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Prevention of Low Back Pain in Police Officers

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RÉSUMÉ

Ce mémoire est divisé en deux parties : une revue systématique de la littérature et une intervention auprès de policiers. Les policiers sont à risque de développer des lombalgies en raison de la nature de leur travail. Dans ce mémoire, la douleur est liée à la lombalgie, une condition catégorisée comme non spécifique et rapportée comme un inconfort entre la partie inférieure des côtes et le haut du bassin. Une revue systématique a d'abord été élaborée, dans laquelle les traitements pour la lombalgie sont présentés et les tâches policières sont décrites. Une conclusion essentielle de cette revue est que la lombalgie s'avère être une problématique aux multiples dimensions, qui requiert des mesures à la fois subjectives et objectives. À la suite de cette revue systématique, l'intervention effectuée auprès de policiers est décrite : 36 policiers ont répondu à des sondages sur la lombalgie et la santé mentale, et 13 policiers ont effectué une pré-intervention et une post-intervention de 8 semaines avec des évaluations de la condition physique combinées à des sondages sur la lombalgie et la santé mentale. Cette intervention de 8 semaines a mené à une amélioration dans les scores relatifs à la douleur lombaire perçue ainsi qu'à l'endurance des muscles lombaires. Ce projet montre donc que la programmation de l'activité physique représente un modèle concret pour les organisations policières qui recherchent une stratégie de santé au travail afin de limiter les lombalgies chez les policiers.

ABSTRACT

This thesis is divided into two parts: a systematic review and an intervention with police officers. Police officers are at a higher risk of suffering from low back pain due to the nature of their work. In this master's thesis, pain is defined and related to low back pain, a condition often described as non-specific and defined as discomfort between the lower edge of the ribs and the buttock. Current treatments are reviewed, followed by a description of police officers' work. A systematic review is presented on interventions conducted on low back pain in police officers, with a conclusion highlighting the need to consider low back pain as a multidimensional issue requiring subjective and objective measures. Following this review, the intervention conducted during this master's thesis is presented: 36 police officers answered surveys regarding low back pain and mental health, and 13 police officers went through an 8-week pre-intervention and post-intervention design with physical evaluations and online surveys regarding low back pain and mental health. Results of the 8-week intervention showed an improvement in perceived low back pain scores and an increase in objective measures related to low back pain endurance. This project shows physical activity programming as a concrete model that can be used within police organizations as part of occupational health strategies to limit low back pain in police officers.

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SPECIAL THANKS

Thank you to my friends, girlfriend, family, colleagues, and research director who helped, supported, guided and encouraged me through this arduous process. Their presence and their patience as I advance through my studies strengthen my ability to give meaning and value to my research.

PRE-INTRODUCTION

This dissertation includes one article that was completed during my master's degree at Université du Québec à Chicoutimi. The article is a systematic review that presents low back pain in police officers and was published on October 6th 2023 in the Journal of Military, Veteran and Family Health. As the first author of this article, I conducted the full data analysis and writing with support from my co-authors. The objective of this article was to structure a way in which solutions could be proposed during my master's degree to benefit police officers suffering from low back pain. Following the systematic review, an 8-week intervention was conducted with a local team of police officers to evaluate physical activity as a viable means to limit low back pain.

INTRODUCTION

In 1979, the International Association for the Study of Pain (IASP, 2021) defined pain as: "An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage." After over 40 years of this definition being used throughout literature, many specifications were added regarding personal experience, life experience, respect for self-reported pain, pain's effect on mental health, how pain can be felt even if it isn't verbally described, and differences from nociception (Raja et al., 2020). While nociception refers to the neural encoding of tissue damage, pain refers to the subjective experience of harm (Mischkowski et al., 2018).

Challenges occur with pain assessment due to varying human factors. A recent study noted that acceptable pain varies highly between people based on contextual factors and personal experience with pain (Forget et al., 2023). Therefore, to correctly integrate and interpret pain perception in research, basing perceived pain on a number rating from a scale of 0 to 10 isn't sufficient. Using methods that combine qualitative measures such as words and behaviors, and quantitative measures such as self-reported and non-self-reported measures, must be conducted to better understand participants or patients (Wideman et al., 2019).

Along with the multifactorial definition of pain and complexities in its assessment, differentiating acute pain and chronic pain is essential. Acute pain serves as a warning to limit movement and facilitate recovery, while chronic pain is a result of an injury beyond natural repair, repetitive movements, a long recovery due to the nature of an injury, or biological impairment (King, 2013). The cut-off point for pain classification is under three months for acute pain and over three months for chronic pain (Deyo et al., 2014; Merskey & Bogduk, 1994). Even with primary care, many patients still suffer from low back pain after consulting a clinician (Itz et al., 2013).

Chronic pain is a global public health problem with multiple facets and often demands interdisciplinary help to treat (Goldberg & McGee, 2011). Due to how the brain works, pain and depression are correlated, creating the possibility that chronic pain can lead to psychological and mental health problems (Ackerman & Stevens, 1989) such as depression (Sheng et al., 2017). Apart from changes in health-care services, evidence-based intervention options can be a viable means to address the burden of chronic pain (Kohrt et al., 2018). Other measures are also being explored to help limit chronic pain, such as electroencephalographic signals (Segning et al., 2022, 2024). This highlights the importance of working with police officers who have a high prevalence of chronic pain (Carleton et al., 2018) combined with mental health problems due to poor social support, occupational stress, and maladaptive coping strategies (Syed et al., 2020).

A prevalent form of chronic pain is chronic low back pain, which is a documented problem in police officers (Benyamina Douma et al., 2017; Marins et al., 2022). Chronic low back pain, 85% of the time, is either unknown or nonspecific, meaning people suffer from this condition without knowing what it is and therefore how to treat it (Sanzarello et al., 2016). Rather than being a clinical entity or diagnosis, chronic low back pain has become more of a pool of symptoms in patients who have varying stages of impairment, disability, and chronicity (Airaksinen et al., 2006). Information relating specifically to police officers and low back pain will be discussed in CHAPTER 2: LOW BACK PAIN IN POLICE OFFICERS.

CHAPTER 1
LOW BACK PAIN

Low back pain is a multi-faceted issue that requires careful consideration when treating it. This chapter covers low back pain anatomy and diagnostics, followed by possible interventions documented in literature, as well as lifestyle factors.

1.1 ANATOMY AND DIAGNOSTIC

In this master's thesis, three movements were put forward: trunk flexion, trunk lateral flexion, and trunk extension. These movements are detailed in Table 1: Anatomy.

Table 1: Anatomy

Actions utilized	Muscles involved
Trunk Flexion	rectus abdominis, obliquus externus abdominis, obliquus internus abdominis, iliopsoas
Trunk Lateral Flexion	obliquus externus abdominis, internus abdominis, quadratus lumborum, longissimus, iliocostalis, spinalis thoracis, intertransversarii lumborum, semispinalis thoracis, multifidi
Trunk Extension	quadratus lumborum, longissimus, iliocostalis, spinalis, interspinous, intertransversarii lumborum, semispinalis thoracis, multifidi, thoracic rotatores

The underlying problem behind low back pain is the difficulty in finding a diagnosis, which is where the term "non-specific low back pain" arises. For example, magnetic resonance imaging, a commonly used tool to assess issues, can help give an idea of whether a person's low back pain is associated with disc protrusion, nerve root displacement or compression, disc degeneration, and high-intensity zones. However, there are no strong indications to associate such abnormalities with an underlying pathology (Endean et al., 2011).

A recent report analyzed a group of physiotherapists' methods of managing patients with chronic low back pain, and the biomedical model belief was predominant (Santos et al., 2022). In other words, specialists rely on a method where illness can always be broken down into the name of a physical or biological disease (Rocca & Anjum, 2020). This approach has been suggested to be not very effective in preventing low back pain, especially when taking into account the short periods in which these interventions are performed (Demoulin et al., 2012). To further this finding, a recent study comparing conventional physiotherapy and McGill stabilization exercises showed the possibility of additional benefits to patients with low back pain (Ghorbanpour et al., 2018).

Even though most cases of chronic low back pain remain unknown due to their nature being non-specific, and many treatments have been analyzed to help people suffering from this condition, further research is needed to identify risk factors to prevent and treat low back pain (Hoy et al., 2012). Be it low back pain or chronic pain, there are many possibilities for how to provide therapy to individuals suffering from low back pain. A review of current literature in the following section outlines documented treatments.

1.2 INTERVENING WITH LOW BACK PAIN

The following low back pain interventions have been identified: acupuncture, dry needling, topical analgesics, lumbar support, and modifications of lifestyle factors (George et al., 2021).

1.3 NEEDLING

Acupuncture is a nonpharmacological treatment option that is based on the principle of applying small needles or pressure to specific points in the body (Van Hal et al., 2025). Acupuncture treatments have been shown to reduce pain after low back pain treatment (Xiang et al., 2020). Electroacupuncture, a similar method to acupuncture, provides comparable results (Comachio et al., 2020).

While acupuncture was a theory with many contradictions in the past, acupuncture has become a procedure perceived as safe and with regionally specific, quantifiable effects on relevant brain structures (Kaptchuk, 2002).

The practice of acupuncture has been recommended as a viable method by entities such as the American Physical Therapy Association (George et al., 2021). While standardization remains a challenge (Urits et al., 2021), favorable effects have been reported involving self-reported pain and functional limitations. However, more research is necessary to fully understand how acupuncture can influence low back pain (Lam et al., 2013).

While acupuncture itself tends to provide pain relief, some studies have combined this method with other low back pain treatments to further its effect, such as transcutaneous electrical nerve stimulation (Itoh et al., 2009) and a muscle relaxant named baclofen (Zaringhalam et al., 2010) and dry needling (Furlan et al., 2005). Dry needling, having also been studied without other intervention, is considered potentially more effective than acupuncture and sham needling. However, further findings are required to confirm this (Hu et al., 2018).

1.4 TOPICAL ANALGESICS

A common method to offer low back pain relief is the use of topical analgesics, a type of drug used for a variety of painful conditions (Derry et al., 2017). A recent systematic review reported six commonly used medicines or medicine classes to treat low back pain: paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, benzodiazepines, opioids, and antidepressants (Cashin et al., 2023). This systematic review concluded that no high- or moderate-certainty evidence was available to provide medium or high effects on low back pain intensity, considering potential adverse effects that could come with the use of certain pharmaceutical products. It’s important to note that no differentiation was made between prescribed drugs and over-the-counter drugs.

1.4.1 PARACETAMOL (ACETAMINOPHEN)

The systematic review reported no evidence of paracetamol efficacy, and an additional study reported it to be unlikely to help with low back pain treatment (Baron et al., 2016).

1.4.2 NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDSS)

The systematic review reported moderate-certainty evidence for the others, with a mention of adverse effects regarding the use of these drugs. An additional study reported it to be unlikely to help with low back pain treatment (Baron et al., 2016).

1.4.3 MUSCLE RELAXANTS AND BENZODIAZEPINES

The systematic review reported moderate-certainty evidence for the use of benzodiazepines and muscle relaxants in the treatment of low back pain.

