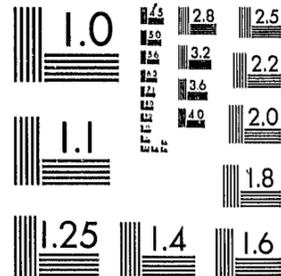


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CORONARY RISK FACTORS

AND LEVEL OF PHYSICAL FITNESS IN POLICE OFFICERS*

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Coronary heart disease is prevalent in most industrialized countries, and in the U.S. alone the annual death toll from coronary heart disease reaches approximately 600,000 (1). Certain risk factors are associated frequently with the development of coronary heart disease. Risk factors established by the American Heart Association include the following: high blood pressure, elevated blood fats (mainly cholesterol and triglycerides), cigarette smoking, obesity, physical inactivity, elevated blood sugar and uric acid, family history, and excessive emotional stress (1-3). Population investigations, such as the Framingham study, have shown not only that the manifestation of coronary heart disease is influenced by certain risk factors but also that the probability is increased drastically with added numbers of risk factors (3,4).

Several studies have indicated a relationship between physical activity and reduced susceptibility to coronary heart disease (3-10). Although there are some conflicting views, recent studies by Morris et al. (8), Paffenbarger and Hale (9), and Cooper et al. (10) have placed stronger evidence in favor of the role exercise plays in preventive medicine. Morris et al. (8) in studying the leisure-time habits of over 16,000 male, executive grade civil servants from 40 to 64 years of age, concluded that vigorous exercise apparently protected them against sudden fatal heart attacks and other first clinical attacks of coronary heart disease. The study by Paffenbarger and Hale (9) on 6,351 longshoremen, 35 to 75 years of age, found that the workers classified in a high caloric output job task had significantly lower death rates from coronary heart disease. Cooper et al. (10) in a cross-sectional study on 3,000 men, found a significant relationship between level of cardiorespiratory

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fitness and selected risk factors and fitness variables (serum cholesterol, triglycerides, glucose and uric acid, systolic blood pressure, percent body fat and weight, resting heart rate, and forced vital capacity).

What is the physical fitness level and risk factor profile of police officers? How do they compare with other occupational groups? What are the physical fitness needs of police officers? A review of the literature failed to provide sufficient information to give adequate answers to these questions. There is some evidence in the literature suggesting that policemen are average to below average in physical fitness and risk for coronary heart disease when compared to the general sedentary population (11-16).

Kaminski (17) reported the need for physical fitness programs for police officers. He stated that physical fitness for law enforcement purposes consists of two distinct but equally important areas; 1) the cardiorespiratory system (conditioning of the heart, lungs, and circulatory system); and, 2) motor ability (achievement abilities such as muscular strength and endurance, agility, and flexibility), that relate to the skills necessary to perform the basic job-related tasks. Good cardiorespiratory fitness is indicative of the ability of the body to adapt and recover from periods of physical stress. This type of fitness results in a more efficient performance of duty, reduced probability of heart disease, and less frequent on or off duty injury due to overexertion (11,14,18). A recent survey conducted with firemen who were placed on an exercise regimen showed lower worker's compensation loss (19). A good fitness program should lead to a greater career expectancy rate as officers would not have to retire prematurely for medical reasons.

Thus there is a need to quantify better the physical fitness level and risk factor profile of police officers. It is felt that this information will provide evidence as to their need for physical fitness and other preventive medicine programs. This paper is based upon the results of a larger study that was conducted to promote physical fitness in police officers (20).

METHOD

The sample consisted of 213 male volunteer police officers from Dallas and Richardson (Texas) Police Departments, and the Texas Department of Public Safety. The officers were between 21 and 52 years of age (\bar{x} = 31.8 yr) and free from known cardiovascular or other serious diseases or disabilities. Several women were a part of the overall study but their sample was too small for inclusion in this report. The officers consented to be evaluated initially and after 20 weeks of physical training. This report includes normative data established from the initial testing sessions. The results from the various physical training regimens will be discussed in a subsequent paper (21).

