

**Patrol cars, low back pain  
and Québec police officers**



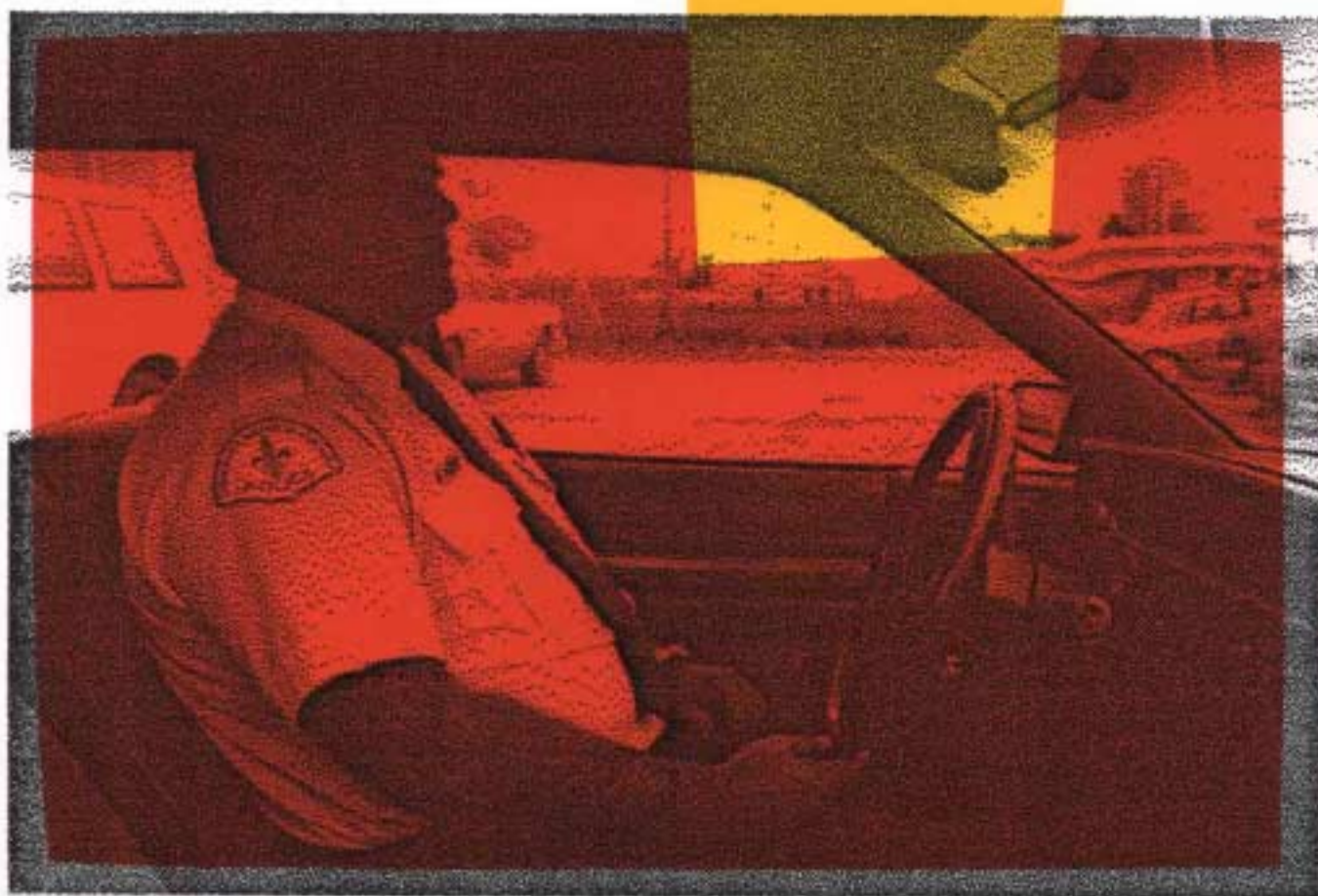
# **BILANS DE CONNAISSANCES**

**Marguerite-Michelle Côté**

**June 1989**

**B-019**

**REPORT**



**IRSST**  
Institut de recherche  
en santé et en sécurité  
du travail du Québec

## La recherche, pour mieux comprendre

L'Institut de recherche en santé et en sécurité du travail du Québec (IRSST) est un organisme de recherche scientifique voué à l'identification et à l'élimination à la source des dangers professionnels, et à la réadaptation des travailleurs qui en sont victimes. Financé par la CSST, l'Institut réalise et finance, par subvention ou contrats, des recherches qui visent à réduire les coûts humains et financiers occasionnés par les accidents de travail et les maladies professionnelles.

Pour tout connaître de l'actualité de la recherche menée ou financée par l'IRSST, abonnez-vous gratuitement au magazine *Prévention au travail*, publié conjointement par la CSST et l'Institut.

Les résultats des travaux de l'Institut sont présentés dans une série de publications, disponibles sur demande à la Direction des communications.

Il est possible de se procurer le catalogue des publications de l'Institut et de s'abonner à *Prévention au travail* en écrivant à l'adresse au bas de cette page.

### ATTENTION

Cette version numérique vous est offerte à titre d'information seulement. Bien que tout ait été mis en œuvre pour préserver la qualité des documents lors du transfert numérique, il se peut que certains caractères aient été omis, altérés ou effacés. Les données contenues dans les tableaux et graphiques doivent être vérifiées à l'aide de la version papier avant utilisation.

Dépôt légal  
Bibliothèque nationale du Québec

IRSST - Direction des communications  
