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Relationship between Anthropometrical and Physiological Parameters with Running Time of Elite Girls, Ardabil, Iran

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Abstract

Background: The relationship between anthropometrical and physiological parameters with running time is important. We aimed to investigate relationship between anthropometrical and physiological parameters with running time of elite girls.

Materials and Methods: In this Cross-sectional study, subjects were selected from 197 elite runner girls 14-16 year, participated in the national championship of the country selection 2019 in Ardabil, Iran. All anthropometrical and physiological parameters (such as Length of limbs and strength) were measured with appropriate and reliable tools. Pearson correlation coefficient was used to examine the relationships between variables.

Results: There was a significant negative relationship between trunk flexibility (r=-0.448, P=0.022), left hand strength (r=-0.445, P=0.023), and left leg strength (r=-0.472, P=0.015) with 60m time; hip length (r=-0.504, P=0.010) with 400m time; between head circumference (r=-0.571, P=0.004), forearm length (r=-0.435, P=0.035), and static balance (r=-0.454, P=0.026) with 800m time; between arm length (r=-0.411, P=0.041), hip circumference (r=-0.487, P=0.014), leg length (r=-0.509, P=0.009), hand length (r=-0.595, P=0.002), and length jump (r=-0.482, P=0.015) with 1500m time; between wrist circumference (r=-0.439,P=0.041) with 3000m time; between arm length (r=-0.420, P=0.026), and leg length (r=-0.434, P=0.021) with 4×100m relay race time. Whereas there was a significant positive relationship between trunk circumference at hip (r=0.462, P=0.020) with 400m time; between length jump (r=0.408, P=0.048) with 800m time; between palm length (r=0.481, P=0.015) with 1500m (n=25) time; between dynamic balance (lateral) (r=0.455, P=0.033) with 3000m time; between trunk circumference at hip (r=0.394, P=0.038) with 4×100m relay race time.

Conclusion: Based on the results, there was a significant relationship between anthropometrical and physiological parameters with running time. So, it´s recommended that coaches pay attention to the results of this study to select and substitute of talented runners for gaining more success in reaching the peak of athletic performance.

Key Words: Anthropometrical parameters, Elite girls, Physiological parameters, Time running.

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1- INTRODUCTION

An athlete's success is influenced by a combination of his or her athletic ability, body composition, morphological and physiological characteristics (1-5). The characteristics of physiological, physical-motor fitness and skill are very important in identifying talented athletes in endurance, speed running, jumping, and throwing. Girls and boys benefit from exercise and competition (6-7). They are able to improve their running and jumping performance from childhood to adolescence (6). Differences in the physical characteristics of young athletes might reflect the selection at a relatively young age for the body demands of a specific sport (8-9). Athletes usually start serious training before the onset of puberty and achieve international competitive level at a relatively early age. Also, they start heavy training at a relatively young age (1-5). Various parameters such as anthropometrical, physiological, biomechanical parameters and range of motion joints affect exercise performance in adolescents (9-13).

So, anthropometric and physical fitness properties can be associated with exercise performance (8, 14). These indicators should be considered to predict the performance of adolescent athletes (10, 15-16). Therefore, identifying talent is the most important and most effective factor in successful competitive sports (17-19). These indices can be useful in identifying susceptible individuals, especially as body indices are influenced by genetic factors and have little effect on exercise and nutrition (4). It is important to study different parameters that might affect complex running performance, taking into account various anthropometrical and physiological aspects of running at early age (9, 11, 20). This enables consideration of specific parameters when predicting success and planning specific training programs in young athletes (20). Anthropometry is known as a non-invasive and inexpensive method that provides considerable information in a short time to a large number of subjects (1-2). Anthropometrical and physiological parameters are used as an important part of the screening process of talent identification in track and field (1-2). Track and field is a basic sport and its growth in each country leads to the development of other sports (17-19). In addition, there are over 47 separate medals in the Olympic championships, 24 men's and 23 women's (17-19). A number of studies considered the relationship between anthropometrical and physiological parameters with sport performance of young elite athletes and reported contradictory results. Modess et al. (2013) and Natchtelet al. (2008) showed that there is a significant relationship between height, body mass, fat and lean body mass index, arm circumference, thigh length, subcutaneous fat and limb circumference with sport performance (21-22).

Mahmoudkhani et al. (2013) by examining different Iranian ethic groups showed that the ectomorphic-mesomorphic body type is more susceptible to long and medium distances in track and field (23). Lewandowska et al. (2011) showed that speed elite runners have an endomorphic-mesomorphic body type (24). O'Connor et al. (2007) by studying physical parameters and athletic performance reported that physical and morphological characteristics play a very important role in the success of athletes (5).In contrast, Foland et al. (2017) showed that there is no significant relationship between the characteristics of running and running performance (25). Wei (2000) also showed there is not a relationship between static and dynamic hip extension and physiological characteristics with running performance on treadmills (26).

