

## Health- Related Physical Fitness and Normative Data in Healthy Women, Tehran, Iran

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### Abstract

**Background:** The purpose of this study was to determine the age- related loss of health-related physical fitness and normative data in healthy population women aged 20-60 years old of Tehran, Iran.

**Methods:** In this cross-sectional study, 1000 healthy women aged 20-60 years old were randomly selected from northern, southern, eastern, western and center regions of Tehran. Cardiovascular fitness was determined by Ros and Jakson protocol. Body composition were measured using Jackson and Poolak procedure, flexibility was determined by sit and reach test, muscular strength with a standard dynamometer and muscular endurance were measured with Sit-ups test in one minutes.

**Results:** Cardiovascular fitness ( $vo_{2max}$ ), body composition, flexibility, muscular strength and endurance remained unchanged in the 20 and 30 year old age groups. Around of 40 years old, cardiovascular fitness, muscular strength and endurance began to gradually decline but body composition increased and flexibility unchanged. Data for  $Vo_{2max}$  and the other variables in 4-yr groups provide "normative" results. Result indicated age- related declined in  $Vo_{2max}$  ( $0.43 \text{ ml/ kg/min} \times \text{yr} (-1)$ ), muscular strength ( $0.004 \text{ kg/weight} \times \text{yr} (-1)$ ) and endurance ( $0.63 \text{ repetition} \times \text{yr} (-1)$ ), and increased in body fat ( $0.43 \% \times \text{yr} (-1)$ ) in 30-60 year. One-way ANOVA test showed that all variables significantly differed ( $P < 0.001$ ) among decades except sit and reach test ( $P < 0.059$ ) between the second and third decades.  $V_{o_{2max}}$  had a significant relationship ( $P < 0.01$ ) with Age, BMI, body fat percent and muscular strength and endurance.

**Conclusion:** Iranian women have a greater decline in cardiovascular fitness; muscular strength and endurance. The results of this study can be used as reference material for clinical studies in different age groups.

**Keywords:** Health-related physical fitness, Normative data, Healthy women, Iran

### Introduction

Aging and health related factors are the one of the important issues that commencing in the 20<sup>th</sup> century. The number of older people will increase from about 600 million in 2000 to almost 2,000 million in 2050 (1). The increase older population will be greatest in developing countries, similar Iran. It is estimated to quadruple during the next fifty years (2). Internationally, the percentage of peoples aged 60 yr and +60 are expected to be twofold between 2000 and 2050 from 10 to 21 percent, whereas the percentage of children is expected to decrease by a third, from 30 to 21 percent (1). Also, proportions of women aged 60-70 yr are growing and in the next 3-4 decades expected grow from 1.5 million in 2000 to 7.5 million.

The physiological changes of aging are dramatic and in some instances are associated with pro-

gressive decline in physical activity (3, 4). Aging also increase some remarkable changes in health related physical fitness (HRFF) including body composition, skeletal muscle strength, a process called sarcopenia (5), endurance, cardiovascular fitness ( $vo_{2max}$ ) and flexibility (6). It is established that disabilities are in reason of change in HRFF and functional fitness (7).

Because of the alarming statistics on the lack of physical fitness and activity in the developing countries along with the strong evidence of the many benefits of physical activity on health, some country trying to increase physical activity (8, 9). While substantial evidence demonstrates physical activity is effective at increasing HRFF and reducing risk for Cardiovascular and other diseases (10), the percentage of older women, especially in Iranian because cultural and other reasons,

participating in regular activity is low (9). Female Iranian adolescents face unique cultural challenges that make achieving adequate levels of physical activity for HRFF benefits even more difficult. In consequences of decreasing physical activity in female adolescents, older women stricken with unfavorable health outcomes such as cardiovascular disease, diabetes, cancer, disability, depression, and cognitive decline.

In Iranian women, some reports are alarming. Janghorbani et al. recently reported that excess body weight appears to be common in Iranian population (11). It is reported that incidence of metabolic syndrome and all related abnormalities are higher among Tehrani women compared with men 20-70 yr old (12). While in western countries women are 10 yr behind of the men regarding coronary artery disease (13) women in Iran were near in age to the men. A recent large population based study in Tehran showed that two-third of Iranian middle aged women are either overweight or obese (14). Furthermore, accumulating data have showed that overweight has increased in Iranian children and adolescent girls over the last two decades, and it is more common among Iranian girls than boys (15). In a study of Iranian adolescents, only 36% of girls (12-17 yr) compared to 61.5% boys were at adoption stages of physical activity indicating that they were achieving physical activity recommendations. This may imply that early onset of obesity and the resulting cumulative exposure to atherogenic risk factors predispose Iranian women to CAD at an early age. With this health related consequences of inactivity lifestyle of women and aging in next decades we witness the more disabilities and unhealthy adult women that its need to prevention and treatment strategies are urgently needed to address the health burden. For this purpose, primary we need to survey the effect of aging on HRFF of adults, especially women, and have a normative data can be used as reference material for clinical setting in different age groups and for a potential preventive and non-pharmacological program against unhealthy outcomes of aging and inactive lifestyle.