Testing sessions were conducted at the Institute for Aerobics Research, Dallas, Texas, and included the following test battery.

- A. Cardiovascular - Respiratory
 1. Resting
 - a. heart rate (sitting)
 - b. blood pressure (sitting)
 - c. 12-lead electrocardiogram
 2. Submaximal - three minute bench step

3. Maximal stress test
 - a. oxygen intake
 - b. treadmill time
 - c. electrocardiogram
 - d. heart rate
- B. Pulmonary function (spirometry)
 1. Vital capacity
 2. Forced expiratory volume for one second
- C. Body composition
 1. Height and weight
 2. Total of 6 skinfold fat measures: chest, axilla, triceps, abdomen, suprailium, and front thigh.
 3. Percent fat
 4. Lean body weight
 5. Selected girth measures: shoulder, waist, gluteal, forearm.
- D. Blood (serum)
 1. Cholesterol
 2. Triglycerides
 3. Glucose
 4. Uric Acid
- E. Motor ability
 1. Flexibility: sit and reach
 2. Muscular endurance: situps and pushups
 3. Muscular strength: one repetition bench press
 4. Power: vertical jump
 5. Agility: Illinois agility run

Medical history forms were also completed which gave information concerning family history of heart disease and smoking habits.

Tests were administered under strict experimental control. Specific instructions as to the procedures of test administration will be outlined in the next paper entitled "Evaluation of Physical Fitness Programs for Police Officers."

The data were averaged and standard deviations calculated. Then percentile score tables were constructed on each variable. To determine coronary risk the data were compared to the standards recommended by the American Heart Association (1) and the Cooper Clinic^a. To compare the fitness levels of police officers, the data for the general population, Los Angeles County Sheriff's Department Personnel and Highway Patrolmen, and prison inmates were plotted on the norm scales developed for police officers.

RESULTS AND DISCUSSION

Coronary Heart Disease Risk

The data related to coronary heart disease risk for police officers are shown in Table 1 and Figure 1. These variables include performance time on the treadmill (TMT), cholesterol (CHOL), triglycerides (TRI), uric acid (UA), percent body fat (% FAT), systolic blood pressure (SBP), diastolic blood pressure (DBP), a blood relative less than 50 years of age having heart disease (FH), cigarette smoking (CIG), and abnormal exercise electrocardiogram (ECG). Data for smoking, family history of coronary heart disease, and abnormal exercise electrocardiogram were quantified as to a yes or no response. To quantify coronary risk for police officers the data were compared to the standards recommended by the Cooper Clinic. Figure 1 lists the criteria used to determine if an individual is at risk, and shows the percentage of police officers at risk for each of the age groups.

^a Cooper Clinic 12100 Preston Road, Dallas, Texas 75230

The results show a distinct increase in coronary risk with age. This relationship is well established in the literature (1,4,22). Compared to the general population, the police officers studied in this investigation were shown to be average in coronary risk in all variables except body fat in men 20-29 years of age; serum triglycerides and body fat in men 30-39 years of age; and treadmill performance, serum cholesterol, serum triglycerides, and body fat in the group aged 40-52. In comparison with 68 Los Angeles City Fire Fighters who were 40-50 years of age, the police scored significantly lower in cardiorespiratory endurance, and higher in serum cholesterol, diastolic blood pressure, percent fat, and percent of smokers (23). Overall the younger police officers seem to be of average risk and the older officers appear to be at higher than average risk.

The results showed that of the 213 police officers studied, 88% had at least one risk factor, 48% had three, 31% had four, and 16% had five. As mentioned earlier, an increase in coronary risk is significantly greater with each added risk factor (3,4,22). Thus, these data reflect the potential danger of coronary heart disease in these police officers.

Although much of the risk factor data found with police officers were considered average in relation to the general population in the United States, it must be remembered that Americans lead the world in deaths from coronary heart disease (1). The need for a good preventive medicine program for police officers is apparent.