Therefore, it is important to assess which parameters may be the best predictors of running time performance. Further studies need to investigate which elements, acquired skills and techniques have the highest impact on the running time (13). Undoubtedly, disregarding some of the early determinants or prerequisites of talent will limit and weaken achievement of the best performance. To our knowledge, no studies have investigated the anthropometrical and physiological parameters for talent identification and predicting elite running times in young girls. Therefore, the aim of present study was to determine relationship between anthropometrical and physiological parameters with running time of elite girls.

2- MATERIALS AND METHODS

2-1. Study design and population

In this cross sectional, survey research study, 197 elite young girl jumpers and throwers (age: 14-16 years; height: 163.28±1.17 cm; weight: 52.68±1.45 kg), who get top ranks in their provinces' competitions and participated in the national championship of the country selection 2019 in Ardabil, Iran; signed the consent form. Anthropometric and physiological parameters were measured in Ardabil Takhti gym for 5 days. Thirty girls competed 60m running except four subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 26 subjects. Twenty-nine girls completed 60m hurdle except 5 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 24 subjects. Twenty-eight girls competed 400m running except 3 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 25 subjects. 26 girls competed 800m running except 2 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 24 subjects. Twenty-seven girls competed 1500m running except 2 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 25 subjects. Twenty-five girls competed 3000m running except 3 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 22 subjects. Thirty-two girls competed 4×100m relay race except 4 subjects, due to lack of cooperation on the measurement of two parameters and declines in the study. So, the anthropometrical and physiological parameters were measured from 28 subjects (1, 7, 27).

2-2. Measuring tools

The without shoes weight was measured by the standard digital weighing scale (Omron HBF400). Shoeless height was measured after deep breathing by a graded wall with a meter of Chinese rubber band, with a sensitivity of one millimeter. To measure arm circumference, the hands are open and parallel to the ground and the distance between the tip of the third right and the tip of the third left finger is measured after a deep breath by a graded wall with meter. The head circumference is measured from the temporal region with meter. The circumference of the chest was measured with meter at the height of the nipple while the subject was standing anatomically, and the arms were slightly away from the trunk, from the sternum in the fourth joint in the anterior part and a point marked on the same horizontal plate in the chest posterior. The hip circumference was measured with meter horizontally in the serine muscle area while the subject was standing anatomically. The humerus length was measured while the hand was bent at the elbow and the forearm was 90°, from the greater tuberosity to olecranon process at posterior part with a Chinese VERINER caliper with an error of 0.02 mm. The forearm length was measured with caliper in a standing position from olecranon to styloid process at the posterior, the hand was bent at the elbow, and the forearm was 90°. The length of the hand was measured with meter while the subject was standing, the hand was bent at the elbow and the forearm was 90°, from the 3rd metatarsal to 3rd distal phalanx at anterior part. Shoulder width, the distance between the two acromion processes at posterior, was measured with caliper while the subject was sitting. The circumference of humerus was measured in the largest section with meter while the subject was standing, her elbow bent and her forearms 90°.

Forearm, wrist and palm circumference were measured at the greatest section with meter while subject was sitting, elbow bent and forearm 90°. Second and fourth fingers' lengths to the tip were measured with meter while subject was sitting, elbow bent and forearm 90°. Second to fourth finger ratio was measured. Thigh circumference was measured in the largest section while subject was sitting on a chair and the right leg bent with knee at 90°. Tibia circumference at the greatest section was measured while subject was standing and leg was straight. Ankle circumference at the greatest section was measured while subject was standing and the leg was straight. The length of the thigh was measured at the distance of the greater trochanter of the thigh to the head of the patella, while the subject was sitting on a chair with her knee bent 90°. Tibia length was measured from the patella to the ankle while the subject was sitting on a chair with a 90-degree knee. All limbs circumference' were measured using a China rubber band meter, with a sensitivity of one millimeter. All limbs lengths were measured with China VERINER caliper with a sensitivity of 0/02 mm. Tricepsfat thickness was measured by Iran Pouya Caliper, 99,32% and validity 99,8 % with sensitivity (0.5 mm), in the back of the arm between the shoulder and elbow joints, in a vertical direction. Subscapularis fat was measured by Iran Pouya Caliper from back to below the shoulder blade (subscapular) that is located below the shoulder blade at 45 degrees. Supraspinatus fat was measured by Iran Pouya caliper from the top of the iliac crest, the protrusion of the pelvic bone, slightly forward from the waist at the horizontal level. Performance (distance) was measured the greatest distance triple jump, high jump, weight throw, discus throw and javelin throw in competition (1, 7, 27).

