

## Racial Comparisons in Police Officer Bench Press Strength over 12.5 Years

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### ABSTRACT

*International Journal of Exercise Science 7(2): 140-151, 2014.* Strength, when considering gender and race, provides a basis for training, hiring, and retention for police officers. The purpose of this study is to identify muscular strength differences among racial groups from initial-recruit to in-service tests. Strength variables included bench press, bench press/lean mass and bench press/body mass. Scores were retrieved for the 1990 to 1995 recruit classes and were paired to the 2006 in-service fitness log. Sample included 309 officers: 30 females (13 black, 17 white) and 279 males (41 black, 238 white). Mean age of recruit was  $24.6 \pm 3.4$  years and for in-service was  $37.1 \pm 3.7$  years. Time between tests was  $12.5 \pm 2.0$  years. Bench press strength significantly increased for all gender and racial groups. Black males were significantly stronger in bench press at initial-recruit and at in-service than white males. All racial and gender groups increased in bench press/lean mass, however, the increase in white females was not significant. No differences were found between black and white females in all strength variables at both testing periods. Black males were significantly stronger than white males in bench press/body mass only at the initial-recruit test. White males showed a significant increase in bench press/body mass over time, but they did not reach the strength level of the black males at in-service. Police departments, with a properly designed physical fitness program, can expect to see increases in strength of personnel over the first half of their careers; however, there are gender and racial differences.

**KEY WORDS:** Bench press, police, longitudinal study, body weight, race differences

### INTRODUCTION

Muscular strength is a critical factor in the health and job performance of police officers. Increased muscular strength is positively associated with health (21) and provides protective benefits against disability (6, 32) and chronic diseases such as heart disease (38), diabetes (29) and

metabolic syndrome (43). Strength supports an officer's ability to safely perform critical emergency functions (15, 36) while fulfilling the agency's legal responsibility to deliver adequate protection to the public. Strength remains an important criterion in the selection and hiring of police officers, however legal ramifications exist as to the potential adverse impact upon the hiring of

legally protected groups such as females and minorities (8, 34, 36).

Strength usually peaks between the ages of 20 to 30 for males and a few years earlier for females and then decreases with age (1, 41). Previous studies regarding age related changes in muscular strength report an annual decline in muscle strength from approximately 0.8% to 5%, depending on gender, the muscle group and the type of work (2, 3, 38). Gender differences are reported to be greater in upper body strength than in lower body strength (19, 28). Untrained females have been shown to have approximately 50 - 60% of the upper body strength of men (28, 36, 37). In addition, some data suggests that the rate of muscular strength decline differs between males and females (24, 33, 41). A major contributor to the decrease in strength with aging is a loss in muscle cross-sectional area (12).

The literature supports the need for ongoing physical fitness training for police officers as the occupation of police officers is primarily sedentary, though mentally challenging, with occasional periods of maximal exertion (39). Furthermore, the physical demands of the occupation are often inadequate to maintain necessary physical fitness to perform the infrequent but possibly life-saving tasks (40).

Understanding longitudinal strength changes over the employment duration of a police officer provides agencies with essential information to address health issues, the proper physical performance of duties and the potential legal ramifications of hiring and retention criteria (4). It is evident that collecting strength data on police officers from recruitment to in-

service status, especially when considering gender, race, and age would identify trends and provide data for designing effective training procedures and requirements.

No police studies were found that examined race muscular strength changes within genders over time. Also, no studies were found that addressed longitudinal change in upper body strength related to the level of strength at hire. The information found regarding bench press or handgrip strength in relation to aging was located in normative tables developed from cross-sectional data (14, 26, 31, 42). Other authors also reported a lack of longitudinal strength data (35).

### METHODS

Through a longitudinal design, this study sought to determine whether there were differences in muscular strength scores from the first week of recruit training to police officer tests approximately 12.5 years later and if there were gender and racial change differences. Strength scores were comprised of bench press, bench press/lean mass and bench press/body mass. We planned to provide gender and racial strength mean scores with statistical comparisons for each of the testing periods.

