REVIEW PAPER

International Journal of Occupational Medicine and Environmental Health 2014;27(6):891–901
http://dx.doi.org/10.2478/s13382-014-0318-0

ANTHROPOMETRIC INDICATORS OF OBESITY IN POLICEMEN: A SYSTEMATIC REVIEW OF OBSERVATIONAL STUDIES

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Abstract
The aim of this paper was to summarize scientific literature on obesity in policemen through a systematic review of observational studies. For this purpose the following electronic databases were selected: Medline by Pubmed, CINAHL, and Scopus; and a manual search of the referenced studies concerning this topic was performed. There were no restrictions with respect to the year or language of the publication. Twenty-three studies were identified and 9 articles, considered as potentially relevant, were included. The labor time, shift and career progression promoted changes in body composition. Most of the policemen taking part in the studies included in this paper were overweight (BMI: 25.2–29.3), obese (body fat ≥ 25%), had increased waist (90.4–102 cm) and abdominal perimeters (18.9–90.5 cm), and had a higher risk of chronic disease, which is associated with depression and stress development. Interventional studies are needed for the purpose of proposing preventive and rehabilitation programs, which would result in providing physical and mental well-being, improvement of life quality and, especially, prevention of obesity related to police work.

Key words:
Obesity, Police, Systematic review, Observational study

INTRODUCTION

Obesity is an increasingly prevalent disease worldwide and can be regarded as a health problem among individuals of different occupations, including policemen, who are responsible for public security [1–7]. Furthermore, excess body fat is considered a risk factor for cardiovascular, metabolic and psychological diseases, and affects occupational performance. Obese workers are more prone to illnesses, absenteeism and earlier retirement compared to the non-obese workers [8].

According to Alasagheirin et al. [7], physical fitness is an essential condition for police positions because police officers should be able to perform physically demanding tasks. However, the body mass increase caused by obesity can compromise this physical condition. Although policemen, in their early career, are considered more physically active than the general population, studies indicate that police officers are more prone to being obese or having diseases related to obesity over time as a result of physical and psychological work requirements that are

Source of financial support: Foundation for Research and Innovation in the State of Santa Catarina (FAPESC) under protocol 13.680/2011-8.
Received: February 4, 2014. Accepted: July 18, 2014.
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sometimes in conflict with maintenance of physical fitness [1,7,9,10].

Over the last decade, numerous studies on the changes in body composition of policemen caused by their occupation have been performed. Nevertheless, the lack of a review including the studies concerning obesity in policemen justifies undertaking such an evaluation of this theme. Therefore, the aim of this paper was to summarize scientific literature on police obesity through a systematic review of observational studies.

MATERIAL AND METHODS

This systematic review was registered under the number CRD42013005990 in the International Prospective Register of Systematic Reviews – PROSPERO and followed the proposed recommendations of the Cochrane [11] collaboration and Preferred Reporting Items for Systematic Review and Meta-analyses: The PRISMA Statement [12].

Eligibility criteria

Cohort observation, cross-sectional and case-control studies were included in this review. All the included studies have explored the theme of police obesity and have been indexed in the previously selected databases, with available abstracts showing the results in averages and standard deviations. Full online access was ensured but there was no information on the year and language restrictions. In addition to identifying preliminary studies, this review included studies that had been identified in a manual search for reference articles.

Search strategy

Medline (Medical Literature Analysis and Retrieval System on-line) by Pubmed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and Scopus (Elsevier) were the electronic databases selected for this study. In addition, a manual search among references for the published studies on this theme was conducted.

The search strategy included the following proposed descriptors in the Medical Subject Headings (MeSH) related to the following issues: anthropometric obesity indicators – "Body Composition", "Body Compositions", "Composition, Body", "Compositions, Body", and "Anthropometric Indexes of Obesity"; the study population – "Police", "Police Force", "Police Forces", "Police Officers", "Officer, Police", "Officers, Police", "Police Officer", and "Military Police"; and the study type (observational) – "Epidemiologic studies", "Exp case control studies", "Exp cohort studies", "Case control", "Cohort adj" (study or studies), "Cohort analys", "Follow up adj" (study or studies), "Observational adj" (study or studies), "Longitudinal", Retrospective", "Cross sectional", and "Cross-sectional studies". All search operations were performed in October, 2013.