Normative data about cardiovascular fitness, muscle strength, endurance, body composition, and flexibility in Iranian women is rare. Therefore the purpose of this study was the evaluate health- related physical fitness and normative data in healthy population women aged 20-60yr old of Tehran, Iran.

## Materials and Methods

### Subjects

We selected randomly 1000 women in 20-60 yr by a proportionate sampling of any decades. Subjects selected in common area locations such as: health clubs, universities, mosques, old people's home, and education centers of four geographical areas (west, east, middle, and north) of Tehran. They were divided into four age groups that each representing a decade, 250 people at 20-29 and 40-49 yr old, 350 people was in 30-39 and 150 people was from 50-60 yr old group. In this study, participating special features was prevented that influenced in average of data participant special specialty for example; high weight, tallest women, pregnancy women and elite women. All women were informed about procedure of study gave informed constant for their participation.

### Assessments

#### *Cardiovascular fitness and self-reported physical activity*

Persian version of Self-Reported Physical Activity Scale (SR-PA) was used to survey physical activity of subjects, which were dichotomized into yes or no for activities performed during the last 30 d (16, 17). This scale asks respondents to rate their typical weekly level of physical activity on a seven point scale ranging from avoidance of walking or exertion to running over 10 miles per week or spending 3 h per week in comparable physical activity (Table1). Estimated  $V_{O_{2peak}}$  for women were calculated using the participants' scores from the physical activity scale, age, and body mass index, as recommended by Jackson et al, that designed for men and women aged 20 to 70 yr (16, 17).

**Table 1:** Description five-category of self-reported physical activity scale

Activity Level	Properties	Reference
Level 1 (SR-PA-0)	Little activity other than walking for pleasure.	(0, 1, 2)
Level 2 (SR-PA-1)	Some regular participation in modest physical activities involving sports, recreational activities.	(3, 4)
Level 3 (SR-PA-2)	Aerobic exercises such as run/walk for 20 to 60 minutes per week.	(5)
Level 4 (SR-PA-3)	Aerobic exercise such as run/walk for 1 to 3 hours per week.	(6)
Level 5 (SR-PA-4)	Aerobic exercise such as run/walk for >3 hours per week	(7)

Abbreviation: SR-PA; Self-Reported Physical Activity Scale.

$Vo_{2max} (ml/kg/min) = 44.31 - 0.326(\text{age}) - 0.227(\text{BMI}) + 4.471 \times (\text{physical activity scores}) - 0.135(\text{BMI} \times \text{physical activity scores})$  (16, 17).

### **Anthropometric measurement**

Height and body mass were assessed by king scale and standard meter (cm) that fixed on the wall respectively. Body mass index (BMI) of subjects were calculated with equation of weight (kg)/(height)<sup>2</sup>, also Fat free mass (FFM) calculated by use of this equation:  $FFM = \text{body weight (kg)} - \text{fat weight (kg)}$  (18). Body fat was estimated by the method of Pollock et al (18). This test is a valid ( $r = 0.79\%$ ) test for estimation of body fat in adult population studies, and recently (2007) used (19).  $BF\% = (1.16 \times \text{BMI}) + (0.13 + \text{age}) - (12.1 \times \text{gender}) - 13.9$  (kg).

### **Flexibility**

Flexibility lower back and hamstring muscles assessed by sit and reach (SR) test in this procedure: before testing, the subjects performed standardized static stretching exercises for 5 min on the lower back and hamstring muscles. Then the participant in a same position (shoes were removed) placed on a standard sit-and-reach box; heels were placed against the standard sit-and-reach box; legs were extended with the knees straight but not locked; fingertips were kept parallel so that leading with one hand or the other was not permitted. The position of the feet being flexed was marked at 38 cm, and the best of three trials was recorded. During the reach, the subject exhaled slightly and the head was lowered between the arms (20).

### **Muscular endurance and strength**

The Hand-grip dynamometer was use to assess muscular strength. The subject should stand with

feet shoulder-width apart and arms to the side, holding the dynamometer in either hand. Then, in 3 time squeeze the dynamometer, making sure to keep the arm to the side (do not bend the elbow). The best of three measurements used as the final score. In addition, the sum of the highest trial for the right and left hand was used as the measurement of maximal grip strength (21, 22).