#### *Participants*

The retrospectively studied sample included 327 police officers, 30 females (13 black, 17 white) and 297 males (41 black, 238 white, and 18 other) that participated in the recruit classes between 1990 and 1995. Officers that could not be classified as black or white were removed from the sample. Physical fitness test logs were obtained from the Charlotte-Mecklenburg Police Department, a large metropolitan police

department in the southeastern United States of America. Ninety-nine percent of the in-service fitness tests were conducted between the years of 2003 to 2006. Mean values with their standard deviations, SD, are provided in the text as mean  $\pm$  SD. The average number of years between tests was  $12.5 \pm 2.0$  years. The mean age at initial-recruit test was  $24.6 \pm 3.4$  years and for in-service was  $37.1 \pm 3.7$  years. There were no significant differences when comparing genders or races for age and time between the two tests. Officers were primarily college-educated and their socio-economic status ranged from lower-middle to upper-middle class. The University of North Carolina at Wilmington Institutional Review Board approved this study following the United States National Institutes of Health guidelines concerning the rights of human subjects. Participants signed a written informed consent form. Tests and measurements were required as a part of conditions of employment.

*Protocol*

Body mass, percent body fat scores, and bench press strength scores were retrieved for officers in the 1990 to 1995 recruit classes. Officers' recruit scores were paired to their most recent scores on the 2006 in-service fitness log. Scores for officers in the recruit log that were not in the in-service log were discarded.

Emphasis was placed on encouraging recruits to continue healthy exercise habits following completion of the 16-20 week recruit training. The same physical fitness coordinator, certified by the American College of Sports Medicine (ACSM), administered tests over the study period. Sworn officers (in-service) received an annual fitness test. An officer's physical

capacity was a consideration at hiring, but the hiring protocol was inconsistent. The physical fitness coordinator suggested nutritional and/or exercise programs for officers following evaluations and when requested.

Included in the physical fitness test battery for recruits and sworn officers was body mass, percent body fat using a skinfold caliper (18) and a one repetition maximum (1RM) bench press test a measure of upper body muscular strength (30) using a Smith Bench Press Machine (Atlantis Angled Smith Machine E-155, Quebec, Canada). Tests were administered the first week of recruit training (initial-recruit test). The physical fitness test battery was conducted in the following order for recruits: body fat (18), sit and reach flexibility (42), bench press (30), push-up, and 1.5 mile run (42). The testing protocol for the in-service officers was body fat (18), treadmill (13), bench press (30), muscular endurance (either curl-ups or push-ups) and sit and reach (42). A rest was given between the treadmill test and the bench press test. This investigation's variables of interest, body mass, percent body fat, and the bench press test protocols, remained consistent over the time period of the study.

*Statistical Analysis*

The Statistical Package for Social Sciences (SPSS, Inc) version 15.0 was used to analyze data. Paired sample t-tests compared mean differences between initial-recruit to in-service test for age, body mass, lean mass, bench press, bench press/lean mass, and bench press/body mass. Lean body mass was calculated with the following formula: Body Mass - (Body Mass x Body Fat percentage/100). Analysis of variance (ANOVA) procedures compared gender

