method of this study consists of athlete strength and anaerobic fatigue according to flywheel resistance by adjusting the athlete's weight to the Wingate test (Monark cycle ergometer). Since this study is a scenario theoretical study, it is planned to be implemented in the athlete with this scenario study in the future. The reliability and mathematical modeling of the scenario data arranged with the statistical method according to the found and calculated data were demonstrated in this study. SPSS 28.0 statistical analysis software is used for data analysis and evaluation. The data reliability of the scenarios was assessed using regression analysis. R^2 is 0.994 and respectively are presented in the graph in the equations. The $P<0.05$ was regarded as statistically significant. Data validation and statistical analysis show that athletes' weights are proportional to their anaerobic power using precision analysis, regression curves, and mathematical expressions. This study shows one-way ANOVA, spectral analysis, autocorrelation function, and t-test (Paired Samples Statistics). Force and power data errors can be verified by scenario data.

The body heats from sports energy. Wind and temperature fluid mechanics and conduction, convection, and radiation heat transfers should be studied by athletes (blood circulation, heart pumping). Fluid mechanics and heat transfer equations. Food affects athletes' performance. After exercise, 600 kcal/h is burned. Contracting muscles produce cellular molecules and condense extracellular fluids (14). The reactant-product energy difference is hydrolysis-free free energy. Eq. (R1) produces high-energy phosphate ATP (14):

$$\text{(R1): } ATP + H_2O \xrightarrow{\text{ATPase}} ADP + P_i - \Delta G\ (7.3\,\tfrac{\text{kcal}}{\text{mol}})$$

ATP is made of adenine, ribose, and three phosphates. Energy is stored in outer phosphate high-energy bonds (13). In 8 seconds, muscle high-energy phosphate bonds provide intense energy for volleyball, football, baseball, and golf (13). Anaerobic energy transfer calculates sports energy systems. The athlete's force, distance, and time determine power. Wingate cycle ergometer tests modeled anaerobic capacity (a mechanically braked bicycle ergometer tester). Electrical or mechanical counters measure flywheel revolutions at 5 [d/s] for 30 seconds, working energy [J], and working power [W]. Flywheel resistance (FR) is 0.075 kg/kg body mass (13, 14). This study used a model to examine 55–90 kg 21 scenario athletes (simulation). The weights of 21 scenario athletes ranged from 36.8 [N] to 66.2 [N].

The Wingate test (Monark cycle ergometer) was modeled using literature pedal revolution and applied resistance force (6.0 m/rev) (13, 14). In 30 seconds, there are 60 pedal cycles with 15, 12, 9, and 6 [rev] equal intervals per 5-second interval. Eqs. (1) and (2) calculate the athlete's power application during active sport (14, 23):

$$(1):\ \mathrm{P_{sport}}\ [\mathrm{W}] = \frac{\mathrm{E_{sport}[J]}}{\mathrm{t\ [s]}}$$

$$(2):\ \mathrm{P_{sport}}\ [\mathrm{W}] = \frac{\mathrm{W_{sport}[N] \times d[m]}}{\mathrm{t\ [s]}}$$

Where $\mathrm{P_{sport}}$ is a power application of the athlete, $\mathrm{E_{sport}}$ is an energy application of the athlete, $\mathrm{W_{sport}}$ is a force application of the athlete, and d is the distance of the cycle tolling, and traveling me of the athlete's active during the sport.

The force of the athlete can be determined from Eq. (3) as below (23):

$$(3):\ \mathrm{W_{sport}}\ [\mathrm{N}] = \mathrm{FR}\left[\frac{\mathrm{kg}}{\mathrm{kg\ body}}\right] \times \mathrm{m[kg]} \times \mathrm{g}\left[\frac{\mathrm{m}}{\mathrm{s^2}}\right]$$

Where m is the mass of the athlete and g is the gravity of the earth (nearly 9.81 [m/s^2]).

