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## The impact of fitness levels on marksmanship: A critical narrative review

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*Recommended citation(APA):*  
Muirhead, H., Birge, S., Orr, R. M., Schram, B., & Dawes, J. (2019). *The impact of fitness levels on marksmanship: A critical narrative review*. Poster session presented at Rocky Mountain American College of Sports Medicine Annual Meeting 2019, Denver, Colorado, United States.

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## INTRODUCTION

- The occupational demands of a police officer can vary between two divergent roles; the more sedentary of which consists of desk bound administrative work while the more physically demanding encompasses manual tasks (1).
- Due to the nature of these manual tasks, police officers are often required to quickly transition from periods of prolonged sedentary tasks to more physically demanding tasks such as running, jumping, crawling, balancing, vaulting, climbing, lifting, carrying, pushing, pulling, fighting, dragging and restraining a suspect (2).
- Police officers must maintain a level of physical fitness in order to safely and effectively perform these required tasks (3). However there exists a high variety in fitness levels of police officers that can be influenced by stage of training, duration of career, sex and age.
- In addition to these strenuous demands, officers may also be required to accurately aim and fire a weapon in the line of duty; failure of which may result in injury to the officer, suspect, or the general public (4).
- Therefore, the purpose of this review was to identify, critically appraise and to synthesize the research reporting on relationships between measures of fitness and marksmanship to inform police fitness and marksmanship practices.

## METHODS

- Two authors (HM & SB) conducted independent, comprehensive literature searches using four databases (PubMed, CINAHL, SPORTDiscus and OVID) as seen in Figure 1.
- A third author (RO) reviewed the reference lists of eligible studies to identify additional studies not found in the initial database search.
- Of the resultant articles, the following inclusion and exclusion criteria were applied:

### Inclusion Criteria:

- A measure of one of the 5 components of fitness as defined by the ACSM (5)
- A performance or measure of marksmanship of firearms and,
- Human adult participants as subjects.

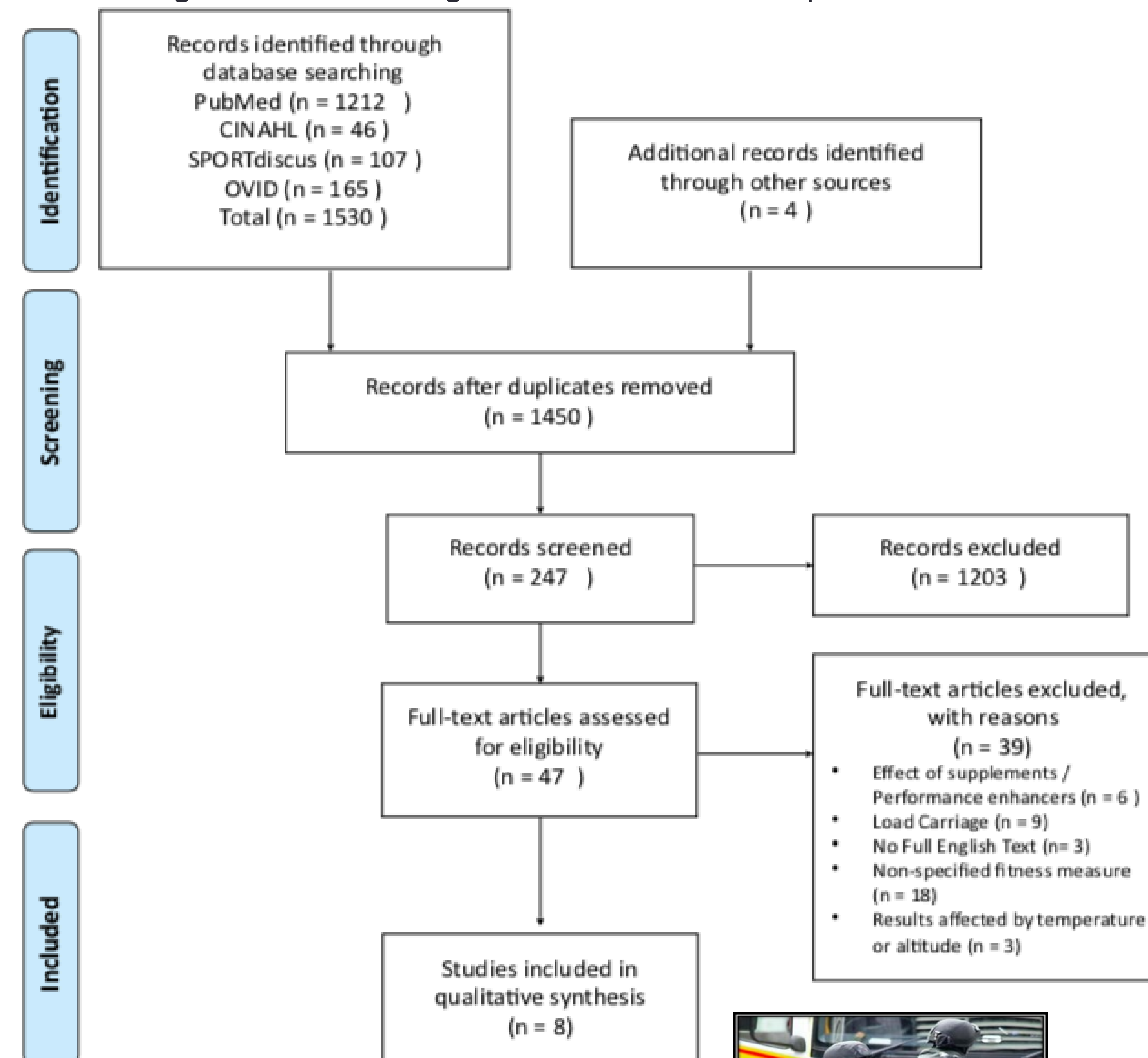
### Exclusion Criteria:

- Effects of a substance / performance enhancer,
- Load carriage,
- No full English text,
- Non-specified fitness measure,
- Results affected by temperature or altitude or,
- Examined the effects of altitude or temperature.

- The quality of the chosen studies was then assessed using the modified Downs and Black Checklist, with the raw score then converted to a percentage to form the Critical Appraisal Score (CAS). A kappa analysis was used to measure the level of agreement between the two appraisers.
- The methodological quality was defined by the Kennelly grading system as <43.8% being 'poor', 46.9 - 59.3% being 'fair' and > 62.5% being 'good'.

## METHODS.. CONT

Figure 1. PRISMA diagram of literature search protocol.



## RESULTS & SYNTHESIS

- Following the application of the inclusion and exclusion criteria, a total of eight studies remained.
- Substantial agreement was achieved between two raters ( $k = 0.642$ ).
- Methodological quality of the included studies had a mean CAS of  $68.5 \pm 9.3\%$ , ranging from 53.6% to 80.4%. The CAS scores and Kennelly Grade are outlined in Table 1 for each study.
- Of the eight studies:
  - Six were conducted in police populations
  - One observed a military population
  - One examined competitive sport shooters
  - There were a total of 531 males and 60 females participants with 310 participants of a non-specified sex.
  - Three studies included both males and females, three studies included male participants only and two studies did not specify sex.

## RESULTS & SYNTHESIS...CONT

- All eight articles concluded that grip strength positively influenced marksmanship.
- A variety of other outcome measures to assess fitness were used (Table 1), with inconsistent or non-significant results observed between studies.
- The measure of marksmanship varied slightly between studies with a strong focus on accuracy between all eight articles.

Study	OUTCOME MEASURES							Average CAS (Grade)
	Grip Strength	Trigger Finger Strength	Deltoid Strength	Static Push-up	20-metre shuttle run	Curl Up Test	1RM Bench Press	
Anderson & Plecas (2000)	✓ *			✓				73.2% (Good)
Copay & Charles (2001)	✓ ***							58.9% (Fair)
Kayihan et al. (2013)	✓ **				✓	✓		67.9% (Good)
Mon et al. (2015)		✓ *	✓					71.4% (Good)
Moore et al. (1992)	✓	✓ *					✓	78.6% (Good)
Orr et al. (2017)	✓ ***							80.4% (Good)
Rodd et al. (2008)	✓							64.3% (Good)
Vercruyssen et al. (1989)	✓		✓					53.6% (Fair)

Table 1. Comparison of reported strength related outcome measures and CAS scores. ✓ = Measurement was used; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$

## DISCUSSION AND CONCLUSION

- This critical review identified a positive relationship between fitness and marksmanship, particularly in relation to grip strength.
- Police officers can lose fitness during their careers due to the nature of the job or increasing age and variability in fitness associated with stage of training and sex.
- Any loss in fitness (notably grip strength) can have a negative effect on the safety of the officer, the general public and a suspect if an officer is unable to effectively aim and fire a weapon when required.
- Therefore it is of high importance to monitor and maintain fitness levels in law enforcement officers.

## KEY REFERENCES

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