1.4.4 OPIOIDS

The systematic review notably evaluated papers that involved tapentadol and tramadol: Firstly, tapentadol had high-certainty evidence regarding pain reduction. Secondly, tramadol had low-certainty evidence for tramadol for pain reduction. However, there was low-certainty evidence for nausea, headaches, constipation, and dizziness when using opioids.

Moreover, an article reported moderate evidence of efficacy in chronic low back pain with risk of averse effects, and it was not recommended in general guidelines (Baron et al., 2016).

1.4.5 ANTIDEPRESSANTS

The systematic review reported low-certainty evidence when comparing placebo versus treatment interventions with antidepressants. There are no clear indicators of antidepressants being a concrete solution for preventing non-specific low back pain (Urquhart et al., 2008).

1.5 LUMBAR SUPPORT

Another method of pain reduction in people with low back pain is the use of lumbar support, a device that influences posture: lumbar support. Due to varying types of lumbar supports and research performed in recent years, while extensive research still needs to be conducted on this subject, lumbar supports went from being considered inconclusive in 2008 (Duijvenbode et al., 2008) to viable in 2025 (Akbar et al., 2025).

To answer whether lumbar support is a viable method, a recent systematic review (Akbar et al., 2025) found 24 articles (16 qualitative and 8 quantitative) that evaluated lumbar support in patients above the age of 18 with non-specific low back pain. Results suggested that lumbar support can significantly reduce pain in patients with low back pain by limiting spinal motion and stabilizing the spine to alleviate strain and prevent further injury.

Lumbar belts, known primarily as a tool used in the rehabilitation process, still have few studies done demonstrating how well they work in practical situations (Ludvig et al., 2019; Shahvarpour et al., 2019).

1.6 LIFESTYLE RISK FACTORS

Lifestyle risk factors are everyday habits that can influence health. Examples of these include nutrition, sleep habits, physical activity, and substance use (Heart&Stroke, 2026b).

1.6.1 SUBSTANCE USE, FOOD INTAKE, SLEEP AND MENTAL HEALTH

More specifically for low back pain, lifestyle factors such as smoking, alcohol intake, exercise, physical activity, walking speed, weight control, eating habits, and sleep affect low back pain (Yoshimoto et al., 2020). Furthermore, low back pain can affect people psychologically with comorbid conditions such as panic and anxiety disorders, sleep disturbances, and depression (Hagen et al., 2006).

With the risk of throwing people into a never-ending spiral of bad habits and low back pain, lifestyle factors are an important element to consider.

1.6.2 PHYSICAL ACTIVITY

Among many lifestyle factors, exercise and physical activity modifications with stabilization exercises for the lower back have been shown to have potential (Ghorbanpour et al., 2018; S. McGill, 2016; Oliveira et al., 2012; Sutanto et al., 2022).

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985). Substantial health benefits can be associated with physical activity. Literature suggests that for an adult to be considered active, they need to move more and sit less throughout a day and do at least 150 minutes of physical activity per week (or 75 minutes if performing moderate to vigorous intensity aerobic activities) (ACSM, 2022). As physical activity can also help prevent low back pain (IQWIG, 2025; Leung et al., 2024), the added benefits of physical activity create an interesting avenue. To add to the potential of physical activity, current evidence suggests that exercise alone or in combination with education is effective for preventing low back pain (Steffens et al., 2016).

In Québec, a trend in workplaces has gone from treatment to prevention. More specifically, instead of only focusing on healthcare treatment, possibilities are being explored to shift to prevention-based companies and reduce the long-term cost of healthcare services (ASPQ, 2025). With society's evolving perception of preventing diseases and injuries instead of treating them, the same concepts are applied to low back pain and call for an interdisciplinary approach that combines mental and physical aspects. Adding on to the basic physical and psychological needs to move in humans (Stults-Kolehmainen, 2023), practicing physical activity is essential to preventing low back pain (Gordon et al., 2016).

CHAPTER 2
LOW BACK PAIN IN POLICE OFFICERS

Low back pain can be particularly prevalent in certain population groups. This thesis focuses on low back pain prevention in police officers through physical activity. Police officers have the very important role of protecting citizens, and tasks require precise execution with multiple risks that can impact their health and safety, To illustrate this, a recent Australian study evaluating 292 different dispatch tasks in 77 work shifts with 53 police officers showed that most time was spent checking bona fides (27.4%), responding to domestic disputes (14.0%) and conducting concern for welfare checks (9.6%). Furthermore, police tasks are highly varied and depend on the region the police officer is in, the type of task, and the duration (R. Orr et al., 2020). These tasks require a lot of driving (Holmes et al., 2013).

While a consensus has yet to be found regarding the link between occupational sitting and low back pain (Roffey et al., 2010), police officers are exposed to higher risks of musculoskeletal disorders, including low back pain (Benyamina Douma et al., 2017). While some musculoskeletal disorders can be managed through self-management, it’s been documented that low back pain might not be (Oliveira et al., 2012). Since treating low back pain is a broad subject with no fixed consensus on how to get the best results, and police officers are exposed to low back pain, a systematic review was conducted to evaluate low back pain in police officers (Range et al., 2023).

2.1 ARTICLE INFORMATION

This review article was published in open access on October 6th, 2023 in the Journal of Military, Veteran and Family Health, Volume 9, Number 4. This peer-reviewed article had no competing interests, no funding and no ethics approval (not required).

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

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2.2 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 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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).

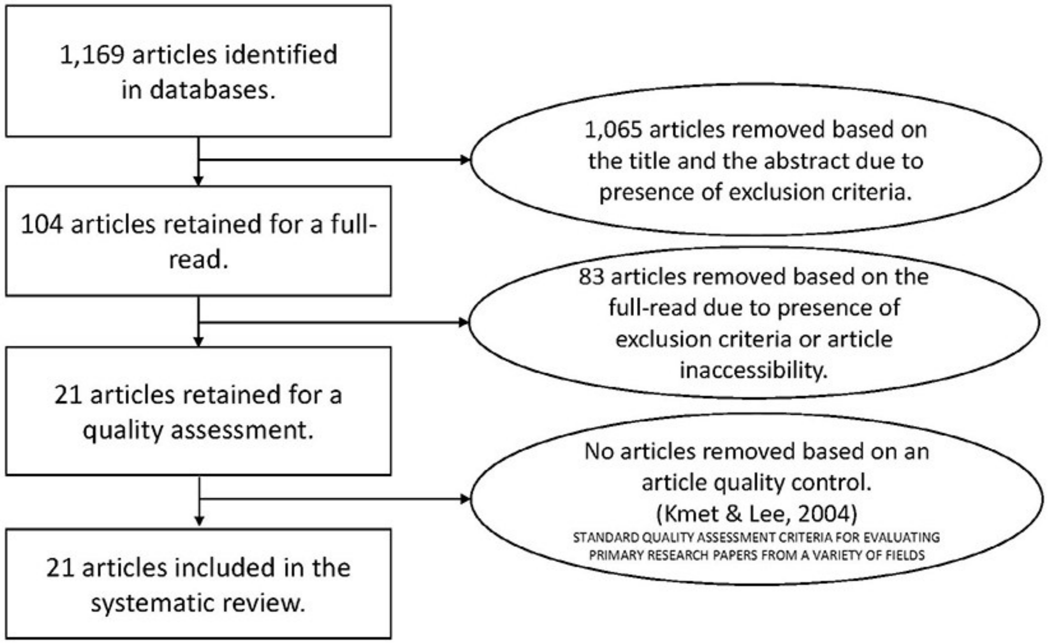

Figure 1 - Flow diagram of the paper selection process

2.7 RESULTS

2.7.1 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.

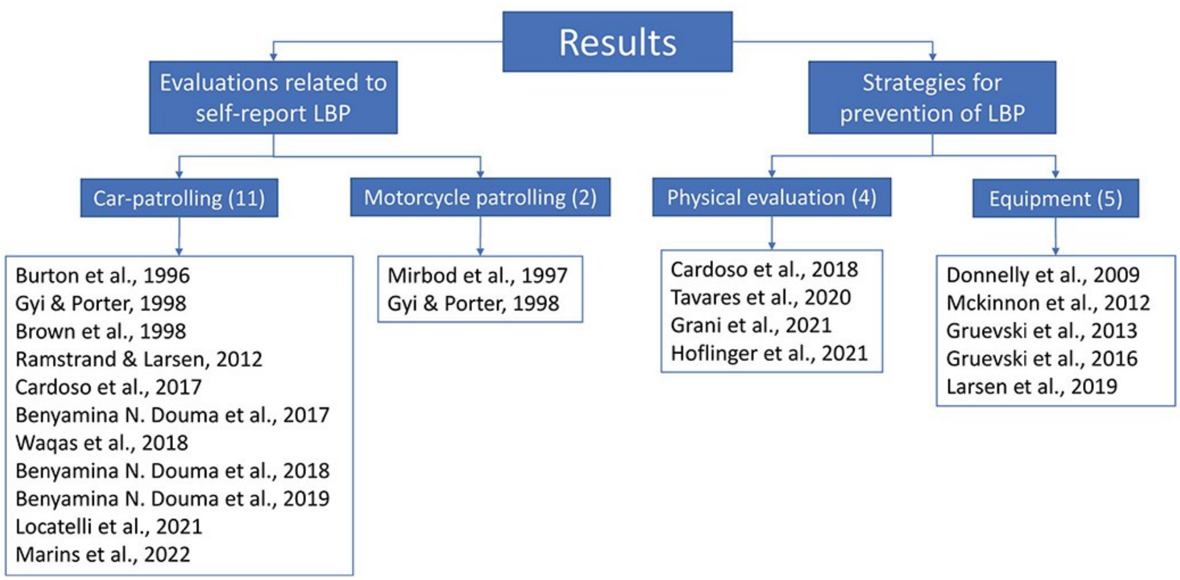

Figure 2 - Summary of the main topics related to low back pain among police officers

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-work-shift 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 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.

2.7.2 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.

2.8 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]

2.9 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]

2.10 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.

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CHAPTER 3
8-WEEK EXERCISE-BASED INTERVENTION TO PREVENT LOW BACK PAIN

Following the literature review, an approach using physical activity was selected to fill a gap in literature regarding practical methods that can be applied to prevent low back pain in police officers. Lumbar stabilization programs have been reported to help reduce low back pain related to pain and disability in studies, with more research needing to be done (Hayden et al., 2021; Liu et al., 2026; Viderman et al., 2025; Willson et al., 2005). For example, among multiple ways to evaluate lumbar stabilization, the authors (Shahvarpour et al., 2018) tested patients' trunk postural control in an unstable seated position. Results suggested a relationship between movement quality and pain. Furthermore, in a 2018 study performed on patients suffering from non-specific chronic low back pain, stabilization exercises throughout an 8-week period evaluated pain-related disability, sleep disturbance, and psychological status. Pain-related disability was reduced, and sleep quality, depression levels and anxiety levels improved following the intervention, providing insight into how positive effects stabilization exercise can have on a person with non-specific chronic low back pain (Akodu & Akindutire, 2018). These two studies were used to decide on an exercise prescription intervention focused on increasing postural musculature and movement quality over an 8-week period to reduce low back pain.