Physical Fitness

Percentile tables were constructed for police officers and included data relating to working capacity, cardiorespiratory fitness, body composition, and motor ability. Tables 2 and 3 show data for police officers 21-35 years of age and Tables 4 and 5, 36-52 years of age. The 50th percentile on each table represents the mid point in the variable

measured for each group of police officers with half scoring lower and half higher. For comparative purposes, data for the general population (23,24,25), inmates (26), Sheriff's Department Personnel (14) and Highway Patrolmen (16) are plotted on the various tables.

Young police officers. Tables 2 and 3 show normative data on working capacity, cardiorespiratory endurance, pulmonary function, serum lipids, body composition, and motor ability of police officers 21-35 years of age. When compared to the normal sedentary population of similar age, the younger officers were about the same in all variables except body weight (+), body fat (+), waist circumference (+), vital capacity (+), and trunk flexion (+). The percent body fat between groups was similar, thus the heavier weight was a result of more bone and muscle tissue. Since the average person in the U.S. is considered below standards in physical fitness compared to many other industrialized countries, the standards should be thought of as inadequate for young police officers.

Data from the Sheriff's Department Personnel and Highway Patrolmen show similar results to the young policemen in cardiorespiratory fitness, but show them to have higher levels of serum cholesterol and triglycerides. Firemen (not shown in tables) have greater cardiorespiratory endurance and less body weight, fat, and waist circumference.

The question that should be considered is how fit should young police officers be? Is a standard that is average for a normal sedentary population acceptable? If a job requires physical effort, such as running, climbing, and jumping an officer needs to have endurance and the ability to handle his own body weight, then the answer is negative. Many positions on the police force do require some intense physical activity. Therefore, higher levels of fitness are necessary.

A recent study conducted on 100 inmates (26) showed them to be in better physical condition than police officers (Tables 2 and 3). This included a higher working capacity and cardiorespiratory endurance, and lower body weight, fat, waist circumference, diastolic blood pressure and serum cholesterol. This comparison to police officers has been shown elsewhere (12). The inmates' ability to expel air from their lungs quickly ($FEV_1 \div VC$) was lower and was thought to be related to their heavy smoking habit. Although most inmates lose body weight while incarcerated, it was surprising to find them in such good cardiorespiratory fitness. Similar to the police officers tested, the inmates had had no endurance training prior to being tested. It is imperative that police officers be in better physical condition in order to cope with fit young persons who commit crimes in a variety of situations.

Middle-Aged police officers. Tables 4 and 5 show normative data on physiological and performance variables of middle-aged police officers 36-52 years of age. When compared to the normal sedentary population of similar age, they were considered below average in working capacity, cardiorespiratory fitness and body composition. Specifically, the results show middle-aged police officers low in treadmill performance, maximum oxygen intake, efficiency on a bench step test; and, high in body weight and fat, waist circumference, and serum lipids. When compared to the normal population the middle-aged police officer is in worse physical condition than the young police officer.

The data from the Sheriff's Department Personnel and Highway Patrolmen show similar body composition results to the police officers in this investigation, but were closer to the normal population in cardiorespiratory fitness. Thus, the low values for cardiorespiratory fitness found in

this study may not be typical of police throughout the country. Even so, the need for further development in physical fitness and attention to factors related to risk of coronary heart disease in police officers is well documented in this investigation.