Physiological parameters including: trunk flexibility was measured with China meter, while subject stood up and spread his legs shoulder-width apart, then bent over and pulled his hands between his legs as far back as he could. The distance from the center of the feet to the tips of the leg fingers was measured in this position. Highest legs strength were measured while subject stood on the dynamometer and pull the handle towards herself (the Grip Dynamometr-Blue model (0-130 Kg) of the American model) with maximum effort, in two steps. Highest hands strength were measured in standing position while subject presses the dynamometer [the Grip Dynamometr-Blue model (0-130 Kg) of the American model] with hand and maximum effort, in two steps. Hand action and reaction velocity was measured by hand Nelson test, while subject sat on the chair and bent the elbow 90°, then the examiner dropped the ruler and the subject took it and the value was measured at this point. Leg action and reaction velocity was measured by leg Nelson test while subject sat on the chair with straight knees, then the examiner dropped the ruler between two toes, the subject took it with toes and the value was measured at this point. The time of Static Balance was measured by Flamingo Balance with timer (KhosRo1/ 100SECSW50). Dynamic Balance was measured by Star Excursion Balance Test in a graded earth in 4 directions (anterior, posterior, inner and outer) with meter. Leg power (high jump) was measured while subject stood by the graded wall and touched it with her hand over her head. Then she performed the Sargent jump to the top, and the highest point she could reach, was measured. Leg power (high jump) was measured by long jump, while the subject jumped to the forward on the graded ground and paired legs. Then the last point of the foot hit the ground was measured (1, 7, 27).

2-3-Ethical consideration

All measurements were performed in duplicate. This study was approved by the Ethics Committee of the Medical University of Ardabil (IR.ARUMS.REC.1398.185), according to the Helsinki Declaration regarding human research. All runners and their coaches were informed of the purposes and methods of the study and a written informed consent was obtained from the athletes, coaches and parents before participation in the study.

2-4. Inclusion and exclusion criteria

Subjects were athletes participating in the national track and field competitions who won first to third positions in their provinces and had selected for national championships.

2-5. Data Analyses

The normality of distribution was assessed on all data using the Shapiro-Wilk test. Mean ± standard deviation (SD) values were used for all data. The relationship between anthropometrical and physiological parameters with running time were analyzed with Pearson correlation coefficient. A $p<0.05$ and 95% confidence intervals were considered to be statistically significant. SPSS for Windows, version 23.0 (SPSS Inc. Chicago, IL) was used for all analyses.

3- RESULTS

Shapiro-Wilk test showed that all data have normal distribution at $P<0.05$. **Table.1** shows baseline characteristics of subjects including age, height, weight, BMI, history of running, running time.

Table-1: Baseline characteristics of subjects and history of running and of young elite female runners in national competitions.

Parameter, mean± SD	60m (n=26)	60m hurdle (n=24)	400m (n=25)	800m (n=24)	1500m (n=25)	3000m (n=22)	4×100m relay race (n=28)
Age (year)	15.27±0.18	15.54±0.22	15.44±0.21	15.29±0.19	15.60±0.18	15.27±0.23	15.39±0.19
Height (cm)	163.15±1.33	162.04±1.06	164.62±0.33	164.32±1.25	162.71±1.47	162.41±1.47	163.71±1.28
Weight (Kg)	53.65±1.13	51.60±1.30	53.72±1.69	53.05±1.80	52.95±1.28	51.41±1.71	52.38±1.22
BMI (Kg/m^2)	20.17±0.10	19.69±0.17	19.97±0.08	19.72±0.23	20.20±0.33	19.24±0.42	19.69±0.17
History of running (year)	5.21±1.13	5.20±1.16	5.14±1.32	5.14±1.29	5.21±1.15	5.09±1.31	5.18±1.18
Time (Second)	8.51±0.10	10.78±0.10	69.72±0.84	173.71±1.48	348.24±4.50	891.51±0.14	120.25±1.00

SD: Standard deviation, BMI: Body mass index.

Tables 2 and 3 show mean of anthropometrical and physiological parameters and their relationship with 60m running (8.51±0.10 S), 60m hurdle (10.78±0/10 S), 400m (69.72±0.84S), 800m (173.71±1.48S), 1500m (348.71±4.50 S), 3000m (891.51±0.14 S) and 4×100m relay race (120.25±1.00 S) of Iranian young elite female runner.

Table.2 shows that there was a significant negative relationship between thigh length (r = -0.504, P = 0.010) with 400m running time. Whereas, there was a significant positive relationship between trunk circumference at hip (r = 0.462, P = 0.020) with 400m running time. There was a significant negative relationship between head circumference (r = -0.571, P = 0.004) and forearm length (r = -0.435, P = 0.030) with 800m running time. There was a significant negative relationship between humerus length (r = -0.411, P = 0.041), palm width (r = -0.595, P = 0.002), thigh circumference (r = -0.487, P = 0.014), and foot length (r = -0.509, P = 0.009) with 1500m running time. Whereas, there was a significant positive relationship between hand length (r = 0.481, P = 0.015) with 1500m running time. There was a significant negative relationship between wrist circumference (r = -0.431, P = 0.039) with 3000m running time. There was a significant negative relationship between foot length (r = -0.434, P = 0.021) and humerus length (r = -0.420, P = 0.026) with 4×100m relay race time. Whereas, there was a significant positive relationship between trunk circumference at hip (r = 0.394, P = 0.038) with 4×100m relay race time. In contrast, there were no significant relationships between anthropometrical parameters with 60m and 60m hurdle running time.