3.1 PRE-INTERVENTION AND ADMINISTRATIVE PROCEDURES

Considering the potential benefits physical activity can have on general health and low back pain (Gordon et al., 2016), a study was conducted with police officers to evaluate mental health, physical health and their impact on quality of life and low back pain. Through collaboration with a local police station in Québec, Canada, a 5-step research project began. Ethics approval was given by the *Comité d'éthique de la recherche de l'Université du Québec à Chicoutimi* (#2025-1817). Sections 3.2 through 3.6 represent the Methods section.

3.2 STEP ONE: RECRUITEMENT

The candidate went into the police station to present the project to every police patrol officer rotation, covering the whole force. Police officers were given an overall 5-minute explanation of the project and were told to pay attention to upcoming emails. Following every presentation, an email was sent to 147 police officers with an invitation to complete a 20-minute online survey. They were informed that there would be a follow-up one month later to continue the project. A total of 36 police officers completed the initial survey.

3.3 STEP TWO: SURVEYS

The first phase of the project was an online survey using LimeSurvey that was briefly presented in person with a provided link through email. The survey aimed to document demographic information, mental and physical well-being, quality of life, and low back pain with each police officer. Following a consent form found in ANNEX I – CONSENT FORM, participants were asked to give their email address, their name and surname, their sex, their gender, the amount of time for which they've been a police officer, their position title, and the number of hours per week spent in a patrol vehicle. An analysis of existing validated questionnaires was performed (Davidson & Keating, 2002). Two questionnaires were chosen: the SF-36 and the Oswestry Disability Index.

3.3.1 Demographic information

The demographic information was selected to provide an idea of what kind of police officers were included in the study. The focus was to include police officers that have a main occupation of police patrolling in a standard-sized vehicle. During this study, sex and gender were separated into different questions. Gender was analysed as a fundamental reference associated with social and cultural influences, while sex was analysed as a reference to a biological variable that could influence results (Krieger, 2003). Demographic information questions can be found in ANNEX II – DEMOGRAPHIC INFORMATION.

3.3.2 Mental and physical well-being

To evaluate mental and physical well-being in participants, the SF-36 survey was conducted. The SF-36 is a survey used in clinical practice and research, health policy evaluations, and general population surveys, covering eight health concepts: 1) limitations in physical activities because of health problems; 2) limitations in social activities because of physical or emotional problems; 3) limitations in usual role activities because of physical health problems; 4) bodily pain; 5) general mental health (psychological distress and well-being); 6) limitations in usual role activities because of emotional problems; 7) vitality (energy and fatigue); and 8) general health perceptions (Ware & Sherbourne, 1992). As this project was conducted with a French population, a validated French version of the SF-36 (Leplège et al., 1998) was used. Questions can be found in ANNEX III – SF-36.

3.3.3 Quality of life and low back pain

The Oswestry Disability Index is a questionnaire that was developed in 1980 (Fairbank et al., 1980) and asks questions regarding low back pain that relate to pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling, and employment. It is scaled from 0 to 50: a score of 0-4 indicates no disability, 5-14 indicates mild disability, 15-24 indicates moderate disability, 25-34 indicates severe disability, and 35-50 indicates completely disabled. This questionnaire has become a standard and was validated to evaluate outcome measures in the management of spinal disorders (Fairbank & Pynsent, 2000). In more recent literature, the Oswestry Disability Index is reported to be an easily reproducible, reliable, and objective score of disability in low back pain that can help in its long-term management (Yates & Shastri-Hurst, 2017). A freely translated French version of the Oswestry Disability Index was used in this project. Questions can be found in ANNEX IV – OSWESTRY DISABILITY INDEX.

3.4 STEP THREE: PHYSICAL EVALUATION PROTOCOL

All 36 police officers who completed the initial survey were invited to continue the process with a physical evaluation at Université du Québec à Chicoutimi through email. Following this email, 20 responded and completed a 90-minute physical evaluation. The physical evaluation comprised anthropometric measurements (weight, height, and waist circumference), cardiovascular measurements (heart pressure and heart rate), a cardiovascular submaximal VO_{2max} test (choice between cycling and running), open-ended questions on physical activity habits, a trunk flexibility test (Sit-and-Reach), vertical jump, grip strength, and the McGill test battery. Tests were selected based on literature with the aim of offering the possibility of a generalized exercise prescription adapted to each individual, with three exercises specific to preventing low back pain (Hoffman & Collingwood, 2015; S. McGill, 2016).

3.4.1 ANTHROPOMETRIC MEASUREMENTS

Weight, height, and waist circumference were evaluated to determine general information for each individual to document general health risk. Weight was taken in kilograms using a Seca 700 mechanical column scale with an eye-level beam and manually calibrated using a built-in counterweight. Height was taken in centimeters using a Seca 213 stadiometer. Waist circumference was measured using a standard tape measure.

3.4.2 PHYSICAL ACTIVITY HABITS

Prior to testing, during online reservations, participants were asked how many times per week they performed physical activity. This question transitioned to an open-ended question on physical activity habits: “Pouvez-vous nous donner une brève description de ces activités? Voici quelques pistes: Quel type d'activité physique pratiquez-vous? Combien de temps par activité? À votre avis, quelle est l'intensité de vos activités (sur une échelle de 1 à 10, 1 étant peu intense et 10 étant très intense)?” During the physical evaluation, the participant’s answer was brought up and investigated using the FITT principle, which involved physical activity type, frequency, intensity, and time (Physiopedia, 2025). The answer to this question guided the conversation to document each participant's level of physical activity with the aim of adjusting the cardiovascular submaximal VO_{2max} test and exercise prescription.

3.4.3 CARDIOVASCULAR EVALUATION

Following questions on physical activity habits, participants went through a pre-screening process for submaximal exercise tests using the CSEP Get Active Questionnaire (CSEP, 2026). This questionnaire ensures a safe physical activity experience throughout the test by asking questions regarding physical conditions, medical conditions, conversations with health care providers, and current physical activity level. Emergency contact information was noted on paper.

Participants were given the choice between cycling and running. Prior to the cardiovascular submaximal VO_{2max} test, blood pressure was taken once, and a heart-rate monitor was installed on the participant to continuously monitor heart rate. Blood pressure was manually taken using a Lithmann 2 stethoscope and a calibrated DS58 Welch Allyn sphygmomanometer. Participants wore a chest-mounted heart-rate monitor positioned at the level of the solar plexus. A Polar H10 heart rate sensor was attached using a strap and synchronized with a Polar VantageM watch for the duration of the cardiovascular evaluation. The initial requirement for the cardiovascular submaximal VO_{2max} test was documented after being seated for five minutes (Whelton et al., 2018). Blood pressure below 135/85 was considered adequate due to the measurement tool being a sphygmomanometer (Rabi et al., 2020) Heart rates between 60 bpm and 100 bpm were considered normal (Heart&Stroke, 2026a).

To measure cardiovascular capacity, participants were given the choice between cycling and running. The tests were prepared on the spot by the candidate based on each individual's physical activity habits regarding cardiovascular performance. Maximal estimated heart rate for men and women under 30 years old was calculated using the following equation: maximal heart rate = 211 – (0.64*age) (Nes et al., 2013). Maximal heart rate for men and women over 29 years old was calculated using the following equation: maximal heart rate = 207 - (0.7*age) (Gellish et al., 2007).

Participants who chose running followed the ACSM cardiovascular fitness guidelines (American College of Sports Medicine et al., 2022a). A Cybex 790T treadmill was used and manually calibrated prior to the project in increments of 2.5km/h using the center of tension of the running belt, the running belt circumference, and calculations of revolutions per minute. Every calculation of actual participant speed can be found in ANNEX V – TREADMILL CALIBRATION.

Participants who chose cycling followed the ACSM cardiovascular fitness guidelines (American College of Sports Medicine et al., 2022a). The protocol used can be found in A Monark 828E cycle ergometer was used and manually calibrated prior to the project to four kiloponds according to the Monark 828E manual (Monark, 2017).

In both treadmill and cycle ergometer tests, the baseline of the protocol comprised a three-minute warmup, four three-minute stages, and a three-minute cool-down. Heart rate was measured each minute using the Polar VantageM watch.

Physical exertion was evaluated every three-minute stage using the Borg scale, a scale that evaluates self-perceived physical exertion from 1 to 10 (Williams, 2017). Furthermore, participants were given the instruction to stop if there were any signs of pain, and encouragement was given during the tests. Signs and symptoms were monitored throughout the test, and participants were asked how they were feeling every three-minute stage.

Following each test protocol, VO_{2max} estimated value was extracted in $mL*kg^{-1}*min^{-1}$ using the Friend equation (Kokkinos et al., 2018). This equation calculates an estimated value of a person's VO_{2max} based on heart rate, speed and incline for the treadmill, and heart rate, kiloponds, and RPM for the cycle ergometer.

3.4.4 TRUNK FLEXIBILITY TEST

Trunk flexibility was evaluated using a standard sit-and-reach test (Gibson et al., 2019). A baseline sit-and-reach test box was used with a 23-centimeter footline. Participants were asked to sit down, place their feet slightly separated against a sit-and-reach test box, keep their legs extended, and gradually flex their trunk until it was no longer possible for them to do so. Two attempts were permitted, and the best result was documented. Participants were given the instruction to stop if there were any signs of pain, and encouragement was given during the tests.

3.4.5 VERTICAL JUMP

Countermovement vertical jump was evaluated using the MyJump2 mobile application, an app that is validated and reliable in sports such as fencing, swimming, and diving (Peng et al., 2024). This app, after filming a person's jump, calculates jump height and jump time using a built-in equation that involves a participant's weight and two measurements. More specifically, for each participant, the length between the greater trochanter and the fifth metatarsal in plantar flexion was measured in a seated position, as well as the length between the greater trochanter and the ground in a squat position with a 90-degree angle between the trunk and the femur. Participants were filmed jumping twice without swinging their body, and video was analyzed to ensure the protocol was followed. Jump height was extracted in centimeters, and jump time was extracted in milliseconds. As no relevant or applicable norm tables were found, values were compared before and after the 8-week exercise prescription. Participants were instructed to stop if there were any signs of pain.

3.4.6 HAND GRIP STRENGTH

Hand grip strength was evaluated due to it being a rapid test to perform that serves as an important biomarker of health (Vaishya et al., 2024). During the physical evaluation, hand grip strength was taken using a Lafayette 5030L1 dynamometer, which was calibrated with a Mark10 M3-500 dynamometer prior to testing. Using the ACSM hand grip strength protocol (American College of Sports Medicine et al., 2022b), participants were required to sit on a chair with both feet flat against the floor and their back against the chair. The dynamometer was adjusted to have a 90 degree-angle between the second phalange and the wrist. Participants were asked to have a 90-degree angle with their elbow while holding the dynamometer and to keep the wrist dorsiflexed between 0 and 30 degrees. The evaluator monitored these instructions throughout the test and made sure breathing wasn't blocked, and the muscle contraction wasn't compensated with other muscular groups. Starting with the right side, participants alternated three times per side for a total of six measurements. Results were documented in kilograms. Participants were instructed to stop if there were any signs of pain, and encouragement was given during the tests.