Study selection and data extraction

The studies identified by the search strategy were initially evaluated by 2 independent reviewers according to their titles and abstracts. Then, the reviewers evaluated the complete articles and selected studies according to the eligibility criteria specified above. Studies that were not in accordance with the adopted criteria were excluded from the study. Disagreements between the reviewers were solved by consensus. The following data were extracted from the selected studies: identification of the publication, venue of the study, participants characteristics (gender and age), methods used to detect obesity, study design, sample size, follow-up time (cohort studies), results by average and standard deviation, and percentage of policemen found to be overweight/obese.

Quality assessment

Methodological quality of each study included in this review was also evaluated in an autonomous manner by 2 reviewers using an instrument developed by the authors and

based on the Newcastle-Ottawa Scale (NOS) [13], which is used to evaluate the quality of nonrandomized studies. The questionnaire developed by Sarmento et al. [14] was also applied because it evaluates the quality of cohort observational and case-control studies.

The instrument is composed of the following items: clear, focused and appropriate question; sufficient duration of a follow-up (for cohort studies); inclusion and exclusion criteria used for participants selection; participant selection controlled for potential confounders; representative sample (for cohort studies); outcomes assessed by blinded investigators (for cohort studies); outcomes assessed in a valid and standardized way; losses accompanying the study (for cohort studies); losses and exclusions; as well as clearly presented and discussed results.

RESULTS

Literature search

This search resulted in the identification of 18 articles. After additional, manual evaluation of the references for these articles, 5 more studies were added, resulting in a total of 23 articles. Eight studies were excluded after a general evaluation because their titles and abstracts did not address the theme investigated in the present paper. Further detailed review revealed that 4 studies were not considered observational and 2 studies did not present the results in averages and standard deviations. Therefore, 9 studies were considered potentially relevant and were included in the systematic review. The search strategy is summarized in Figure 1.

Study characteristics

The primary methodological characteristics of the included studies are shown in Table 1. Two were cohort design studies [1,4] with follow-ups ranging from 12 [4] to 15 years [1] and 7 studies employed cross-sectional design [6,7,15–19]. The cohort study sample sizes ranged

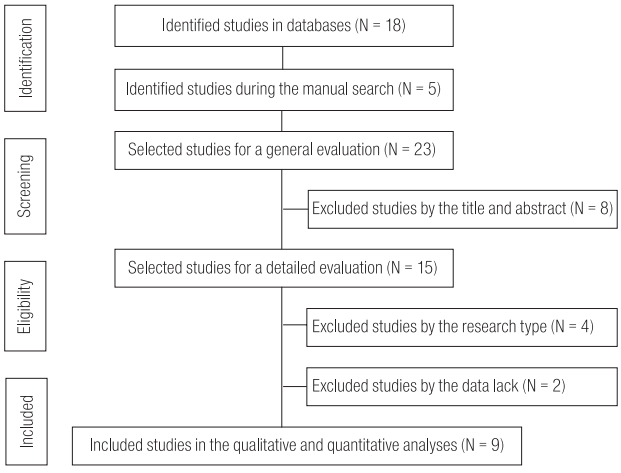

Fig. 1. Summarized search strategy

from 103 [1] to 327 [4] participants, and the cross-sectional studies ranged from 12 [15] to 408 [19] participants.

With regard to the methods of obesity detection in the target population, direct measurements (body mass, fat mass, lean mass, abdominal girth, and waist circumference) as well as indirect measurements (body mass index, waist-height ratio, waist to hip ratio, and fat percentage) were used.

The main demographic characteristics of the studies are shown in Table 1; 6 studies were performed in North America [6,7,15–17,20], 2 in Europe [1,4], and 1 in South America [18]. Among the cohort studies, Boyce et al. [4] studied both men and women, whereas Sorensen et al. [1] included only men. Among the cross-sectional studies, 5 studies included both men and women [6,15–17,19], and 2 included only men [7,18]. The average age of the cohort study participants ranged from 24.6 to 48.7 years, and the average age of the cross-sectional study participants ranged from 32.4 to 44 years.

