REVIEW

Driving the prevention of low back pain in police officers: A systematic review

Jerome Range[a], Charles Côté[b], Héctor I. Castellucci[c], Mathieu Tremblay[d] and Martin Lavallière[a]

ABSTRACT

Introduction: Police officers spend a lot of time at work seated in a patrol car. Being seated for hours can cause low back pain (LBP) and is documented as sedentary behaviour, and the risk of work injuries related to LBP grows for police officers as a result of equipment and individual factors. This can result in an increase in health and safety costs for organizations and has a negative impact on quality of life. This systematic review 1) evaluated the risks associated with police patrolling while considering external factors that could influence a police officer's well-being and 2) identified solutions to improve posture while seated in vehicles and discerned preventive measures that can be implemented to alleviate LBP. **Methods:** A systematic review focused on LBP in police officers was conducted. PubMed, Scopus, Academic Search Complete, CINAHL, and *Military Medicine* were searched for articles published between January 1990 and December 2022. **Results:** Of 1,169 articles initially identified, 104 met the criteria for full-text review. Twenty-one articles specifically discussed LBP in police officers, vehicle ergonomics, training programs, and health habits. **Discussion:** To minimize LBP, analyzing optimal positions for the mobile data terminal, raising awareness among police officers (civilian and military), offering preventive or corrective training programs for trunk musculature, having multidisciplinary teams in organizations, and participating in regular physical activity could have positive effects on preventing LBP.

Key words: car, ergonomics, low back pain, occupational health, police, posture, prevention, sitting

RÉSUMÉ

Introduction : Les policier(ère)s passent un grand nombre de leurs heures de travail en position assise, dans les véhicules de patrouille. Le fait d'être assis(e) pendant des heures correspond à un comportement sédentaire, et peut causer des douleurs dans la région lombaire, ou lombalgie. Le risque d'accident du travail lié à la lombalgie est élevé chez les policier(ère)s en raison de l'équipement et de facteurs individuels. C'est une situation susceptible d'augmenter les couts en santé et sécurité pour les organismes, et qui nuit à la qualité de vie des personnes qui en souffrent. Cette revue de littérature 1) évalue les risques associés à la patrouille policière, tout en tenant compte des facteurs extérieurs capable d'influencer le bien-être des policier(ère)s, et 2) détermine des solutions pour améliorer la posture assise en voiture ainsi que des mesures préventives à mettre en place pour soulager les douleurs lombaires. **Méthodologie :** Une revue de littérature systématique, centrée sur la lombalgie chez les policier(ère)s, a été réalisée. Les archives de PubMed, de Scopus, d'Academic Search Complete, de CINAHL et de *Military Medicine* ont été fouillées, afin de trouver des articles pertinents publiés entre janvier 1990 et décembre 2022. **Résultats :** Des 1 169 articles trouvés, 104 répondaient aux critères de sélection pour la revue du texte intégral. De ceux-ci, 21 concernaient précisément la lombalgie chez les policier(ère)s, l'ergonomie des véhicules, les programmes de formation et les habitudes de vie. **Discussion :** Dans le but de réduire les douleurs lombaires, les éléments de prévention les plus prometteurs sont : l'analyse des positions optimales au moyen du terminal de données mobiles ; la sensibilisation des policier(ère)s, tant civil(e)s que militaires ; la mise en place de programmes d'entrainement préventif ou correctif pour la musculature du haut du corps ; la formation d'équipes multidisciplinaires dans les organismes ; l'activité physique régulière.

Mots clés : automobile, ergonomie, lombalgie, santé au travail, police, posture, prévention, position assise

LAY SUMMARY

Police officers are exposed to multiple risks that increase the prevalence of low back pain. Few interventions have been tailored to help with prevention of low back pain. This systematic literature review aimed to analyze interventions

a Department of Health Sciences, Université du Québec à Chicoutimi, Chicoutimi, Québec, Canada
b Department of Management Sciences, Université du Québec à Rimouski, Rimouski, Québec, Canada
c Faculty of Medicine, Universidad de Valparaíso, Valparaíso Province, Chile
d Department of Health Sciences, Université du Québec à Rimouski, Rimouski, Québec, Canada