505, boul. de Maisonneuve Ouest  
Montréal (Québec)  
H3A 3C2  
Téléphone : (514) 288-1 551  
Télécopieur: (514) 288-7636  
Site internet : [www.irsst.qc.ca](http://www.irsst.qc.ca)  
© Institut de recherche en santé  
et en sécurité du travail du Québec,

# Patrol cars, low back pain and Québec police officers

Marguerite-Michelle Côté  
Work Organization Program  
IRSST

with the collaboration of :  
Blaine Hoshizaki and Mary-Ann Datzell  
McGill University

**BIANIS DE  
COMMISSAIRES**

**REPORT**

TABLE OF CONTENTS

iii

	Page
TABLE OF CONTENTS.....	iii
ACKNOWLEDGEMENTS.....	v
LIST OF FIGURES.....	vii
LIST OF ILLUSTRATIONS.....	ix
INTRODUCTION.....	1
1. BACKGROUND.....	3
2. THEORY AND HYPOTHESES.....	5
3. METHODOLOGY.....	11
4. RESULTS OF THE BIOMECHANICAL STUDY.....	15
4.1 Analysis of the context of the sitting position in patrol cars by Blaine Hoshizaki, Ph.D.....	15
4.2 Impact of belt-attached equipment on police officers' low back pain by Mary-Ann Dalzell, M.Sc., Ph.Th.....	25
5. RESULTS OF THE SOCIOGRAPHIC STUDY.....	35
5.1 Back pain, a subject hardly discussed.....	35
5.2 Low back pain and car seats.....	37
5.3 The patrol car.....	40
5.4 Work organization.....	41
5.5 The argument of responsibility.....	42
5.6 Bureau de normalisation du Québec.....	47
DISCUSSION.....	51
APPENDIX 1 - List of Advisory Committee members.....	53
APPENDIX 2 - Schedule of activities.....	57

**ACKNOWLEDGEMENTS**

We sincerely thank all the members of the Advisory Committee (Guy Bilodeau, Marcel Bonenfant, Serge Gascon, Robert Loranger, Claude Mérineau, André Nadon, Georges Painchaud, Pierre Trudeau and Michèle Tremblay) for their participation in our working sessions.

We particularly wish to thank Messrs. Mérineau, Gascon and Bonenfant for their help in arranging the field activities.