The main results of each study included in the present systematic review are shown in Table 2. However, it should be noted that the use of different methods for obesity detection did not allow for a meta-analysis of the results. Thus, despite the necessary relativization of the results according to their methodological characteristics, the cohort studies

Table 1. Main characteristics of the included studies

Reference	Study location	Design (monitoring)	Respondents (n)	Gender	Age (years) (M±SD)	Obesity detection method	Police officers found to be overweight/obese (%)
Spliter et al. (1987) [15]	Greensboro Police Department (North Carolina)	cross-sectional	12	male and female	32.4±4.7	body density, skinfold	n.d.
Sorensen et al. (2000) [1]	Police College of Finland	cohort (15 years)	103	male	33.6±4.1 (in 1981) 48.7±4.1 (in 1996)	body mass, BMI, waist circumference, skinfold thickness	29.0 (in 1981) 51.0 (in 1996)
Violanti et al. (2006) [16]	Buffalo Police Department (USA)	cross-sectional	100	male and female	44±7.6	body mass, BMI, fat percentage, lean mass	n.d.
Charles et al. (2008) [17]	Buffalo Police Department (USA)	cross-sectional	110	male and female	39.6±7.6	BMI, waist circumference, abdominal girth, waist-hip ratio, waist-high ratio	n.d.
Boyce et al. (2008) [4]	Mecklenburg Police Department (Germany)	cohort (12 years)	327	male and female	24.6±3.4 (in 1990) 37.1±3.7 (in 2006)	body mass, fat percentage, fat and lean mass	81.0
Donadussi et al. (2009) [18]	Cascavel/Paraná (Brazil)	cross-sectional	183	male	35.4±6.3	BMI, abdominal girth and fat percentage	63.9
Violanti et al. (2011) [6]	Preventive Medicine center of Health Public School and Buffalo's Health Professions (USA)	cross-sectional	99	male and female	39.3±7.6	BMI, waist circumference and abdominal girth	n.d.
Alasagheirin et al. (2011) [7]	Iowa University (USA)	cross-sectional	84	male	39.4±9.1	BMI, fat and lean mass, fat percentage	39.3 (through BMI) 70.2 (through fat percentage)
Gu et al. (2012) [19]	Buffalo Police Department (USA)	cross-sectional	408	male and female	42.8±7.9	BMI, waist circumference and abdominal girth, and fat percentage	40.0

M – mean; SD – standard deviation; BMI – body mass index; n.d. – no data.

showed a clear increase in all variables, indicating that the police officers were overweight, with waist circumferences above the recommended measurement [1], and obese [4].

On the other hand, in the case of cross-sectional studies, most of the results showed that the policemen were overweight and were at risk of developing co-morbidities,

Table 2. Main results of the included studies concerning anthropometric indicators of obesity and cardiovascular risk factors

Reference	Factor (M±SD)												Coronary risk
	fat (%)	fat free (kg)	body mass (kg)	BMI	WC (cm)	skinfold thickness (mm)	bone density (g/cm^2)	lean mass (kg)	AG (cm)	WHR (cm)	WHtR (kg/m^2)	fat mass	
Spliter et al. (1987) [15]	15.9±4.9[a] 19.1±5.8[b]	63.1±6.7[a] 41.9±2.7[b]	–	–	–	–	–	–	–	–	–	–	no
Sorensen et al. (2000) [1]	–	–	90.3±13.0	27.3±3.7	98.7±10.0	11.4±4.6[c] 5.2±2.7[d] 18.5±10.1[e] 12.2±5.9[f]	–	–	–	–	–	–	yes
Violanti et al. (2006) [16]	26.9±7.1	–	85.8±17.6	28.5±5.7	–	–	1.2±0.1	61.0±12.2	–	–	–	–	yes
Charles et al. (2008) [17]	–	–	–	28.0±4.4	90.4±13.0	–	–	–	20.7±3.2	0.85±0.08	0.52±0.07	–	yes
Boyce et al. (2008) [4]	25.3±6.1[a] 19.1±5.9[b]	–	66.0±8.7[a] 94.6±15.9[b]	–	–	–	–	49.0±5.4[a] 75.9±9.6[b]	–	–	–	18.7±8.5[a] 17.0±5.8[b]	yes
Donadussi et al. (2009) [18]	20.9±5.0	–	–	26.6±4.0	–	–	–	–	90.5±10.5	–	–	–	yes
Violanti et al. (2011) [6]	–	–	–	29.0±3.8[a] 26.2±4.5[b]	96.8±10.0[a] 80.3±10.0[b]	–	–	–	18.9±2.8[a] 18.9±2.8[b]	–	–	–	yes
Alasagheirin et al. (2011) [7]	29.6±7.7	–	–	29.3±4.5	–	–	–	63.9±7.6	–	–	–	21.1±11.9	yes
Gu et al. (2012) [19]	25.8±6.2	–	–	29.1±4.4	94.3±13.7	–	–	–	20.8±3.3	–	–	–	yes