Correspondence should be addressed to Martin Lavallière at Université du Québec à Chicoutimi, Sciences de la santé, 555 Boulevard de l'Université Chicoutimi, Québec, Canada, G7H 2B1. Telephone: 418-545-5011 ext. 4214. Email: martin_lavalliere@uqac.ca

done with civilian or military police officers for this ongoing problem and to identify solutions to help alleviate low back pain in this population. Approaches in the literature regarding police officers and low back pain included an analysis of equipment in patrol vehicles, equipment worn by police officers, and individual factors, such as physical condition and mental state. Findings show multiple methods that can be used to further study low back pain among police officers and reduce its burden.

INTRODUCTION

Low back pain (LBP) is a complex phenomenon that results in huge burdens on health care systems and is a leading cause of disability worldwide.[1] Separating types of lower back pain is practically impossible because of the spectrum of overlapping factors that cause pain in this region, mainly in the lumbar spine.[2] Relieving pain, restoring function, and avoiding recurrence are the main objectives when searching for ways to minimize LBP.[3] On a broad scale, the number of people with LBP globally went from 377.5 million in 1990 to 577 million in 2017.[4] One-year LBP prevalence affects approximately 38.0% of the general population.[5] In comparison, 67.7% of police officers are reported to be affected.[6] From a health and safety perspective, many costs can be associated with occupational injuries such as LBP.[7] In 2020, almost $2,400,000 was spent on occupational injuries in Québec, Canada, by the Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST). Additionally, back pain issues consistently represented more than 50% of CNESST cases between 2017 and 2020.[8] Back pain, particularly lower back pain, is considered one of the most common musculoskeletal problems in Canada.[9,10] Considering these costs, identifying risk factors and appropriate interventions to prevent LBP are essential, especially for police organizations.[5,11]

Both civilian and military police officers have the very important role of protecting citizens, which involves a plethora of tasks that must be executed with precision, involving multiple risks that can affect health and safety.[12] These tasks require an adequate fitness level and could put the lives of police officers and the citizens around them in danger if they are not executed safely and efficiently.[13] To do so, police officers must take care of themselves so they are ready to intervene when needed, which requires adequate physical conditioning.[14] Military police officers also need to be ready to deploy at a moment's notice, whether for an emergency on their local base or an international mission.

Although it is well known that being seated for many hours, which is documented as sedentary behaviour,[15-17] can cause LBP, the risk of developing LBP is increased for police officers.[6] Police officers can be exposed to work-related risk factors, such as sudden physical exertion and stress due to added weight from equipment such as body armour, acute and chronic psychological stress from potentially repeated exposure to traumatic events, and shift work due to law enforcement having to be active during the day, the evening, and at night.[18] Among these work-related factors, an increased risk of LBP may be associated with both physical and psychological stress.[19] Shift work does not seem to influence LBP; however, more research on this subject is needed.[20] Many non-work-related factors must also be considered regarding LBP, such as socio-demographic, occupational, and health-related factors.[21] The combination of non- work-related factors, work-related factors, poor posture, and equipment worn around a police officer's waist and chest can greatly increase the risks of developing LBP while seated in a vehicle.[22]

Military police officers actively patrolling in a vehicle have duties similar to those of civilian police officers, apart from the types of vehicles they may be driving or how these vehicles are retrofitted with necessary equipment.[23,24] In general, much of a police officer's time is spent seated in a patrol car.[22] Similarly, as with other employees who have jobs that require driving, common causes of LBP are poor posture, vehicle adjustment, in-vehicle equipment, and vehicle vibration.[25,26]

Compared with Canadian civilian police officers, Canadian military police officers have two additional required job qualifications. First, a 13-week basic military boot camp must be completed.[27] Although no studies have analyzed the Canadian context of such a training regimen, an American review by Shephard et al. found that many new recruits have suboptimal health and lifestyle backgrounds,[28] such as smoking, drug use, and high levels of alcohol consumption. Second, in Canada, military police officers must annually complete a physical fitness evaluation consisting of four physical fitness tests.[29] The evaluation includes 20-meter sprints, a sandbag lift, intermittent loaded shuttles, and sandbag drags.[30] The goal of the test is to maintain a physical fitness standard. Currently, similar types of annual evaluations are not consistent among Canadian

civilian police officers, except upon entry to the job.[31] However, some Canadian police organizations, such as the Winnipeg Police Service,[32] and some canine units have annual evaluations.[33]