SUMMARY

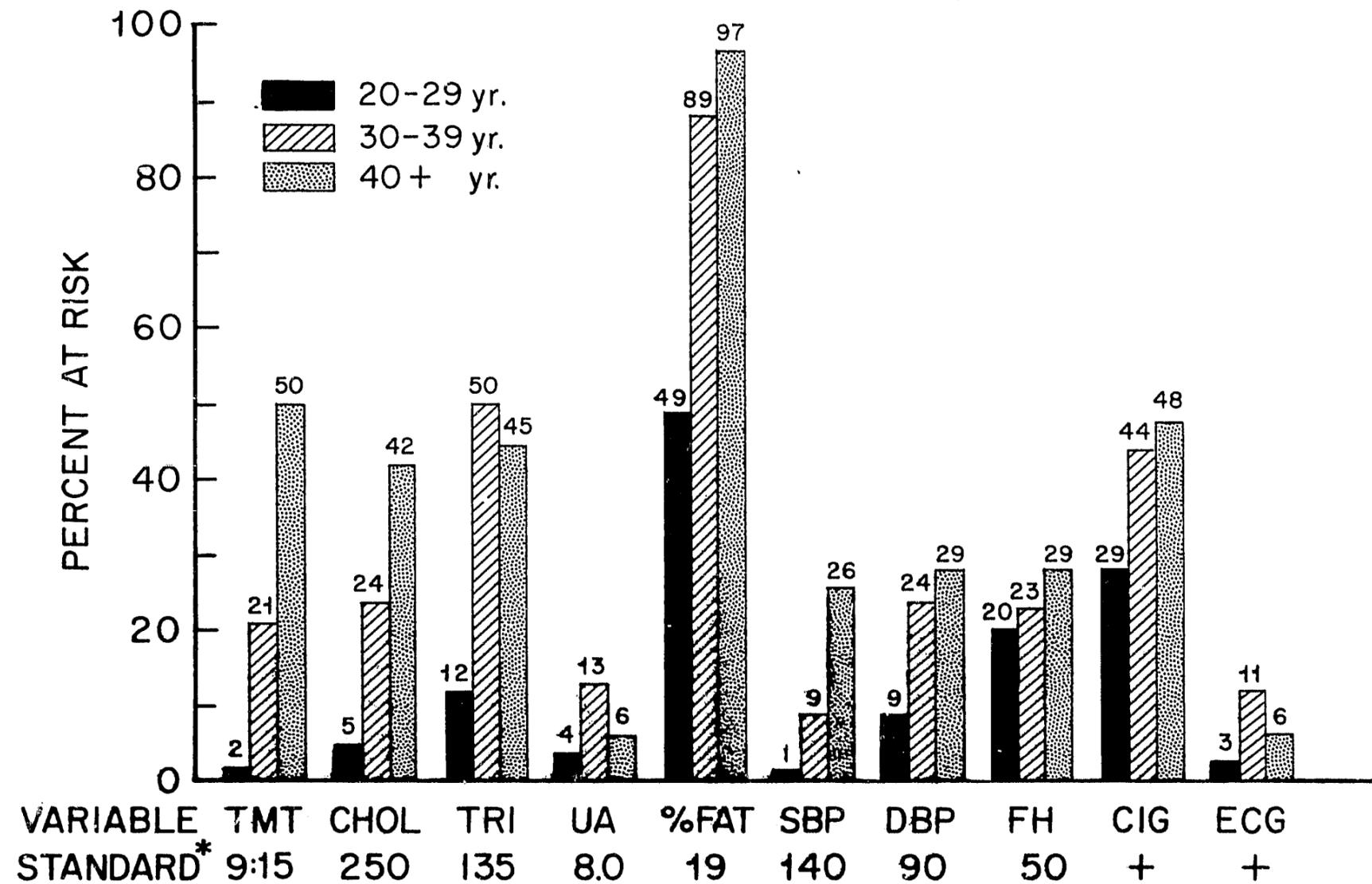
Two hundred thirteen male police officers between 21 and 52 years of age volunteered to participate in a physical evaluation and conditioning program. Information concerning risk of coronary heart disease and physical fitness status of police officers were shown. Younger police officers (< 30 years of age) tended to be of average risk for coronary heart disease and average in physical fitness compared to the normal population. Middle-aged police officers were shown to be at higher risk and lower in physical fitness than the normal population. The results from this investigation support the need for physical fitness and preventive medicine programs for police officers.

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**CORONARY RISK FOR POLICE OFFICERS
20-52 YEARS OF AGE (n=213)**

* Risk Factor Standards Used at Cooper Clinic, Dallas, Texas

FIGURE 1.