This research also benefited from the comments and advice of Dr. Serge Bouchard, the Director of Internal Research at the IRSST, and of Dr. Ilkka Kuorinka, Invited Researcher at the IRSST. They both contributed greatly to the quality of this exploratory research.

In addition, we wish to mention the particularly warm reception that we received in all the municipal and provincial police stations that we visited. Except for one or two cases, we met with management, union representatives, and as many patrolmen as the circumstances allowed. This welcome, as well as the availability and generosity of the people that we met contributed greatly to the achievement of our research goals.

Finally, we would like to sincerely thank Lise Brière who organized our meetings, and edited all the preliminary reports as well as the final report.

**LIST OF TABLES AND FIGURES**

1. Body lean (front view).....	21
2. Anterior-posterior balance.....	22
3. Head and neck position.....	23
4. Equipment placement, Left side - counterbalanced.....	31
5. Equipment placement, Anterior - counterbalanced.....	32
6. Equipment placement - Anterior only.....	33
7. Postural deviations.....	34

**LIST OF ILLUSTRATIONS**

1. Illustration of a tall police officer's sitting position..... 38
2. Illustration of a medium-sized police officer's sitting position 38

**INTRODUCTION**

The problem of low back pain in the workplace is one of the most difficult problems to deal with. This is due to its very nature, which is not easy to grasp, and because our means of detecting, diagnosing, and consequently of preventing and curing it are seen as being deficient. It is even harder to understand through its discussion among the general public. Anyone attempting to deal with back pain in a rigorous manner risks being condemned by current opinion which runs high on the subject.

However, we must proceed. Otherwise, lack of knowledge becomes established. We believe that the problem should be documented and analyzed wherever possible in order to promote useful and productive discussion. The IRSST is therefore pleased to present this report from this perspective.

The questions asked were the following: Do Québec police patrol officers suffer from low back pain, and if so, to what is it related? Can the passenger compartment, and in particular the seat, be considered as influential factors?

The study is considered as preliminary in that it explores the subject from more than one viewpoint. First, with regard to methodology, the patrol officers' opinions are considered through direct interviews as well through subsequent analysis of the problem. Then, concerning the objectives, the focus is on correctly stating the problem instead of drawing too hasty conclusions.

Finally, there is the multidisciplinary aspect, where different viewpoints are considered as being better than one. The in-depth interviews and field observations are complemented by a biomechanical approach that solidly supports the other information brought to light.



This study should therefore be read in its proper context, considering the fact that it is a brief but rigorous study of low back pain in police patrol officers. It also deals with all the factors related to equipment, work organization, and policy standards.

As Director of the research programs in work organization and ergonomics, I am very pleased to endorse the conclusions of this report and I hope that they will have a positive impact on the subject.

Dr. Serge Bouchard

## 1. BACKGROUND

In November 1985, the Institut de recherche en santé et en sécurité du travail du Québec (IRSST), Quebec's occupational health and safety research institute, studied all the occupational injuries that received compensation from the Commission de la santé et de la sécurité du travail (CSST), Quebec's workers' compensation board. The report covered a number of problems concerning the validity of data, and consequently the reliability of the analysis that could be drawn from the CSST data.

From the point of view of the statistics as well as the phenomenon itself, the final report<sup>1</sup> by Berthelette and Gervais (1986) considered it premature to orient new research on the arrangement of the patrol car driver's seat without first clarifying and identifying the health risks in this occupational sector.

This recommendation was considered by the joint associations (Association paritaire pour la santé et la sécurité du travail - secteur Administration provinciale [APSSAP] and the Association paritaire pour la santé et la sécurité du travail - secteur Affaires municipales [APSAM]) who initiated two studies on the subject. The first was carried out for APSAM by Arsenault, Dolan and Van Ameringen (1987)<sup>2</sup> from M.D.S. Inc., and the second was a joint study by Hôpital St-Luc's community health department and the APSSAP (Tremblay & Tougas, 1988)<sup>3</sup>.

