Macronutrient Intake And Energy Expenditure Between Sanda And Taolu Athletes: Gender Differences And Performance Implications

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ABSTRACT

Background: *Nutritional profile of Wushu (events like Sanda and Taolu) is vital for optimizing athletic performance. Present study correlates and analyzes macronutrient profile of Sanda and Taolu to understand gender differences, and performance implications linked with macronutrient intakes, and energy expenditure measures.* ***Methods:*** *Thirty trained Wushu athletes [14 males (Sanda=7, Taolu=7) and 16 females (Sanda=7, Taolu=9)] were selected as subjects. Anthropometric (height, weight, BMI); Macronutrient intake (carbohydrate, protein, and fat); energy expenditure measures [RMR, Total Daily Energy Expenditure (TDEE), Estimated Activity-Energy Expenditure (eAEE)/Estimate Energy Expenditure (EEE), estimated Fat-Free Mass (eFFM)]. Nutritional intake was assessed by using a 24-hour dietary recall method and analyzed via DietCal software. Statistical analysis was done using SPSS software.* ***Results:*** *Male athletes showed significantly higher values in height, weight, carbohydrate intake, energy intake, RMR, TDEE, NEEE, and EEE than females. Sanda athletes reported higher protein, fat, and carbohydrate intakes than Taolu athletes. Gender-wise both groups maintained similar EA levels, although the values were relatively low, indicating a potential risk of low energy availability. Sanda athletes exhibited significantly higher RMR than Taolu, reflecting greater muscle mass and physical demands. Correlation analysis revealed positive and significant associations between EI with protein intake (r = 0.831), fat intake (r = 0.910), and carbohydrate intake (r = 0.896). The EA was positively and significant with protein intake (r = 0.527), fat intake (r = 0.642), and carbohydrate intake (r = 0.513). Regression analysis showed that body weight, BMI, protein, fat, carbohydrate intake, TDEE, NEAT, and EEE significantly predicted RMR and EA.* ***Conclusion:*** *Sanda athletes demonstrated higher RMR as compared to Taolu athletes which reflects their higher energy intake and protein demand. Energy intake was positively correlated with macronutrient consumption. Regression analysis emphasized the importance of body weight and carbohydrate intake in predicting RMR and EA.*

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INTRODUCTION

The nutritional profiling of Sanda and Taolu, two styles of Wushu, are distinct due to the unique demands of each style and is very crucial for optimizing performance and achieving optimal body composition (Cortel et al., 2018, Artioli et al., 2009). The two primary competitive formats in wushu sport are fighting (Sanda) and exhibiting (Taolu). The main events of Taolu count as an artistic form under Wushu. This second event, Sanda is counted as the fighting aspect of Wushu. Sanda demands higher anaerobic endurance and power for optimizing in a full-combat style which can be enhanced through a diet containing high protein and carbohydrates (i.e., whole grains, fruits, and vegetables) specially to maintain optimal energy levels during competition. Carbohydrate provides energy for the high-intensity activities, intermittent nature of the sport. Similarly, protein is also essential for muscle recovery and development, particularly after intense training sessions. In contrast, Taolu, a demonstrative martial art, emphasizes aesthetics and technique, requiring a more balanced diet that supports both energy and muscle maintenance (Tan et al., 2018). Where Taolu athletes focus more on complex carbohydrates, lean protein, and healthy fats (Artioli et al., 2009).

Body composition is a key factor in both Sanda and Taolu athletes, as it affects performance and injury risk. Chathuranga et al., (2022) have reported that the body composition, particularly abdominal skinfolds of Sanda athletes was significantly related to sports performance. Where diet that supports optimal body composition, with a focus on lean muscle mass and low body fat, is essential for both styles (Sarkar et al.,2019, Chathuranga et al.,2022).

The availability and energy intake are essential factors in high-intensity game forms like Wushu. Energy availability refers to the amount of energy available in the body after accounting for the energy expended during training (Abulmeaty et al., 2024).Inadequate energy availability can cause athletes to become fatigued, have decreased strength, and delay their recovery, all of which can negatively affect their performance. On the other hand, sustaining ideal energy availability with a well-balanced diet can improve performance and lower the chance of injuries (Cassaza et al, 2018). Overall, maintaining adequate energy availability through a balanced diet and understanding the impact of training load on energy availability are crucial for Wushu athletes to perform at their best and limit the hazards associated with low energy availability.