# RACIAL STRENGTH COMPARISONS IN POLICE

**Table 1a.** Police bench press strength of initial-recruit tests with gender and race comparisons over 12.5 years.

	Race	Initial-Recruit								
		Female				Male				
		N	Mean	SD	p-value <sup>R</sup>	N	Mean	SD	p-value <sup>R</sup>	p-value <sup>G</sup>
Age (yrs)	Black	13	24.9	3.7	0.399	41	25.1	3.6	0.331	0.626
	White	17	23.9	2.5		238	24.5	3.5		
	Total	30	24.3	3.1		279	24.6	3.5		
Body Mass (kg)	Black	13	59.3	7.9	0.570	41	84.9	10.3	0.167	0.000***
	White	17	57.8	6.6		238	82.0	12.9		
	Total	30	58.4	7.1		279	82.4	12.6		
Percent Fat	Black	13	19.8	4.4	0.859	41	13.2	6.0	0.420	0.000***
	White	17	20.5	5.0		238	14.6	5.7		
	Total	30	20.2	4.7		279	14.4	5.8		
Lean Mass (kg)	Black	13	47.3	4.7	0.398	41	73.6	9.4	0.007**	0.000***
	White	17	45.8	4.8		238	69.6	8.7		
	Total	30	46.4	4.7		279	70.2	8.9		
Bench Press (kg)	Black	13	38.6	5.0	0.536	41	95.1	24.6	0.003**	0.000***
	White	17	37.2	6.3		238	84.2	21.2		
	Total	30	37.8	5.7		279	85.8	22.0		
Bench Press/ Lean Mass	Black	13	0.82	0.12	0.908	41	1.28	0.28	0.059	0.000***
	White	17	0.81	0.13		238	1.21	0.24		
	Total	30	0.82	0.12		279	1.22	0.25		
Bench Press/ Body Mass	Black	13	0.66	0.10	0.771	41	1.12	0.27	0.037*	0.000***
	White	17	0.65	0.10		238	1.03	0.23		
	Total	30	0.65	0.10		279	1.05	0.24		

<sup>R</sup> = p-value to compare races    <sup>G</sup> = p-value to compare genders

SD = Standard Deviation

ANOVA comparisons between races and genders. \*p ≤ 0.05, \*\*p ≤ 0.01, \*\*\*p ≤ 0.001

and race (black/white) in the amount of mean change from initial-recruit to in-service tests in these same variables. The p-value used to define significance is p ≤ 0.05.

## RESULTS

When all groups were combined bench press and bench press/lean mass

significantly increased (p ≤ 0.001) over the 12.5 year period, contrary to existing cross-sectional literature. Overall, this was accompanied by increases in body mass, percent fat and lean mass (p ≤ 0.001).

The descriptive characteristics of the officers by age, body mass, lean mass, segmented by gender and racial groups at

# RACIAL STRENGTH COMPARISONS IN POLICE

**Table 1b.** Police bench press strength of in-service tests with gender and race comparisons over 12.5 years.

	Race	In-Service								
		Female				Male				
		N	Mean	SD	p-value <sup>R</sup>	N	Mean	SD	p-value <sup>R</sup>	p-value <sup>G</sup>
<b>Age (yrs)</b>	Black	13	37.5	3.2	0.495	41	38.0	3.6	0.125	0.770
	White	17	36.6	3.6		238	37.0	3.8		
	Total	30	37.0	3.4		279	37.1	3.8		
<b>Body Mass (kg)</b>	Black	13	68.5	11.8	0.168	41	101.4	14.0	0.003**	0.000***
	White	17	64.0	5.0		238	93.4	15.9		
	Total	30	66.0	8.7		279	94.6	15.9		
<b>Percent Fat</b>	Black	13	25.5	6.1	0.712	41	19.8	5.8	0.157	0.000***
	White	17	25.1	6.4		238	19.0	5.9		
	Total	30	25.3	6.1		279	19.1	5.9		
<b>Lean Mass (kg)</b>	Black	13	50.5	5.9	0.188	41	80.8	8.7	0.000***	0.000***
	White	17	47.8	4.8		238	75.0	9.5		
	Total	30	49.0	5.4		279	75.9	9.6		
<b>Bench Press (kg)</b>	Black	13	44.8	7.8	0.168	41	109.5	20.3	0.001***	0.000***
	White	17	40.8	7.6		238	97.4	20.7		
	Total	30	42.6	7.8		279	99.2	21.0		
<b>Bench Press/Lean Mass</b>	Black	13	0.89	0.10	0.450	41	1.35	0.20	0.128	0.000***
	White	17	0.85	0.13		238	1.30	0.21		
	Total	30	0.87	0.12		279	1.31	0.21		
<b>Bench Press/Body Mass</b>	Black	13	0.66	0.10	0.557	41	1.09	0.20	0.363	0.000***
	White	17	0.64	0.11		238	1.06	0.22		
	Total	30	0.65	0.10		279	1.06	0.22		