Muscular endurance was measured with the 1-min timed sit-up test (22) in this procedure: the subject lie on their back with the knees bent and the hands crossed over the chest. The administrator holds the subject's feet and be ready to count the number or repetitions. The subject have practice a couple of sit-ups. Then, the subject should lift high enough to touch the forearms to the quadriceps and return to touch the shoulder blades on the floor. The number sit-ups completed in one minute is the score muscular endurance test.

### **Statistical Analysis Statistical Analysis**

Descriptive statistics has been used to classify and arrange data. All data were presented as mean  $\pm$  standard deviation (SD). The Kolmogorov-Smirnov (KS) statistic was used for testing the normality of distribution of scores for each fitness test within each age group. For comparison of groups, analysis of variance (ANOVA) and a multiple comparison test of Tukey HSD test (as a post hoc test) were used. Pearson correlation test was used to evaluate the correlation between variables. Differences were considered significant at the level of  $\alpha < 0.05$ . SPSS for windows version 12 was used for statistical analysis.

## Results

Demographic and SR-PA data that describe characteristics of women are shown in Table 2. The women in the four age group were equivalently matched for height, mass, BMI, % body fat, and FFM. When histograms were plotted for all of the fitness tests (Cardiovascular fitness, bench press, grip strength, sit-and-reach), the frequency of scores followed the normal distribution for each variable at each age group. The mean and normative data for each of the fitness parameters ranked according to percentiles were shown for VO<sub>2</sub>max, grip strength, and sit-and-reach, and sit up.

### Age-related cross sectional Changes

#### Cardiovascular fitness

Cardiovascular fitness declined with age, as expected, with the sharpest decline occurring during the sixtieth decade (Table 3). One-way ANOVA test showed that V<sub>o2</sub>max declined with increasing the age ( $P < 0.01$ ). The correlation between cardiovascular fitness with other parameters also is shown in Table 4. All correlations except fat free mass were statistically significant ( $P < 0.01$ ). The highest correlations were found between age, BMI, BF and SR-PA.

To further examine the cross-validity of each of the regression models, correlations were computed between estimated Vo<sub>2</sub>max levels of cardiovascular fitness. Table 5 includes regression weights of each independent variable, which were identical for age, BMI, SR-PA. All variables used in the model were independently related to cardiovascular fitness. The R square obtained was 0.996 that proportion of Age, BMI and SR-PA in predict of Vo<sub>2</sub>max are -0.628, -0.498 and 0.303 respectively. Normative values for cardiovascular fitness and other famous norm (ACSM) were generated with percentile rankings in Table 6.

#### Self-reported physical activity score

Fig. 1 shows that self-reported physical activity of Tehran's adult women population decreases significantly. With increasing, the age inactivity score increased. Present of SR-PA scores summarized in Table 2. This figure indicates numbers of women

which in any age group have physical activity scores of 0-5 (rang inactive to very high active) that describe in Table 2. For example: in 20-29 age groups, about 120 persons have score of 0, 80 persons, score1, 40 person score 2, and about 10 persons have score 3-5.

#### Body composition (BMI, BF, FFM)

On way ANOVA test showed that BMI in a significant pattern increase with age ( $P < 0.01$ ) (Table 3). These increases were approximately 0.182 in any year. In addition, %BF increase with age ( $P < 0.01$ ), these increase approximately 0.43% in any year from 30-60 yr. The FFM declines with age ( $P < 0.01$ ). These declines were approximately 0.087 kg in any year. Normative values for Body Composition (% Body Fat), BMI and other famous norm (ACSM) were generated along with percentile rankings in tables 7, 8.

#### Muscle strength

One way ANOVA test showed that grip muscular strength declines significantly with age ( $P < 0.01$ ). These declines approximately were 0.004 kg/weight in any year for right and left hand. Normative values for Grip strength (maximal right-left hands) were generated along with percentile rankings in Table 9.

#### Muscle endurance

One-way ANOVA test showed that muscular endurance declines with age ( $P < 0.01$ ). This decline is approximately 0.63 repetition  $\times$ yr (-1). Normative values for Sit Up test were generated along with percentile rankings in Table 10.

#### Flexibility

On way ANOVA test showed that flexibility do not have a significant change with age, and increased in 30-39 yr old by approximately 17%, declines in 40-49 yr old by approximately 13.5% and decline in 50-60 yr old by approximately 5.9%. Normative values for Sit and Rich test were generated along with percentile rankings in Tables 11.