Very few solutions currently exist to minimize the risk of developing LBP among police officers, as well as to preserve and promote health and safety. The aims of this systematic review are to 1) evaluate the risks associated with police patrolling while considering external factors that could influence a police officer's well-being and the presence of LBP and 2) identify solutions to improve posture when police officers are seated in their vehicles or discern preventive measures that can be implemented to alleviate LBP. To achieve these aims, we searched for direct evaluations of or interventions with police officers that involved risks for LBP.

METHODS

A systematic review was performed to find interventions involving police officers and police organizations and LBP. The methodology used aimed to produce an in-depth analysis of this literature that is replicable and scientifically transparent.[34] PubMed, Scopus, Academic Search Complete, CINAHL, and *Military Medicine* databases were searched, covering the period from January 1990 to December 2022. PubMed was chosen because it is an optimal tool in biomedical research,[35] and *Military Medicine* was added to ensure that interventions that discussed military police officers were included. The three other databases were searched to avoid missing any articles relevant to this review.

For all databases, excluding *Military Medicine*, the keywords used for the first search were as follows: "police*" OR "law enforcement" AND "low back pain" OR "lower back pain" OR "low backache" OR "lumbago." The MeSH term search in PubMed was as follows: ("low back pain" OR "Low Back Pain" [MeSH] OR "low backache*" OR "Lower Back Pain" OR "Lumbago") AND ("Police" [MeSH] OR police* OR "law enforcement" OR "enforcement officer*") AND (1990/1/1:2023/12/13[pdat]). An additional search was conducted in the *Military Medicine* database using the key word "military police" to verify that no articles involving military police officers were missed during the initial search. Any articles that did not directly involve either an interaction or an intervention with a police organization or police officers and LBP were excluded. After title and abstract screening, the remaining articles were fully reviewed and either included or excluded depending on the aforementioned criteria.

The remaining articles were then analyzed using standard quality assessment scoring for qualitative study protocols.[36] Using the selected key words, 1,169 articles were initially identified. The screening process determined that 21 articles met the criteria, as presented in Figure 1. The article search process was conducted by the primary author (JR) and validated by a contributing author (ML).