Energy Availability can be calculated via the Energy Balance (EA-EB) method, which calculates energy intake by combining objective measures of body energy storage and total energy expenditure (Lane et al., 2019). Adults' total energy expenditure (TEE) is composed of three parts: activity-energy expenditure (AEE), thermal effect of food (TEF), and basal/resting energy expenditure. Exercise energy expenditure (EEE) and Non-Exercise activity thermogenesis (NEAT) are two more subgroups of the AEE. The NEAT is the amount of energy used by skeletal muscles during non-voluntary exercise and physical activities. Instead of focusing on EEE, the researchers assess the AEE in athletes to understand the trends in energy expenditure measures associated with physical activity which is not related to exercise (NEAT) (Casazza et al., 2018).

There are limited studies about nutritional requirement among Indian Wushu players with relation to their energy expenditure. The present study aims to determine the difference between Sanda and Taolu by analyzing the nutritional profiles also finding their correlation between Energy Intake (EI), Energy Availability (EA), Total Daily Energy Expenditure (TDEE), and Resting Metabolic Rate (RMR).

METHODOLOGY

Subject selection:

The present study was conducted on thirty (n=30) trained Wushu players under the various schemes in Sports Authority of India, NS NIS Patiala which includes 14 males (Sanda=7, Taolu=7); and 16 females (Sanda=7, Taolu=9) athletes. Mean age of male=20.64±2.47 years, and female=20.31±2.85 years. All the players had a minimum of 5 years of formal training history. Before the commencement of the test, all subjects were clinically examined and only the medically fit players were recruited for the present study. The present study followed the ethical guidelines of the Declaration of Helsinki (1975) and informed consent was also obtained from every player.

Anthropometric measurements:

Standing height (cm) was recorded to the nearest 0.1cm by using a Seca stadiometer (model – 213, Seca Deutschland, Germany), and Body weight (kg) was measured to the nearest 0.1 kg by using a calibrated Seca alpha weighing scale (model 770) by following standard procedure (Sarkar et al.,2019).

Nutritional assessment:

Data were obtained regarding eating behaviors, including meal schedules, frequency, likes and dislikes of food, and meal skipping. A 24-hour dietary recall questionnaire that had been pre-tested was used to determine the amount of each food items that was consumed. The amount of water and supplements consumed each day was also noted. The nutrients in the prepared foods were converted to their raw amounts and computed using the information gathered from the 24-hour recall method. The All-India Institute of Medical Sciences (AIIMS), New Delhi's Department of Dietetics created the software DietCal (version 10.0), which was used to compute the nutrients. The software's nutritional values are derived from the numbers listed in the ICMR publication "Nutritive Value of Indian Foods." (Singh et al., 2015).

Measuring the RMR:

The Resting Metabolic Rate (RMR) is measured by the Cunningham equation (Abulmeaty et al., 2024). The fat-free mass (FFM) of each athlete was calculated by using their Inbody Body composition analyzer (model: Inbody770, Inbody Co. Ltd., Seoul, Korea) data i.e., body weight (kg) and body fat (%).

The Cunningham RMR formula: RMR = 500 + (22*FFM)

Estimated Activity-Energy Expenditure:

The statistical study employed the estimated average activity-energy expenditure (eAEE) (kcal/day), which accounts for both non-exercise activity thermogenesis (NEAT) and Exercise Energy Expenditure (EEE). The software calculates average eAEE/activity hour (kcal/h), metabolic equivalent (MET), step count, steps per minute, and daily counts per minute (CPM). Exercise energy expenditure (EEE) was calculated using the Compendium of Physical Activity (Amy et al., 2019, Lane et al., 2019).

Energy Intake and Energy Availability:

Energy availability was calculated by subtracting the average EEE (kcal/day) from the EI (kcal/day) and dividing the result by the eFFM. Energy availability status was categorized by risk level for low EA: At risk (AR): ≤ 30 kcal/kg eLBM; Moderate risk (MR): 30–45 kcal/kg eLBM; and No risk (NR): ≥ 45 kcal/kg eLBM. Energy availability at less than 30 Kcal/kg eFFM/day was considered low energy availability (LEA) (Lane et al,2019).