---

<sup>1</sup> Diane Berthelette and Michèle Gervais. Les maux de dos chez les policiers de la Sûreté du Québec, IRSST, Montreal, 1986, 10 p.

<sup>2</sup> Arsenault, Dolan, and Van Ameringen. Les principaux risques pour la santé et la sécurité du travail des policiers-patrouilleurs, APSAM, Montreal, 1987.

<sup>3</sup> This research is in progress.

The study by M.D.S. Inc. groups the sources of problems in police work into four categories: task content, technical organization of the work, work context, and human resources management. Vehicle seats, the amount of paperwork, and communications equipment are the three main problems pinpointed by the firm that are related to the technical organization of the work. Furthermore, the technical organization of police work is the most important of all the problems identified by the study. The researchers suggested a relationship between these deficiencies in technical organization and a series of occupational health problems: back pain, depression, excessive workload, stress, and marked loss of motivation.

The results of this first study prompted APSAM to submit a request to the IRSST. We agreed to bring together all parties involved in the dossier. An Advisory Committee was formed, made up of representatives of the employers (Sûreté du Québec, Service de police de la Communauté urbaine de Montréal [SPCUM], Association des chefs de police), the unions (Fédération des policiers du Québec, Fraternité des policiers de la Communauté urbaine de Montréal (CUM), Association des policiers de la Sûreté du Québec), joint associations (APSAM and APSSAP), and researchers. In the spring of 1988, the IRSST undertook a short exploratory study to identify the problems and their possible sources.

---

<sup>1</sup> See list of members in Appendix 1.

## 2. THEORY AND HYPOTHESES

A study of patrol car seats, however limited it might seem at first glance, is very helpful in advancing our knowledge and research methods relating to relationships between back pain and sitting position, between work organization and state of health, and between the statistical value and the true value of a phenomenon.

Our theoretical approach takes into account the research already carried out in this sector by Dolan, Arsenault and Van Ameringen (op. cit.). We were also influenced by the results of the Spitzer report, "Scientific Approach to the Assessment and Treatment of Activity-Related Spinal Disorders". (1987)<sup>1</sup> The Spitzer report had more than one feature of interest to us. On the one hand, it stressed the therapeutic and diagnostic difficulty represented by back ailments, and the necessity of an approach that is clearly multidisciplinary. On this point, the report emphasized that beyond the clinical problems, we must be capable of evaluating the functional, economic, social and sometimes legal consequences related to back ailments (Spitzer, 1987:D1). Furthermore, the Spitzer report proceeded to validate the CSST file for back- and neck-related ailments. The results of this validation revealed that

"36.5% of the cases of requests for compensation related to the anatomical region of the back and neck were poorly classified in the computerized files. This resulted in the exclusion of cases which truly originated in the back from back ailment diagnostics".<sup>2</sup> (Spitzer, 1987:D7)

---

<sup>1</sup> W.O. Spitzer et al. Scientific Approach to the Assessment and Treatment of Activity-Related Disorders. University of Toronto Press, Toronto, September 1987, 57 p.

<sup>2</sup> Translated from French.

Secondly, we compiled expert assessments requested by the police from consulting firms or from CSST inspectors. To our knowledge, several police departments had received complaints related to patrol car seats. Several commissioned expert evaluations were requested.

Mr. Paul Poirier, Engineer Ergonomist, stated in a 1982 report produced for a Quebec municipality concerning the 1982 Mercury Zephyr that

"it seems essential that work stations be designed and made available to police officers that meet as adequately as possible their anatomical and physiological characteristics, with the primary purpose of reducing accident risks and the impact on the physical state of these workers."<sup>1</sup>

In the report he recommended:

- support for the lumbar vertebrae;
- a seat that is adjustable for height, depth and inclination;
- an adjustable steering wheel;
- seat suspension;
- and, over the long term, redesigning of the entire passenger compartment.

Over the years, other expert evaluations had generally resulted in the same recommendations. There has been very little follow-up on these recommendations.