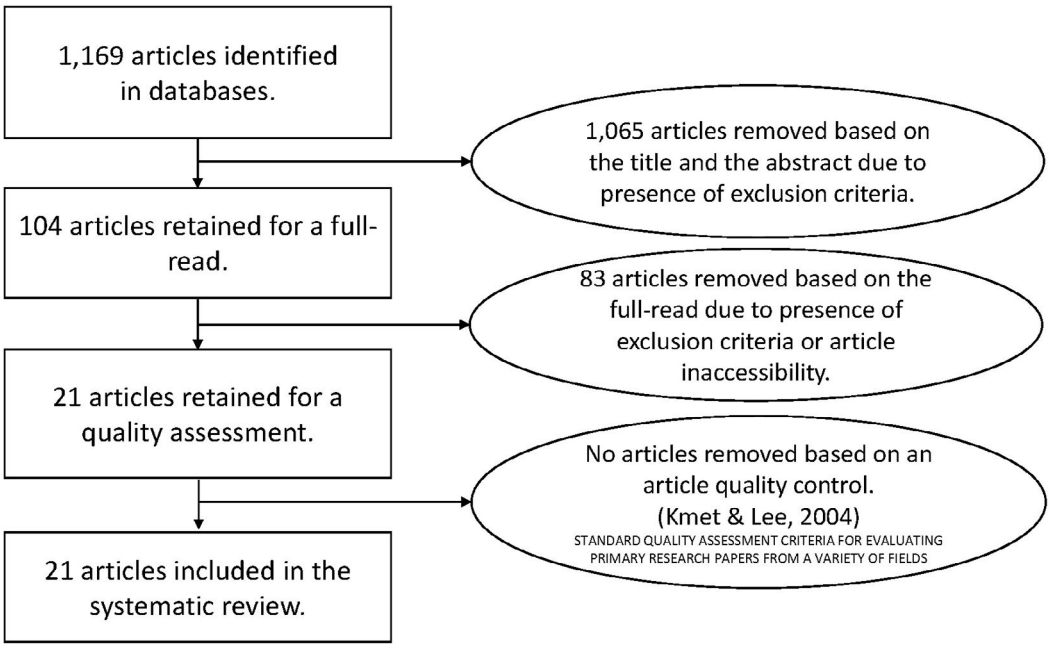

Figure 1. Flow diagram of the paper selection process

RESULTS

Evaluations conducted with civilian and military police officers related to self-reported LBP

Car patrolling

Among the 21 articles presented in Figure 2, 11 covered police officers' self-reported LBP. Ten of these articles involved civilian police officers. Each was based on a questionnaire, and three were from the same research team. A questionnaire regarding LBP was sent to nine police organizations around the province of Québec, Canada, with a total of 3,589 responses (2,082 male, 979 female, and 528 undeclared), including 2,208 car patrol police officers. From the results, three articles were written, covering the relationship between police officers and LBP. The first was an evaluation of how police officers perceived the level of comfort of their vehicles.[6] This article concluded that police officers who primarily sit in the driver's seat of the vehicle, and those who are older, showed an increased prevalence of LBP, and an approach that examined preventive solutions was recommended.

The second article, based on the same questionnaire, evaluated the prevalence of LBP among police officers and the functional impact on police organizations.[11] In total, 91.5% of the police officers reported experiencing LBP at least once in their lives, 67.7% of which occurred in the 12 months preceding the questionnaire. Also, 28.7% of respondents reported chronic LBP. On the basis of other questions involving time lost as a result of LBP in this study sample, 13,976 workdays were calculated to have been lost due to LBP, and 96.5% of participants mentioned LBP to be either partially or totally related to workplace activities. To lower these statistics, it was suggested that promotion of chronic LBP prevention in police organizations be emphasized, with the help of workplace management programs. A similar study that focused more on chronic LBP and had a study sample of 208 (193 male and 15 female) Brazilian federal highway police officers found a reported 67.2% prevalence of chronic LBP.[37]

In the third study, the same authors conducted an evaluation of how police officers perceive LBP's effect on their health-related quality of life.[21] This study demonstrated how LBP can become a burden to police officers not only during their work hours but also in their everyday lives, especially at older ages. This burden was also associated with psychological factors such as job satisfaction, posttraumatic stress, perceived stress, anxiety, and depression.

An article by Cardoso et al. evaluated how 16 (10 male and 6 female) police officers felt about their equipment and vehicles using a pre- and post-workshift method with questionnaires to compare perceived LBP as well as to evaluate differences between day and night shifts when driving.[20] Results showed no differences between day and night shifts and that pain was perceived more on the right side than the left side. The