3.4.7 MCGILL TEST BATTERY

Lumbar stabilization exercises to prevent low back pain can be divided into three categories: trunk flexion endurance, trunk lateral flexion endurance, and trunk extension endurance. From these exercises, a test battery was created, named the McGill stabilization exercise battery (S. M. McGill et al., 1999). This test battery can provide benefits to patients with low back pain (Ghorbanpour et al., 2018) and was chosen for this purpose.

Trunk flexion endurance was evaluated using a box designed specifically for the McGill stabilization test battery. Participants were asked to be seated and to bend their hips and knees at a 90-degree angle (validated with a goniometer). Afterwards, they were asked to fold their arms across their chest and to lean against a board at a 55-degree incline. Instructions were given to keep the head in a neutral position and to keep the shoulders open. Feet were strapped down to help maintain the position, and one warning was permitted during the test if it was corrected. The objective of the test was to hold an isometric contraction as long as possible.

Trunk lateral flexion endurance was evaluated on a mat. Participants were instructed to lie down, move to their side, and extend their legs. Next, they had to have their feet on top of each other and place their elbow on the mat, slightly below their nearest shoulder. Once in position, participants had to align their head, hips, and ankles to form a side-plank position and maintain it as long as possible.

Trunk extension endurance was evaluated using the Biering-Sorensen test (Biering-Sørensen, 1984). Participants were asked to place themselves on Hoist Fitness back extension bench (HF-5664). Next, they were asked to perform a back extension in order to be parallel with the floor, which was verified manually by the evaluator using a wooden stick placed on the participant. Once in position, participants had to maintain a parallel position as long as possible.

During every test in the McGill test battery, to limit the risk of injury, participants were strongly advised to avoid the Valsalva maneuver and to contract their abdominal muscles. Apart from a second warning from the evaluator, participants were instructed to stop if there were any signs of pain, and encouragement was given during the tests.

3.5 STEP FOUR: EXERCISE PRESCRIPTION

Following the physical evaluation, police officers were given an exercise prescription and a journal to note workouts in. The journal contained a description of the project followed by eight pages with three places to document an exercise session. Participants were asked to evaluate their low back pain on a scale from 1 to 10 before and after each exercise session. A comment section was provided for cases of variance. The information on the logbook's content can be found in ANNEX VI – PARTICIPANT LOGBOOK. The general request was to work out three times per week.

The baseline used by the evaluator was to comprise each exercise prescription of three exercises: one for trunk flexors, one for trunk extensors, and one for lateral trunk stabilizers. Each exercise was individualized and specific to each police officer's performance during the test. Every two weeks, police officers were contacted to modify, progress, and vary the exercises that were given.

Police officers were offered the possibility to go beyond the three exercises. Due to the presence of a cardiovascular test, a full exercise prescription was given to those who requested it. Moreover, while there wasn’t enough muscular evaluation to give repetitions, load, and sets, exercises were recommended that involved the lower back based on requests from participants.

3.6 STEP FIVE: POST-INTERVENTION

Among the 20 police officers who completed the two surveys and the first 90-minute physical evaluation, seven participants did not complete their 8-week exercise program. More specifically, three police officers quit within four weeks of their program after the physical evaluation due to disinterest, one police officer quit after 8 weeks due to lack of time for the second physical evaluation, and three police officers were injured during their 8-week intervention (each for reasons outside the exercise program). Attempts were made to restart or adjust the program with the police officers who were injured, to no avail.

This left 13 police officers who completed the full intended process in this master’s thesis. These police officers conducted a second physical evaluation and redid the initial surveys to document pre-intervention and post-intervention measures. In the Results section, statistical tests will be presented as results are shown. Every result was tested for normal distribution to determine whether a non-parametric or parametric test would be performed.

3.7 RESULTS

Results are divided into two analyses. Firstly, the 36 police officers who completed the initial two-part survey will be analyzed. Secondly, the 13 police officers who completed the full project, consisting of a pre-post intervention with surveys, physical evaluation, and exercise prescription, will be analyzed. As surveys were conducted in French, figures were kept in their original language as extracted from the survey. All analyses were conducted on SPSS version 30.

3.7.1 PRE-INTERVENTION SURVEY DESCRIPTIVE RESULTS

Among the 36 police officers who completed the initial survey, when asked about work experience, police officers answered an average of 9.92 years (± 7.24 years). The police officer with the most experience had 27 years of service, while the one with the least had 1 year of service. Sex and gender were separate questions and yielded the same result: 20 men (55.6%) and 16 women (44.4%). These characteristics, combined with Figure 3 - Weekly Hours Spent on Police Patrolling, are meant to contextualize the demographics of police officers before describing their health-related answers.

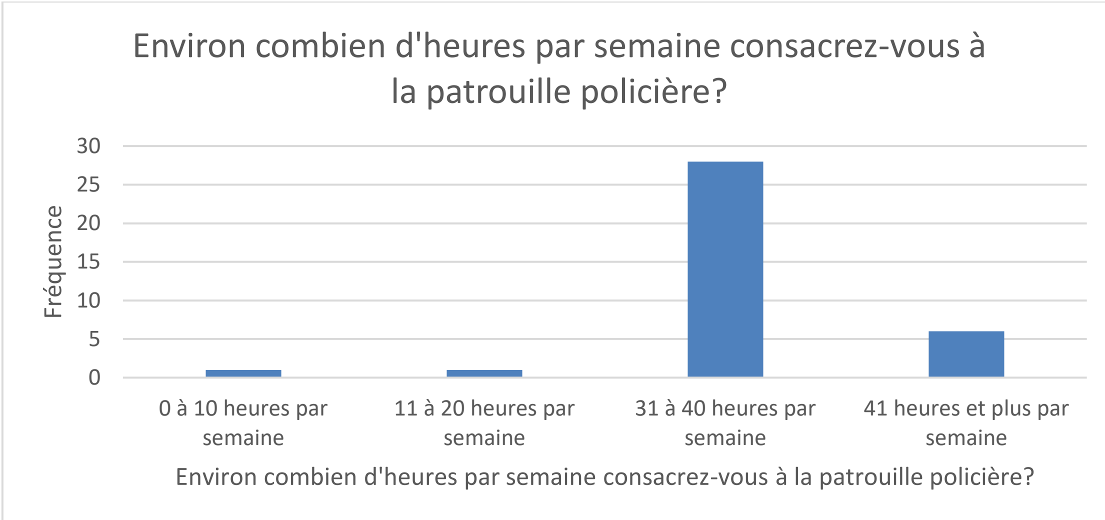

Figure 3 - Weekly Hours Spent on Police Patrolling

Police officers were then asked how they perceived their general health; their answers can be found in Figure 4 - Perception of General Health. Moreover, when asked about low back pain and sleep, 52.8% of police officers reported having their sleep sometimes affected by low back pain.

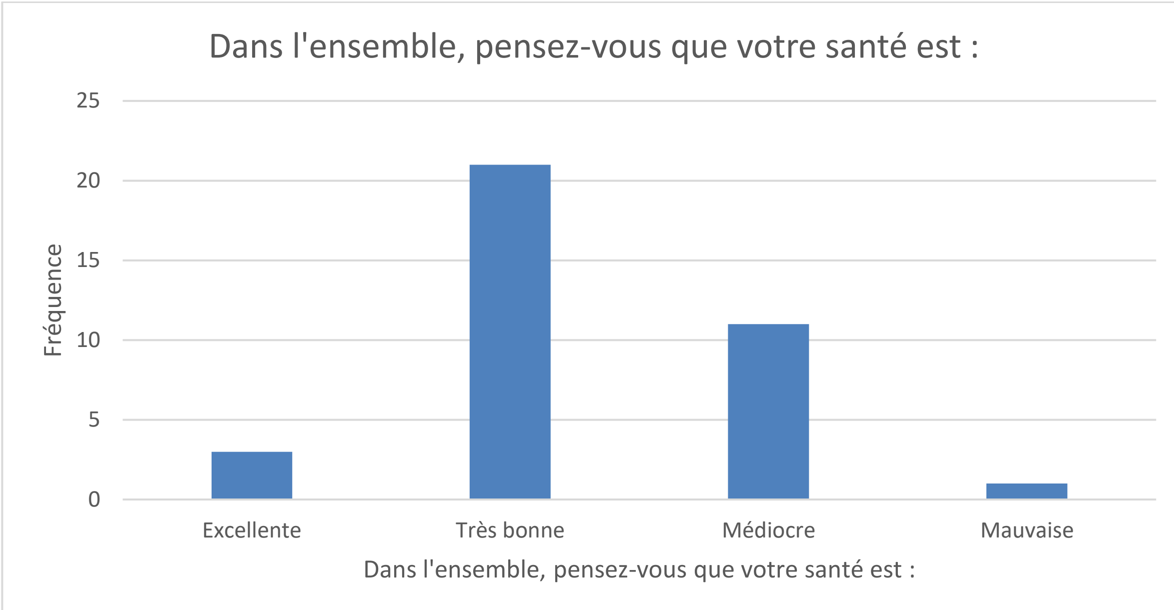

Figure 4 - Perception of General Health

Moving slightly outside the scope of low back pain, when asked about intensity of perceived physical pain in the last four weeks, police officers' answers can be found in Figure 5 - Perceived Physical Pain (Past Four Weeks). Furthermore, 61.1% of police officers reported that their low back pain affected their work or daily lives at least a bit in the last four weeks. These indicators were used to understand whether the reported pain was indeed recent and genuinely affected everyday life.