Table-2: The relationship between anthropometrical parameters with 60m, 60m hurdle, 400m, 800m, 1500m, 3000mand 4×100m relay race running time of Iranian young elite female runners.

Parameter	60m (n=26)	60m hurdle (n=24)	400m (n=25)	800m (n=24)	1500m (n=25)	3000 (n=22)	4×100m relay race (n=28)
Arm Span (cm)	158.50±1.65 r=0.168 P=0.411	156.58±2.83 r=-0.137 P=0.524	156.24±2.55 r=0.219 P=0.293	154.63±2.73 r=-0.007 P=0.974	160.92±1.40 r=0.119 P=0.570	155.73±2.57 r=-0.292 P=0.187	157.82±2.31 r=0.009 P=0.965
Head circumference (cm)	55.69±1.14 r=-0.087 P=0.674	55.71±0.98 r=-0.110 P=0.608	56.96±1.44 r=0.309 P=0.134	56.88±1.51 **r=-0.571 P=0.004	56.80±1.44 r=-0.150 P=0.473	54.68±0.33 r=-0.371 P=0.089	56.50±1.30 r=0.317 P=0.100
Trunk Circumference at Nipple Height (cm)	81.15±1.19 r=-0.114 P=0.580	80.46±1.07 r=-0.097 P=0.668	79.96±1.14 r=0.204 P=0.328	81.21±1.32 r=0.104 P=0.628	79.80±1.04 r=-0.116 P=0.582	80.23±1.23 r=-0.042 P=0.854	79.46±0.99 r=-0.120 P=0.543
Trunk Circumference at Hip (cm)	68.96± 1.11 r=0.014 P=0.945	69.80±1.03 r=0.071 P=0.743	69.04±1.23 *r=0.462 P=0.020	69.96±1.26 r=-0.171 P=0.425	69.76±0.97 r=0.364 P=0.090	67.86±1.35 r=-0.355 P=0.105	68.17±0.27 *r=0.394 P=0.038
Humerus length (cm)	32.50±0.65 r=0.003 P=0.990	32.38±0.71 r=-0.096 P=0.655	33.92±0.42 r=-0.068 P=0.747	32.54±0.77 r=-0.313 P=0.136	32.72±0.56 *r=-0.411 P=0.041	33.05±0.54 r=0.000 P=1.000	32.96±0.56 *r=-0.420 P=0.026
Forearm Length (cm)	23.04±0.66 r=0.102 P=0.621	22.65±0.51 r=-0. 154 P=0.473	24.10±0.66 r=0.016 P=0.939	22.52±0.48 *r=-0.435 P=0.035	23.98±0.65 r=-0.245 P=0.237	22.45±0.57 r=-0.290 P=0.191	23.77±0.60 r=-0.044 P=0.825
Hand length (cm)	19.23±0.80 r=0.021 P=0.920	19.71±0.88 r=-0.373 P=0.073	18.36±0.35 r=-0.027 P=0.897	19.63±0.89 r=0.192 P=0.370	19.96±0.77 *r=0.481 P=0.015	17.64±0.33 r=-0.098 P=0.665	19.57±0.65 r=0.289 P=0.136
Shoulder Width (cm)	37.62±0.48 r=-0.169 P=0.409	36.96±0.51 r=-0.201 P=0.347	37.60±0.43 r=-0.122 P=0.562	36.79±0.49 r=0.042 P=0.846	37.20±0.51 r=-0.364 P=0.074	37.87±0.39 r=0.061 P=0.787	37.36±0.43 r=-0.297 P=0.125
Humerus circumference	23.70±0.50 r=-0.059	23.04±0.45 r=0.194	22.99±0.45 r=0.228	23.38±0.56 r=0.208	23.08±0.38 r=-0.229	23.18±0.56 r=-0.105	23.11±0.34 r=0.043

