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Fitness in amateur track events athletes

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Abstract
The health athletes of is pivotal in athletic management and optimal sports performance. Although information on the fitness of amateur track events athletes has been well documented, few incidences have been given to Ghanaian athletes. This study presents the energy intake, blood pressure, heart rate, body composition and flexibility of amateur track events athletes and juxtapose that athletes are not always healthy. A cross sectional sample of 153 (Mage = 20.92 ± 2.41, Male =128, Female = 25) athletes participated in this study. 8.5% were underweight, 11.8% were pre-obese while 79.7% have healthy weight. The athletes significantly lack required energy intake ($P<0.05$). Differences on track events and body mass index classifications were significant ($P<0.05$). There were significance differences in body mass index (P =.000), systolic blood pressure (P =.001), diastolic blood pressure (P =.001), resting metabolism (P =.000), visceral fat (P =.000), %muscle mass (P =.000), % total body fat (P =.045) depending on gender. Fitness enhancing interventions that focused on integrated health performance monitoring approaches would be needed to improve energy intake, blood pressure, heart rate, body composition and flexibility of Ghanaian amateur track events athletes.

Keywords: Energy intake, blood pressure, resting metabolism, body fat, athletics

1. Introduction
According to Hirsch, Smith-Ryan, Trexler and Roelofs [1], track and field events is the most highly participated sport by female student and the third most participated sport for men all over the world. Sport participation is generally admitted to be highly demanding activity that requires exhibition of high fitness level and physiological functioning. [2-3] Athletic lifestyle compromised rigorous daily training schedules, weekly travels to competitions, high expectations from coaches and fans as well as uncertainties that cannot be predicted. [4-5] To become successful professionally, athletes are required to invest a lot of resources in terms of their time and energy towards their training programmes. This implies that athletes engage in strength and conditioning training programs to enhance their fitness levels. The success of an individual in any sport discipline is highly dependent on their health and fitness level. For athletes to make first team selection, successful club transfer-, avoid injuries and meeting the physical demands of the game largely depends on their level of fitness. Making a transition from amateur level to a professional level athlete requires enhanced skill acquisition and understanding of the game [1].

General optimal health and specific physiological functioning are significant higher level performance ingredients athletics [6]. The high physical demands in engaging in sport require that apart from maintaining a healthy profile, athletes should have reservoirs of energy for replenishment post high training and competitive intensities [7]. Worldwide, there has been a significant increment in the stature, body mass, BMI and decline in life expectancy of various population [8] especially developing countries such as Ghana. Subsequently, various morphological parameters have increased in these populations. Complexity and diversity in sport incorporate genetic, physiological capacities and psychological skills, in which morphological propensities equally play a role [9-10].

Consequently, recruiting athletes appropriate morphological profiles continued to be a common fascinating mile stone for most sports coaches [10-11]. Study has reported a relationship between success in track and field and morphology [2]. BMI is an energy indicator with significant correlation between total mass and height, and allows the comparison of athletes on various distances. Marc *et al*. [11] gave consideration to BMI as the most applicable profiles and conditions to realize optimal performance among track and field athletes as well as marathoners. Marc *et al*. [11] further reported that optimal BMI for men was 19.8 kg.m^2, and for the 10 best performers of all time a BMI range between 17.5 and 20.7 kg.m^2.

The undisputed influence of gender on the relative performance of athletes has been reiterated [12]. Gender is a vital interpersonal and genetically inclined parameter in competitive sports and study has reported that female athletes demonstrate higher cognitive anxiety [13] and low self-confidence [14] compared to males. Females demonstrate more emotion-focused coping strategies while males show more problem focused coping strategies associated to physiological compromise [15]. Katsikas, Argeitaki & Smirniotou [13] stated that female athletes were more focused on personal goals and reported higher on goal orientation while males were more focused on interpersonal comparison and reported high on win orientation. Katsikas, Argeitaki & Smirniotou [13] and Vealey [16] found that self-confidence levels were not statistically different for male and female elite athletes as physiological demands.