<sup>R</sup> = p-value to compare races    <sup>G</sup> = p-value to compare genders

SD = Standard Deviation

ANOVA comparisons between races and genders. \*\*p ≤ 0.01, \*\*\*p ≤ 0.001

each testing periods can be found in Tables 1a and 1b. ANOVA comparisons between genders and between racial groups within each testing period were made. There were significant differences between genders in both body mass and lean mass ( $p \leq 0.001$ ) with males being heavier at both testing periods. No significant differences were found between black and white females in body mass, percent fat, and lean mass at

either testing period. Black males had a significantly greater lean mass than white males at both testing periods ( $p \leq 0.01$ ). Furthermore, black males were also significantly ( $p \leq 0.01$ ) heavier in terms of body mass at the in-service testing period only.

Table 2 compares body mass, lean mass, and percent fat changes of gender and race

## RACIAL STRENGTH COMPARISONS IN POLICE

**Table 2.** Comparison of body mass, lean body mass, and percent fat changes of gender and race groups of police from initial-recruit to in-service over 12.5 years

	Female					Male				
	Race	N	Mean	SD	p-value <sup>R</sup>	N	Mean	SD	p-value <sup>R</sup>	p-value <sup>G</sup>
<b>Body Mass Change (kg)</b>	Black	13	9.2	6.7	0.194	41	16.5	8.9	0.002**	0.006**
	White	17	6.2	5.5		246	11.7	9.1		
	Total	30	7.5	6.1		287	12.3	9.2		
<b>Lean Mass Change (kg)</b>	Black	13	3.2	3.5	0.318	41	7.2	5.5	0.029*	0.001***
	White	17	2.0	2.7		246	5.4	4.7		
	Total	30	2.5	3.1		287	5.7	4.9		
<b>Percent Fat Change</b>	Black	13	5.7	3.2	0.511	41	6.6	4.8	0.010**	0.760
	White	17	4.6	5.1		245	4.5	4.8		
	Total	30	5.1	4.3		286	4.8	4.8		

<sup>R</sup> = p-value to compare races    <sup>G</sup> = p-value to compare genders

SD = Standard Deviation

ANOVA comparisons between races and genders. \* $p \leq 0.05$ , \*\* $p \leq 0.01$ , \*\*\* $p \leq 0.001$

Paired sample T-tests indicate significant increase from initial-recruit to in-service tests in all gender and racial groups in body mass, lean mass and percent fat ( $p \leq 0.01$ ).

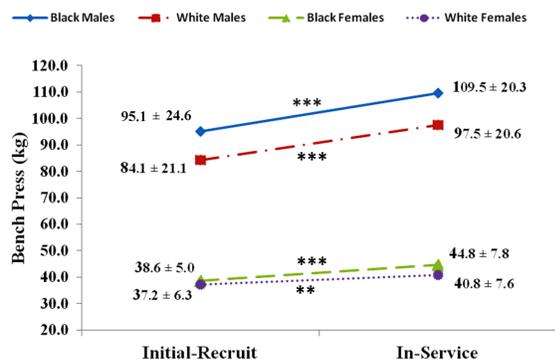
groups of police from initial-recruit to in-service. Paired sample T-tests indicate significant increase from initial-recruit to in-service tests in all gender and racial groups in body mass, lean mass and percent fat ( $p \leq 0.01$ ). Compared to white males, black males increased significantly more in body mass ( $p \leq 0.01$ ), percent fat ( $p \leq 0.01$ ), and lean mass ( $p \leq 0.05$ ), Males increased significantly more in body mass ( $p \leq 0.01$ ) and lean mass ( $p \leq 0.001$ ) than females over the 12.5 year period.

Figure 1 compares the bench press scores by gender and race from initial-recruit to in-service over 12.5 years. Bench press strength significantly increased ( $p \leq 0.05$ ) for all gender and racial groups from

initial-recruit to in-service tests. No differences were found between black and white females in bench press strength at either testing period. Black males had a significantly ( $p \leq 0.01$ ) greater bench press strength than white males at both testing periods. However, the amount of change between races in bench press strength was not significant. Males were significantly stronger than females at both testing periods ( $p \leq 0.001$ ). Males changed significantly more than females from initial-recruit to in-service tests ( $p \leq 0.001$ ).