BMI – body mass index; WC – waist circumference; AG – abdominal girth; WHR – waist-hip ratio; WHtR – waist-to-height ratio.
[a] Male; [b] female; [c] triceps; [d] biceps; [e] subscapular; [f] suprailiac.

as identified by body mass index (BMI), waist circumference, abdominal girth, waist-hip ratio, waist height ratio and fat percentage.

Quality assessment

The cohort studies, which were included in this systematic review do not meet all the criteria that were previously established to evaluate methodological quality. Among the cross-sectional studies, 3 [6,16,18] include all the previously established criteria for evaluating methodological quality. Nevertheless, all the 10 studies aimed at answering a clear and focused question.

In the 2 cohort studies, monitoring duration was considered adequate, though they did not present a participant selection process that was controlled for potential confounders and they did not report whether the outcomes were assessed by blinded investigators. In addition, the study sample of Violanti et al. (2011) [6] was not representative and did not show whether there were losses during the follow-up.

Seven cross-sectional studies evaluated the outcomes in a standardized and valid way, and the results were clearly presented and discussed. The studies by Violanti et al. [6], Violanti et al. [16], and Donadussi et al. [18] did not report the inclusion and exclusion criteria used for selecting the participants. The study by Gu et al. [19] reported that the inclusion and exclusion criteria for selecting participants were not adopted.

Despite these omissions, most of the analyzed papers presented an adequate methodological quality.

DISCUSSION

The occupation of police officer is considered to be a profession with high-risk activities, considering that these professionals encounter violence, brutality and death in their daily work. Therefore, physical fitness as well as good health are essential for the proper performance of functions of a police officer [1,4,7,15]. Spliter et al. [15] have emphasized that police officers should have good physical fitness to meet the job's demands.

Nevertheless, majority of the police officers, in different contexts, presented anthropometric changes that could hinder their actions [1,4,6,7,16–19], with the exception of those in the study by Spliter et al. [15], in which the target population was described as healthy and physically fit. That study's positive outcome may be related to the small sample size (12 subjects) and the average age of the participants; in other words, the sample consisted of younger officers.

Anthropometric changes may be related to the deleterious influence of police work because the job's physical demands are often inadequate for physical fitness maintenance needed to perform occupational tasks [9]. Soininen [20] has reported that approximately 1/4 of the police officers aged 40–54 years should work at their maximum or near maximum physical ability at least 5 times per year. Furthermore, police officers' progress in their careers and their physical activity at work decrease over time [1], contributing to anthropometric changes. Stamford et al. [9] have observed that after 1 year of training, recruits exhibited a dynamic power reduction that impaired their physical capacity for dealing with emergency situations.

In the Sorensen et al. [1] cohort study, assessment of changes in physical activity, physical fitness and body composition of 103 Finnish police officers during 15 years of follow-up has indicated that the overweight proportion (BMI < 27) was considerably lower in 1981 than in 1996 (29% vs. 51%, respectively); almost 2/3 of the officers (64%) had a waist circumference > 94 cm, and more than 1/3 (38%) had a waist circumference > 102 cm.

Similarly, in the Boyce et al. [4] cohort study of the Charlotte Police Department in Mecklenburg County, North Carolina (United States of America), the time spent on working by a police officer contributed to an increase in body composition values after the 1st decade, including

a significant increase in body mass, fat percentage and fat mass.