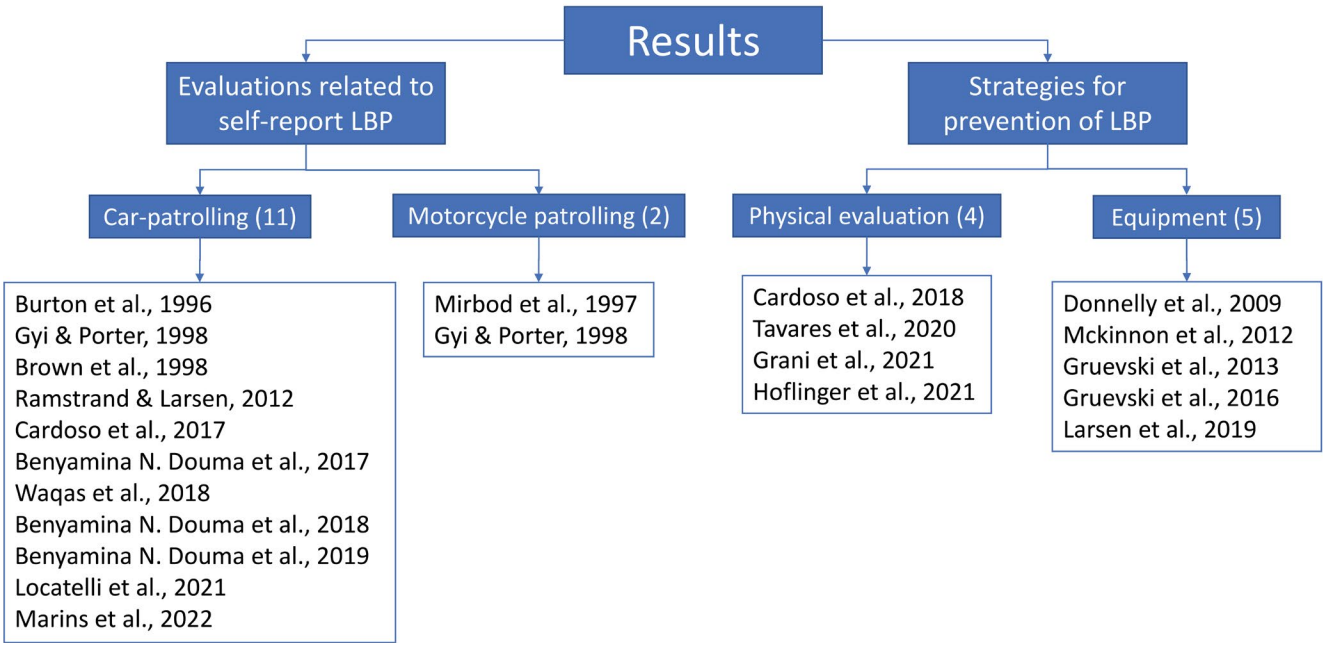

Figure 2. Summary of the main topics related to low back pain among police officers

hypothesis presented was that vehicles require more use of the right side of the body because of extra equipment such as the mobile data terminal, seatbelt attachment point, and vehicle functions such as the gear shift lever and gas and brake pedals under the right foot.

Two articles looked at musculoskeletal injuries in general instead of LBP in specific. Interestingly enough, in a Swedish study that used six focus group sessions with researchers and 33 (19 male and 14 female) police officers,[38] LBP was considered so prevalent that identifying other musculoskeletal injuries was difficult. Some of the issues raised related to LBP were seat design, the duty belt restricting adequate posture, and narrow seats. In a study by Waqas et al.,[39] a questionnaire about perceived musculoskeletal pain in the legs, lower back, shoulders, knees, arms, hands, feet, and neck was sent to 204 male traffic police wardens in Pakistan. LBP had the second-highest prevalence, at 38.8%. Health education was recommended as a long-term solution to lowering pain prevalence among police wardens.

In a study by Gyi and Porter of a rural police force in the United Kingdom,[40] an interview was conducted with two groups: 80 (79 male and 1 female) traffic police officers and a control group of 91 (87 male and 4 female) general duty officers. The two groups were divided on the basis of driving exposure. Results showed a connection between self-reported LBP and the number of hours and distance driven while patrolling. In another UK study,[19] a group of 377 urban police officers (87% male and 13% female) was compared with a group of 1,508 (92% male and 8% female) Northern Ireland police officers equipped to combat terrorism with heavier body armour (8.5 kg on average) and armour-plated vehicles, which provide a less comfortable ride. The surveys asked about LBP risk factors. The authors concluded that heavier body armour increased the prevalence of LBP, and ergonomic interventions were recommended to limit spinal loading.

In a large-scale Canadian study by Brown et al.,[41] a survey was conducted with 805 members of the Royal Canadian Mounted Police (88.9% male and 11.1% female), a federal police force. The survey contained questions about the patrol car seat, the duty belt, and perceived LBP. Contrary to the other studies mentioned earlier, the authors of this study concluded that the LBP prevalence of 54.9% among police officers did not appear to be higher than in the general population.