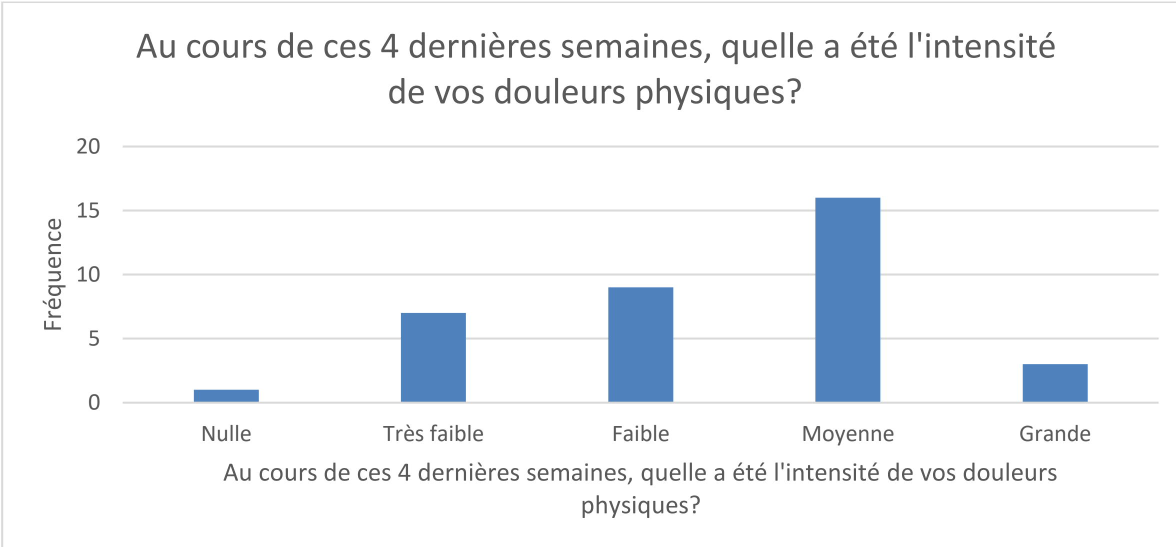

Figure 5 - Perceived Physical Pain (Past Four Weeks)

The second survey, the Oswestry Disability Index, yields a final score out of 50 based on every answer (Fairbank & Pynsent, 2000). Disability level is evaluated as follows: 0-4 is no disability, 5-14 is mild disability, 15-24 is moderate disability, 25-34 is severe disability, and 35-50 is completely disabled. Among the 36 police officers, 15 self-evaluated no disability, 20 self-evaluated mild disability, and 1 self-evaluated moderate disability. The average score was of 6.03 (± 4.03), situated in the mild disability category. In this 10-question survey, the most related question to police patrolling is displayed in Figure 6 - Low Back Pain while seated.

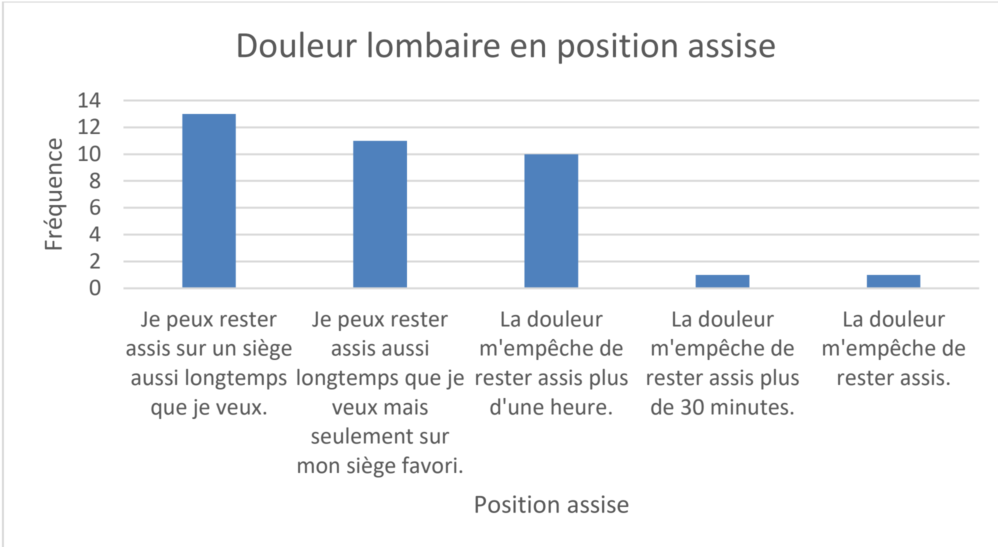

Figure 6 - Low Back Pain while seated

3.7.2 PRE-INTERVENTION SURVEY CORRELATION RESULTS

When analyzing police patrol officer weekly hours and sitting limitations using Spearman's Rho, no significant correlation was found ($\rho = -0.231$, $p = 0.175$). However, a positive correlation was found between reported limitation in a seated position and in a standing position ($p = 0.001$) using Spearman's Rho, suggesting a moderate connection between police officers who report low back pain when seated and police officers who report low back pain when standing.

Oswestry Disability Index scores and years of work experience as a police officer were correlated using Spearman's Rho. A significant correlation was found ($p = 0.003$) indicating a moderate relationship ($\rho = 0.478$) between the two variables.

To compare Oswestry Disability Index scores and police patrol officer weekly hours, a Kruskal-Wallis test was performed and revealed no significant differences across exposure levels to driving ($H = 2.933$, $p = 0.402$) in this sample, suggesting that low back pain disability does not vary significantly with police patrolling.

Finally, a multiple linear regression model was performed on the Oswestry Disability Index scores using the following variables: police patrol officer weekly hours, sex, years of work experience, as well as low back pain in seated position, standing position, and while sleeping. Only low back pain in a standing position was significantly associated with Oswestry Disability Index scores ($B = 1.463$, $p = 0.003$). Other predictors were not significant, and no collinearity issues were identified ($VIF < 1.5$).

3.7.3 PRE-INTERVENTION SURVEY RESULTS

The sample description and correlations show that many police officers had Oswestry Disability Index scores indicating mild disability, and postural limitations that can be linked to low back pain were reported. Correlations mainly showed a physical constraint related to low back pain when standing and weekly hours of police patrolling. While weekly hours of police patrolling were not correlated with Oswestry Disability Index scores, the overall results suggest that police officers continue to be exposed to risk factors that can contribute to low back pain.

3.7.4 INTERVENTION RESULTS – DEMOGRAPHIC INFORMATION

Among the 13 police officers who completed the pre-intervention and post-intervention, there were 8 men (61.5%) and 5 women (38.5%). These police officers did their prescribed low back pain exercises an average of 2.57 times per week (n=12) during their 8-week intervention period. To adequately present this population, the following information was documented either in the survey or during the physical evaluation: their age, their work experience, their time spent patrolling per week, their weight, their height, and their waist circumference. This information can be found in Table 2: Demographic Information.

Table 2: Demographic Information

Characteristics	Mean (SD) n = 13
Age (years)	32,62 (9,13)
Weight (kg)	83,08 (10.67)
Height (cm)	172,30 (7.15)
Waist circumference (cm)	92,52 (11.18)
Work experience (years)	9,88 (8.38)
Time spent patrolling per week (hours)	32,69 (10.92)

Prior to further analysis, as this intervention used a small sample size ($n = 13$), all pre-post variables were subjected to a Shapiro-Wilk test to ensure normal distribution. Variable deltas with $p > 0.05$ were considered to be normal.

3.7.5 INTERVENTION RESULTS – LOW BACK PAIN TESTS

To measure whether this project aimed to prevent low back pain in police officers was a success, seven variables were considered and compared in the pre-post intervention: trunk flexion endurance, trunk lateral flexion endurance (left), trunk lateral flexion endurance (right) and trunk extension endurance, Oswestry Disability Index scores (as described in Section 3.7.1), perceived physical pain in the last four weeks, and low back pain discomfort while seated. Five variables followed a normal distribution; five paired t-tests were performed. The other two, perceived physical pain in the last four weeks and low back pain discomfort while seated, did not follow normal distribution and were analyzed using a non-parametric Wilcoxon signed-rank test.

These variables were separated into two parts. Firstly, four variables related to objective measures taken during the physical evaluations were analyzed. Secondly, three variables related to subjective measures taken during the online survey were analyzed.

Starting with objective measures during the physical evaluation, the following four paired t-tests of the McGill test battery were documented: trunk flexion endurance, left-side trunk lateral flexion endurance, right-side trunk lateral flexion endurance, and trunk extension endurance. Results can be found in **Error! Reference source not found.**.

Table 3: Lower Back Physical Evaluation Analysis

Paired t-tests with McGill Test Battery	Average increase (standard deviation)	df	p-value	Cohen's d
Trunk flexion	24.27 (40.91) seconds	12	0.054	0.593 (medium effect-size)
Trunk lateral flexion (left)	11.38 (23.92) seconds	12	0.112	0.476 (small effect-size)
Trunk lateral flexion (right)	14.04 (15.76) seconds	11	0.01*	0.891 (large effect-size)
Trunk extension	14.12 (30.41) seconds	11	0.136	0.464 (small effect-size)

* = statistically significant ($p \leq 0.05$)

Continuing with subjective measures during the online survey completions, three variables were analyzed. Oswestry Disability Index scores were documented using a paired t-test as there was a normal distribution. A non-significant improvement of 2.25 points after the intervention was reported. The difference was not statistically significant ($t(11) = 2.123$, $p = 0.057$), but it represented a medium-sized effect ($d = 0.61$). Further investigating the Oswestry Disability Index, a specific question of interest was analyzed due to police officers' positions when patrolling in vehicles: perceived low back pain when seated.

Perceived pain when seated improved (decreased) by an average of 0.417 points out of 5 after the intervention. The difference was not statistically significant ($t(11) = 1.603$, $p = 0.137$) and represented a large-sized effect ($d = 0.9$). Finally, in the SF-36, there was a question on reported physical pain perception in the last four weeks. Results showed an improvement (decrease) following the post-intervention. A Wilcoxon signed-rank test was performed as the distribution was not normal and indicated a statistically significant reduction in perceived pain ($Z = -2.456$, $p = 0.014$) with a large-sized effect ($r = 0.74$).

Overall, although the McGill test battery results lacked statistical significance, results improved in all four tests due to the intervention. As for police officers' perception of their low back pain, there was a slight improvement in low back pain perception in the Oswestry Disability Index survey, and a clear decrease in perceived low back pain when seated and general physical pain perception in the last four weeks.

3.7.6 INTERVENTION RESULTS – ADDITIONAL COMPONENTS

As stated in the administrative procedures (Section 3.5), police officers were offered an exercise prescription beyond three exercises aimed at prevention of low back pain. Outside the scope of wanting to evaluate low back pain, the kinesiologist (and candidate) offered an exercise prescription to every participant. More specifically, 4 out of 13 police officers were not interested, 6 police officers were given a cardiovascular prescription, and 5 police officers were given muscular exercises based on their goals and equipment they had (2 police officers took both running and muscular). During the physical evaluation, the following tests were performed that are less directly linked to low back pain: vertical jump, trunk flexion, grip strength, and VO_2max. All tests followed a normal distribution (Shapiro-Wilk test) and were analyzed using paired t-tests except for left-side grip strength, which was analyzed using a Wilcoxon signed-rank test. Left-side grip strength did not change significantly during the intervention and showed no statistical significance ($Z=-0.804$, $p=0.422$). Results can be found in Table 4: Additional .

Table 4: Additional Components

Paired t-tests with Additional factors	Average increase	df	p-value	Cohen's d
Trunk flexion	2.34 cm	12	0,007*	0.894 (large effect-size)
Vertical jump	-0.73 cm	11	0,582	0.164 (small effect-size)
Grip strength (right side)	0.54 kg	12	0,887	0.174 (small effect-size)
VO_{2max} treadmill	-1.30 $mL*kg^{-1}*min^{-1}$	7	0,344	0.359 (small effect-size)
VO_{2max} cycle ergometer	0.31 $mL*kg^{-1}*min^{-1}$	3	0,71	0.204 (small effect-size)

* = statistically significant ($p \leq 0.05$)

Trunk flexion flexibility improved even though no exercises were given that focused on flexibility. Vertical jump, grip strength, and VO_{2max} showed no significant improvement.