Athletics is a sport that alternate between aerobic and anaerobic energy systems, hence requiring muscular strength and power capability. Such muscular strength is derived from the energy supplies of the athletes. Although information on health profile 45 of amateur track events athletes has been documented [5, 17-18] addressing specific nation such as Ghana cannot be overemphasized. It also stems from the angle scarce sources of data in a striving nation. On the basis of realizing the need for athletes to exhibit high energy and fitness levels for optimum performance, the study examined and compared based on energy intake, blood pressure, heart rate, body composition, and flexibility the health and fitness profile of amateur track events athletes in Kumasi, Ghana. Studies in Ghana investigating the fitness components of track and field athletes in Ghana are limiting and as such the importance of this study. With the association between morphological parameters and success in athletics, it is also imperative why a study such as this investigating the trends in fitness components of amateur track events athletes is important.

2. Materials and methods

2.1 Study Design

This cross-sectional exploratory study assessed the energy intake and the health profile of amateur track events athletes who based in five cities: Kumasi, Cape Coast, Sunyani, Koforidua and Tamale but train at the Baba Yara Sports Stadium at Kumasi, Ghana. A bi-stage sampling technique was employed in the study. A total of 153 amateur track events athletes with a mean age of 20.92 (128 males and 25 females) were recruited using proportional cluster sampling technique. Convenient sampling was used to recruit athletes from 7 different track events in each cluster including 100m (N = 30, 19.6%), 110m hurdles (N= 31, 20.3%), 200m (N=30, 19.6%), 400m (N=13, 8.5%), 800m (N=24, 15.7%), 1500m (N= 18, 11.8%) and 5000m (N= 7, 4.6%).

2.2 Measurements (Times New Roman, 12, Bold)

Demographic information of age, gender, type of track events was obtained through self-reported response by the participants before they started their training in the morning. Measurements of height and body weight to the nearest 0.1m and 0.5kg respectively were done with the participants standing bare foot using a stadiometer (Seca 217, Hamburg, Germany). Body mass index (BMI) in kg/m2 was calculated by dividing weight (kg) by the square of height (m). [19] Omron blood pressure monitor (M10-IT, Omron Healthcare) was used to measure systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate at rest. Resting blood pressure was measured 3 times and the average recorded as the final blood pressure of the athletes. Values of resting metabolism, visceral fat, percentage muscle mass and percentage total body fat were recorded form the analysis obtained in Omron Body Composition Monitor (BF511, Omron Healthcare, Hoofddorp, Netherlands). Flexibility was measured using the acuflex Modified sit and reach test box (Model 01285B, Novel Products, Inc., Rockton, IL, USA) while energy intake of the athletes were assessed using the 24-hour recall and then analysed using the nutrient content of some Ghanaian foods compiled by Tayie and Lartey. [20] The total energy requirements of the athletes were also calculated using the Harris-benedict equation. For men: B.E.E. = 66.5 + (13.7577 x kg) + (5.003 x cm) - (6.775 x age); for women: B.E.E. = 655.1 + (9.563 x kg) + (1.850 x cm) - (4.676 x age). Total Caloric Requirements equal the B.E.E. multiplied by the sum of the stress and activity factors. Stress plus activity factors range from 1.2 to over 2.

2.3 Statistical Analysis

Data collected were inputted into Statistical Package for Social Sciences (SPSS) version 23.0 for analysis. Descriptive statistics of all variables including mean, standard deviation and skewness were determined. One-way ANOVA was performed to determine differences on measured variables based on track events and BMI classifications. Gender differences were investigated using independent sample t-test. Statistical significance was set at $p<0.05$ for all analysis.

3. Results & Discussion

Table 1: Summary Results of Variables, Gender, Track Events and BMI Classification (N=153)