Of the studies describing self-reported LBP among car patrolling police, only one was conducted with military police officers. Locatelli sought to evaluate LBP prevalence among military police officers.[42] The sample consisted of 221 male military police officers, 194 with belt holsters for their weapons and 27 with drop leg holsters. The group with belt holsters showed a higher prevalence of LBP (74.2% vs. 70.1%), and perceived LBP was also higher for employees who had worked for a longer period. Use of a drop leg holster appeared to be a potential solution to decrease weight on the lumbar spine, and weight distribution on the body was proposed to help limit LBP.

Motorcycle patrolling

Two articles investigated motorcycle patrolling among police officers.[40,43] One article was focused on car patrolling but contained a section on motorcycle patrolling. It did not specifically discuss LBP, but it did mention an increased risk of musculoskeletal issues resulting from motorcycle patrol officers having to repeatedly lift their motorcycle on and off parking stands.[40] The other article specifically investigated motorcycle patrolling, with questionnaires completed by 46 current and 72 former motorcycle traffic policemen in Japan.[43] A high number of subjective symptoms were reported by current motorcycle policemen, and measures such as ergonomic training and education on physical exercise were suggested.

Strategies for prevention of low back pain among civilian and military police officers

Interventions conducted among military police officers related to physical evaluation

Four articles discussed interventions related to physical evaluations among military police officers. These authors attempted to solve the issue of using only self-reported and subjective methodology. For example, Grani et al. conducted a pre- and post-training evaluation of 20 Brazilian military police officers.[44] The 20 participants were equally distributed into a control group and a trunk training group. Every participant went through an initial physical evaluation of anthropometric measurements (height, weight, and waist circumference), trunk endurance (side plank, double leg lift, and sit-up tests), and physical performance (shuttle, pull-up, and aerobic tests). The physical evaluation was repeated at the end of the intervention for comparison. Both groups engaged in a 60-minute general workout five times per week for nine weeks. However, the trunk training group had 25 minutes of trunk training incorporated into their general workouts. The added trunk training consisted of a

warm-up and 15 minutes of exercises such as variations of the plank and the birddog. The results indicate that trunk training can reduce general musculoskeletal pain and increase endurance of the trunk muscles, without affecting operability.

Other studies specifically examined posture-related muscles. Tavares et al. performed an intervention with 103 male Brazilian military police officers in which they were grouped on the basis of LBP rated with a visual analog scale.[45,46] The aim of this study was to determine the relationship between peak torque and endurance of the trunk flexor and extensor muscles. Participants were divided into three groups: no or light pain (24 participants), moderate pain (42 participants), and severe pain (37 participants). Each participant went through an evaluation consisting of body mass, stature, strength, and endurance tests of trunk flexor and extensor muscles (in a random order) and peak torque of trunk extensor and flexor muscles. As hypothesized, peak torque and flexor muscle endurance varied depending on pain intensity group; however, this was not the case with extensor muscle endurance. The major finding was that extensor muscles and peak torque correlate on the basis of pain intensity group.

Cardoso et al. evaluated strategies to prevent LBP by interviewing 97 male military police officers to evaluate their level of disability before and after a work shift, flexibility, postural alterations, and anthropometric measures.[47] The authors concluded that LBP prevalence was high, with 82.5% of participants reporting difficulties in daily activities. It was suggested that LBP be analyzed as a public health problem that affects the whole population.

Hoflinger et al. searched for methods to avoid spinal shrinkage among male military police officers using tests that evaluated torso muscular endurance among 14 car patrol police officers, 14 motorcycle police officers, and 14 administrative police officers.[48] The stature of each group participant was measured, and trunk flexor and extensor peak torque were evaluated. In a pre- and post-intervention study, officers performed a six-hour period of regular workout routines, which was followed by an analysis of stature loss and recovery. It was concluded that external equipment negatively affected trunk flexor and extensor muscles and should be modified to prevent this effect. Also, the authors mentioned that having a better understanding of mechanisms related to stature loss and recovery could help in refining weight distribution and workout routines for police officers.

