Entry Fitness Levels and Subsequent Academy Performance Outcomes in Massachusetts Police Recruits-A validation study

Maria Korre ScD, Kevin Loh DO, MP, Flavia Lessa MD, Luiz Guilherme G. Porto PhD , Costas Christophi PhD, Stefanos N. Kales MD, MPH

Abstract
Introduction
Methods
Results
Conclusions

ABSTRACT

Introduction: Police academies require that their recruit officers possess sufficient fitness to successfully engage in law enforcement activities. In a previous retrospective study, we found recruits with poor entry level fitness had lower graduation rates.

Aims: We sought to validate our findings prospectively, assessing the probability of successful completion and graduation from a police academy as a function of recruits' baseline fitness levels at the time of academy entry; and validate our previous suggested minimum and target entry fitness criteria respectively prior to acceptance to police academy.

Methods: Prospective cohort study. Recruit officers 18 years of age and older who entered police academies throughout Massachusetts bduring 2015-2016. Entry fitness levels were quantified from the following measures, as recorded at the start of each training class: body composition, push-ups, sit-ups, sit-and-reach, and 1.5-mile run-time. The primary outcome of interest was the odds of not successfully graduating from an academy. Reasons for failure were also collected. We used generalized linear mixed models in order to fit logistic regression models with random intercepts for assessing the probability of not graduating, based on entry-level fitness.

Results: The fitness measures most strongly associated with academy failure were lesser number of pushups completed (odds ratio [OR] = 6.7, 95% confidence interval [CI] (2.52, 17.85), for 20 versus 41–60 push-ups) and slower run times (OR = 4.4, 95% CI (1.88, 10.35), [1.5 mile run time of 15′20″-12'33]. On average, successful graduates are leaner and have better overall entry fitness performance results. Prospective results supported our previously recommended fitness criteria.

Conclusions: Baseline pushups and 1.5-mile run-time were successfully validated as predictors of successful academy graduation.

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INTRODUCTION

Law enforcement is one of the top nine occupations with the highest number of fatal work-related injuries in Massachusetts.

Table 3. The Nine Industries with the Highest Numbers of Fatal Occupational Injuries, Massachusetts, 2000–2007

Detailed Industry	Number	% of Total Occupational Fatalities
Commercial Fishing	33	6.2
Freight Trucking	22	4.1
Building Contractor – Residential	21	3.9
Roofing/Siding Contractor	21	3.9
Eating and Drinking Places	18	3.4
Heavy Construction	16	3.0
Landscaping & Horticultural Services	14	2.6
Automotive Repair & Maintenance	14	2.6
Police Protection/Law Enforcement	12	2.2
Total	**171**	**31.9**

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Sudden Cardiac Deaths are much more likely to occur during stressful duties, especially physical altercations and suspect pursuits, while they account for up to 10% of all on-duty deaths during police activities.

The state of Massachusetts mandates all recruit police officers pass a state-regulated medical examination and then a job-specific physical ability test, prior to potential entry into one of the Commonwealth's police academies.

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INTRODUCTION

Endurance runs

- 1.5 miles in length
- Increase incrementally to a maximum of 5 miles
- Pace of 11 minutes/mile

Resistance training and exercise

- Push-ups, crunches, jumping ropes, sprint work, flexibility, etc

Cooper's Assessment

- Entry-level, 2nd, and 3rd

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AIMS

We sought to validate our findings prospectively, assessing the probability of successful completion and graduation from a police academy as a function of recruits' baseline fitness levels at the time of academy entry; and validate our previous results on minimum and target entry fitness criteria respectively prior to acceptance to police academy.

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METHODS

Prospective cohort study.

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RESULTS

16 academies participating;

N=724 recruits, 89.6% were males;

Mean weight of 190.9 (SD: 34.5)pounds and 206.0 (SD:44.0)pounds, among graduates and not graduates respectively ;

weight, body-fat %, push-ups, sit-ups, 1.5 mile run and VO2max had significant differences between recruits passing and failing .