Shift work is also a risk factor for obesity. In the Gu et al. [19] cross-sectional study, male police officers from a metropolitan region of the United States of America who worked during the night shift had significantly higher values of waist circumferences and body mass index (BMI). The explanation for this association, according to the same authors, could be nutritionally inadequate food intake, as the officers who work at night only have access to convenience stores or fast food; in other words, they opt for calories and high-fat foods. Other possible explanations given by Gu et al. [19] and Vila [21] could be related to changes in the sleep-wake pattern, changes in the circadian rhythm as well as restricted opportunities to practice physical exercise.

Some studies have also demonstrated an association between obesity and chronic diseases, including cardiovascular diseases and metabolic syndrome [22–29]. There are many risk factors responsible for cardiovascular diseases. Vincent et al. [24] have considered that oxidative stress and inflammation are the biological mechanisms through which obesity leads to cardiovascular and other chronic diseases. In the Charles et al. [17] cross-sectional study, associations between anthropometric measures and biomarkers of oxidative stress were investigated in 110 police officers, and the results have indicated that adiposity is significantly associated with several markers of oxidative stress and antioxidant defense.

Studies by Calamita et al. [27], Barbosa and Silva [28], and Braga Filho and Oliveira Jr. [29] have described the prevalence of risk factors in Brazilian police officers. In the study by Calamita et al. [27] the prevalence of the analyzed factors in São Paulo (Brazil) policemen was: 13% for smoking, 39% for dyslipidemia, 3% for diabetes mellitus, 5.3% for systemic hypertension, 38% for family history of CVD, 18% for obesity and 16% for physical inactivity. The prevalence of stress concerned 48% of policemen.

In the study by Barbosa and Silva [28], the prevalence of cardiovascular risk factors observed in 112 police officers from Rio Grande do Sul State (Brazil) was: 58.04% for family history, 67.86% for alcoholism, 36.61% for insufficient physical activity, 54.05% for overweight, 54.05% for dyslipidemia and 93.75% for stress. Braga Filho and Oliveira Jr. [29] have identified a high prevalence of systemic hypertension (55.76%), hypertriglyceridemia (50.85%), waist circumference > 102 cm (31.76%), low levels of high-density lipoprotein cholesterol (30.46%), impaired fasting glucose (28.15%) and metabolic syndrome (38.54%) in 452 police officers from Bahia State (Brazil).

Studies involving policemen from other countries have also shown a high prevalence of cardiovascular risk factors among police officers. In the study conducted in India on 900 policemen, Thayyil et al. [30] have found that 16.8% of them had metabolic syndrome and 65.6% had high body mass index, 37.7% – hypertension, and 7% – diabetes; 10% of the police officers smoked and 48% consumed alcohol.

Simon et al. [31] have suggested an association between obesity and depression. The study by Violanti et al. [6] aimed at examination of the associations between adiposity and depression in 115 police officers, and the authors have concluded that the officers with higher BMIs and an increased abdominal girth tended to suffer from depressive symptoms. The results of the study by Santana et al. [32], who studied 53 police officers, have shown a positive association between BMI and fatigue, the appearance of irritation and nervous system problems, or emotional problems related to work. Thus, excess body weight is suggested to be associated with emotional and physical stress at work.

In the study by Donadussi et al. [18], the police officers were considered overweight and obese, with a higher risk of metabolic complications in association with obesity through abdominal girth and higher body fat percentage indicators. Regarding methods for obesity assessment

used in the case of police officers, BMI and body fat percentages were the most common anthropometric indicators used in the studies included in the present systematic review. However, Violanti et al. [16] have reported that BMI may not reflect differences in muscle mass or biological differences in fat distribution between genders. Other studies of police officers have also shown a higher prevalence of BMIs above 25 (level above normal weight) among officers (82.6%) than among the general population (74.7%), which could be misleading with regard to the potential risk for metabolic and cardiovascular diseases [33,34].