**Table 2:** Anthropometric characteristics (mean±Standard Deviation) of women in each parameter and level of self-reported physical activity

Parameters	Age groups(yr)				Total (n=1000)	P value
	20-29 (n=250)	30-39 (n=350)	40-49 (n=250)	50-60 (n=150)		
Age, (yr)	23.8(3)	34.29(2.92)	44.12(2.73)	56.90(3.65)	37.53(11.27)	<0.001
Height, (cm)	1.61(0.06)	1.59(0.06)	1.58(0.06)	1.55(0.06)	1.59(0.06)	<0.001
Mass, (kg)	60.8(10.6)	66.10(12.7)	70.76(11.31)	69.63(9.73)	66.48(12.06)	<0.001
BMI (kg/m <sup>2</sup> )	23.2(3.9)	25.9(5)	28.4(4.6)	28.7(3.7)	26.28(4.99)	<0.001
BF (%)	26.6(6.4)	32.2 (8.2)	37.5 (7.5)	39.7 (6.0)	33.3(8.7)	<0.001
FFM (kg)	44.0(4.3)	43.8(4.0)	43.4(3.5)	41.4(3.3)	43.4(3.9)	<0.001
<b>Self-Reported Physical Activity Scale</b>						
SR-PA-0 (inactive)	54.8%	44.3%	43.6%	42.7%	46.5%	-
SR-PA-1 (very low)	25.2%	34.3%	36.8%	36.7%	33%	-
SR-PA-2 (low)	16.4%	15.4%	15.2%	14.0%	15.4%	-
SR-PA-3(moderate)	2%	5.7%	3.6%	6.7%	4.4%	-
SR-PA-4 (high)	0.8%	0.3%	0.8%	0.0	0.5%	-
SR-PA-5 (very high)	0.8%	0.0	0.0	0.0	0.2%	-

Values are means\_ SD (standard deviation) for n = 1000 subjects. BMI, body mass index is in kg . m<sup>2</sup>, Groups with different superscripts are significantly. P< 0:05. BF; body fat. FFM; fat free mass, SR-PA; Self-Reported Physical Activity Scale,

**Table 3:** Health related physical fitness tests of age groups in a normative data for adult Tehran women population. Values are means (SD), grip strength ratio = (maximal right+ maximal left)/kg body mass, sit-and-reach position of the flexed feet was marked at 38.1 cm (15 in)

Test	Age groups(yr)				Total(n=1000)	P value
	20-29(n=250)	30-39(n=350)	40-49(n=250)	50-60(n=150)		
Vo2max (ml/kg/min)	32.61(3.29)	28.12 (3.55)	23.70 (3.39)	19.60 (3.05)	26.86(5.53)	<0.001
Grip Strength (Kg/w)	0.632(0.15)	0.600(0.149)	0.515(0.163)	0.377(0.162)	0.553(0.177)	<0.001
Sit up (Rep)	34.65(14.21)	30.28(14.41)	23.85(17.57)	15.46(14.68)	27.54(16.50)	<0.001
Sit and Rich (cm)	25.35(9.94)	27.07(8.92)	25.72(9.06)	25.13(9.19)	26.01(9.28)	<0.059

Values are means\_ SD (standard deviation). BMI, body mass index. W, weight. FFM, fat free mass. BF, body fat. Kg, kilogram. Cm, centimeter .Rep, repetition

**Table 4:** Pearson correlation between cardiovascular fitness with no exercise independent variables and other fitness tests

Variable	Age(yr)				Total
	20-29	30-39	40-49	50-60	
Age (years)	0.379**	0.302**	0.322**	0.481**	0.819**
BMI(kg/m <sup>2</sup> )	0.738**	0.836**	0.864**	0.772**	0.771**
SR-PA	0.670**	0.501**	0.613**	0.614**	0.322**
Weight(kg)	-0.614**	-0.752**	-0.724**	-0.530**	0.625**
Height(m)	-0.244**	-0.218**	0.314**	0.360**	0.399**
BF (%)	-0.705**	-0.848**	-0.874**	-0.805**	-0.848**
FFM(kg)	-0.341**	-0.222**	-0.015	0.115	0.042
<b>Other fitness test</b>					
<b>Grip Strength (Kg/w)</b>					
Right hand	-0.051	-0.086	0.244**	0.240**	0.259**
Left hand	-0.092	-0.160*	0.214**	0.271**	0.279**
Sit up (Rep)	0.315**	0.400**	0.371**	0.392**	0.509**
Sit and Rich (cm)	0.032	0.100	0.136*	0.016	0.062*

Note: \*\*.Correlation is significant at the 0.01 level \*.Correlation is significant at the 0.05 level