Variables	n	Sample value
Age years †	108	42.2± 8.2
Height inches †	107	70.3 ± 2.4
Heart Rate bpm †	107	78.3 ± 12.5
Resting SBP mmHg †	107	126.4 ± 12.0
Resting DBP mmHg †	107	80.5 ± 9.2
Self-reported HTN *	116	26 (21.8)
High Risk of OSA *	118	26 (22.1)
Body Mass Index kg/m^2 †	107	30.0 ± 4.1
Smoking *	115	12 (10.4)
Personal History of Heart Rhythm Problems *	119	19 (16.0)
Family History of cardiac problems*	119	45 (37.8)
Age >= 40 years *	108	64 (59.3)
BMI>= 30 kg/m^2 *	107	47 (43.9)
Low CRF *	107	35 (32.7)
MVPA Physical Activity min/week †	116	226.7 ± 138.0
LVM_ECHO g †	118	200.7 ± 43.5
LVM_CMR g †	116	152.6 ± 24.3
LVM_ECHO indexed to height$^{1.7}$ g †	107	75.0 ± 16.3
LVM_ECHO indexed to height$^{2.7}$ g †	107	41.8 ± 9.3
LVM_CMR indexed to height$^{1.7}$ g †	104	56.4 ± 8.5
LVM_CMR indexed to height$^{2.7}$ g †	104	31.4 ± 5.1

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RESULTS

Minimum Entry Fitness criteria of >10 push-ups and a 1.5 mile run of <15′20″ for women applicants, and >20 push-ups and a 1.5 mile run time of <15′20″ for male applicants

Suggested 'Target' Entry Fitness Criteria of >20 push-ups and a 1.5 mile run time of <14′ for females and >40 push-ups and 1.5 mile run time of <12′30″ for males.

We have now found that:

Women	**PROSPECTIVE**	**RETROSPECTIVE**
If meet minimum entry criteria, Graduation rate was 89%	(76.4, 96.4)	95%
If meet minimum target criteria, Graduation rate was 92%	(74.9, 99.1)	98%
Men		
If meet minimum entry criteria, Graduation rate was 95%	(92.7, 96.5)	95%
If meet minimum target criteria, Graduation rate was 98%	(95.7, 99.5)	98%

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CONCLUSIONS

Prospective results supported our previously recommended fitness criteria.

Baseline pushups and 1.5-mile run-time were successfully validated as predictors of successful academy graduation.

IMPLICATIONS

Establishing and validating evidence-based fitness standards through this additional prospective study gives future recruits actionable information to better prepare for police academy training and improve their likelihood of successful graduation.

Rather than present a barrier for applicants who are below fitness standards, discrete minimum fitness goals could empower candidates to achieve a level of physical fitness most associated with police academy success.