Peak power during the first five seconds of exercise emphasizes the energy system's energy-producing capacity (ATP and the muscle's high-energy phosphate element) (16, 18). Eq. (4) calculates relative peak power ($\dot{\mathrm{P}}_{\mathrm{sport}}$) output (13, 14, 23):

$$(4):\ \dot{\mathrm{P}}_{\mathrm{sport}}\ \left[\frac{\mathrm{W}}{\mathrm{kg}}\right] = \frac{\mathrm{P_{sport}[W]}}{\mathrm{m\ [kg]}}$$

Anaerobic fatigue is expressed as a percentage of power output drop during testing and total ATP generation using short-term energy. Eq. (5), Eq. (6), and Eq. (7) calculate anaerobic fatigue and capacity (14):

$$(5):\ \eta_{\mathrm{anaerobic}}[\%] = \frac{\mathrm{P_{high}\ [W] - P_{low}\ [W]}}{\mathrm{P_{high}\ [W]}} \times 100\%$$

$$(6):\ \mathrm{P_{high}}\ [\mathrm{W}] = \mathrm{P_{low}}\ [\mathrm{W}] = \frac{\mathrm{W_{high\ or\ low}[N] \times d[m]}}{\mathrm{t\ [s]}}$$

$$(7):\ \mathrm{P_{anaerobic}}\ [\mathrm{W}] = \frac{\mathrm{W_{sport}[N] \times d[m]}}{\mathrm{t\ [s]}}$$

Where $\mathrm{P_{anaerobic}}$ is an anaerobic capacity and $\eta_{\mathrm{anaerobic}}$ is anaerobic fatigue.

RESULTS

Analysis of the weight, sport, and anaerobic power was calculated from the scenario data. Power and weight equations for sport and anaerobic power can be used to analyze weight, sport, and power. Firstly, the rate of ATP consumption during sports activity was estimated from the data. Table 1 shows that high ATP turnover requires a resting athlete to consume ATP in 6 hours. In intense sports, ATP consumption can reach 5 kg/min (in about 10 min).

Table 1. The rate of ATP consumption during sports activity

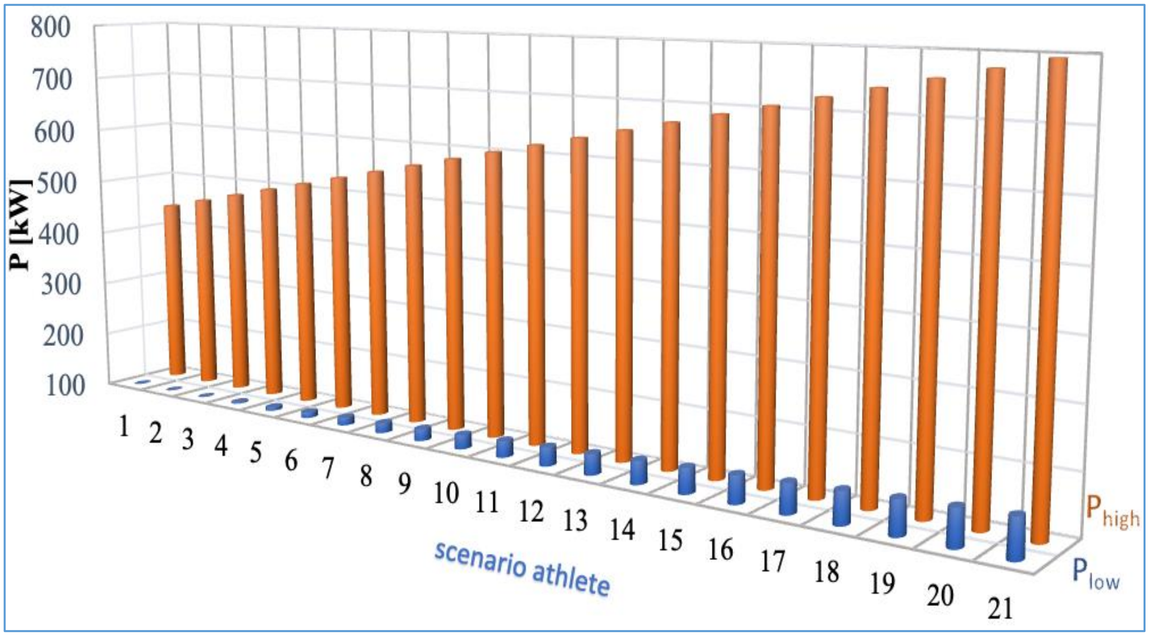
Definition of ATP	Rate of ATP consumption during sports activity		
Turnover	0.0278 kg/min	1.67 kg/h	40.08 kg/day
Intense sports	0.5-1 kg/min	30-60 kg/h	720-1440 kg/day

Data from the scenario was used to analyze the weight, sport, and anaerobic power. From Eq. (1) to Eq. (7) estimated anaerobic fatigue and capacity. The athletes' relative power was 13.2 [W/kg]. The mass relationship between the highest achievable power and the lowest power determined anaerobic fatigue for all athlete scenarios Table 2 presents 21 scenario athletes that had anaerobic fatigue by 79% and anaerobic capacities of 9.3 to 16.7 [kW]. Additionally, the scenarios' sport power ranged from 662.2 to 1191.9 [kW]. In the analysis of weight and anaerobic power, the association between the anaerobic power capacity and weights for the scenario study of 21 athletes' weights was taken into consideration.