	Mean	S.E.M	Std. Dev.	Skewness	Gender	N	%
Age (yrs)	20.92	.19	2.41	.000	Male	128	83.7
Weight (kg)	59.19	.58	7.20	.886	Female	25	16.3
Height (cm)	165.99	.44	5.51	-.017	**Track Events**		
BMI (kg/m^2)	21.86	.22	2.84	.352	100m	30	19.6
Systolic Blood Pressure (mmHg)	126.79	1.11	13.84	-.603	11m Hurdles	31	20.3
Diastolic Blood Pressure (mmHg)	78.13	.85	10.51	-.433	200m	30	19.6
Resting Heart Rate (bpm)	74.37	1.20	14.91	.329	400m	13	8.5
Resting Metabolism	1487.96	12.14	150.24	-.352	800m	24	15.7
Visceral Fat	4.49	.22	2.74	.737	1500m	18	11.8
Percent Muscle Mass	39.34	.50	6.19	-1.116	5000m	7	4.6
Percent Total Fat	18.79	.50	6.26	.552	**BMI Classification**		
Flexibility (cm)	9.50	.43	5.37	.004	Underweight	13	8.5
Energy Intake (kJ)	1879.93	227.79	2817.66	4.679	Normal weight	122	79.7
					Pre-Obesity	18	11.8

Table 2: Comparison of Means by BMI Classification

		SS	df	MS	F	P-value
BMI	Between	922.996	2	461.498		
	Within	303.533	150	2.024	228.063	.000*
	Total	1226.529	152			
Systolic Blood Pressure	Between	2332.101	2	1166.051		
	Within	26793.206	150	178.621	6.528	.002*
	Total	29125.307	152			
Diastolic Blood Pressure	Between	2475.860	2	1237.930	12.946	.000*
	Within	14343.526	150	95.624		
	Total	16819.386	152			
Resting Heart Rate	Between	3485.705	2	1742.852	8.619	.000*
	Within	30330.308	150	202.202		
	Total	33816.013	152			
Resting Metabolism	Between	1346074.922	2	673037.461	48.414	.000*
	Within	2085241.914	150	13901.613		
	Total	3431316.837	152			
Visceral Fat	Between	594.891	2	297.446	81.515	.000*
	Within	547.344	150	3.649		
	Total	1142.235	152			
Percent Muscle Mass	Between	424.972	2	212.486	5.885	.003*
	Within	5415.586	150	36.104		
	Total	5840.559	152			
Percent Total Fat	Between	1236.050	2	618.025	19.601	.000*
	Within	4729.430	150	31.530		
	Total	5965.480	152			
Flexibility	Between	87.305	2	43.653	1.522	.222
	Within	4302.434	150	28.683		
	Total	4389.739	152			
Energy Intake	Between	5935000.099	2	2967500.049	.371	.691
	Within	1200828938.090	150	8005526.254		
	Total	1206763938.189	152			

*Significant at $P<0.05$

As shown in table 2, ANOVA results based on BMI classification revealed significant differences in all variables ($p<$ 91 0.05) except for flexibility and energy intake which recorded a p value of 0.222 and 0.691 respectively. Scheffe's post hoc analysis for specific significant differences in BMI classifications is in table 3.

Table 3: Scheffe's Post Hoc Multiple Comparisons by BMI Classification

Variables	BMI Class (I)	BMI Class (J)	Mean Diff. (I-J)	Std. Error	P-value	95% CI
BMI	18.5-24.9	Less than 18.5	5.099*	.415	.000	4.073, 6.125
	25.0-29.9	Less than 18.5	10.843*	.517	.000	9.563, 12.123
		18.5-24.9	5.744*	.359	.000	4.856, 6.632
SBP	25.0-29.9	Less than 18.5	17.461*	4.864	.002	5.434, 29.488
		18.5-24.9	8.434*	3.374	.047	.091, 16.777
DBP	18.5-24.9	Less than 18.5	11.997*	2.852	.000	4.943, 19.051
	25.0-29.9	Less than 18.5	17.871*	3.559	.000	9.072, 26.671
Resting Heart Rate	Less than 18.5	18.5-24.9	16.750*	4.148	.000	6.493, 27.008
		25.0-29.9	18.589*	5.175	.002	5.793, 31.386
Resting Metabolism	18.5-24.9	Less than 18.5	248.968*	34.399	.000	163.920, 334.016
	25.0-29.9	Less than 18.5	422.230*	42.914	.000	316.128, 528.332
		18.5-24.9	173.262*	29.770	.000	99.658, 246.865
Visceral Fat	18.5-24.9	Less than 18.5	3.147*	.557	.000	1.769, 4.525
	25.0-29.9	Less than 18.5	8.333*	.695	.000	6.614, 10.052
		18.5-24.9	5.185*	.482	.000	3.993, 6.378
%Muscle Mass	18.5-24.9	Less than 18.5	5.965*	1.753	.004	1.631, 10.300
Percent Total Fat	25.0-29.9	Less than 18.5	10.976*	2.043	.000	5.923, 16.029
		18.5-24.9	8.237*	1.417	.000	4.732, 11.743