EA = (energy intake (EI; kcals) − (exercise energy expenditure (EEE; kcals) − resting metabolic rate (RMR]/min of exercise))/kilograms of estimated lean body mass (eLBM)

Statistical analysis:

The analysis of data was done by using Statistical Program for the Social Sciences (SPSS) version 20.0 for Windows (SPSS Inc., Chicago, Il, USA). All recorded values were expressed as mean standard deviation (SD) and the normality was verified using the Shapiro-Wilk W-test. The difference between the mean of various groups was done by an independent sample t-test. Pearson bivariate Correlation was analyzed to check the correlation coefficient. Multiple regression equation was also done to identify the predicting variables for the dependent variables. Scatter plot graphs were analyzed among some selected variables to check the inter-variable relationship. The significance level was determined by fixing the confidence interval at 95% ($p<0.05$).

RESULTS

Table 1 depicts the gender-wise comparison of anthropometric variables and selected nutritional profile indices of trained wushu players. Variables i.e., height ($p<0.001$), weight ($p<0.01$), carbohydrate ($p<0.01$), energy ($p<0.05$), RMR ($p<0.001$), TDEE ($p<0.001$), NEEE ($p<0.001$), EEE ($p<0.01$) were found to be significantly higher in male wushu athletes in comparison to their female

Table 1: Comparison of Gender difference for general anthropometric variables and selected nutritional profile indices.

Variables	Male	Female	t-value	Sig.	% difference
Height (cm)	170.51±6.62	159.61±6.75	-4.455	<0.001***	6.39
Weight(kg)	67.68±8.62	57.06±6.41	-3.859	0.001**	15.69
BMI(kg/m^2)	22.78±2.19	22.29±1.12	-0.789	0.437 ^{NS}	2.15
Protein Intake (gms)	133.23±42.04	114.32±38.35	-1.289	0.208 ^{NS}	14.29
Fat Intake (gms)	150.24±44.47	121.59±46.87	-1.711	0.098^{NS}	19.07
Carbohydrate Intake (gms)	381.37±119.89	259.06±98.93	-3.061	0.008**	32.07
Energy(Kcal)	3460.26±909.47	2629.02±898.51	-2.514	0.018*	24.02
EA (Kcal/kg effm/day)	16.99±13.84	20.46±20.79	0.529	0.601^{NS}	-20.42
RMR(Kcal/day)	1780.79±134.58	1410.36±114.21	-8.158	<0.001***	20.80
TDEE (Kcal/day)	4474.50±689.31	3504.60±429.8	-4.688	<0.001***	21.68
NEEE(Kcal/day)	2374.77±273.78	1809.15±240.48	-6.026	<0.001***	23.83
EEE(Kcal/day)	2105.58±492.38	1695.45±305.77	-2.779	0.010**	19.48

Values are expressed as mean±SD, * = p < 0.05, **= p<0.01, *** = p < 0.001, NS = not significant, Sig.= significance, RMR=Resting metabolic Rate, EA = Energy Availability, EI= Energy Intake, TDEE = Total daily energy expenditure, NEEE=Non-Energy Expenditure, EEE= Exercise Energy Expenditure.

counterpart. Whereas, other variables i.e., BMI, protein intake, fat intake, and energy availability do not show any significant mean difference when compared between both genders.

Table 2 shows the comparison of male Sanda and Taolu concerning their anthropometric variables and selected nutrition variables. The RMR was found to be significant (p<0.05) whereas other variables i.e., BMI, protein intake, fat intake, carbohydrate intake, and energy intake do not depicted any significant mean difference among specific gender in Sanda and Taolu. Although fat intake, protein intake, carbohydrate intake, and energy intake were found to be higher in male Sanda as compared to their male Taolu counterpart.

Table 3 depicts that the female Sanda and Taolu have no significant difference among the variables. Variables i.e., carbohydrate intake, energy availability, energy intake, and TDEE, female sanda depicted slightly higher values in comparison to male counterparts although the difference was statistically insignificant.

Table 4 depicts the Pearson's correlation matrix for Energy Intake (EI), Resting Metabolic Rate (RMR), and

Table 2: Comparison among male Sanda and Taolu for general anthropometric variables and selected nutritional profile indices.