Figure 2 compares bench press/lean mass and bench press/body mass of gender and race groups of police from initial-recruit to in-service tests over 12.5 years. Focusing on

bench press/lean mass strength, with the exception of white females the racial and gender groups significantly increased over time ( $p \leq 0.05$ ). The bench press/body mass slopes in Figure 2 suggest very little difference in the amount of change over the 12.5 years in bench press/lean mass between black and white females and between black and white males.

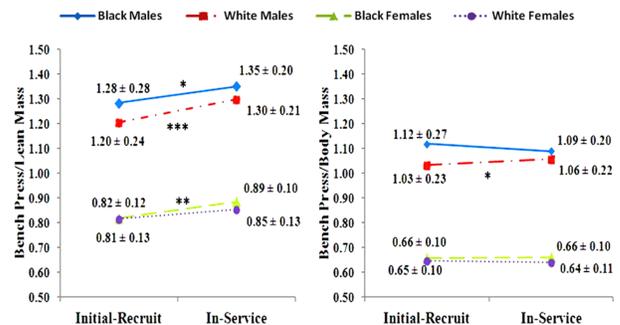


**Figure 1.** Comparison of bench press gender and race groups of police from initial-recruit to in-service over 12.5 years (mean ± standard deviation). Paired-sample T test comparison between initial-recruit and in-service: \* $p \leq 0.05$ ; \*\*\* $p \leq 0.001$ . Black males were significantly stronger than white males at both testing periods ( $p \leq 0.01$ ). Males increased significantly more than females from initial-recruit to in-service test ( $p \leq 0.001$ ).

Additional ANOVA comparisons between gender and race indicated both black and white males were significantly stronger in bench press/lean mass and bench press/body mass than black and white females at both testing periods ( $p \leq 0.001$ ). However, no differences were found between black and white females in these strength variables at either testing period.

When focusing on bench press/body mass in Figure 2, although black males were significantly ( $p \leq 0.05$ ) stronger than white males as recruits, blacks tended to decrease in this strength variable over the 12.5 year period. Conversely, the white males

significantly ( $p \leq 0.05$ ) increased in bench press/body mass strength over time while both black and white females maintained their bench press/body mass strength over time.



**Figure 2.** Comparison of bench press/lean mass and bench press/body mass of police from initial-recruit to in-service over 12.5 years (mean ± standard deviation). Paired-sample T test comparison between initial-recruit and in-service: \* $p \leq 0.05$ ; \*\* $p \leq 0.01$ ; \*\*\* $p \leq 0.001$ . Black males were significantly stronger in bench press/body mass than white males at initial recruit ( $p \leq 0.05$ ).

## DISCUSSION

The results of this study did not follow expected strength trends, as described in earlier studies, which reported plateaus in muscular strength in males and females (38, 39, 41). Overall, the officers in our study increased in strength well into their late thirties and early forties. This longitudinal data on police officer strength is unique in the literature, to our knowledge, as the research found previously in regards to bench press strength was cross-sectional (31, 42) and none was located regarding bench press strength and police specifically.

Our study found that female police officers had approximately 44% of the upper body strength of the male officers. This trend was slightly lower than the 50-60%

reported by others (28, 36, 37). Although, the literature reports a difference in muscular decline between males and females (24, 33, 41), our study showed strength increases in both genders. The female strength increase was approximately 42% of the males' over the 12.5 year period. It is interesting to note that the initial strength difference between males and females paralleled their differences in strength increase over time. The fact that males gained significantly more lean mass than females may account for these differences as well, which would be supported in previous research related to strength per unit of muscle cross-sectional area (17). These differences in strength indicate that there will be an adverse impact on females in employment tests that use bench press scores as a qualifying standard for police work. Furthermore, departments can expect that the increases in upper body strength will be significantly greater in males and this may be dictated by the greater lean mass in the males. It has been reported in short-term fitness training studies that untrained individuals who are low in strength can have greater potential for strength gain than those who are already closer to their maximum strength potential (9, 10, 16). Our 12.5 year longitudinal findings did not follow these same trends. Even though the black males were stronger in their bench press scores as a recruit, the black males continued to have gains similar to white males.