*****The mean difference is significant at the 0.05 level.

Table 4: Comparison of Means by Track Events

		SS	df	MS	F	P-value
BMI	Between	282.257	6	47.043	7.274	.000*
	Within	944.273	146	6.468		
	Total	1226.529	152			
Systolic Blood Pressure	Between	12219.819	6	2036.636	17.589	.000*
	Within	16905.489	146	115.791		
	Total	29125.307	152			

Diastolic Blood Pressure	Between	3763.249	6	627.208	7.014	.000*
	Within	13056.137	146	89.426		
	Total	16819.386	152			
Resting Heart Rate	Between	8837.657	6	1472.943	8.609	.000*
	Within	24978.356	146	171.085		
	Total	33816.013	152			
Resting Metabolism	Between	831560.851	6	138593.475	7.783	.000*
	Within	2599755.985	146	17806.548		
	Total	3431316.837	152			
Visceral Fat	Between	252.385	6	42.064	6.902	.000*
	Within	889.850	146	6.095		
	Total	1142.235	152			
Percent Muscle Mass	Between	480.185	6	80.031	2.180	.048
	Within	5360.374	146	36.715		
	Total	5840.559	152			
Percent Total Fat	Between	912.677	6	152.113	4.395	.000*
	Within	5052.803	146	34.608		
	Total	5965.480	152			
Flexibility	Between	760.431	6	126.738	5.098	.000*
	Within	3629.308	146	24.858		
	Total	4389.739	152			
Energy Intake	Between	179175014.890	6	29862502.482	4.243	.001*
	Within	1027588923.299	146	7038280.297		
	Total	1206763938.189	152			

*Significant at $P<0.05$

Table 4 showed ANOVA results based on track events. Where significant differences were found in all variables ($p<0.05$), table 5 reveals its Scheffe's post hoc analysis.

Table 5: Scheffe's Post Hoc Multiple Comparisons by Track Events

Variable	Track Event (I)	Track Event (J)	Mean Diff. (I-J)	Std. Error	P-Value	95% CI
BMI	100.00	5000.00	6.920*	1.067	.000	3.076, 10.764
	110.00	5000.00	5.367*	1.064	.001	1.535, 9.200
	200.00	5000.00	5.860*	1.067	.000	2.016, 9.704
	400.00	5000.00	6.100*	1.192	.000	1.806, 10.393
	800.00	5000.00	5.925*	1.092	.000	1.991, 9.858
	1500.00	5000.00	5.300*	1.132	.002	1.220, 9.379
Systolic Blood Pressure	100.00	800.00	11.550*	2.946	.022	.938, 22.161
		5000.00	25.800*	4.516	.000	9.535, 42.064
	110.00	800.00	19.975*	2.925	.000	9.440, 30.511
		5000.00	34.225*	4.502	.000	18.010, 50.441
	200.00	800.00	16.750*	2.946	.000	6.138, 27.361
		5000.00	31.000*	4.516	.000	14.735, 47.264
	400.00	800.00	14.057*	3.705	.031	.713, 27.401
		5000.00	28.307*	5.044	.000	10.141, 46.473
	1500.00	800.00	20.416*	3.355	.000	8.334, 32.498
		5000.00	34.666*	4.793	.000	17.406, 51.926
Diastolic Blood Pressure	100.00	800.00	10.100*	2.589	.023	.774, 19.425
		5000.00	14.600*	3.969	.041	.306, 28.893
	110.00	800.00	9.532*	2.571	.038	.273, 18.791
	400.00	800.00	16.192*	3.256	.001	4.465, 27.919
		5000.00	20.692*	4.433	.002	4.728, 36.656
Resting Heart Rate	200.00	100.00	17.200*	3.377	.000	5.038, 29.361
		110.00	19.980*	3.349	.000	7.917, 32.043
		1500.00	20.066*	3.899	.000	6.023, 34.109
Resting Metabolism	100.00	5000.00	259.000*	56.012	.003	57.300, 460.699
	110.00	5000.00	255.451*	55.840	.003	54.368, 456.534
	200.00	5000.00	311.000*	56.012	.000	109.300, 512.699
	400.00	5000.00	373.769*	62.558	.000	148.496, 599.041
	800.00	5000.00	222.000*	57.321	.025	15.585, 428.414
	1500.00	5000.00	330.333*	59.439	.000	116.291, 544.375
Visceral Fat	100.00	110.00	2.374*	.632	.034	0.097, 4.651
		5000.00	4.600*	1.036	.005	0.868, 8.331
	200.00	110.00	2.774*	.632	.005	0.497, 5.051
Percent Total Fat	100.00	1500.00	7.053*	1.753	.016	0.737, 13.369
		5000.00	9.820*	2.469	.019	0.927, 18.712
	1500.00	100.00	-7.053*	1.753	.016	-13.369, -.737
	5000.00	100.00	-9.820*	2.469	.019	-18.712, -.927
Flexibility	200.00	100.00	5.000*	1.287	. 024	0.364, 9.635