(cm)	P=0.771	P=0.365	P=0.272	P=0.329	P=0.271	P=0.642	P=0.827
Forearm circumference (cm)	22.31±0.40 r=-0.224 P=0.271	21.67±0.37 r=0.208 P=0.3330	21.72±0.41 r=0.039 P=0.855	21.83±0.31 r=0.389 P=0.060	21.84±0.39 r=-0.204 P=0.329	21.86±0.44 r=-0.154 P=0.494	22.00±0.33 r=-0.012 P=0.952
Wrist circumference (cm)	16.08±0.42 r=-0.157 P=0.443	15.71±0.19 r=-0.240 P=0.259	16.12±0.44 r=0.057 P=0.787	16.08±0.45 r=0.399 P=0.053	16.20±0.43 r=-0.142 P=0.498	15.59±0.26 *r=-0.439 P=0.041	16.14±0.38 r=0.202 P=0.303
Palm Width (cm)	09.23±0.80 r=0.162 P=0.429	09.71±0.88 r=-0.178 P=0.404	08.36±0.35 r=0.097 P=0.644	09.63±0.89 r=-0.347 P=0.096	09.96±0.77 **r=-0.595 P=0.002	08.36±0.35 r=0.015 P=0.949	08.36±0.35 r=-0.154 P=0.434
Second finger length (cm)	7.65±0.42 r=-0.131 P=0.524	7.22±0.13 r=-0.220 P=0.303	7.78±0.43 r=0.108 P=0.609	7.59±0.46 r=-0.367 P=0.078	7.71±0.43 r=0.131 P=0.532	7.20±0.17 r=0.071 P=0.755	7.68±0.38 r=0.195 P=0.321
Fourth finger length (cm)	7.65±0.40 r=-0.105 P=0.608	7.38±0.13 r=-0.075 P=0.727	7.84±0.41 r=0.106 P=0.613	7.60±0.44 r=-0.323 P=0.124	7.80±0.41 r=-0.166 P=0.427	7.39±0.14 r=-0.005 P=0.983	7.79±0.36 r=0.101 P=0.607
Second to fourth finger ratio	0.98±0.01 r=-0.226 P=0.268	0.98±0.02 r=-0.182 P=0.394	0.99±0.01 r=-0.005 P=0.979	0.99±0.01 r=-0.231 P=0.278	0.99±0.01 r=0.117 P=0.577	0.98±0.02 r=0.102 P=0.653	0.98±0.01 r=0.301 P=0.119
Thigh circumference (cm)	45.35±0.91 r=0.177 P=0.387	43.96±0.95 r=-0.017 P=0.936	44.80±0.81 r=0.089 P=0.672	44.25±0.94 r=-0.158 P=0.462	44.76±0.84 *r=-0.487 P=0.014	44.55±0.85 r=-0.082 P=0.718	45.07±0.79 r=-0.037 P=0.851
Tibia circumference (cm)	36.15±0.52 r=0.067 P=0.743	35.88±0.49 r=0.017 P=0.937	36.56±0.55 r=0.197 P=0.345	36.46±0.45 r=-0.003 P=0.988	36.48±0.52 r=-0.385 P=0.057	35.64±0.58 r=-0.270 P=0.224	36.50±0.45 r=0.130 P=0.509
Ankle circumference (cm)	22.96±0.30 r=0.018 P=0.929	22.29±0.27 r=0.296 P=0.160	22.40±0.33 r=0.195 P=0.349	22.58±0.31 r=-0.091 P=0.673	22.60±0.29 r=-0.109 P=0.605	22.41±0.36 r=-0.167 P=0.458	22.61±0.26 r=0.202 P=0.304
Thigh Length (cm)	40.88±0.42 r=-0.142 P=0.482	41.08±0.41 r=-0.381 P=0.066	41.64±0.39 *r=-0.504 P=0.010	40.63±0.38 r=-0.120 P=0.576	41.28±0.38 r=-0.218 P=0.296	40.63±0.38 r=-0.349 P=0.112	40.63±0.38 r=0.336 P=0.081
Tibia Length (cm)	36.15±0.52 r=-0.257 P=0.205	35.88±0.49 r=-0.190 P=0.375	36.56±0.55 r=0.345 P=0.091	36.46±0.56 r=-0.065 P=0.764	36.48±0.52 r=0.097 P=0.464	35.64±0.58 r=-0.281 P=0.206	36.50±0.45 r=0.178 P=0.364
Foot Length (cm)	23.77±0.42 r=0.069 P=0.739	23.71±0.36 r=-0.278 P=0.188	24.20±0.34 r=-0.032 P=0.879	23.66±0.45 r=-0.054 P=0.804	23.84±0.29 *r=-0.509 P=0.009	24.05±0.44 r=0.015 P=0.949	24.11±0.22 *r=-0.434 P=0.021
Triceps Fat (mm)	12.55±0.84 r=0.032 P=0.876	11.38±0.62 r=-0.184 P=0.390	11.96±0.90 r=0.077 P=0.713	12.27±0.87 r=-0.085 P=0.692	11.91±0.75 r=0.071 P=0.736	11.90±0.90 r=-0.231 P=0.302	11.36±0.73 r=0.088 P=0.657
Subscapularis Fat (mm)	8.95±0.78 r=0.114 P=0.579	8.17±0.44 r=-0.197 P=0.357	8.34±0.83 r=0.169 P=0.419	8.83±0.84 r=0.031 P=0.884	8.23±0.45 r=-0.125 P=0.550	8.87±0.89 r=-0.076 P=0.738	7.89±0.44 r=0.176 P=0.370
Supraspinatus Fat (mm)	12.09±1.21 r=-0.057 P=0.782	11.63±1.58 r=-0.109 P=0.612	11.82±1.42 r=0.071 P=0.736	12.30±1.56 r=-0.100 P=0.641	10.51±1.03 r=-0.171 P=0.415	13.11±1.61 r=0.072 P=0.750	09.80±0.97 r=-0.021 P=0.914
Performance (time) (second)	8.51±0.10	10.78±0.10	69.72±0.84	173.71±1.48	348.24±4.50	891.51±0.14	120.25±1.00