Variables	Sanda	Taolu	t- value	Sig.	% difference
Height (cm)	172.61±7.05	168.40±5.89	1.213	0.248 NS	2.44
Weight (kg)	71.73±9.96	63.63±4.85	1.934	0.077 NS	11.29
BMI (kg/m^2)	22.86±3.02	22.70±1.12	0.133	0.896 NS	0.71
Protein Intake (gms)	150.26±47.59	116.21±29.81	1.604	0.135 NS	22.66
Fat Intake (gms)	165.89±53.69	134.60±28.82	1.358	0.199 NS	18.86
Carbohydrate Intake (gms)	425.82±149.01	336.93±65.83	1.444	0.174 NS	20.88
Energy (Kcal)	3855.55±1079	3064.97±512.78	1.751	0.106 NS	20.50
EA (Kcal/kg effm/day)	16.56±17.52	17.38±10.36	-0.107	0.917 NS	-4.95
RMR(Kcal/day)	1861.64±129.23	1699.94±85.38	2.762	0.017*	8.69
TDEE (Kcal/day)	4526.52±968.55	4422.49±291.68	0.272	0.790 NS	2.30
NEEE(Kcal/day)	2371.63±346.98	2377.92±204.90	-0.041	0.968 NS	-0.27
EEE(Kcal/day)	2169.18±678.76	2041.99±234.82	0.469	0.648 NS	5.86

Values were expressed as mean±SD, *= p<0.05, **=p<0.01, *** = p<0.001, NS = Not Significant, RMR = Resting metabolic Rate, EA = Energy Availability, EI= Energy Intake, TDEE =Total daily energy expenditure, NEEE= Non-Energy Expenditure, EEE= Exercise Energy Expenditure, Sig.=significance.

Energy Availability (EA) with some selected nutritional variables. Where, EI, RMR, and EA were found to be positively correlated with most of the variables. Energy intake has a positive correlation with protein intake, fat intake, and carbohydrate intake with p<0.01 level and a positive correlation with EA, RMR, and EEE with p<0.05 level. Energy Availability has a positive and significant (p<0.01) correlation with protein, fat, and carbohydrate intakes. The RMR was positively significantly correlated with weight, TDEE (p<0.01), and carbohydrate and EEE (p<0.05).

Table 5 depicts the regression Equation predicting the resting metabolic rate (RMR) and energy availability (EA). The regression equation for predicting RMR via various nutritional-related variables with F=16.967, p<0.001; coefficient constant t=1.424, p= 0.170. On the other hand, the regression equation for EA depicts F=8.499, p<0.001; coefficient constant t=-0.788, p= 0.440.

Graph 1(A) represents the relationship between Energy vs RMR (Male: y= -7.72E2+2.38*x, R^2=0.124; Female: y=

Table 3: Comparison among female Sanda and Taolu for general anthropometric variables and selected nutritional profile indices.

Variables	Sanda	Taolu	t-value	Sig.	% difference
Height (cm)	161.23±8.74	158.43±4.90	-0.840	0.415 NS	-1.82
Weight(kg)	59.31±8.89	55.31±3.14	-1.264	0.227 NS	-7.24
BMI(kg/m^2)	22.61±1.42	22.04±0.82	-1.006	0.331 NS	-2.57
Protein Intake (gms)	106.79±35.20	120.25±41.55	0.686	0.504 NS	11.20
Fat Intake (gms)	120.58±45.71	124.11±47.33	0.150	0.883 NS	2.84
Carbohydrate Intake (gms)	289.91±98.61	235.96±96.95	-1.094	0.292 NS	-22.86
Energy (Kcal)	2711.21±935.85	2582.20±890.44	-0.281	0.783 NS	-5.00
EA (Kcal/kg eFFM/day)	19.16±20.30	21.54±22.28	0.220	0.829 NS	11.04
RMR (Kcal/day)	1451.69±144.21	1378.22±78.76	-1.306	0.213 NS	-5.33
TDEE (Kcal/day)	3541.92±591.05	3475.58±286.64	-0.297	0.771 NS	-1.91
NEEE (Kcal/day)	1864.79±310.06	1765.88±177.51	-0.807	0.433 NS	-5.60
EEE (Kcal/day)	1677.12±389.37	1709.71±247.14	0.205	0.841 NS	1.91

Values were expressed as mean±SD, * = p < 0.05, **=p<0.01, *** = p < 0.001, NS = Not Significant. RMR = Resting metabolic Rate, EA = Energy Availability, EI-=Energy Intake, TDEE =Total daily energy expenditure, NEEE=Non-Energy Expenditure, EEE=Exercise Energy Expenditure, Sig.=significance.