		400.00	7.024*	1.655	.009	1.063, 12.986
	1500.00	400.00	6.984*	1.814	.026	0.449, 13.519
Energy Intake	110.00	100.00	2832.226*	679.448	.011	385.526, 5278.926
		200.00	2703.652*	679.448	.018	256.952, 5150.352

Table 6: Gender Differences among Variables

	Gender	Mean, SD	t-test for Equality of Means			
			Mean Diff.	**t**	**P-value**	**95% CI**
Age	Male	20.69, 2.31	-1.384	-2.671	.008*	-2.409, -.360
	Female	22.08, 2.62				
Weight	Male	60.99, 6.44	10.966	8.410	.000*	8.390, 13.543
	Female	50.02, 1.98				
Height	Male	166.12, 5.16	.824	.683	.496	-1.562, 3.212
	Female	165.30, 7.14				
BMI	Male	22.53, 2.45	4.103	7.798	.000*	3.063, 5.142
	Female	18.43, 2.14				
SBP	Male	128.36, 12.68	9.647	3.289	.001*	3.851, 15.443
	Female	118.72, 16.74				
DPB	Male	79.37, 10.49	7.615	3.426	.001*	3.222, 12.007
	Female	71.76, 8.24				
Resting Heart Rate	Male	73.49, 13.66	-5.427	-1.674	.096	-11.833,.978
	Female	78.92, 19.87				
Resting Metabolism	Male	1537.21, 10.57	301.418	13.689	.000*	257.914, 344.922
	Female	1235.80, 37.66				
Visceral Fat	Male	4.98, 2.70	3.024	5.512	.000*	1.940, 4.108
	Female	1.96, 1.01				
Percent Muscle Mass	Male	40.77, 5.63	8.779	7.588	.000*	6.493, 11.065
	Female	32.00, 2.83				
Percent Total Fat	Male	18.35, 6.13	-2.746	-2.025	.045*	-5.425, -.066
	Female	21.09, 6.53				
Flexibility	Male	9.38, 5.64	-.769	-.653	.515	-3.095, 1.556
	Female	10.15, 3.69				
Energy Intake	Male	1996.81, 30.61	715.295	1.162	.247	-500.615, 1931.207
	Female	1281.52, 54.18				

*Significant at $P<0.05$ (2-tailed), Df= 151

Table 6 results on independent sample t-test showed significant differences in age (t = -2.671, p = 0.008), weight(t = 8.410, p = 0.000), BMI(t = 7.798, p = 0.000), systolic blood pressure(t= 3.289, p = 0.001), diastolic blood pressure(t = 3.426, p =0.001), resting metabolism(t = 13.689, p = 0.000), visceral fat(t = 5.512, p = 0.000), percentage muscle mass (t = 7.588, p = 0.000) and percentage total fat(t = -2.025, p = 0.045).