DISCUSSION

This master's thesis aimed to combine police officers' pain perception with objective measures to find solutions that could help mitigate low back pain in police officers. By conducting two online surveys (Oswestry Disability Index and SF-36) and a physical evaluation (notably with the McGill test battery), the benefits that an intervention can have from a kinesiologist working with police officers were shown. Results from the physical evaluation showed an increase in tests directly related to the lower back and improved online survey scores were documented. Furthermore, vertical jump, grip strength, and VO_{2max} (both on treadmill and on cycle ergometer) showed no statistically significant change with small effect-sizes. These variables were not expected to vary, as the body will adapt specifically to the demands placed on it (Lambert, 2020), and the intervention in this master's thesis did not specifically aim to improve them. Since exercises prioritized the lower back, while causality cannot be proven, results further suggest that the physical improvement in the lower back was due to the intervention. In the same line of thought, considering how police officers tent to not maintain an adequate physical condition their careers (R. M. Orr et al., 2018), offering possibilities to police officers regarding exercise prescription and workout time can greatly help prevent workplace injuries.

Referring to the systematic review in this master's thesis, conclusions suggested finding approaches and intervention strategies and help prevent the development of low back pain among police officers (Range et al., 2023). This project, aiming to document subjective and objective measures related to low back pain, applied this suggestion with online surveys and a physical evaluation. This project aligns with two other studies that conducted physical evaluation tests with police officers and were analyzed in the systematic review (Grani et al., 2022; Hoflinger et al., 2021). However, the intervention documented in this master's thesis included both subjective and objective measures to provide a more comprehensive assessment of low back pain, an approach that wasn't used in these articles.

More specifically, Grani et al. (2022) conducted a similar study to this one with a pre-intervention and post-intervention evaluation of 20 Brazilian military police officers. However, in this test, exercises were performed over 9 weeks, 5 times per week, and 60 minutes per workout. The physical evaluation was similar to this study except for the inclusion of the McGill test battery, an added value to an intervention that aims to quantify trunk endurance using validated measures (S. McGill, 2016). Instead, this study selected workout exercises that were associated with trunk endurance: side plank, double leg lift, and sit-up tests. Similarly to the master's thesis results, Grani concluded that trunk training can reduce general musculoskeletal pain and increase endurance of the trunk muscles, without affecting operability.

As for the other study, Hoflinger et al. (2021) also aimed to evaluate low back pain in police officers using physical activity, but had an approach focused on the influence of equipment. A pre-intervention and post-intervention design was performed on 42 police officers, but only during a 6-hour period. This was to show that external equipment negatively affects trunk flexor and extensor muscles and should be modified to prevent this effect. While this master's thesis didn't touch upon vehicles and equipment ergonomics, the results showing that external equipment negatively affects lower back endurance muscles remain relevant when analyzing occupational contributors to low back pain.

This project was conducted with one police station in the province of Québec. Considering the total number of police officers informed of this project was approximately 140 and about 100 had the project presented to them in person, an initial response rate of 36 participants highlights the need for intervention in low back pain in the police organizations. This aligns with evidence that suggests that low back pain prevalence is higher among police officers (Benyamina Douma et al., 2017; Range et al., 2023).Results in the SF-36 showed that the focus should not only be on physical evaluation and objective measures, but also on mental health and well-being, due to the burden police officers face with the multidimensional nature of low back pain (Benyamina Douma et al., 2019). Moreover, a recent study have suggested that occupational stressors and some health outcomes of officers worsened over time, indicating the need for self-health monitoring and wellness programs for police organisations (Violanti et al., 2025). Thus, current results can not only influence low back pain prevention, but also help police officers improve mental health with the help of physical activity. Physical activity can influence sleep, anxiety, blood pressure, and many other factors (CDC, 2025).

Considering the similar need to maintain operational fitness in police officers and in organizations such as the Canadian Armed Forces, job requirements can make physical fitness a duty (National Defence, 2013). Operational fitness can be aligned with working as a police officer given physical demand and injury risks (R. Orr et al., 2020). Although official directives do not guarantee workout time during working hours nor the facilities to do so, many units provide the time and equipment to support physical training as a daily routine. The model used by the Canadian Armed Forces can offer insights into how police stations can support police officers in physical training and limit common musculoskeletal disorders such as low back pain. Such initiative can contribute to supporting groups of first responders with this kind of initiative, we add protective factors to those who protect us.

The argument about supporting police officers with physical training can also be associated with the notion of industrial athletes, a parallel made between athletes and workers who can be exposed to similar physical demands and injury risks on a daily basis (Sevier et al., 2000). In sports medicine, athletes have structured programming year-round to favor injury prevention and performance that is allocated for specific time periods or events. This begs the question: why can't the same be applied to working populations that require physical ability to perform adequately, such as police officers (Bonneau & Brown, 1995)? Considering the higher work-related expectations of performance in police officers than that of the general population (Dawes et al., 2017), this highlights the need for police organizations to dedicate resources to provide support in maintaining physical fitness.

LIMITATIONS

This study contained multiple limitations: shift work, the physical evaluation evaluator, selection bias, attrition bias, and confounding bias.

PHYSICAL EVALUATION EVALUATOR

Out of 13 participants evaluated during the physical evaluation, two of them had a different evaluator than the others, creating a limitation in data interpretation. More specifically, the McGill test battery requires the evaluator to stop the participant when they perceive that the movement has changed. Since all evaluators perceive this differently, when possible (11 out of 13 times), the same evaluator did both the pre-intervention and post-intervention evaluations.

SELECTION BIAS

Participants were gathered by having the master's candidate go to a local police station eight times and present the project to every rotation. This project was volunteer-based, so only those who were interested participated.

ATTRITION BIAS

This study began with 36 participants who answered the initial online survey. Twenty answered the call for a one-hour physical evaluation, and 13 continued until the end as mentioned in Section 3.6 STEP FIVE: POST-INTERVENTION. The time investment required for this project was large (20-minute survey, 1-hour evaluation, 8 weeks of working out 3 times per week, 20-minute survey, and 1-hour evaluation). Moreover, injuries were an issue for attrition. No injuries were reported as related directly to the exercise prescription by the kinesiologist, but many delays and cancellations were due to police officers not being physically apt to do the pre-intervention or post-intervention physical evaluation.

CONFOUNDING BIAS

As this is a study with humans, confounding bias was inevitable as it's unrealistic to control human physical activity for 8 weeks in police officers. Efforts were put in place to optimise participation by offering a physical activity program and not mentioning any limits beyond having to conduct low back pain prevention three times per week, which inevitably influenced the results. The main limitation involving the participants was shift work. Physical evaluations were scheduled solely based on availabilities of both the evaluator and the police officers. While this wasn't documented, some police officers completed one physical evaluation while on night shifts and another while on day shifts, even though evaluations were conducted between 9 a.m. and 7 p.m.

CONCLUSION

In conclusion, this is among the first studies of its kind to evaluate low back pain in police officers using a quasi-experimental pre-post design. Our results showed overall improvement in objective measures from the physical evaluation and in subjective measures from the Oswestry Disability Index and SF-36 surveys.

This project shows a concrete solution to help limit low back pain in police officers: physical activity programming. Exercise prescription and follow-ups can help support the physical integrity of police officers and, down the line, prevent employment injuries, forced time off work, and even early retirement.

Moreover, results of this project present a model that can be used to prevent low back pain prevalence in police officers. While the number of police officers (n = 13) was small and limited our analyses, benefits were clear and should be reproduced in other police organisations.

THESIS CONCLUSION

By combining a systematic literature review with an 8-week intervention to prevent low back pain in police officers, this master's thesis covered a subject with a gap. Since police officers cannot be compared to other workers regarding low back pain, due to the nature of their work, interventions must be tailored to them. While the number of participants were small, results showed that adding lower back-related exercises to a workout program is a simple and efficient way to help prevent low back pain. This master's thesis shows the need to gather further data on police officers and highlights the pertinence of providing a favorable environment for police officers to adapt and/or maintain healthy lifestyle habits (with emphasis on physical activity). Examples of this are to allocate space to working out at police stations, to reimburse gym memberships, and to offer services from health professionals such as kinesiologists to balance work demands, mental health and physical activity habits.

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CERTIFICATION ÉTHIQUE

Ce mémoire a fait l'objet d'une certification éthique auprès du CER-UQAC. Le numéro du certificat est 2025-1817.

ANNEX I – CONSENT FORM

Formulaire d’information et de consentement électronique CONCERNANT LA PARTICIPATION

Ce formulaire d’information et de consentement a été approuvé le 6 février 2025 par le Comité d’éthique de la recherche de l’Université du Québec à Chicoutimi (CER-UQAC). No de référence : [2025-1817].

Nous sollicitons votre participation à un projet de recherche intitulé « Prévention des lombalgies chez les policiers patrouilleurs ».

Cependant, avant de donner votre consentement pour participer à ce projet, veuillez prendre le temps de lire, de comprendre et de considérer attentivement les renseignements qui suivent. De plus, nous vous invitons à poser toutes les questions que vous jugerez utiles au chercheur responsable du projet ou aux autres membres affectés à ce projet de recherche et à leur demander de vous expliquer tous les mots ou les renseignements qui ne sont pas clairs pour vous.

1. Présentation des chercheurs

Chercheur responsable : Jerome Range, B.Sc., Étudiant à la maîtrise en santé durable

Direction : Martin Lavallière, Ph.D., Professeur à l’Unité d'enseignement en kinésiologie

Codirection : Charles Côté, Ph.D., Professeur à l’Unité départementale des sciences de la gestion, UQAR

2. Financement

Ce projet est financé par la Chaire de recherche en santé durable.

3. Description du projet et objectif

Dans le cadre d'un projet de recherche portant sur la prévention des maux de dos chez les policiers patrouilleurs réalisé par l'Université de Québec à Chicoutimi (chercheur responsable Jerome Range), nous sommes à la recherche de personnes participantes chez les policiers et policières qui effectuent de la patrouille régulière dans leurs tâches.

Plus spécifiquement, nous cherchons à documenter l'efficacité de l'activité physique pour prévenir les maux de dos qui surviennent lors de la patrouille policière régulière.

Notre objectif est d'évaluer l'impact d'un programme d'entraînement sur les facteurs qui touchent la lombalgie et différentes facettes de la santé dont l'état physique et l'état de bien-être.

4. Déroulement

Pour participer à l'étude, vous devez être en mesure de compléter ces 6 étapes :

1. Ce formulaire de consentement sera consulté.

2. Des questionnaires sur votre santé et vos douleurs lombaires seront remplis (durée de 15 à 20 minutes).

3. Une évaluation de la condition physique sera effectuée à l'UQAC (durée d'une heure).

4. Un programme d'entraînement sera préparé pour vous par un kinésiologue et un physiothérapeute. La capacité physique de chaque individu sera considérée et des exercices ciblant le bas du dos vous seront donnés.

5. Nous vous demanderons d'utiliser le programme d'entraînement pour vous entraîner. Plus précisément, pendant 8 semaines, 24 entraînements d'une durée d'une heure seront effectués (3 entraînements par semaine).