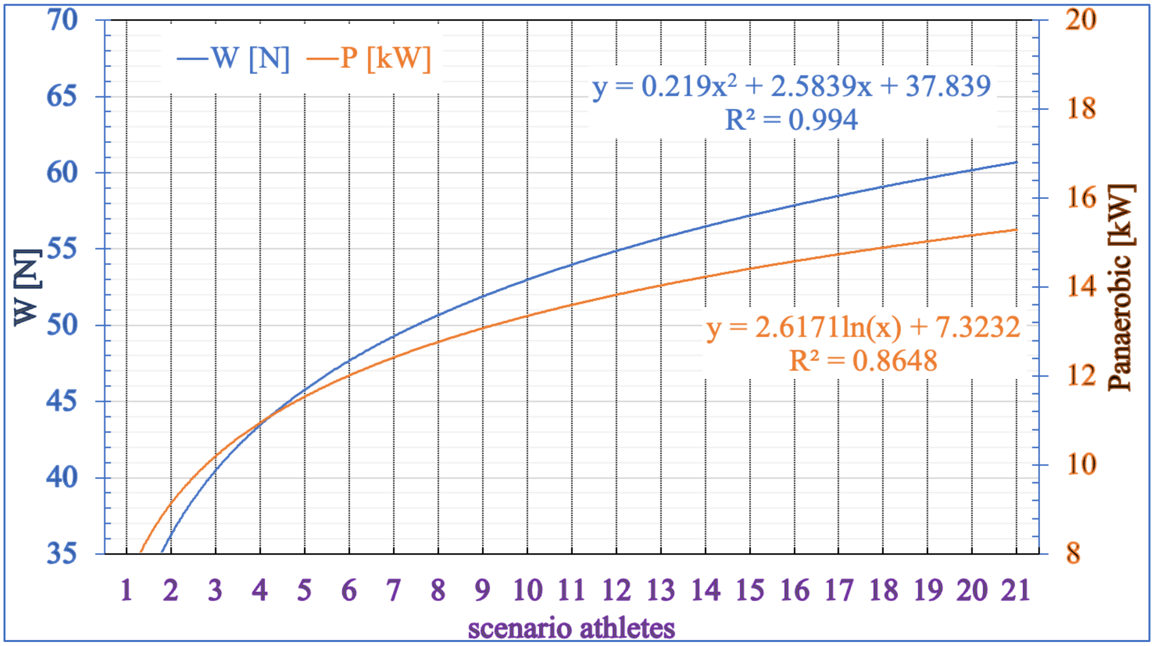
Table 2. The results of the anaerobic fatigue and capacity of the scenario athlete from 1 to 21

	Scenario athlete						
Parameters	1	2	3	4	5	6	7
m [kg]	50	52	54	56	58	60	62
W_{sport} [N]	36.8	38.3	39.7	41.2	42.7	44.1	45.6
P_{sport} [W]	662.2	688.7	715.1	741.6	768.1	794.6	821.1
$P_{anaerobic}$ [W]	9270.5	9641.3	10012.1	10382.9	10753.7	11124.5	11495.4
$P_{anaerobic}$ [kW]	9.3	9.6	10.0	10.4	10.8	11.1	11.5
	Scenario athlete						
Parameters	8	9	10	11	12	13	14
m [kg]	64	66	68	70	72	74	76
W_{sport} [N]	47.1	48.6	50.0	51.5	53.0	54.4	55.9
P_{sport} [W]	847.6	874.1	900.6	927.0	953.5	980.0	1006.5
$P_{anaerobic}$ [W]	11866.2	12237.0	12607.8	12978.6	13349.4	13720.3	14091.1
$P_{anaerobic}$ [kW]	11.9	12.2	12.6	13.0	13.3	13.7	14.1
	Scenario athlete						
Parameters	15	16	17	18	19	20	21
m [kg]	78	80	82	84	86	88	90
W_{sport} [N]	57.4	58.9	60.3	61.8	63.3	64.7	66.2
P_{sport} [W]	1033.0	1059.5	1086.0	1112.5	1138.9	1165.4	1191.9
$P_{anaerobic}$ [W]	14461.9	14832.7	15203.5	15574.4	15945.2	16316.0	16686.8
$P_{anaerobic}$ [kW]	14.5	14.8	15.2	15.6	15.9	16.3	16.7