Table 1. Coronary risk factor scores of police officers

Age Group		Coronary Risk Factor Variables*								
		TMT (min:sec)	CHOL (mg %)	TRI (mg %)	GLU (mg %)	UA (mg %)	% FAT	SBP (mmHg)	DBP (mmHg)	AGE (yr)
20-29 (n=91)	\bar{X}	10:46	188	92	81	6.2	18.0	122	81.2	25.8
	SD	1:0	36	42	5.7	1.0	5.3	7.2	5.8	2.1
	Range	8-13:40	106-315	35-254	68-95	3.9-9.4	8-33	106-140	65-94	21-29
30-39 (n=90)	\bar{X}	10:00	219	146	84	6.5	24.1	123	83	33.4
	SD	1:0	43	76	6.9	1.2	4.3	10.9	8.4	2.7
	Range	7:30-12:45	122-364	44-420	63-102	4.5-9.8	16-35	100-156	65-100	30-39
40-52 (n=32)	\bar{X}	9:06	242	164	85	6.2	25.0	123	84.1	44.0
	SD	0:48	41	144	8.3	1.0	3.4	9.0	7.9	3.0
	Range	7:08-10:45	162-366	58-858	69-108	4.9-8.9	18-32	102-138	58-100	40-52

* TMT = Treadmill time, CHOL = Cholesterol, TRI = Triglycerides, GLU = Glucose, UA = Uric Acid,
 SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

Table 2. Work capacity, cardiorespiratory and pulmonary function, and serum lipids of police officers 21-35 years of age.

Percentile Rankings	TMT (min:sec)	VO ₂ max (ml/kg·min)	HR max (bts/min)	Step Test (bts/min)	RHR (bts/min)	RSBP (mmHg)	RDBP (mmHg)	VC (L)	FEV ₁ %VC (%)	Chol. (mg/100ml)	Tri. (mg/100ml)
99	13:00	50.0	213	76	47	106	65	7.99	91	122	42
95	12:15	48.0	210	81	51	108	70	7.26	88	138	46
90	12:00	47.0	204	88	52	112	74	6.88	86	152	54
85	11:30	45.5	204	93	55	114	75	6.50	85	157	60
80	11:15	44.8	202	97	58	116	76	6.39	85	163	63
75	11:00	44.0	200	98	59	116	78	6.28	84	169	69
70	11:00	43.2	199	99	60	118	78	6.16	84	178	74
65	10:45	42.4	198	101	60	118	80	6.05	83	184	76
60	10:45	42.0	196	103	62	120	80	5.94	83	188	80
55	10:30	41.6	194	105	63	122	82	5.83	82	190	88
50	10:30	40.7	194	108	64	122	82	5.72	82	195	94
45	10:25	40.1	193	109	66	124	83	5.61	81	202	100
40	10:15	39.5	192	111	66	124	84	5.49	80	207	110
35	10:15	38.6	192	114	68	126	84	5.34	79	211	116
30	10:02	37.7	190	116	69	126	86	5.20	79	216	124
25	10:00	37.1	188	119	70	128	86	5.05	77	224	150
20	9:50	36.7	186	121	71	128	88	4.90	76	228	162
15	9:45	36.0	183	125	73	130	90	4.75	76	238	178
10	9:25	35.2	180	129	74	132	92	4.60	73	251	200
5	8:45	34.2	177	138	76	137	94	4.27	67	266	236
1	8:00	30.8	168	153	85	143	98	3.65	14	332	384
N	154	153	153	152	153	153	153	154	154	154	154
X	10:32	40.7	194	108	64	122	82	5.68	79	199	115
SD	1:01	4.5	10	16	8	8	7	.80	11	42	67

TMT = treadmill time; VO₂ max = maximum oxygen intake; HR max = maximum heart rate; Step Test = 3 min step test recovery heart rate; RHR = resting heart rate; RSBP = resting systolic blood pressure; RDBP = resting diastolic blood pressure; VC = vital capacity; FEV₁ %VC = forced expiratory volume for one second divided by vital capacity; Chol. = cholesterol; Tri. = triglycerides.