6. Les mêmes questionnaires que l'étape 2 seront remplis et l'évaluation de la condition physique de l'étape 3 sera effectuée de nouveau.

5. Risques et bénéfices

Risques :

Le projet de recherche comporte des risques psychologiques : la perception de vos douleurs lombaires et de votre état de santé pourrait être affectée de façon négative par la complétion des questionnaires.

Le projet de recherche comporte des risques physiques : vous pourriez être à risque de vous blesser lors de vos entraînements et de l'évaluation de la condition physique. Afin que les risques de blessures soient limités, au début du projet de recherche, une démonstration sur la façon de réaliser chaque mouvement de façon sécuritaire sera effectuée.

Bénéfices :

Dans le cadre du projet, vous aurez deux évaluations de la condition physique (avant et après un programme d'entraînement sur 8 semaines). En plus du programme d'entraînement sur 8 semaines individualisé et spécifique à vos besoins qu'il vous sera possible de garder par la suite, vous recevrez les résultats de vos évaluations de la condition physique.

6. Confidentialité, diffusion et conservation

a. Le questionnaire vous demandera votre prénom, votre nom et votre adresse courriel dans l'objectif d'être en mesure de vous contacter pour la deuxième partie de la recherche.
b. Ce questionnaire vous est soumis par l'intermédiaire d'un outil de sondage en ligne hébergé à l'UQAC. Ce faisant, l'accès aux données est assujetti à la Loi canadienne sur l'accès à l'information.
c. Toutes les évaluations seront conservées de façon confidentielle sur le serveur. Les chercheurs seront les seules personnes qui peuvent accéder à cette information codée à l'aide d'un mot de passe.
d. Tous les renseignements identificatoires des documents de recherche seront remplacés par un code de participant pour la durée du projet. Une fois l'étude complétée, les données de chaque participant seront anonymisées et les renseignements identificatoires seront détruits selon des méthodes sécuritaires. À la suite de cette procédure, il ne sera plus possible de vous retirer de l'étude, puisque les chercheurs ne pourront pas associer vos données de recherche à vos informations personnelles. Les données ainsi dénominalisées seront détruites après 7 ans.
e. Les résultats de cette recherche seront diffusés dans un mémoire de recherche accessible par l'entremise du dépôt institutionnel numérique de l'UQAC et dans des publications scientifiques. Parmi ces résultats, seules des données de moyennes et d'étendues seront présentées. Aucune donnée individuelle ne sera présentée.

7. Compensation

Aucune rémunération ou compensation n'est offerte.

8. Participation volontaire et droit de retrait de l'étude

Votre participation à ce projet de recherche est volontaire. Vous êtes donc libre de refuser d'y participer en ne répondant pas au questionnaire envoyé.

Vous pouvez contacter l'équipe de recherche pour accéder à vos données de recherche.

À tout moment pendant la durée de l'étude, vous pouvez contacter l'équipe de recherche pour vous retirer de l'étude sans conséquences négatives. Dans ce cas, vous pourrez demander la destruction de vos données jusqu'à ce qu'elles soient anonymisées et celles-ci ne seront pas utilisées dans le cadre du projet de recherche.

En aucun cas, le fait de donner son consentement pour participer à la recherche n'implique qu'on y renonce à ses droits légaux ni ne décharge les chercheurs, les promoteurs ou les institutions impliquées de leurs responsabilités légales et professionnelles.

9. Engagement du chercheur responsable et personnes ressources

Le chercheur responsable de ce projet de recherche s'engage, avec l'équipe de recherche, à respecter ce qui a été convenu dans le formulaire d'information et de consentement. De plus, si vous avez des questions concernant le projet de recherche ou si vous éprouvez un problème que vous croyez lié à votre participation au projet de recherche, vous pouvez communiquer avec le chercheur responsable du projet de recherche aux coordonnées suivantes : Jerome Range, jerome.range1@uqac.ca

Pour toute question d'ordre éthique concernant votre participation à ce projet de recherche, vous pouvez communiquer avec la coordonnatrice du Comité d'éthique de la recherche aux coordonnées suivantes : 418 545-5011 poste 4704 (ligne sans frais : 1-800-463-9880 poste 4704) ou cer@uqac.ca

10. Consentement du participant

J'ai pris connaissance des informations ci-dessus et j'en comprends le contenu. De ce fait, ma participation est volontaire et je consens à ce que mes réponses soient utilisées pour les fins de ce projet de recherche.

J'accepte de participer :
☐ Oui. (1)
☐ Non. (2)

ANNEX II – DEMOGRAPHIC INFORMATION

Partie 1 : Informations démographiques

Dans le cadre d’un projet de recherche portant sur la prévention des maux de dos chez les policiers patrouilleurs réalisé par l’Université du Québec à Chicoutimi (chercheur responsable : Jerome Range), nous cherchons à documenter l’efficacité de l’activité physique pour prévenir les maux de dos qui surviennent lors de la patrouille policière régulière. Vos réponses aux questions ci-bas nous permettront d’avoir une idée de votre perception de votre santé générale et de vos inconforts lombaires.

Date: _____/_____/_____

Adresse courriel :_________________

Prénom : ________________

Nom : _____________________

Quel est votre sexe à la naissance?______________

Quel est votre genre?______________

Depuis combien de temps occupez-vous le poste de policier?__________________

Environ combien d'heures par semaine consacrez-vous à la patrouille policière?*

Veuillez sélectionner une seule des propositions suivantes :

- 0 à 10 heures par semaine
- 11 à 20 heures par semaine
- 21 à 30 heures par semaine
- 31 à 40 heures par semaine
- 41 heures et plus par semaine

ANNEX III – SF-36

Partie 2 : Sondage SF-36

Sondage SF-36 (Leplège et al., 1998)

Malgré la ressemblance de certaines formulations, chaque question est différente. Veuillez répondre à toutes les questions en les lisant attentivement et en encerclant la réponse qui correspond à votre situation. ***Vous n’avez en aucun cas l'obligation de répondre à une question. Dans ce cas, veuillez ne rien sélectionner.

Dans l'ensemble, pensez-vous que votre santé est : *

Veuillez sélectionner une seule des propositions suivantes :

☐ Excellente

☐ Très bonne

☐ Bonne

☐ Médiocre

☐ Mauvaise

Par rapport à l'année dernière, comment trouvez-vous votre état de santé en ce moment? *

Veuillez sélectionner une seule des propositions suivantes :

☐ Bien meilleur que l'an dernier

☐ Plutôt meilleur que l'an dernier

☐ À peu près pareil que l'an dernier

☐ Plutôt moins bon que l'an dernier

☐ Beaucoup moins bon que l'an dernier

Les questions suivantes se rapportent sur des activités que vous feriez dans une journée type. Est-ce que votre état de santé actuel vous limite dans ces activités? Si oui, à quel point? *

Choisissez la réponse appropriée pour chaque élément :

	Oui, beaucoup limité(e)	Oui, un peu limité(e)	Non, pas du tout limité(e)
Efforts physiques importants tels que courir, soulever un objet lourd, faire du sport, etc.			
Efforts physique modérés tels que déplacer une table et passer l’aspirateur, etc.			
Soulever et porter les courses (épicerie)			
Monter l'escalier (plusieurs étages)			
Monter l'escalier (un étage)			
Se pencher vers l'avant, se mettre à genoux, s’accroupir			
Marcher plus d’un kilomètre à pied			
Marcher plusieurs centaines de mètres			
Marcher une centaine de mètres			
Prendre un bain, une douche ou s’habiller			

Au cours de ces 4 dernières semaines, dans quelle mesure votre état de santé physique vous a-t-il limité(e) dans votre travail ou vos activités de la vie quotidienne? *

Choisissez la réponse appropriée pour chaque élément :

	En permanence	Une bonne partie du temps	De temps en temps	Rarement	Jamais
Avez-vous réduit le temps passé à votre travail ou à vos activités habituelles?					
Avez-vous accompli moins d'activités que ce que vous auriez souhaité?					
Avez-vous dû arrêter de faire certaines activités?					
Avez-vous eu des difficultés à faire votre travail ou toute autre activité (par exemple, cela vous a demandé un effort supplémentaire)?					

Au cours de ces 4 dernières semaines, dans quelle mesure votre état de santé émotionnelle vous a-t-il limité(e) dans votre travail ou vos activités de la vie quotidienne?*

Choisissez la réponse appropriée pour chaque élément :

	En permanence	Une bonne partie du temps	De temps en temps	Rarement	Jamais
Avez-vous réduit le temps passé à votre travail ou à vos activités habituelles?					
Avez-vous accompli moins d'activités que ce que vous auriez souhaité?					
Avez-vous eu des difficultés à faire ce que vous aviez à faire avec autant de soin et d'attention?					

Au cours de ces 4 dernières semaines, y a-t-il eu des moments où votre état de santé, physique ou émotionnelle, vous a gêné(e) dans vos activités de la vie quotidienne avec votre famille, vos amis ou votre entourage? *

Veuillez sélectionner une seule des propositions suivantes :

- ☐ Pas du tout
- ☐ Un petit peu
- ☐ Moyennement
- ☐ Beaucoup
- ☐ Énormément

Au cours de ces 4 dernières semaines, quelle a été l'intensité de vos douleurs physiques? *

Veuillez sélectionner une seule des propositions suivantes :

- ☐ Nulle
- ☐ Très faible
- ☐ Faible
- ☐ Moyenne
- ☐ Grande
- ☐ Très grande

Au cours de ces 4 dernières semaines, dans quelle mesure vos douleurs physiques vous ont-elles limité(e) dans votre travail ou vos activités de la vie quotidienne? *

Veuillez sélectionner une seule des propositions suivantes :

- ☐ Pas du tout
- ☐ Un petit peu
- ☐ Moyennement
- ☐ Beaucoup
- ☐ Énormément

Les questions suivantes portent sur comment vous vous sentez et comment les choses sont allées pour vous au cours de ces 4 dernières semaines. Choisissez la réponse qui se rapproche le plus de ce que vous ressentez.

Au cours de ces 4 dernières semaines, y a-t-il eu des moments où :*

Choisissez la réponse appropriée pour chaque élément :

	En permanence	Une bonne partie du temps	De temps en temps	Rarement	Jamais
Vous vous êtes senti(e) très nerveux(se)?					
Vous vous êtes senti(e) si découragé(e) que rien ne pouvait vous remonter le moral?					
Vous vous êtes senti(e) calme et détendu(e)?					
Vous vous êtes senti(e) triste et abattu(e)?					
Vous vous êtes senti(e) bien dans votre peau?					
Vous vous êtes senti(e) dynamique?					
Vous vous êtes senti(e) débordant(e) d'énergie?					
Vous vous êtes senti(e) épuisé(e)?					
Vous vous êtes senti(e) fatigué(e)?					