Interventions involving equipment among civilian police officers

Five articles discussed equipment in police patrol vehicles, specifically car seats, the mobile data terminal, and body armour distribution. Donnelly et al. analyzed whether using an active lumbar system could be helpful in preventing LBP.[49] This intervention was divided into two phases with 58 police officers (49 male and 9 female). In Phase 1, data on how police officers perceived their equipment were gathered; Phase 2 examined whether using an active lumbar system influenced officers' perception of LBP. Using an active lumbar system was found to reduce perceived discomfort among the police officers, and the mobile data terminal was mentioned by some as a factor in perceived LBP discomfort. Similarly, McKinnon et al. simulated police activities to evaluate the influence of five mobile data terminal locations, along with two types of seats with 20 participants (10 male and 10 female).[50] Perceived discomfort was lower when participants were given the option of choosing their preferred mobile data terminal location, and the use of a modified seat reduced perceived LBP by 28% during the study. The authors recommend combining a self-selected mobile data terminal location and a modified driver's seat to lower perceived LBP among police officers.

Two other articles, both by Gruevski et al.,[51,52] were based on simulated driving and the mobile data terminal used by police officers. Two 120-minute driving simulations were performed with 18 participants (9 male and 9 female) with data collected every 15 minutes. The first article suggested that using the mobile data terminal increased perceived discomfort in the neck, right shoulder, and mid-back to the pelvis over prolonged driving intervals.[52] The second article used the same methodology, with two 120-minute driving simulations for data collection, this time with 14 participants (7 male and 7 female).[51] The authors used the same methodology to evaluate the functionality of a thoracic support prototype to help prevent the discomfort perceived in the first study. The results showed that the thoracic support prototype led to reduced discomfort by decreasing pressure in the lower back compared with a standard vehicle package.

Of the articles discussing equipment, one focused on police officers' equipment instead of vehicle equipment.[53] Using pressure distribution technology on car seats, as well as self-rated questionnaires completed by 22 police officers (11 male and 11 female), in-vehicle sitting pressure was evaluated and compared using a

load-bearing vest and thigh holster or a standard load carriage system consisting of a duty belt. The authors concluded that a relocation of equipment from the duty belt to the load-bearing vest could potentially improve posture in police officers who drive fleet vehicles.

DISCUSSION

When analyzing proposed solutions to improve LBP issues among police officers, physical activity positively correlates with reduced LBP development. Physical activity can have a profound effect on muscle mass and strength, which can also help to reduce the risk of mobility impairment in old age.[54] However, because the correlation between LBP and physical activity is mainly evaluated through self-report and subjective methods, using physical activity as a method to solve LBP issues can be difficult.[55] For this to be an objective method, evaluating physical fitness by using data such as peak oxygen consumption and muscular dynamic endurance capacity can be seen as an alternative to documenting one's health for the reduction or prevention of LBP.[56] This opens multiple avenues to prevent the development of LBP among police officers.

Police officers have an added risk of developing LBP as a result of their duty belts. In general, duty belts weigh approximately 4.5 kilograms, with various objects such as handcuffs, a phone, pepper spray, and a baton attached. This means police officers have added weight to carry, which can obstruct adequate posture when seated.[57] Duty belts can cause pain from the lower back to the sacrum, and women have a higher risk of developing LBP as a result of the police duty belt. However, a reduced-weight duty belt, as well as an active lumbar support, can lessen the risk of developing LBP.[22,49,51]

Apart from personal equipment, police officers also have equipment in their vehicles that can increase the risk of developing LBP. A common problem, for example, is the mobile data terminal, which is located at the centre of the vehicle and can influence LBP.[50,52] When considering vehicle equipment, three aspects of positioning need to be examined: operational capability, safety, and comfort. Although each of these aspects is important, comfort is often the least-considered aspect when positioning equipment in police vehicles.[58]

Limitations

Uncontrollable factors in preventing police officers from developing LBP include everything that happens outside the workplace. Although encouraging healthy living can be beneficial to this population, unhealthy habits can lead to the creation, or worsening, of LBP. Cardiovascular disease risk factors such as hypertension, obesity,[59] family medical history, sedentary lifestyle, and age greatly factor into the overall health of police officers.[18]