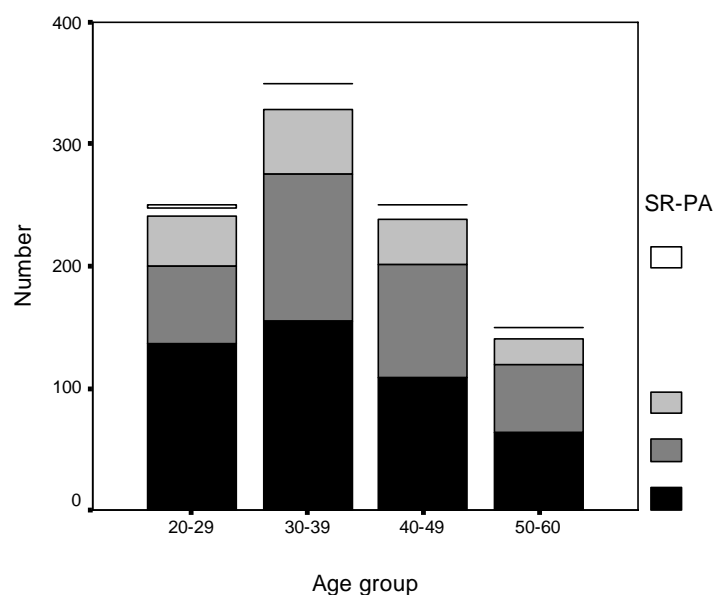
**Table 5:** Regression analysis of dependence variables (age, BMI, SR-PA) in predicting cardiovascular fitness.

dependence Variable	b	t
Age (years)	-0.628	-288.07
BMI <sub>(kg/m<sup>2</sup>)</sub>	-0.498	-227.85
SR-PA	0.303	150.95

BMI; Body mass index, SR-PA; Self-Reported Physical Activity Scale

**Table 6:** Maximal Aerobic Power ( $V_{o2max}$ ) norms ( $\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) in different age groups of Tehranian women in present study and ACSM guidelines (23, 24).

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (percentile)</b>					
90	37.06	32.52	28.28	24.43	33.81
80	35.16	30.76	26.59	21.79	31.78
75	34.52	30.31	26.01	21.33	30.91
70	34.08	29.89	25.55	20.98	30.07
60	33.26	29.07	24.53	20.15	28.73
50	32.39	28.31	23.47	19.23	27.18
40	31.63	27.28	22.79	18.51	25.71
30	30.94	26.47	21.91	17.80	23.68
25	30.48	26.13	21.26	17.32	22.71
20	29.92	25.50	20.72	16.97	21.63
10	28.76	23.82	19.45	15.76	19.16
<b>ACSM guidelines</b>					
90	49.0	45.8	42.6	37.8	-
80	44.2	41.0	39.4	34.6	-
70	41.0	39.4	36.2	33.0	-
60	39.4	36.2	34.6	31.4	-
50	37.8	34.6	33.0	29.9	-
40	36.2	33.0	31.4	28.3	-
30	33.0	31.4	29.9	26.7	-
20	31.4	29.9	28.3	25.1	-
10	28.3	26.7	25.1	21.9	-



**Fig. 1:** Cumulative age-specific physical activity score in Tehran's adult women population.

**Table7:** Body Composition (% Body Fat) for Tehranian Women in different age groups in present study other studies

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (percentile)</b>					
90	19.09	23.34	28.37	32.20	22.91
80	21.51	25.66	30.64	34.31	25.65
75	22.37	26.79	31.18	35.09	26.89
70	23.18	27.88	32.57	35.86	28.15
60	24.41	29.68	34.60	37.58	30.34
50	25.62	31.15	36.94	39.05	32.45
40	27.07	32.68	39.06	41.24	34.80
30	28.82	34.97	41.26	43.35	37.38
25	29.66	35.89	42.80	44.07	38.88
20	30.66	37.67	43.80	44.80	40.81
10	35.27	42.55	47.70	47.91	44.77
<b>ACSM guidelines(23,24)</b>					
90	14.5	15.5	18.5	21.6	-
80	17.1	18.0	21.3	25.0	-
70	19.0	20.0	23.5	26.6	-
60	20.6	21.6	24.9	28.5	-
50	22.1	23.1	26.4	30.1	-
40	23.7	24.9	28.1	31.6	-
30	25.4	27.0	30.1	33.5	-
20	27.7	29.3	32.1	35.6	-
10	32.1	32.8	35.0	37.9	-

**Table 8:** BMI (Body Mass index) for Tehrani women in different age groups in present study

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (percentile)</b>					
90	18.67	20.68	22.86	24.04	20.70
80	20.18	21.88	23.98	25.31	21.94
75	20.70	22.47	24.54	25.94	22.69
70	21.10	23.05	25.05	26.40	23.30
60	21.79	24.23	26.50	27.44	24.53
50	22.62	25.25	28.09	28.34	25.53
40	23.49	26.10	29.34	29.66	26.98
30	24.66	27.66	30.69	30.85	28.46
25	25.08	28.22	31.61	31.19	29.35
20	25.65	29.26	32.19	31.64	30.29
10	28.80	32.46	34.73	34.12	33.01