Au cours de ces 4 dernières semaines, y a-t-il eu des moments où votre état de santé, physique ou émotionnelle, vous a gêné(e) dans vos activités sociales (par exemple, visiter des amis ou des proches)? *

Veuillez sélectionner une seule des propositions suivantes :

- ☐ En permanence
- ☐ Une bonne partie du temps
- ☐ De temps en temps
- ☐ Rarement
- ☐ Jamais

Dans l'ensemble, comment percevez-vous votre état de santé? *

Choisissez la réponse appropriée pour chaque élément :

	Totalement vrai	Plutôt vrai	Je ne sais pas	Plutôt faux	Totalement faux
Je tombe malade plus facilement que les autres					
Je me porte aussi bien que n'importe qui					
Je m'attends à ce que ma santé se dégrade					
Je suis en parfaite santé					

ANNEX IV – OSWESTRY DISABILITY INDEX

Partie 3 : Questionnaire d'évaluation de la capacité fonctionnelle – Inconforts lombaires

Ce questionnaire est conçu pour nous donner des informations sur la façon dont vos inconforts lombaires influencent votre vie. Veuillez répondre à toutes les sections du questionnaire. Pour chaque section, cochez une seule case, celle qui vous décrit le mieux actuellement. ***Vous n'avez en aucun cas l'obligation de répondre à une question. Dans ce cas, veuillez ne rien sélectionner.

Intensité de la douleur*

Veuillez sélectionner une seule des propositions suivantes :

☐ Je n'ai pas mal actuellement.

☐ La douleur est très légère actuellement.

☐ La douleur est modérée actuellement.

☐ La douleur est plutôt intense actuellement.

☐ La douleur est très intense actuellement.

☐ La douleur est la pire que l'on puisse imaginer actuellement.

Soins personnels (se laver, s'habiller, etc.)*

Veuillez sélectionner une seule des propositions suivantes :

☐ Je peux prendre soin de moi normalement, sans augmenter la douleur.

☐ Je peux prendre soin de moi normalement, mais c'est très douloureux.

☐ Cela me fait mal de prendre soin de moi, et je le fais lentement et en faisant attention.

☐ J'ai besoin d'aide, mais dans l'ensemble je parviens à me débrouiller seul(e).

☐ J'ai besoin d'aide tous les jours pour la plupart de ces gestes quotidiens.

☐ Je ne m'habille pas, me lave avec difficulté et reste au lit.

Manutention de charges *

Veuillez sélectionner une seule des propositions suivantes :

- Je peux soulever des charges lourdes sans augmenter mon mal de dos.
- Je peux soulever des charges lourdes mais cela augmente ma douleur.
- La douleur m'empêche de soulever des charges lourdes à partir du sol mais j'y parviens si la charge est bien placée (par exemple sur une table).
- La douleur m'empêche de soulever des charges lourdes mais je peux déplacer des charges légères ou de poids moyen si elles sont correctement placées.
- Je peux seulement soulever des objets très légers.
- Je ne peux soulever ni transporter quoi que ce soit.

Marche à pied*

Veuillez sélectionner une seule des propositions suivantes :

- La douleur ne limite absolument pas mes déplacements.
- La douleur m'empêche de marcher plus de 2 kilomètres.
- La douleur m'empêche de marcher plus de 1 kilomètre.
- La douleur m'empêche de marcher plus de 500 mètres.
- Je me déplace seulement avec une canne ou des béquilles.
- Je reste au lit la plupart du temps et je me traîne seulement jusqu'à la salle de bain.

Position assise *

Veuillez sélectionner une seule des propositions suivantes :

- Je peux rester assis sur un siège aussi longtemps que je veux.
- Je peux rester assis aussi longtemps que je veux mais seulement sur mon siège favori.
- La douleur m'empêche de rester assis plus d'une heure.
- La douleur m'empêche de rester assis plus de 30 minutes.
- La douleur m'empêche de rester assis plus de 10 minutes.
- La douleur m'empêche de rester assis.

Position debout *

Veuillez sélectionner une seule des propositions suivantes :

☐ Je peux rester debout aussi longtemps que je veux sans augmenter la douleur.

☐ Je peux rester debout aussi longtemps que je veux mais cela augmente la douleur.

☐ La douleur m'empêche de rester debout plus d'une heure.

☐ La douleur m'empêche de rester debout plus d'1/2 heure.

☐ La douleur m'empêche de rester debout plus de 10 minutes.

☐ La douleur m'empêche de rester debout.

Sommeil *

Veuillez sélectionner une seule des propositions suivantes :

☐ Mon sommeil n'est jamais perturbé par la douleur.

☐ Mon sommeil est parfois perturbé par la douleur.

☐ À cause de la douleur, je dors moins de 6 heures.

☐ À cause de la douleur, je dors moins de 4 heures.

☐ À cause de la douleur, je dors moins de 2 heures.

☐ La douleur m'empêche complètement de dormir.

Vie sexuelle *

Veuillez sélectionner une seule des propositions suivantes :

☐ Ma vie sexuelle n'est pas affectée et n'augmente pas mon mal de dos.

☐ Ma vie sexuelle n'est pas affectée, mais elle augmente la douleur.

☐ Ma vie sexuelle est pratiquement normale, mais elle est très douloureuse.

☐ Ma vie sexuelle est fortement limitée par la douleur.

☐ Ma vie sexuelle est presque inexistante à cause de la douleur.

☐ La douleur m'interdit toute vie sexuelle.

Vie sociale (sport, cinéma, danse, souper entre amis)*

Veuillez sélectionner une seule des propositions suivantes :

☐ Ma vie sociale est normale et n’est pas affectée par la.

☐ Ma vie sociale est normale, mais elle augmente la douleur.

☐ La douleur n'a pas d'effet sur ma vie sociale, sauf pour des activités demandant plus d'énergie (sport par exemple).

☐ La douleur a réduit ma vie sociale et je ne sors plus autant qu'auparavant.

☐ La douleur a limité ma vie sociale à ce qui se passe chez moi, à la maison.

☐ Je n'ai plus de vie sociale à cause du mal de dos.

Déplacements (en voiture ou en transports en commun)*

Veuillez sélectionner une seule des propositions suivantes :

☐ Je peux me déplacer n'importe où sans effet sur mon mal de dos.

☐ Je peux me déplacer n'importe où, mais cela augmente la douleur.

☐ La douleur est pénible mais je supporte des trajets de plus de 2 heures.

☐ La douleur me limite à des trajets de moins d'une heure.

☐ La douleur me limite aux courts trajets indispensables, de moins de 30 minutes.

☐ La douleur m'empêche de me déplacer, sauf pour aller voir le docteur ou me rendre à l'hôpital.

Insérer votre texte en respectant les règles décrites dans le guide de rédaction. Vous trouverez le guide sur le site web du Décanat des études.

ATTENTION : Votre discipline peut exiger que les annexes soient placées avant la bibliographie.

ANNEX V – TREADMILL CALIBRATION

Date : 7 mai 2025
Tapis roulant : M8031-790TX068N
Longueur courroie : 328.0 cm

T/100 rév (sec)	Vitesse Indiquée (km/h)	Vitesse réelle (km/h)
240.66	5.0	4.91
162.44	7.5	7.27
121.60	10.0	9.71
97.38	12.5	12.13
81.13	15.0	14.55
69.63	17.5	16.96
60.85	20.0	19.41
50.73	24.0	23.28

ANNEX VI – PARTICIPANT LOGBOOK

Projet sur la prévention des lombalgies chez les policiers patrouilleurs

Explication du journal de bord

Merci de participer au projet de prévention des lombalgies chez les policiers, qui vise à documenter l'efficacité de l'activité physique pour prévenir les maux de dos qui peuvent survenir lors de la patrouille policière régulière.
Ce journal de bord vous accompagnera tout au long du programme d'activité physique vous guidera dans votre progression tout au long du 8 semaines du programme de façon sécuritaire et progressive.

L'équipe de recherche

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Objectif du journal de bord

Le cahier de bord vous permettra de voir votre progression au fil des semaines quant à vos entraînements et vos lombalgies.

Quoi écrire dans le journal de bord

Il y a **une feuille dédiée à chaque semaine et une entrée à faire par entraînement.**
<u>Sur l'échelle visuelle d'une échelle de 0 à 10, encerclez le chiffre qui correspond le mieux à votre situation.</u> Si vous oubliez de vous entraîner, faites simplement l'indiquer dans le journal de bord. Notre objectif est de pouvoir avoir un suivi des entraînement effectués durant le projet et de nous référez au journal de bord en cas de problème reliés à vos inconforts lombaires.
Pour toute question sur l'utilisation du cahier, n'hésitez pas de nous contacter à jerome.range1@uqac.ca. À la fin du programme, ce cahier du participant sera récupéré par l'équipe de recherche.

Consignes avant l'entraînement

- Portez des vêtements et des chaussures confortables.

- Assurez-vous que le plancher soit libre de tout objet.

- Indiquez votre perception de vos inconforts lombaires au début et à la fin de l'entraînement.

- Si votre inconfort augmente pendant l'entraînement, arrêtez et référez-vous ci-bas.

Consignes en cas d'inconfort

À tout moment, n'hésitez pas de contacter l'équipe (jerome.range1@uqac.ca).

Étape 0 : Aucun inconfort ressenti
Continuez votre programme d'exercices.

Étape 1 : Inconfort ressenti
Attendre 5 minutes et continuez votre programme d'exercices.

Étape 2 : Inconfort persiste
Arrêtez l'entraînement et favoriser un état de repos pendant 24 heures.

Étape 3 : Inconfort persiste
Contactez l'équipe de recherche (jerome.range1@uqac.ca).

La meilleure solution pour gérer les douleurs lombaires est le repos. Quelques mesures additionnelles peuvent être entamées pour limiter les inconforts :

Chaleur
Pour une durée de 15 minutes à une fréquence de trois fois par jour, vous pouvez placer une serviette ou débarbouillette chaude sur votre dos.

Automassage avec une balle contre un mur
Pour une durée de 3 minutes (30 secondes de pratique et 30 secondes de pause) à une fréquence de trois fois par jour, vous pouvez vous mettre contre un mur avec une balle pour automassage dans votre région lombaire et vous déplacer lentement pour faire bouger la balle. Ajustez la pression que vous mettez sur la balle selon votre niveau de confort au besoin.

Approuvé le [06 février 2025] par le Comité d'éthique de la recherche de l'Université du Québec à Chicoutimi (CER-UQAC). No de référence : [2025-1817].

Entraînement Semaine #1 à 8

Dates de la semaine :____

Entraînement #1 Date :____________________

Avant l'entraînement #1

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Après l'entraînement #1

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Commentaires :____

____

Entraînement #2 Date :____________________

Avant l'entraînement #2

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Après l'entraînement #2

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Commentaires :____

____

Entraînement #3 Date :____________________

Avant l'entraînement #3

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Après l'entraînement #3

0 1 2 3 4 5 6 7 8 9 10

Aucun inconfort **Inconfort modéré** **Inconfort extrême**

Commentaires :____

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Approuvé le [06 février 2025] par le Comité d'éthique de la recherche de l'Université du Québec à Chicoutimi (CER-UQAC). No de référence : [2025-1817].