3.43E3-0.56*x, R^2= 0. 005). Graph 1(B) represents the relationship between Energy vs Energy Availability (Male: y= 2.78E3+39.82*x, R^2=0.367; Female: y= 1.86E3+37.48*x, R^2= 0. 752). Graph 1(C) represents the relationship between TDEE vs RMR (Male: y= 3.91E3+0.32*x, R^2=0.004; Female: y= 2.26E3+0.89*x, R^2= 0.055). Graph 1(D) represents the relationship between Weight vs RMR (Male: y= 16.7+0.05*x, R^2= 0.547; Female: y= -15.15+0.05*x, R^2= 0.833).

DISCUSSION

Understanding energy availability (EA) and energy intake is crucial for optimizing performance and health in Wushu athletes. The present study aimed to examine and establish the relation among the nutritional intake of macronutrients, energy expenditure, EA,

Table 4: Pearson's correlation among Energy intake, Energy availability, RMR with anthropometric variables, and selected nutritional indices.

Variables	Energy Intake	Energy Availability	RMR
Weight(kg)	0.213	-0.086	0.851**
BMI(kg/m^2)	-0.072	0.069	0.273
Protein Intake (gms)	0.831**	0.527**	0.332
Fat Intake (gms)	0.910**	0.642**	0.357
Carbohydrate(gms)	0.896**	0.513**	0.434*
EA (Kcal/kg effm/day)	0.636**	1	-0.107
RMR(Kcal/day)	0.430*	-0.107	1
TDEE (Kcal/day)	0.351	-0.243	0.608**
NEEE(Kcal/day)	0.197	0.424	0.707
EEE(Kcal/day)	0.420*	-0.050	0.412*

Values expressed are Pearson's correlation coefficient, *=p< 0.05 level (2-tailed), **= p<0.01 level (2- 2-tailed), RMR = Resting metabolic Rate, EA = Energy Availability, EI= Energy Intake, TDEE =Total daily energy expenditure, NEEE=Non-Energy Expenditure, EEE= Exercise Energy Expenditure.

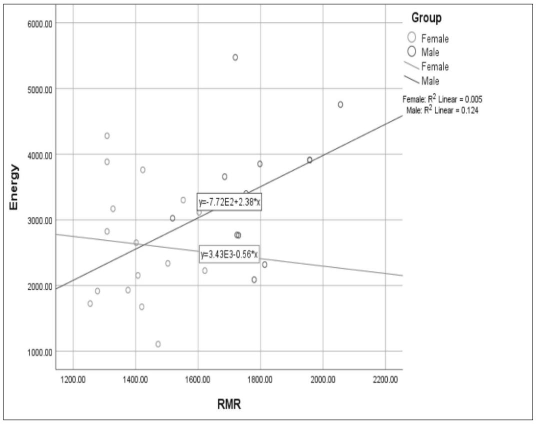
Table 5: Multiple Regression equation formation for RMR and EA of trained wushu players.

Multiple Regression Equation	R	R^2	SEE
RMR = (0.849)WGT(0.207)BMI+(0.144)PRO+(0.072)FAT+(0.326)CHO-(0.349)EI +(2.255)TDEE-(0.898)NEEE-(1.413)EEE +554.037	0.940	0.884	91.807
EA = (-0.392)WGT + (0.347)BMI + (0.290)PRO + (1.03)FAT + (0.982)CHO - (1.188)EI + (7.015)TDEE - (3.929)NEEE - (4.235)EEE – 32.369	0.890	0.793	9.691

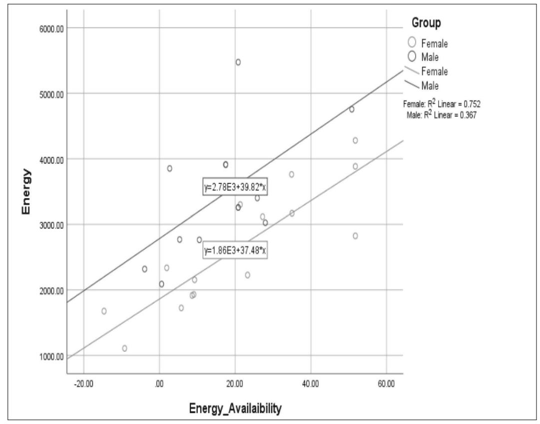
R=Correlation coefficient, SEE =Standard error of the estimate, RMR = Resting metabolic Rate, EA =Energy Availability, WGT= body weight, EI=Energy Intake, TDEE = Total daily energy expenditure, NEEE=Non-Energy Expenditure, EEE=Exercise Energy Expenditure, BMI= body mass index, PRO= protein intake, FAT= fat intake, CHO= carbohydrate intake.

and resting metabolic rate (RMR) among various wushu game forms i.e., Sanda and Taolu athletes.