The athlete scenarios calculate low and high power and graph in Figure 1a. The scenario shows athletes rise 441.63–794.93 [kW] and 91.93–165.48 [kW]. Figure 1b shows weight affects anaerobic power athlete results. The accuracy analysis, regression curves (logarithmic trend), and mathematical expression show that athletes' weights directly proportion to their anaerobic power. Anaerobic power increases from 9.27 [kW] to 16.69 [kW], and weight increases from 36.8 to 66.2 [N].



(a)



(b)

Figure 1. The athlete's anaerobic power capacity and weight graphs.

Descriptive data (mean ± one standard deviation, and 95% confidence intervals) in Figure 2 can validate scenario data (24-26). According to the summary of the mean (SD) result of force and power, Wsport data range from 0.01 to 0.055, Psport data from 0.05 to 0.26, and Panaerobic data from 0.005 to 0.035.

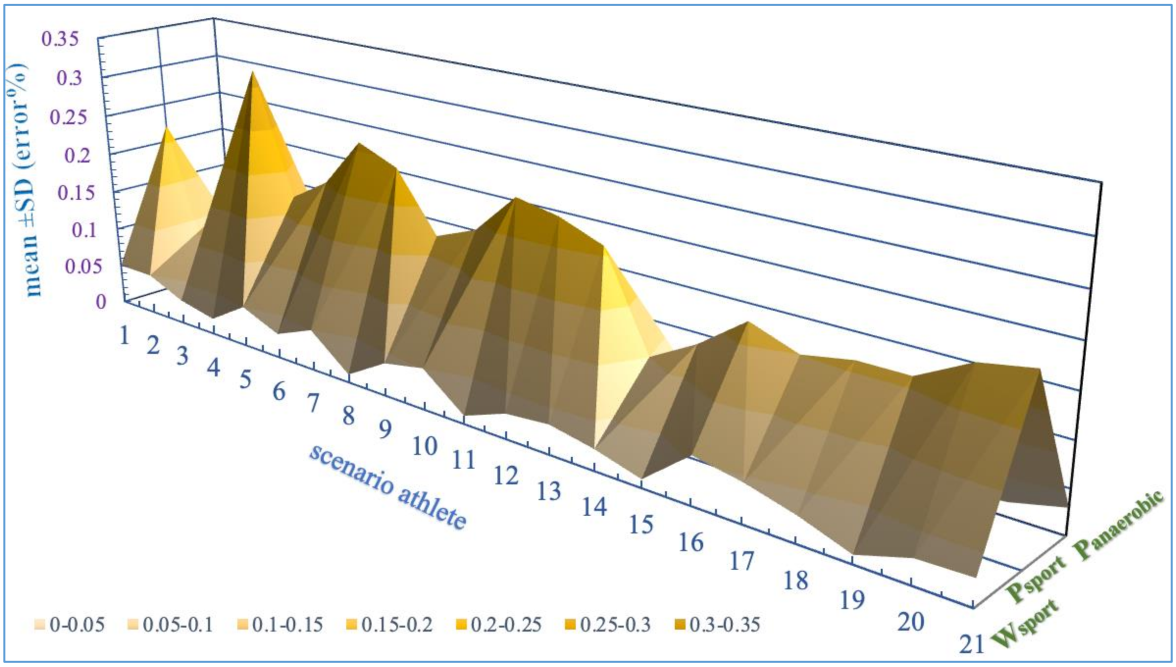


Figure 2. Validation of the force and the power data error.