* Correlation is significant at P<0.05. ** Correlation is significant at P<0.01.

Table.3 shows that there was a significant negative relationship between trunk flexibility (r=-0.488, P=0.022), left leg strength (r=-0.445, P=0.023), left hand strength (r=-0.473, P=0.015) with 60m running. There was a significant negative relationship between static balance (r=-0.454, P=0.026) with 800m running time, whereas there was a significant positive relationship between leg power (Length jump) (r=0.408, P=0.048) with 800m running time. There was a significant negative relationship between leg power (High jump) (r=-0.482, P=0.015) with 1500m running time. There was a significant positive relationship between dynamic balance (Lateral) (r=0.455, P=0.033) with 3000m running time. In contrast, there were no significant relationships between physiological parameters with 60m hurdle, 400m and 4×100m relay race time.

Table-3: The relationship between physiological parameters with60m, 60m hurdle, 400m, 800m, 1500m, 3000mand 4×100m relay race running time of Iranian young elite female runners.

Parameter		60m (n=26)	60m hurdle (n=24)	400m (n=25)	800m (n=24)	1500m (n=25)	3000m (n=22)	4×100m relay race (n=28)
Trunk Flexibility (cm)		40.31±1.66 *r=-0.488 P=0.022	38.79±2.37 r=-0.326 P=0.120	39.12±2.65 r=0.298 P=0.148	39.00±2.10 r=0.279 P=0.187	41.44±2.15 r=0.104 P=0.622	37.09±0.49 r=0.208 P=0.353	41.04±2.04 r=0.206 P=0.294
Leg Strength (kg)	Right	70.81±2.71 r=-0.364 P=0.083	69.46±2.42 r=0.176 P=0.411	70.36±2.71 r=0.046 P=0.825	70.50±2.67 r=0.148 P=0.491	71.32±2.54 r=-0.071 P=0.734	68.68±2.79 r=-0.044 P=0.846	70.96±2.29 r=0.176 P=0.370
	Left	69.81±2.55 *r=-0.445 P=0.023	68.67±2.26 r=0.149 P=0.488	68.76±2.55 r=0.015 P=0.942	68.88±2.46 r=0.103 P=0.633	70.60±2.37 r=-0.183 P=0.380	67.86±2.55 r=-0.058 P=0.798	70.18±2.24 r=0.105 P=0.595
Hand Strength (kg)	Right	64.67±2.76 r=-0.331 P=0.098	63.71±2.52 r=0.226 P=0.287	63.30±2.87 r=0.067 P=0.751	64.48±2.64 r=0.172 P=0.421	64.92±2.75 r=-0.015 P=0.943	62.34±2.94 r=0.059 P=0.793	64.54±2.47 r=0.244 P=0.210
	Left	63.42±2.07 *r=-0.473 P=0.015	60.63±2.71 r=0.082 P=0.702	61.39±2.97 r=0.126 P=0.547	62.33±2.59 r=0.005 P=0.980	63.40±2.82 r=-0.083 P=0.694	59.18±2.90 r=0.076 P=0.735	62.64±2.71 r=0.257 P=0.187
Hand Action and Reaction Velocity (cm)		18.73±1.33 r=0.355 P=0.075	18.75±1.50 r=-0.140 P=0.513	18.66±1.54 r=0.051 P=0.808	17.85±1.39 r=-0.395 P=0.056	20.42±1.47 r=0.083 P=0.692	17.59±1.63 r=0.135 P=0.550	20.16±1.33 r=-0.033 P=0.867
Leg Action and Reaction Velocity (cm)		23.96±1.44 r=-0.357 P=0.073	21.29±1.25 r=0.285 P=0.177	23.64±1.54 r=-0.033 P=0.877	24.13±1.65 r=-0.142 P=0.509	22.84±1.50 r=-0.099 P=0.638	22.32±1.32 r=0.192 P=0.392	23.00±1.39 r=0.172 P=0.381
Static Balance (S)		90.39±7.00 r=-0.376 P=0.058	62.21±9.36 r=-0.142 P=0.507	80.48±9.06 r=0.258 P=0.212	66.88±5.35 *r=-0.454 P=0.026	63.76±3.49 r=-0.142 P=0.499	92.23±5.76 r=-0.011 P=0.961	65.11±4.96 r=0.175 P=0.374
Dynamic Balance (cm)	Inferior	55.23±2.17 r=-0.211 P=0.301	53.71±1.45 r=0.164 P=0.455	54.76±2.33 r=0.258 P=0.213	56.54±2.42 r=0.313 P=0.137	54.56±2.23 r=-0.021 P=0.919	56.54±2.42 r=0.089 P=0.695	52.27±1.33 r=0.278 P=0.152
	Posterior	72.42±5.19 r=-0.187 P=0.361	72.96±4.76 r=0.328 P=0.117	77.12±6.82 r=0.012 P=0.956	78.75±6.98 r=0.304 P=0.149	73.16±5.29 r=-0.069 P=0.744	66.73±2.02 r=0.379 P=0.082	76.40±6.04 r=-0.147 P=0.545
	Lateral	59.54±1.86 r=0.277 P=0.171	61.75±2.30 r=0.074 P=0.731	60.08±2.48 r=0.110 P=0.600	62.08±2.49 r=0.051 P=0.814	59.60±1.86 r=0.221 P=0.288	59.55±2.44 *r=0.455 P=0.033	61.29±2.04 r=-0.043 P=0.828
	Internal	53.65±1.47 r=-0.035 P=0.866	55.75±1.66 r=-0.098 P=0.649	55.32±1.91 r=0.316 P=0.124	56.08±1.71 r=0.257 P=0.225	56.36±1.85 r=0.087 P=0.680	52.00±1.56 r=0.260 P=0.242	56.07±1.68 r=0.365 P=0.065
Leg Power (cm)	High Jump	66.73±4.55 r=0.228 P=0.263	64.31±4.55 r=-0.151 P=0.481	70.34±3.99 r=-0.320 P=0.119	62.40±5.03 r=-0.196 P=0.358	65.68±5.12 *r=-0.482 P=0.015	70.12±2.80 r=0.106 P=0.638	66.46±4.24 r=-0.337 P=0.079
	Length Jump	154.15±4.36 r=-0.341 P=0.088	151.66±4.71 r=0.157 P=0.465	150.08±0.84 r=-0.048 P=0.821	155.45±4.15 *r=0.408 P=0.048	153.56±4.63 r=0.310 P=0.131	147.18±3.90 r=-0.061 P=0.788	156.18±4.40 r=0.156 P=0.429