--- Inmates
 — Sedentary average
 Sheriff's Department and Highway Patrolmen

Table 3. Body composition and motor ability of police officers 21-35 years of age.

Percentile Rankings	Height (in)	Weight (lb)	Fat (%)	Skinfolds Sum of 6 (mm)	Waist (in)	Press ¹ (lb)	Pushups (No.)	Situps (No.)	VJ ² (in)	Agility ³ (sec)	Flex ⁴ (in)
99	77.2	140.9	9.8	36	29.4	245	46	49	26.1	16.5	24.3
95	75.2	146.9	12.1	60	30.6	195	38	44	23.3	16.8	23.0
90	74.2	150.4	14.9	79	32.0	180	32	43	22.2	17.0	22.1
85	73.6	153.4	16.4	91	32.6	180	30	41	21.1	17.3	21.3
80	73.0	155.7	17.8	96	33.0	165	27	40	20.4	17.5	20.9
75	72.4	161.1	19.0	101	33.7	165	25	39	19.7	17.7	20.4
70	71.9	166.2	20.0	110	34.8	165	23	38	19.2	17.9	20.0
65	71.5	170.4	20.5	119	35.2	165	22	37	18.8	18.0	19.5
60	71.1	174.3	20.9	124	35.5	165	22	35	18.5	18.2	18.9
55	70.8	177.2	21.2	126	35.9	145	20	35	18.2	18.3	18.4
50	70.5	180.5	22.5	129	36.3	145	20	34	17.9	18.5	18.0
45	70.1	184.1	23.3	132	36.9	145	20	34	17.6	18.7	17.6
40	69.8	186.1	23.8	136	37.4	145	19	33	17.3	18.8	17.2
35	69.4	191.1	24.2	140	37.8	135	18	32	17.0	18.9	16.9
30	69.1	196.2	24.7	144	38.5	135	16	31	16.6	19.1	16.5
25	68.7	201.6	25.4	155	39.0	135	15	30	16.3	19.2	15.9
20	68.4	205.8	26.7	163	39.4	135	15	29	15.9	19.4	15.2
15	68.1	210.0	27.5	173	40.1	130	15	28	15.5	19.6	14.3
10	67.8	218.0	30.0	180	41.4	115	12	26	15.0	19.9	13.4
5	67.3	231.3	30.9	185	42.9	115	10	25	14.5	20.3	11.9
1	66.6	250.7	32.8	242	44.1	100	7	18	11.9	21.1	8.9
N	154	154	66	154	154	144	143	145	144	135	145
\bar{X}	70.6	182.8	22.1	129	36.5	152	21	34	18.1	18.5	17.8
SD	2.4	26.5	5.4	40	3.6	27	8	6	3.2	1.0	3.4

¹ Press = maximum one repetition bench press; ² VJ = vertical jump; ³ Agility = Illinois agility run; ⁴ Flex = flexibility sit and reach.

--- Inmates
 — Sedentary average
 - - - Sheriff's Department and Highway Patrolmen

Table 4. Work capacity, cardiorespiratory and pulmonary function, and serum lipids of police officers 36-52 years of age.