This study can analyze data using one-way analysis of variance. ANOVA is used to compare the mean scores of multiple data groups. Table 3 indicates the ANOVA and Autocorrelation function (ACF) of the mass, sport and anaerobic power results data. Table 3 shows one-way

ANOVA with one independent variable (a factor) and several conditions. Table 3 shows a mass, sport, and anaerobic power ANOVA results. The independent variable is mass (m). The regression, residual, and total ANOVA values for mass, sport, and anaerobic power were validated. All data had Sig. Values of 0, indicating no significant difference. Regression F values changed to 3021.59 (mass), 3032.32 (sport power), and 3031.85 (anaerobic power value). ANOVA sum of squares total values changed 1665.38 (mass), 5.4 E+5 (sport power), and 1.05 E+8 (anaerobic power value). The continuous variable is under consideration. Analysis of variance examines value differences and similarities between and within sets. A F ratio is calculated to determine if the independent variable causes more variation across groups than within each group (error term). The F test shows group differences. This study controls the autocorrelation function (ACF) by computing mass results (scenario data). SPSS only provides ACF for time series data in Table 3. Time series values are one variable. ACF calculates number lags. The autocorrelation masses were 0.857 to -0.403. The Mass standard error was 0. 203–0. 102. Box-Ljung Statistic Sig.b is 2.5E-5–1.5E-16. The table shows autocorrelation confidence intervals. The Box-Ljung test determines the time series autocorrelation significance.

Table 3. ANOVA and Autocorrelation function (ACF) of the mass, sport and anaerobic power results data

The independent variable is m.	ANOVA	Sum of Squares	df	Mean Square	F	Sig.
mass [kg]	Regression	1654.97	1	1654.97	3021.59	0
	Residual	10.41	19	0.548	-	-
	Total	1665.38	20	-	-	-
sport power [W]	Regression	5.36 E+5	1	5.36 E+5	3032.32	0
	Residual	3363.71	19	177.037	-	-
	Total	5.4 E+5	20	-	-	-
anaerobic power [W]	Regression	1.05 E+8	1	1.05 E+8	3031.85	0
	Residual	6.59 E+5	19	3.47 E+4	-	-
	Total	1.05 E+8	20	-	-	-

Lag	Autocorrelation mass [kg]	Std. Error[a]	Box-Ljung Statistic Value	df	Sig.[b]
1	0.857	0.203	17.743	1	2.5E–5
2	0.716	0.198	30.760	2	2.1E–7
3	0.577	0.193	39.682	3	1.2E–8
4	0.442	0.188	45.221	4	3.6E–9
5	0.312	0.182	48.154	5	3.3E–9
6	0.188	0.176	49.296	6	6.5E–9
7	0.073	0.170	49.479	7	1.8E–8
8	-0.034	0.164	49.521	8	5.1E–8
9	-0.130	0.158	50.200	9	9.9E–8
10	-0.214	0.151	52.216	10	1.0E–7
11	-0.286	0.144	56.159	11	4.8E–8
12	-0.343	0.137	62.467	12	8.0E–9
13	-0.384	0.129	71.389	13	4.4E–10
14	-0.409	0.120	82.937	14	8.0E–12
15	-0.416	0.111	96.840	15	5.2E–14
16	-0.403	0.102	112.497	16	1.5E–16

a. Independence is considered to be the underlying process (white noise).
b. The asymptotic chi-square approximation was utilized.

ACF and PACF validating the coefficient's anaerobic power value (upper and lower limit). ACF curves validate anaerobic power values steadily from 0.8 to -0.4. PACF shows that curves validate anaerobic power values steadily from 0.8 to -0.05. ACF's lagged autocorrelation charts for each estimated model. Each estimated model has a delayed partial autocorrelation table from PACF. Partial autocorrelation confidence intervals are on the table. T-test for paired-samples statistics determines if results differ significantly and are compatible. The mass parameter correlated with strength, sport power, and anaerobic power.

Data statistics and validation were presented to assess the accuracy and reliability of the results. Table 4 summarizes the logarithmic model's R, R^2, adjusted R^2, and estimate standard error. Mass, sport, and anaerobic power R and R^2 are between 0.997 and 0.994, respectively. In addition, Table 4 computes T-test for the one sample statistics. These results are at (25.863), df (20), Std. Deviation (from 9.126 to 2300.861), Std. Error Mean (from 1.991 to 502.089) for the force, sport, and anaerobic power, respectively.

Table 4. Summary of the logarithmic model and T-Test (One-Sample Statistics)

logarithmic model	R	R^2	Adjusted R^2	Std. Error of the Estimate
mass [kg]	0.997	0.994	0.993	0.740
sport power [W]	0.997	0.994	0.993	13.306
anaerobic power [W]	0.997	0.994	0.993	186.292

The independent variable is m.