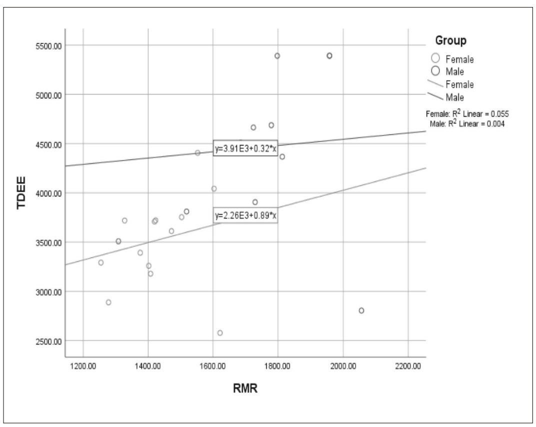
Sanda athletes reported higher intakes of protein [(Male: 150.26 gms (Sanda) vs. 116.21 gms (Taolu); Female: 106.76gms (Sanda) vs. 120.25gms (Taolu)], fat [(Male: 165.89 gms vs. 134.60 gms(Taolu); Female: 120.58gms (Sanda) vs 124.11gms(Taolu)], and carbohydrates [(Male: 425.82 gms (Sanda) vs. 336.93 gms(Taolu); Female: 289.91 gms(Sanda) vs 235.96 gms (Taolu)] as compared to Taolu athletes. Although these differences were not statistically significant, the greater energy



1(A)



1(B)



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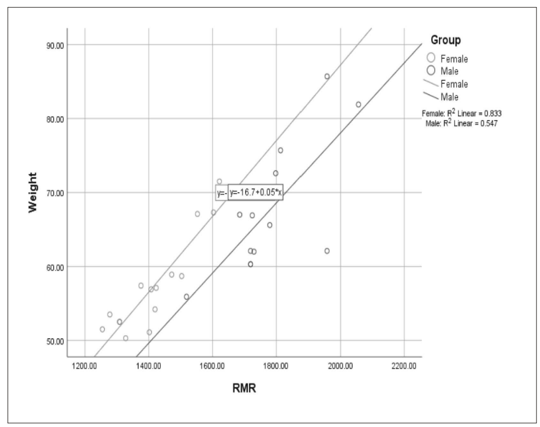

1(D)

Graph 1: The figure represents the following relationship among some selected variables i.e., (A) Energy vs RMR, (B) Energy vs Energy availability, (C) TDEE vs RMR, and (D) Weight vs RMR.

and protein needs of Sanda athletes to support muscle mass and recovery from intensive physical activity. Adequate protein intake is crucial for muscle repair and growth, particularly in combat sports where muscle strength and endurance are vital (Phillips & Van Loon, 2011).

Sanda athletes consumed more total energy [(Male: 3855.55 kcal (Sanda) vs. 3064.97 kcal (Taolu); Female: 2711.21 kcal (Sanda) vs 2582.20 kcal (Taolu)] than Taolu athletes, reflecting the increased energy demands of Sanda training. Ensuring sufficient energy intake is essential for maintaining performance and preventing energy deficits, which can impair recovery and increase injury risk (Burke & Deakin, 2015).

Both groups had similar EA [Male: 16.56 kcal/kg eFFM/day (Sanda) and 17.38 kcal/kg eFFM/day (Taolu); Female: 19.16 kcal/kg eFFM/day (Sanda) and

21.54 kcal/kg eFFM/day (Taolu)], indicating that athletes in both disciplines manage to maintain adequate energy availability for their training demands. However, the EA values are relatively low, suggesting a need for careful monitoring to ensure athletes do not enter a state of low energy availability, which can have adverse effects on health and performance (Mountjoy et al., 2018).