**Table 9:** Grip strength norms by age women groups for combined right and left hand in present study, ACSM and other study, grip strength (maximal right+ maximal left)

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (percentile)</b>					
90	52.25	51.30	47.90	40.00	50.00
80	45.66	46.23	43.80	36.00	44.00
75	43.94	44.30	42.00	33.00	43.00
70	42.62	43.03	40.00	32.00	41.00
60	40.66	40.89	37.60	30.00	39.00
50	38.00	38.71	36.00	26.00	36.00
40	35.09	36.55	34.00	22.40	34.00
30	33.04	34.34	31.00	20.00	31.00
25	31.53	32.92	28.75	17.00	29.00
20	29.93	31.52	26.60	15.00	27.00
10	25.70	27.55	22.00	10.00	22.00
<b>ACSM guidelines (23,24)</b>					
Above average	65-70	66-72	65-72	59-64	-
Average	61-64	61-65	59-64	55-58	-
Below average	55-60	56-60	55-58	51-54	-
Poor	≤54	≤55	≤54	≤50	-
Present study (mean L+R/W)	0.632	0.600	0.515	0.377	-
Other study(25) (mean L+R/W)	0.827	0.897	0.802	0.765	-

**Table 10:** Sit Up (rep) Norms for muscular endurance in age groups of Tehranian women in present study, and other studies (24, 26)

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (%)</b>					
90	51.75	48.57	48.90	37.90	48.90
80	45.54	40.58	39.80	30.00	40.00
75	42.88	38.42	34.25	26.00	38.00
70	40.43	36.40	31.00	22.00	36.00
60	37.53	33.59	27.60	18.00	31.00
50	34.35	30.44	22.50	13.00	29.00
40	30.60	28.40	20.00	10.00	24.40
30	28.50	24.05	15.00	00.00	20.00
25	26.16	22.05	10.00	00.00	17.25
20	24.20	20.08	4.20	00.00	12.00
10	18.60	10.37	00.00	00.00	00.00
Present study (mean of group)	34.65	30.28	23.85	15.46	-
Other studies (24)	38.00	29.00	24.00	20.00	-
CBI health center (26)					-
Good (75%)	67	50	35	50	-
Average (50%)	41	30	25	31	-
Weak (25%)	26	18	22	18	-



**Table 11:** Sit and Rich test (cm) norms by age women groups for trunk forward flexion in present study other studies.

	Age(yr)				Total
	20-29	30-39	40-49	50-60	
<b>Present study (%)</b>					
90	37.11	38.80	37.00	37.00	38.00
80	33.94	34.15	34.00	33.80	34.00
75	32.57	33.00	32.00	31.25	32.00
70	31.40	31.95	31.00	29.70	31.00
60	28.95	30.27	28.00	27.00	29.00
50	26.58	28.07	26.00	25.00	27.00
40	23.66	25.46	24.00	22.00	24.00
30	20.83	22.50	22.00	20.00	21.00
25	18.33	20.86	20.75	18.75	20.00
20	16.30	19.20	20.00	18.00	18.00
10	11.15	15.00	14.00	15.00	14.00
<b>ACSM guidelines(23,24)</b>					
Excellent	41	41	38	39	-
	40	40	37	38	
Very Good	37	36	34	33	-
	36	35	33	32	
Good	33	32	30	30	-
	32	31	29	29	
Fair	28	27	25	25	-
Needs Improvement	27	26	24	24	-

## Discussion

This study examined health related physical fitness of Tehrani women. The present study is unique in the report of  $V_{O_2 \max}$ , body composition, muscular endurance, muscular strength and flexibility for a sample range in the young and old age group (20-60 yr) of Iranian women. We found that aging had a varying effect on health related physical fitness. The most remarkable finding of the study is that sit and rich test, flexibility of lower back and hamstring muscles, no significant ( $P < 0.059$ ) decline in age groups (20-60 yr) and also increased in the 30-39 yr group. Another novel finding is about all norms less than the famous norms (ACSM) about this health related physical fitness tests.