Percentile Rankings	TMT (min:sec)	VO ₂ max (ml/kg·min)	HR max (bts/min)	Step Test (bts/min)	RHR (bts/min)	RSBP (mmHg)	RDBP (mmHg)	VC (L)	FEV ₁ ÷VC (%)	Chol. (mg/100ml)	Tri. (mg/100ml)
99	12:00	44.0	200	82	51	100	70	6.44	99	162	58
95	10:35	41.3	196	90	52	102	70	6.19	85	187	63
90	10:15	39.1	196	94	58	110	70	5.89	84	195	80
85	10:00	36.5	194	96	58	112	76	5.58	83	202	84
80	10:00	35.3	189	97	60	112	78	5.44	83	206	99
75	9:45	34.4	188	101	61	114	78	5.36	83	210	106
70	9:39	34.1	186	104	62	117	80	5.28	83	217	112
65	9:30	33.8	186	106	64	118	82	5.19	82	222	118
60	9:25	33.5	185	108	65	121	82	5.11	81	237	125
55	9:17	33.2	184	111	66	122	82	5.03	79	240	132
50	9:15	32.9	184	111	67	124	84	4.95	79	243	143
45	9:15	32.5	181	116	68	124	84	4.87	78	248	149
40	9:00	32.1	179	117	68	124	86	4.79	77	251	160
35	9:00	31.7	179	118	69	126	86	4.70	76	254	170
30	9:00	31.3	178	119	70	126	88	4.62	74	258	172
25	9:00	31.0	173	121	72	128	90	4.54	73	266	178
20	8:40	30.6	172	129	74	128	90	4.39	72	269	200
15	8:30	29.8	170	136	76	130	92	4.17	71	272	234
10	8:00	29.1	167	139	77	133	94	3.95	70	283	268
5	7:50	28.2	166	144	82	136	98	3.72	68	301	316
1	7:10	27.0	160	152	100	142	100	3.54	54	366	858
N	49	47	47	49	50	50	50	49	49	50	50
\bar{x}	9:15	33.4	182	114	67	122	84	4.90	78	242	164
SD	0:53	3.6	10	17	9	10	7	.59	7	38	119

TMT = treadmill time; VO₂ max = maximum oxygen intake; HR max = maximum heart rate; Step Test = 3 min step test recovery heart rate; RHR = resting heart rate; RSBP = resting systolic blood pressure; RDBP = resting diastolic blood pressure; VC = vital capacity; FEV₁÷VC = forced expiratory volume for one second divided by vital capacity; Chol. = cholesterol; Tri. = triglycerides.

— Sedentary average
 Sheriff's Department and Highway Patrolmen

Table 5. Body composition and motor ability of police officers 36-52 years of age.

Percentile Rankings	Height (in)	Weight (lb)	Fat (%)	Skinfolds Sum of 6 (mm)	Waist (in)	Press ¹ (lb)	Pushups (No.)	Situps (No.)	Flex ² (in)
99	77.0	158.4	17.7	96	34.7	180	35	39	21.3
95	75.8	165.5	18.3	103	35.7	180	23	34	19.4
90	73.3	170.5	20.8	105	36.0	179	22	32	18.9
85	72.7	175.3	21.6	113	36.5	165	20	30	18.4
80	72.3	177.1	21.8	113	36.9	165	20	30	17.2
75	72.0	178.9	22.1	116	37.1	165	20	28	16.3
70	71.7	180.8	22.4	119	37.3	145	18	26	15.9
65	71.4	184.1	23.5	122	37.7	145	18	26	15.5
60	71.3	185.9	23.8	127	37.8	145	17	25	15.1
55	71.1	190.8	24.0	137	38.4	145	15	25	14.6
50	70.9	193.6	24.3	141	38.7	145	14	25	14.0
45	70.8	197.7	24.7	147	38.9	145	12	24	13.4
40	70.6	199.1	26.0	148	39.2	135	12	24	13.1
35	70.4	202.4	27.0	154	40.0	135	12	23	12.8
30	70.2	207.2	27.7	154	40.2	135	11	21	12.4
25	69.9	209.5	28.2	163	40.9	135	10	20	11.9
20	69.7	214.5	29.5	167	41.5	134	10	17	11.3
15	69.4	220.5	30.3	178	42.4	115	9	13	10.1
10	68.9	225.5	31.2	180	43.1	115	8	11	7.4
5	67.9	242.0	32.2	203	44.9	100	8	10	6.2
1	66.0	248.6	35.0	223	47.2	100	7	8	4.0
N	49	50	50	50	50	48	47	47	48
\bar{X}	70.9	196.3	25.3	143	39.2	144	15	23	13.7
SD	2.0	22.1	4.2	31	2.9	21	6	7	4.0

¹ Press = maximum one repetition bench press; ² Flex = flexibility sit and reach.

— Sedentary average

..... Sheriff's Department and Highway Patrolmen

END