Another study, utilizing this same police officer data but beginning at post-recruit training, demonstrated similar strength gains after recruit training (5). This indicated that the reported gains in our study were not simply the result of recruit training but had been influenced by other

factors. Some factors may have included the department's ongoing fitness program as well as the officers' own maturing process and increases in lean weight.

The literature suggests that increases in body mass correspond with increases in lean mass by as much as 44% (11). The officers in this study gained a significant amount of body mass and correspondingly, a significant amount of lean mass. Lean mass is associated with increases in strength (11, 25, 27). Therefore, we would expect to see an increase in absolute bench press strength related to lean mass gain alone. However, the strength gains were negated when dividing the body mass of the officers into their bench press scores. This pattern was not seen in the black males, where they actually decreased in the bench press/body mass ratio. Even though the bench press/body mass measure did not increase over the 12.5 years for black males, it also did not decline as indicated in cross-sectional research (42).

It is interesting to note, that the black males had the greatest body mass gain which also corresponded to a loss in bench press/body mass. The significantly higher percent fat change in black males may explain, at least in part, this decrease. Even with this loss in bench press/body mass, black males still demonstrated greater bench press/body mass strength scores than white males, although this difference was not significant. This corresponds to a previous work on this group of officers where the stronger officers continued to have the greatest strength over time when compared to those with less strength (5).

Between black and white females, there were no significant differences in bench

press/body mass scores. This is notable when considering findings in the literature that reported black females had greater weight gain than all other groups with a magnitude of approximately 1.5 to 2.5 times that of white females in non-police studies (7, 22, 23). In our study, black and white females had similar body mass gains which resulted in comparable bench press/body mass outcomes. This is contrary to population studies that have compared body mass gain patterns of black and white females while controlling for multiple demographic, social, and behavioral variables (20, 23). Therefore, the selection criteria of this police department, which included physical performance and education standards as well as similar physical demands within the police occupation, may have counteracted general population trends in regards to body mass gain in the black female officers.

Further longitudinal study is needed regarding the actual physical performance of police officer job functions as opposed to documenting a single strength measure. Also, this study examined approximately the first decade of a police officer's career. Similar groups of officers need to be studied for the second decade of their career in order to evaluate the protective benefits of strength against disability and chronic disease as well as the ability of the officer to safely perform critical emergency functions.

Through a longitudinal design, this study sought to determine whether there were differences in muscular strength scores from the first week of recruit training to police officer tests approximately 12.5 years later and if there were gender and racial change differences. The findings suggested

that there were very little differences in the change in strength between the blacks and whites. However, the black males were stronger in the bench press than the white males over the first decade. Little racial differences were noted within females. Both black and white males increased more in bench press strength over the first decade than the females. The amount and increase in lean weight over the first decade seems to play a major role in these differences. Also, the strongest groups at hire remained the strongest over the first decade.

In terms of legal and hiring considerations: Although the main target was to report the bench press strength characteristics of officers over time it reinforces the need for physical performance standards at the time of hire. Those strongest groups in bench press remained the strongest. Also, it reemphasizes that an upper body strength test such as a bench press will have little adverse impact on blacks, a racially protected group. However, it will have adverse impact on female recruit and incumbent officers, a gender protected group, no matter if they are black or white. This further supports the need for hiring standards to be based on bona fide occupational demands of the police department especially if females are to be considered for hire.

It is important to reflect on this work as a case study of the Charlotte-Mecklenburg Police Department that has housed an ongoing physical fitness program in recruit training and for its incumbent officers since 1980. The central implication is that a police department with a properly designed and implemented physical fitness program can expect to see increases in the

strength of their personnel over the first decade of their careers. This suggests there are positive benefits to be gained from maintaining ongoing fitness training and testing even though there is no on-duty physical training for the in-service police officers.

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