Specific Hazards to Law Enforcement

Exposure to sudden demands of physical and psychological stress

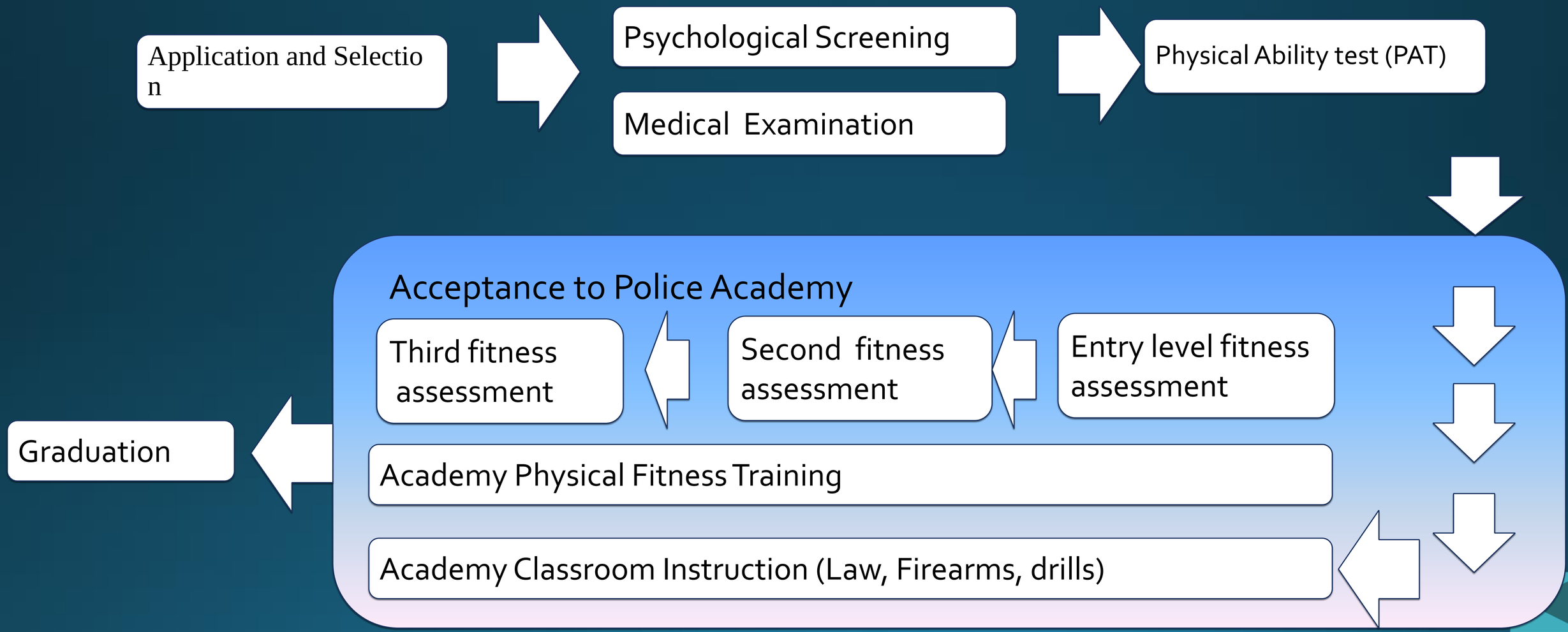
(Preliminary 2015 Law Enforcement Officer Fatalities Report)

- **124 total enforcement fatality in 2015**
- **42 officers shot and killed, 52 died in traffic related incidents**
- **24 officers died from job-related illnesses in 2015, mostly heart attacks**

Infrequent, episodic (irregular) physical activity has been shown to be associated with an increase in the risk of myocardial infarction (RR= 4.98; 95% CI, 1.47-16.91)

Cardiovascular risk factors of non-occupational origin such as obesity, hypertension, high cholesterol, and smoking may also account for an increased prevalence of cardiovascular disease in law enforcement officers

Massachusetts Police Academy



Physical Ability Test

Massachusetts mandates all recruit police officers pass a medical exam and Physical Ability Test (PAT) prior to potential entrance at a Commonwealth Police Academy

PAT is designed to replicate certain functions/capabilities of police work in an effort to test a participant's ability to safely perform essential law enforcement duties

Obstacle course (340-yard), trigger pull event, bag pull, dummy drag

However, the PAT requires only moderate aerobic capacity and overall fitness

Massachusetts MPTC finds many student recruits to be ill prepared for the rigors of police academy training despite having successfully completed the PAT

Previous Retrospective Study

2015 retrospective study (N=2993 between 2006-2012)

Overall 9.6% rejection rate

Total males=2681 (90.3%), Total females = 287 (9.7%)

BMI, Weight, Body fat, Push-ups, Sit-ups and Run-time/VO2 max are all predictors of successful graduation from Massachusetts Police Academies

1.5 mile run-time (estimated VO2 max) and Push-ups are strongest predictors

	Minimum Entry Criteria	Target Entry Criteria	
Female	>10	>20	Push-Ups
	<15’20”	<14’	1.5 mile Runtime
Male	>20	>40	Push-Ups
	<15’20”	<12’30”	1.5 mile Runtime

Exposure Assessment: Entry-Level Physical Fitness Assessment (initial Cooper test)

1. **Height**
2. **Weight**
3. **BMI (calculated)**
4. **Body fat percent**
5. **Push ups (number per one minute)**
6. **Sit ups (number per one minute)**
7. **Sit and reach (flexibility in inches)**
8. **1.5 mile run (time in minutes : seconds)**
9. **VO2 Max Estimated (Calculated)**

Outcome Assessment

Successful graduation: yes/no

Table 1. Baseline characteristics by graduation status including only participants with complete data (i.e. with all Sex, Push-ups, and Run-times available)