T-Test (One-Sample Statistics)	Test Value = 0						Standard	
	t	df	Sig. (2-tailed)	Mean Diff.	95% Confidence Interval of the Diff.		Std. Devia.	Std. Error Mean
					Lower	Upper		
force [N]	25.863	20	0	51.50	47.35	55.65	9.126	1.991
sport power [W]	25.849	20	0	927.04	852.23	1001.85	164.347	35.863
anaerobic power [W]	25.849	20	0	12978.63	11931.29	14025.97	2300.861	502.089

DISCUSSION

Athletes' bodies use and produce ATP to fuel their activities. According to the study, ATP assists athletes perform and exert more power while using less energy. This study showed that the relationship between nutrition and athlete weight and athletic performance was affected by controlling athlete performance in 21 scenarios. In this study, a theoretical study was conducted using the cycle ergometer device and 21 hypothetical athlete weights as standards. This study used the Wingate test on the cycle ergometer to calculate the athlete's anaerobic power and capacities in 30 seconds. Sports requiring high energy use 8.33–16.67 [g/s] of ATP .

Anaerobic fatigue was found in 79% of 7 scenario athletes with different masses, and 21 scenario athletes had 10.2–16.7 [kW] anaerobic power capacities (a scenario study on estimated athlete weights). The results' accuracy and reliability were evaluated. The weight-power regression curve. Weight and anaerobic power were mathematically correct. The scenario data was validated by regression and analysis of the study.

The research reveals a direct correlation between anaerobic power and outcomes, and that certain models (bikes, other sporting vehicles, etc.) could be created by using them in sports (27, 28). The athlete viewed anaerobic fatigue as a flaw. When used properly, proteins, fats, and carbohydrates increase ATP and energy levels.

CONCLUSION

Using power and weight equations for both aerobic and anaerobic power, it is possible to analyze weight, sport, and power in this study. The athletes' relative power was 13.2 [W/kg]. Anaerobic fatigue was determined for all athlete scenarios by the mass relationship between the highest achievable power and the lowest power. Table 2 lists 21 athletes in a scenario who had anaerobic capacities ranging from 9.3 to 16.7 [kW] and anaerobic fatigue by 79%. Furthermore, the sport power in the scenarios ranged from 662.2 to 1191.9 [kW]. The relationship between the anaerobic power capacity and weights for the scenario study of the weights of 21 athletes was taken into account in the analysis of weight and anaerobic power. According to the modeling, the athletes in the scenario had anaerobic power capacities between 10.2 [kW] and 16.7 [kW] and anaerobic fatigue efficiency greater than 80%.

Athletes rise 441.63-794.93 [kW] and 91.93-165.48 [kW] in the scenario. Weight impacts anaerobic power athlete performance, as shown in Figure 1b. The accuracy analysis, regression curves (with a logarithmic trend), and mathematical expression all demonstrate that the relationship between an athlete's weight and their anaerobic power is direct. Weight increases from 36.8 to 66.2 [N], while anaerobic power rises from 9.27 to 16.69 [kW].

APPLICABLE REMARKS

- In 21 scenarios, controlling athlete performance had an impact on the relationship between nutrition, athlete weight, and athletic performance.
- Given that the study correlated energy and power, nutrition and exercise have an impact on the cycle ergometer model and simulation of energy-power.
- The athletes in the scenario had anaerobic power capacities between 10.2 [kW] and 16.7 [kW] and anaerobic fatigue efficiency greater than 80%.
- The body produces and uses ATP, which improves performance.

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This study is an original and novel scientific research that is about food nutrition of the athlete's sports exercise performance by including various scenarios.

AUTHORS' CONTRIBUTIONS

Study concept and design: Oznur Oztuna Taner. Acquisition of data: Oznur Oztuna Taner. Analysis and interpretation of data: Oznur Oztuna Taner. Drafting the manuscript: Oznur Oztuna Taner. Critical revision of the manuscript for important intellectual content: Oznur Oztuna Taner. Statistical analysis: Oznur Oztuna Taner. Administrative, technical, and material support: Oznur Oztuna Taner. Study supervision: Oznur Oztuna Taner.

CONFLICT OF INTEREST

The author mentions that there is no "Conflict of Interest" in this study.

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