Conclusion

Articles in this systematic review highlight many factors contributing to the development of LBP by police officers and provide several avenues to address how future studies can examine this problem. Articles about civilian police officers tended to address the issue via subjective methods, such as questionnaires, whereas those about military police officers used objective methods, such as physical evaluations. However, all of the proposed methods to alleviate LBP identified in this review were similar. Regarding equipment, the mobile data terminal seemed to be the largest cause of discomfort among police officers. One solution to minimize this involved changing the ergonomics of the car seat by using an active lumbar system or added thoracic support.[51] Regarding general solutions to minimize LBP, raising awareness among police officers,[21] offering preventive and corrective training programs for trunk musculature,[44] having multidisciplinary teams in police organizations,[21] and promoting regular physical activity could positively influence the prevention of LBP.[55]

The main limitation of this review is the lack of direct interventions involving police officers. Although police officers face a different reality than other professional drivers, examining interventions related to LBP conducted with other types of professional drivers (e.g., bus drivers) could help discern preventive measures that can be implemented to alleviate LBP.[60,61] Sports medicine specialists must conduct rigorous work directly with participants to tackle this subject effectively.

Although many studies can be used to evaluate the risks associated with police patrolling, as with other professions that require prolonged periods of time seated in a vehicle, very few interventions have been specifically conducted with civilian and military police officers. Because other professions have major differences from car patrolling by police officers (e.g., equipment worn and the mobile terminal), these data are not transferrable. Regarding the duty belt worn by police officers, some Canadian police agencies recently began transitioning to MOLLE vests,[62] which could influence car patrolling analysis. However, we found no studies documenting this transition.

Going forward, solutions to improve the posture of police officers seated in vehicles should be sought. These solutions offer many approaches and possibilities to intervene and help prevent the development of LBP among police officers.

AUTHOR INFORMATION

Jerome Range, BSc, started studying for his BSc in kinesiology at Université du Québec à Chicoutimi in 2020. With the intention of pursuing a higher level of education, he began actively participating in research projects as a research auxiliary and developed research interests in occupational health, first responders, ergonomics, and road safety.

Charles Côté, PhD, is an associate professor in management science at Université du Québec à Rimouski. He has a PhD in physical activity sciences from Université Laval and has completed research involving ergonomics, psychological work dimensions, and health and safety in the workplace.

Héctor I. Castellucci, PhD, is a full professor and Director of the Center for the Study of Work and Human Factors at Universidad de Valparaíso in Chile. He received his BSc in physiotherapy from Universidad de Playa Ancha, Chile, in 2006. In 2009, he received his MSc in human engineering from the University of Minho with the support of The Alban European Program. In addition, he received his PhD in 2015 from the University of Minho with the collaboration of Delft University of Technology.

Mathieu Tremblay, PhD, is an expert in ergonomics and kinesiology at the Université du Québec à Rimouski. Tremblay has a BSc in kinesiology from Université du Québec à Montréal, a MSc in biomechanics from Université de Montréal, and a PhD in ergonomics and kinesiology from the University of New Brunswick. Tremblay's research interests are related to occupational health and safety issues among those exposed to challenging work demands, leading to numerous collaborative research projects.

Martin Lavallière, PhD, has been a professor of kinesiology in the Department of Health Sciences at Université du Québec à Chicoutimi since August 2016. He received his BSc (2005), MSc (2007), and PhD (2013) in kinesiology from Université Laval. He completed a postdoctoral fellowship at the Massachusetts Institute of Technology AgeLab (2013-15) and a second postdoctoral fellowship at HEC Montréal (2015-16). He is an expert on human factors and ergonomics associated with mobility and road safety.

COMPETING INTERESTS

The authors have nothing to disclose.

CONTRIBUTORS

Conceptualization: J Range, C Côté, HI Castellucci, M Tremblay, and M Lavallière

Methodology: J Range and M Lavallière

Validation: C Côté, HI Castellucci, M Tremblay, and M Lavallière

Formal Analysis: J Range

Resources: M Lavallière

Data Curation: J Range

Writing — Original Draft: J Range and M Lavallière

Writing — Review & Editing: J Range, C Côté, HI Castellucci, M Tremblay, and M Lavallière

Supervision: C Côté, HI Castellucci, M Tremblay, and M Lavallière

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