The present study examined the health profile of amateur track events athletes based on energy intake, blood pressure, heart rate, body composition and flexibility who train at Kumasi, the Ashanti Region of Ghana. Generally, as shown in table 1, participants recorded healthy profiles with regards to their weight [22], BMI [23], resting metabolism [24], systolic and diastolic blood pressure [25-26], visceral fat and percentage muscle mass [27], and flexibility [28-29]. However, participants recorded poor resting heart rate [30] and energy intake [31].

Gender differences were determined for all health profiles that were assessed as shown in table 6.The study revealed significant gender differences with regards to the weight of the participants. Although on the average all participants reported a healthy weight, male athletes recorded significantly higher weight compared to their female counterparts. This is in contrast with other studies which showed females to have a higher body weight [32]. This could probably be due to the fact that the males in the present study were relatively older than the females. Other studies have also associated higher body weight to poor eating habit [32-33]. With regards to BMI, though participants showed a healthy BMI on the average, there were again significant gender differences in favour of male athletes. This could be related to the higher weight recorded by males than their female counterparts.

Male participants also showed a significantly higher percentage muscle mass than their female counterparts, which agrees with the findings of Faktor [30]. The higher muscle mass of the male participants could also be a contributory factor to their higher BMI. Visceral fat is another variable which recorded some statistically significant difference in favour of male participants. This is in contrast with other studies [34-35] which found no gender difference in visceral fat even though females recorded higher values. With male participants recording higher body weight and BMI in the present study, it is not surprising that they recorded a higher visceral fat. Participants again demonstrated significant differences in systolic and diastolic blood pressure with males reporting higher values. This is consistent with previous research [36-37] which also reported gender differences with regards to blood pressure. Optimum blood pressure is essential in ensuring efficient cardiac function and aerobic performance as demonstrated by Bangsbo *et al*. [38]

With regards to resting metabolism, male participants recorded significantly higher values than female athletes. This supports earlier findings of Faktor [30] and Egwu *et al*. [37] who also reported gender differences with regards to resting metabolism. Comparing variables based on BMI classifications revealed statistically significant differences in systolic and diastolic blood pressure, resting heart rate, resting metabolism, visceral fat, percentage muscle mass, and percentage total fat (tables 2- 3).

With regards to systolic blood pressure, significant differences were realized between athletes who are overweight and underweight, and between those who are overweight and those with normal BMI, both in favour of overweight athletes. BMI comparisons on diastolic blood pressure revealed significant differences between athletes who had normal BMI and underweight, and between overweight and those that are underweight. This finding is consistent with previous studies which saw a positive correlation between BMI and blood pressure [39-40].

he present study revealed a significant difference with reference to resting heart rate. Underweight athletes recorded a significantly higher resting heart rate than athletes with normal and overweight BMI. Overall, the average resting heart rate of 74 beats per minute indicate a poor cardiovascular function of the athletes. In line with other researchers [30, 41], higher resting heart rate predisposes athletes to cardiovascular diseases. Resting metabolism and visceral fat saw significant differences among all three BMI classifications. Thus higher scores on resting metabolism and visceral fat were associated with higher BMI. Positive associations between these variables have been well reported by past BMI. Participants with higher normal BMI showed higher percentage muscle mass than those who were underweight. This is not surprising as higher scores on muscle mass contribute more weight of an individual and hence a higher BMI. This is in contrast with other studies which found out that percentage muscle mass had an inverse relationship with BMI [42].

With reference to percentage total fat, overweight athletes recorded a higher BMI than normal and underweight athletes. This could be due to the fact that more fat increases the weight of an individual as noted in previous studies. [42-44]

4. Conclusions

The status of energy intake, blood pressure, heart rate, body composition and flexibility of the study sample call for immediate intervention. Integrated health performance monitoring approaches/interventions that considered the contributions of athletes, coaches, fitness trainers, dietician, physician, exercise physiologists, sports psychologist and physiotherapists for the anticipated optimal performance to be attainable is recommended. Collective submissions of this team would also improve the overall health and performance status of Ghanaian A-TEAs and project their image to the international world.

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