Characteristic	Overall (N=724)		Graduated (N=661)		Not Graduated (N=63)		p-value*
	N		N		N		
Academy							0.003
Academy 1	41	5.7	37	90.2	4	9.8	
Academy 2	27	3.7	26	96.3	1	3.7	
Academy 3	46	6.4	40	87.0	6	13.0	
Academy 4	44	6.1	43	97.7	1	2.3	
Academy 5	34	4.7	32	94.1	2	5.9	
Academy 6	29	4.0	29	100.0	0	0.0	
Academy 7	82	11.3	67	81.7	15	18.3	
Academy 8	45	6.2	42	93.3	3	6.7	
Academy 9	37	5.1	37	100.0	0	0.0	
Academy 10	50	6.9	46	92.0	4	8.0	
Academy 11	43	6.0	41	95.4	2	4.6	
Academy 12	45	6.2	41	91.1	4	8.9	
Academy 13	40	5.5	37	92.5	3	7.5	
Academy 14							
Academy 15	58	8.0	46	79.3	12	20.7	
Academy 16	103	14.2	97	94.2	6	5.8	
Sex - N, %							0.018
Males	649	89.6	598	92.1	51	7.9	
Females	75	10.4	63	84.0	12	16.0	
Age (years) - median (Q1, Q3)	723	26 (24, 29)	661	26 (24, 29)	62	27 (24, 31)	0.72
Weight (pounds) - mean ± SD	724	192.2 ± 35.6	661	190.9 ± 34.5	63	206.0 ± 44.0	0.010
Body fat (%) - mean ± SD	723	20.99 ± 7.54	660	20.57 ± 7.46	63	25.39 ± 7.00	<.001
Push-ups (number) - mean ± SD	724	39.47 ± 15.42	661	40.36 ± 15.04	63	30.13 ± 16.32	<.001
Push-ups (number) - N, %							<.001
≤20	80	11.0	59	73.8	21	26.3	
21-40	312	43.1	283	90.7	29	9.3	
41-60	275	38.0	265	96.4	10	3.6	
≥61	57	7.9	54	94.7	3	5.3	
Sit-ups, mean ± SD	723	34.60 ± 9.38	661	35.25 ± 8.93	62	27.63 ± 11.20	<.001
Sit-ups (number) - N, %							<.001
≤15	26	3.6	14	53.9	12	46.1	
16-30	191	26.4	70	89.0	21	11.0	
31-45	425	58.8	398	93.7	27	6.3	
≥46	81	11.2	79	97.5	2	2.5	
Sit-and-reach (inches), mean ± SD	652	17.46 ± 5.17	592	17.29 ± 3.49	60	19.13 ± 13.03	0.28
Sit-and-reach (inches) - N, %							0.88
<16	198	30.4	179	90.4	19	9.6	
16-18	143	21.9	129	90.2	14	9.8	
18-20	147	22.6	136	92.5	11	7.5	
≥20	164	25.1	148	90.2	16	9.8	
1.5 mile run (min), mean ± SD	724	12.79 ± 1.94	661	12.59 ± 1.78	63	14.89 ± 2.36	<.001
VO2 max ($ml*kg^{-1}*min^{-1}$), mean ± SD	724	41.87 ± 6.56	661	42.52 ± 5.97	63	35.01 ± 8.37	<.001
1.5 Mile Run-times - N, %							<.001
≥15′20″	81	11.2	55	67.9	26	32.1	
15′20″-12′33”	274	37.9	247	90.2	27	9.8	
12′33”-10′37”	281	38.8	273	97.2	8	2.8	
<10′37”	88	12.1	86	97.7	2	2.3	

* (difference between recruits passing and failing)

Reasons for Failure

		N
1)	**Personal Resignation** (including the cases where the students realized they are not prepared for the academy training or the police profession or "voluntary")	31
2)	**Resignation due to any medical reason: injury, illness**, etc	8
3)	**Dismissal / Separated (academic)**	**9**
4)	**Dismissal / Separated (disciplinary)**	5
5)	**Dismissal / Separated (did not complete physical training participation standard)**	**5**
6)	**Withdrawal** (by employing department or due to withdrawal of sponsorship)	6
7)	**Dismissal / Separated** (Driving/Firearms)	2