### Cardiovascular Fitness

In this study we used the non-exercise model for measuring cardiovascular fitness. Jackson et al confirmed that non-exercise models were more accurate than established submaximal treadmill prediction models (17). This method including

gender, age, body mass index, and self-reported physical activity and may be accurately estimated in adults aged 20-70 yr old (32). This method recently used for estimation of cardiovascular fitness levels among US youth 12 to 19 yr of age (33).  $VO_2\max$  is known to decline with age. In this study, also  $Vo_2\max$  declined with age. In comparison with the other investigations (Table 12) about the rate of decline of  $Vo_2\max$  in women during aging (Table 6) the rate decline of  $Vo_2\max$  was  $0.43 \text{ ml} \times \text{kg}^{-1} \times \text{min}^{-1} \times \text{yr}^{-1}$  or 9.97%  $\text{ml/kg/min}$  in any decades. This rate of decline is similar to the results of some investigation (Table 12) and American College of Sport Medicine (ACSM) (23, 24). In comparison with other famous norms, ACSM, the primary mean level of  $Vo_2\max$  in four decades is very low. Differences between  $Vo_2\max$  norms of this study with ACSM norm in point of 50 percentile of any age group respectively are 5.41  $\text{ml/kg/min}$  in 20-29 yr old group, 6.29  $\text{ml/kg/min}$  in 30-39, 9.5  $\text{ml/kg/min}$  in 40-49 and 10.67  $\text{ml/kg/min}$  in 50-60 yr group.

$V_{o2max}$  have significant differences but SR-PA scores do not have any significant differences between groups. This indicates that differences between this norms increased with increase the age and may be related to a more inactive life-style, environmental, genetic and cultural-social differences in Iranian woman.

Many studies have attempted to identify the mechanism for the age-related decline of  $Vo2max$  and focusing on central and peripheral adaptations to aging. Some investigators concluded that a major reason why  $Vo2max$  decrease with age is decrease of maximum heart rate with age and decrease maximum cardiac output and pulmonary function with age (27). It is expected that reduced  $HR_{max}$  plays a major role in the central adaptations aging that contribute to reduce  $VO2max$ . Centrally, maximum HR declines at rate of

approximately 3–5% per decade uninfluenced by exercise training or sex (27). However, in older adults whether sedentary or athletic, Frank-Starling is the main mechanism to increase maximal cardiac output through increases in  $Vo2max$  (28). Several studies have also implicated peripheral adaptations with aging that contribute to reduce  $VO2max$ . These clearly involve alterations in body composition, including decreased FFM and increased fat mass (29). The cross-sectional data of Toth et al. (30), demonstrated loss rates in  $VO2max$  of approximately 9% per decade for both men and women that were reduced to 4% per decade when controlling for changes in FFM and fat mass. Rosen et al. (31) utilized statistical modeling to suggest that 35% of the decline in  $Vo2max$  with age was due to age-associated declines in FFM.

**Table 12:** Comparison rate of decline in  $Vo2max$  with age in present study with data reported in other literature

Study	Population	n	age (yr)	Rate of Decline: ( $ml \cdot kg^{-1} \cdot min^{-1} \cdot yr^{-1}$ )
Present study	healthy	1000	20-60	0.43
Stathokostas et al. (44)	Healthy	28	72.1±5.3	0.013
Talbot et al. (45)	General population	497	49.4±16.3	0.33
Paterson et al. (46)	Random sample	146	70.0±8.1	0.25
Fitzgerald et al. (47)	Meta-analysis			
	Endurance trained	911	33.1±14.1	0.62
	Active	1,717	34.7±17.2	0.44
	Sedentary	2,256	40.5±19.4	0.35
Tanaka et al. (48)	Endurance trained	84	21–73	0.57
	Sedentary	74	20–75	0.32
Jackson et al. (49)	Healthy NASA employees	409	39.4±9.6	0.54
Toth et al. (30)	Healthy	224	47±17.0	0.45
Fleg and Lakatta. (50)	Subset of BLSA	101	51.9±6.3	0.25
Posner et al. (51)	Healthy	103	20–89	0.26
Jones et al (52)	General population	50	15–71	0.36
Astrand (53)	Healthy	44	20–65	0.35

Abbreviations: n, Number. of subjects. NASA, National Aeronautics and Space Administration; BLSA, Baltimore Longitudinal Study of Aging

### Body composition

Aging is associated with considerable changes in body composition. After 20–30 yr of age, fat free mass (FFM) progressively decreases, whereas fat mass increases. It is reported that maximal FFM is usually reached at 20 yr of age, and

maximal fat mass is usually reached at 60–70 yr of age (34). Therefore, both FFM and fat mass decrease during old age. FFM (primarily skeletal muscle) decreases by up to 40% from 20 to 70 yr of age (35). Data from large population studies show that mean body weight and BMI gradu-

ally increase during most of adult life and reach peak values at 60–70 yr of age in both men and women (36). In the present study, also mean body weight and BMI (Table 2) gradually increase during 20-49 yr but decrease in 50-60 yr and FFM gradually decreased in 20-60 yr old groups. After the age of 50 yr, mean body weight and BMI trend to decrease. The reason of shifting the FFM to fat tissue (muscle and skeletal mass) is some factors including inactivity life style, socials and cultural factors, age-related changes such as: Sarcopenia (5), and other reasons such as ecological factors (4).