* Correlation is significant at P<0.05.

4- DISCUSSION

The aim of this study was to investigate the relationship between anthropometrical and physiological parameters with running time of young female elite runners for talent identification and performance predicting. Our results showed that there was a significant negative relationship between trunk flexibility, left leg strength, left hand strength, with 60m running. The optimal length of the step is determined mainly by the athlete's physical characteristics and body measurement and the amount of force he exerts at each step (28-31). This force is influenced by the strength, power and flexibility of the athlete. Optimal gait speed depends on the running mechanics, the athlete's coordination technique, as well as factors such as body size, body composition, and the relationship between motor and motor abilities (31-32). Therefore, with increasing flexibility and strength of the limbs, which are biomotor abilitis, the 60m running time in adolescent elite runners in the present study decreased and the record improved.

There was a significant negative relationship between thigh lengths with 400m running time. Whereas there was a significant positive relationship between trunk circumference at hip with 400m running time. Due to the fact that athletes running speed is determined by the length and frequency of the lower limbs and steps (32), it can be said that with increasing the length of the leg in the 400m, the running speed increased and the time decreased. On the other hand, with increasing trunk circumference at pelvic level, the 400m running time, friction between trunk and available air increases and the body tends to backwards for maintaining balance during running, that can de increase the 400m running time.

At 400m running, as the center of gravity moves forward, the gait begins slightly ahead of the center of gravity. The body tends to move back slightly to maintain balance. Thus, with the tendency of the body to move backwards in the 400m running by the elite runner girls to maintain balance in the present study, the 400m running time increased (28-29). There was a significant negative relationship between head circumference, forearm length and static balance with 800m running time. Whereas there was a significant positive relationship between leg power (Length Jump) with 800m running time. Increasing the head circumference at 800m running has led to more body balance (28-29). Also, as the forearm length increases, the oscillating movements of the hands increase during running (28). Due to the fact that the action of the hands is in harmony with the action of the feet in running, these oscillating movements of the hands are transferred to the legs and cause the legs to move faster (28-29). So, the 800m running time in the teenage elite runners' girls was reduced in the present study, and the record was improved. Increasing the static balance in adolescent elite runner girls in the present study means increasing the body's desire to stay calm and reducing ejaculation during the 800m running. Thus, with a decrease in static balance, the body's tendency to relax is reduced and the individual is more prepared to increase the speed and frequency of stepping (28).