Sanda athletes exhibited a significantly higher RMR (Male: 1861.64 kcal/day; Female: 1451.69 kcal/day) compared to Taolu athletes (Male: 1699.94 kcal/day; Female: 1378.22 kcal/day), which might reflect the greater muscle mass and overall physical demands of Sanda athletes. Higher RMR indicates that Sanda athletes need more energy at rest, which must be accounted for in their dietary planning to prevent energy deficits and support recovery (Müller et al., 2002).

Both Sanda and Taolu athletes had comparable TDEE and NEEE values, indicating similar overall daily energy expenditures and non-exercise activity levels. This similarity suggests that, despite the differences in training intensity, both groups engage in similar amounts of daily physical activity outside their specific training regimens (Chathuranga et al., 2022). The exercise energy expenditure was slightly higher in Sanda athletes (2169.18 kcal/day) compared to Taolu athletes (2041.99 kcal/day) for males, aligning with the more intensive physical nature of Sanda training whereas Taolu females had slightly higher (1709.71kcal/day) than Sanda (1677.12kcal/day).

Energy intake showed significant positive correlations with protein ($r = 0.831, p < 0.01$), fat ($r = 0.910, p < 0.01$), and carbohydrate intake ($r = 0.896, p < 0.01$). This indicates that higher energy intake is associated with increased consumption of all three macronutrients, essential for meeting energy demands. Additionally, energy intake was positively correlated with RMR ($r = 0.430, p < 0.05$), suggesting that higher energy consumption supports higher metabolic rates (Burke & Deakin, 2015).

The EA showed significant positive correlations with protein intake ($r = 0.527, p < 0.01$), fat intake ($r = 0.642, p < 0.01$), and carbohydrate intake ($r = 0.513, p < 0.01$). This highlights the importance of balanced macronutrient intake for maintaining adequate EA, which is crucial for optimal performance and recovery (Mountjoy et al., 2018).

The RMR showed strong positive correlations with body weight ($r = 0.851, p < 0.01$) and TDEE ($r = 0.608, p < 0.01$), indicating that heavier athletes with higher total daily energy expenditure tend to have higher metabolic rates. This relationship underscores the importance of maintaining appropriate body weight and an active lifestyle for supporting metabolic health (Müller et al., 2002).

The study's regression analysis revealed significant predictors for both RMR and EA among male and female Wushu athletes. The high R^2 values (0.884 for RMR and 0.793 for EA) indicate that the regression models explain a substantial proportion of the variance in RMR and EA.

The regression equation for RMR

showed that body weight, BMI, protein intake, fat intake, carbohydrate intake, exercise time, TDEE, NEAT, and EEE significantly predict RMR. The positive coefficient for weight suggests that heavier athletes tend to have higher RMRs. This aligns with the understanding that a greater body mass requires more energy for maintenance. Studies have shown that lean body mass, particularly muscle mass, is a significant determinant of RMR (Müller et al., 2011).

The regression equation for EA highlighted the influence of weight, BMI, protein, fat, carbohydrate intake, exercise time, TDEE, NEAT, and EEE. The positive coefficients for body weight and carbohydrate intake indicate that greater body weight and higher carbohydrate intake contribute to higher EA. Carbohydrates are a primary energy source for athletes, crucial for high-intensity activities typical in Wushu (Hawley et al., 1997).

CONCLUSION

The present study underscores the critical role of energy availability (EA) and macronutrient intake in optimizing the performance and health of Wushu athletes. Sanda athletes with their higher energy and protein demands, demonstrated significantly higher RMR compared to Taolu athletes, highlighting the necessity for tailored dietary planning. Energy intake was positively correlated with protein, fat, and carbohydrate consumption, which are essential for meeting the energy requirements of intensive training regimens. The regression analysis emphasized the importance of body weight and carbohydrate intake in predicting RMR and EA. Practical implications include the need for personalized nutrition strategies focusing on balanced macronutrient intake to support the unique demands of Wushu training. Coaches and nutritionists should regularly monitor energy intake, body composition, and EA to ensure athletes maintain optimal energy levels, thereby enhancing performance and reducing the risk of energy deficits and associated health issues.

The high explanatory power of the regression models underscores the complex interplay between various physiological and nutritional factors influencing RMR and EA in Wushu athletes. The emphasis on body weight and carbohydrate intake highlights the need for personalized nutrition strategies to enhance athletic performance. Coaches and nutritionists should consider these variables when designing training and dietary programs. Regular monitoring of body composition and dietary intake can help in adjusting plans to meet the dynamic needs of athletes throughout their training cycles.

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