The prevalence of overweight and obesity in Iranian women is serious. Janghorbani et al. recently reported that the prevalence of overweight and obese women increased in 15-64 yr (36) that is almost similar with norms of this study. They concluded that in Iran, 56.9% of women had excess body weight (BMI >25), the obesity prevalence (BMI>30) was 24.5% in women. We conclude that 54.7% Tehrani women had excess body weight (BMI>25) and the prevalence of obesity (BMI>30) was 21.5%. These data are consistent with local reports of Azadbakht et al. (37), Bahrami et al. (38) and Malekzadeh et al. (39) about the high prevalence of overweight and obesity in Iran and other the Middle East. As reported by other studies in developing countries, obesity tends to increase with age and is more common in women and people with low educational attainment.

### ***Strength and endurance***

The other findings of this study are decreasing strength and endurance of Tehrani women in age group. A comparison of the data generated in this study with the normative values published by the CBI health center (26) shows several differences. When one compares the average muscular endurance score for each of the age groups in this study (Table 10) to the percentile rankings of the CBI norms, one can see that the average ranking for all of the age groups in this study is below the 20-25<sup>th</sup> percentile of CBI rankings. In fact, the average woman in this study would have scored below the first percen-

tile of the CBI rankings until she reached the sixth decade of life. Furthermore if one compares the highest grip strength score in our rankings (90<sup>th</sup> percentile, Table 10) to the ACSM classifications (poor, below average, average, average, above average), our strongest women are never ranked beyond the below average category for ACSM. Similarly, the average woman of any age in this study would have only been ranked between the 20<sup>th</sup> and 50<sup>th</sup> percentile (poor to below average) for grip strength to the ACSM (Table 10). In addition, the mean grip strength (left+right hand grip/weight) reported by Brown and Miller is further than mean grip strength of present study.

### ***Flexibility***

The ACSM rankings for flexibility (sit-and- reach) are also much higher than those of this study (23, 24). The average woman of any age in this study would have ranked in only the 15<sup>th</sup> to 30<sup>th</sup> ACSM percentile, a classification of fair and need to improvement (Table 11). None of percentile of the women in this study would have been classified in either the good or the excellent categories of the ACSM flexibility classifications.

One may criticize the stability of these newly established norms because the number of subjects in some of the groups is rather small. There are no previously established norms at all for cardiovascular fitness, BMI, grip strength, or sit-and reach for Tehrani women in 20-60 yr of age. Furthermore, the some published ACSM norms also have small numbers in some of the groups.

### ***Recommendation***

This study is one of the first studies about HRFF of women in Iran. The results of this investigation have important outcomes for clinical settings and health and sport clubs. It's recommended the other studies in a similar settings survey HRFF of men in population based settings and create a normative data for men. Also since, our study indicated that the HRFF of Tehrani women is under the famous norms (ACSM and other studies), it is proposed a new policy to enhance the health effects and outcomes of

physical activity and exercise of individuals. It is also proposed that by widespread programs enhanced the level of attitudes about physical activity to increase the participation of individuals, especially women, in physical activity, sport, and exercise. The physical activity interventions are cost-effectiveness approach and it is important to consider the potential economic benefits from increased physical activity (40). These recommendations call for 15-60 min of aerobic activities that require large muscle, rhythmic movement, 3-5 d per week, at an intensity equivalent to 40-85% of VO<sub>2</sub>max. However, in guidelines issued by the Centers for Disease Control and Prevention/American College of Sports Medicine (ACSM) recommending light- to moderate-intensity physical activity on a more frequent basis to optimize health (41) However, prescription for adults of all ages.

Additionally, given the contribution of declines due FFM to age-related losses in VO<sub>2</sub>max, it would be advisable to recommend some form of strength training. Strength training leads to increased muscle and muscle mass, and has been shown to be effective even at older ages in both men and women (42). Recommendations for strength training for general fitness are similar regardless of age, and include 1-3 sets of 15 repetitions at 70-80% of one repetition maximum (the maximum amount of resistance an individual can control during one repetition of an exercise) 2-3 times per week (43). One repetition maximum may be extremely low in older adults, and for frail elders beginning levels of intensity and frequency may need to be reduced. Resistance exercise bands, dumbbells and strength exercise machines can all be used effectively for strength training in adults.

In conclusion, the data generated from this research provide normative values for cardiovascular fitness, body composition (BMI, BF), muscular strength, muscular endurance, and flexibility of Thracian women. Since these values were derived from a sample population that is distributed normally in all region of Tehran, the norms pro-

vided here are probably, the best suited for interpreting women's fitness test results.

### Ethical Considerations

All ethical issues including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc have been completely observed by the author.

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The authors declare that they have no conflicts of interest.

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