This physical and mental fitness increased the runner's speed at the start of the race as well as during stepping at 800m running (28-30, 33), and as a result, the 800m running time was reduced and the record was improved. In contrast, the probable causes of the increase in 800m running time in adolescent elite runners in the present study was due to increased jumping length, increased leg strength and muscle mass, and a tendency to stay and stop during running steps (29-30) in 800m running which led to a worse record in the elite runner teenage girls.

There was a significant negative relationship between humerus length, palm width, thigh circumference, foot length and leg power (High Jump)with 1500m running time. Whereas there was a significant positive relationship between hand length with 1500m running time. As mentioned, the athlete's running speed is determined by the length and frequency of the lower limbs and steps (31), it can be said that with increasing the length of the leg at 1500m running, the running speed increased and the time decreased and the record improved. In 1500m running, the shoulders, arms, neck and head are comfortable and free, and the hands swing slowly back and forth and with increasing forearm length, the oscillating movements of the hands increase during running (28). The action of the arms is coordinated with the action of the legs in running, and these oscillating movements cause the arms move to the legs and then the legs to move faster (28). So, it can be said that with increasing humerus length, palm width, thigh circumference and foot length in adolescent elite runner girls, the speed of legs and step length increased in the present study. Therefore, the running time was reduced in 1500m and the record was improved. The amount of high jump increased with increasing speed and explosive power of the legs (29-30).

Also, to increase the high jump record, it is necessary to bend the legs first to get help from their spring force. On the other hand, bending the foot, while stepping during running, is necessary to get the most movement after the front foot contact with the ground and increase the reaction forces of the ground to help push the foot forward in the final step of 1500m running (28, 33). This bending of the foot in running is like the first step in moving the foot in high jump. Increasing the maximum power and explosive power of the legs leads to achieving the maximum running speed (28) in 1500m running of elite runner girls in the present study. Therefore, it can be said that the increase in leg bending and the high jump record was due to the increase of foot contact with the ground and the increase of strength and explosive speed, which led to the improvement of the 1500m running time in the elite runners. The probable cause of the increase in 1500m running time by the increase of the hand length is the possible increase of the restraining and frictional force between the palm and the air around the runner (28-29). That led to an increase in 1500m running time and worse the record in teenage elite runners. There was a significant negative relationship between wrist circumferences with 3000m running time.Whereas there was a significant positive relationship between dynamic balances (Lateral) with 3000m running time. An increase of wrist circumference is associated with an increase of hand strength (28), which helps the hands move faster and more harmoniously (28, 30, 33). Since the movement and action of the hands are in harmony with the movement and action of the legs (28), this increase of the force and the movements of the hands have also been transferred to the legs (28, 33). So, the speed of the 3000m running of the elite runners' girls increased in the present study, and the running time decreased and the record improved. In contrast, increasing the dynamic (lateral) balance means increasing the lateral movements during 3000m running (28-30).

The increase of lateral and extravagant movements during 3000m running in the present study probably led to an increase of 3000m running time in teenage elite female runners, cause worse record of 3000m running. There was a significant negative relationship between foot length and humerus length with 4×100m relay race time. Whereas, there was a significant positive relationship between trunks circumference at hip with 4×100m relay race time. Reducing time and improving the record of 4×100m relay race by increasing arm length, leg speed and stride length of adolescent elite runners in the present study due to the coordination of the action of the arms and legs during running and the transfer of hand movements to the legs. So, the legs move faster. However, with the increase of friction between the trunk and the air, and the tendency of the body to run backwards, which is due to the increase of the circumference of the trunk at the level of the pelvis (28-29) in 4×100m relay race, the time of 4×100m relay race in present study increased and the record worsened. Also, our results showed that there were no significant relationships between anthropometrical and physiological parameters with 60m hurdle time. This finding is consistent with Modess et al. (2013) (22), Mahmoudkhani et al. (2013) (23), Lewandowska et al. (2011) (13), Natchtel et al. (2008) (21), and O'Connor et al. (2007) (5); whereas our finding is inconsistent with Foland et al. (25), and Wei (2000) (26). The possible causes of these inconsistencies are the difference in running events, athletes' age and gender, and their elite and non-elite levels in different studies.

4-1. Study Limitations

Some limitation in the study were lack of desire of some athletes for measuring anthropometrical and physiological parameters and lack of control of sleep the night before the test.

5- CONCLUSION

In conclusion, there was a significant relationship between anthropometrical and physiological parameters. Therefore, the results of this study are informal and useful for helping educators to design and teach training program. Therefore, we recommended that this study be considered by authorities, practitioners, educators and parents because of achieving optimum performance and better results without wasting time and energy and financial resources.

6- CONFLICT OF INTEREST: None.

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