Additionally, Hartley et al. [35] have verified the association between depression symptoms and metabolic syndrome in 450 policemen (410 Buffalo, New York Police Officers and 130 Spokane Heart Study Police Officers). These results have shown that the number of metabolic components increased significantly in all depression symptom categories for men from Spokane and demonstrated that each increase was associated with 47.6% for hypertriglyceridemia, 51.8% for systemic hypertension and 56.7% for glucose intolerance.

The I Brazilian Guidelines for the Diagnosis and Treatment of MS (I-DBSM, 2005) defined this clinical entity as a complex picture characterized by a set of cardiovascular risk factors usually related to the central deposition of body fat and insulin resistance. There is a high association of this syndrome with cardiovascular disease, resulting in a 1.5-fold increase in overall mortality and a 2.5-fold increase in cardiovascular-specific mortality [29].

Some police occupational characteristics were described as conditioning factors for metabolic syndrome, such as work shift and overtime. A study including 98 policemen evaluated whether the atypical work hours were related to metabolic syndrome [36]. The authors have found a significant association between midnight shifts and the number of metabolic syndrome components in those police officers with fewer sleep hours ($p = 0.013$) and more overtime ($p = 0.007$). These results have suggested that fewer sleep hours and more overtime combined with the midnight shift work can be considered important contributors to metabolic syndrome in police officers.

Regarding sleep duration, McCanlies et al. [37] have verified that female police officers with few sleep hours presented a significantly higher number of metabolic syndrome components compared with others with more sleep hours. The authors have also observed that those police officers who stopped breathing during the night presented more metabolic syndrome components than those who did not stop breathing. Therefore, the duration and quality of sleep also contribute to the development of metabolic syndrome in police officers.

Therefore, for the clinical management of these chronic conditions and, as a result, for promoting a better quality of life, lifestyle changes such as a balanced and healthy diet, regular physical activity, and practices that reduce everyday life stress are usually necessary. In the case of police officers, the need for public policies promoting the practice of physical activities, including leisure and sports activities, that promote prevention of obesity related to work, psychological stability, changes in living habits, improvements in health and, therefore, improvements in the quality of life, is imminent.

Regarding anthropometric indicators of obesity, the BMI and the body fat percentage were used most often in the included studies. Alasagheirin et al. [7] aimed at determination of the accuracy of BMI for estimating obesity compared with body fat percentage in police officers. The resulting data have shown that the prevalence of obesity, as defined by a body fat percentage of 25 or more, is high (70.2%) and that obesity is substantially more prevalent than when it is estimated by BMI, which identified only 39% of officers as being obese. One explanation for the discrepancy between BMI and fat percentage is that the body fat percentage does not have a category for overweight. Therefore, when the 2 BMI ratings were

combined, 80% of the officers in this study were classified as overweight or obese. Thus, despite its ease of measurement and wide use in epidemiological studies, BMI may not be valid for specific groups of individuals, such as police officers. Therefore, other anthropometric measures could be used in association with BMI, such as the body fat mass or the percent body fat.

The high heterogeneity among the results of the studies mentioned above did not allow for a meta-analysis. Furthermore, it should be noted that, despite the importance of studies on obesity, studies that investigate the target population of this systematic review are rare, even though most of the analyzed papers presented an adequate methodological quality.

CONCLUSIONS

The results of this study indicate that BMI and body fat percentage were the most commonly used anthropometric indicators in majority of the studies included in this systematic review. However, BMI was not considered to be an accurate method for obesity screening in police officers compared with the measurement of the fat percentage. Therefore, the use of BMI with other anthropometric measures is recommended.

In addition, working time, shift work and career progression of the police officers were noted as factors promoting changes in body composition because most of the police officers in these studies were overweight or obese and exhibited the increased waist circumference and abdominal girth, which lead to an increased risk of developing chronic diseases. Interventional studies are needed for the purpose of proposing some preventive and rehabilitation exercise programs. Providing physical and mental well-being, improvements in the quality of life, and, especially, prevention of obesity related to police work are important because this occupation requires physical fitness and adequate mental health conditions.

ACKNOWLEDGMENTS

We would like to acknowledge the Coordination of Improvement of Higher Education Personnel – CAPES and Foundation for Research and Innovation in the State of Santa Catarina (FAPESC) for providing the source of funding for the project.

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