It is appropriate at this time to present a case history as an example.

---

<sup>1</sup> Translated from French.

From August 28, 1986, at his doctor's recommendation, a Quebec patrolman was absent from work until September 20th, 1986, due to low back pain following the use of a 1986 Chevrolet Caprice that came into service on August 7th of the same year. A request for compensation was submitted to the CSST. The health and safety coordinator requested an evaluation from the CSST. An expert appraisal was subsequently requested from a consulting firm.

The CSST report, which does not contradict the consultant, concluded

"that driver and passenger seats in the 1986 Chevrolet Caprice patrol car (no . ) are not safe, and affect the health of the workers".

We should note these observations:

- There is a deviation of 4.5 cm between the centre of the steering wheel and the centre of the driver's seat.
- The front edge of the driver's seat is not perpendicular to the car's axis, i.e., it forms an angle of 95°.

The decision to modify the seat consists of the following:

1. Respect the natural curve of the spine by specifically providing support for the lumbar vertebrae. This support would be adjustable, if possible.
2. The seat angle would be adjustable.
3. The seat position would be adjustable in height, angle if possible, and definitely in a forward-backward direction.
4. The steering wheel should be adjustable in all new vehicles.
5. Seat padding and springs should absorb the vibrations transmitted to the pelvis, particularly the vibrations located in the resonance zone of the internal organs and other vulnerable parts of the body.

During a verification visit in November 1986, an inspector noted that

"In this problem, it appears that risks related to poor organization of seats have been identified by the two parties. How can seats meeting the requirements identified in the report be obtained?"

On December 19, 1986, the CSST rendered its decision on the patrolman's request for compensation. Following the advice of an orthopedic surgeon involved as arbitrator in the case, the CSST refused payment of compensation for the 23 days of absence from work for low back pain. The doctor stated that there was no relationship between the low back pain and the police officer's work. In this case, he associated low back pain with the fact that the worker was obese and didn't do any physical exercise.

In February of 1987, the patrolman applied to the occupational injury appeal board to appeal the CSST decision. Judgement was rendered on May 3rd, 1988. In an interesting argument which is too long to cover here, the judge reversed the decision, and recognized that the worker had been a victim of an occupational injury.

We therefore have, in the case of police patrol officers, a description of a typical case outlined in the Spitzer report: a complex situation where diagnostic difficulties are juxtaposed with the functional, socioeconomic, and legal aspects related to work organization.

To document the case of low back pain in the police environment, we favored two approaches: one was sociographic, and the other biomechanical.

We stressed the sociographic aspect in order to show more systematically an observation method that is present in almost all research into man-machine relationships, in both engineering and ergonomics, but which is all too often considered as peripheral and complementary. This sociographical aspect must

take into account the general context of the request, the comments of the people affected by the problem, and all non-verbal pertinent information.<sup>1</sup>

The general context of the request is determined from case histories (i.e., the background) and factors peripheral to the dossier such as purchasing policies, the role of the Bureau de normalisation du Québec (BNQ), that of the CSST, manufacturers' interests. It is very evident that the scope given to the general context is limited by depth of the research itself. In these cases, it should be limited to several months.

Furthermore, our approach has taken into account the expertise of the patrol officers themselves in determining and solving the problems. We were able to consider their expertise through individual semi-structured interviews and group meetings. In both cases, we chose the most suitable days and times, within a familiar context that promoted dialogue. Group dynamics was also considered an important aspect since it was where individuals could collectively confront and qualify their knowledge. A climate of confidence between the researcher, the participants, and the patrol officers determined the quality of the information collected.

The body of data established from this field research is the content of a series of discussions whose subject was chosen by the people requesting the study.

In this context, these discussions are very complex to analyze insofar as low back pain is difficult to define theoretically and that the discussion about the passenger compartment and back pain can be a favored means of communication for many different reasons in expressing other problems such as stress, problems in task content or in work organization.

<sup>1</sup> M. Coté. Les jeunes de la rue à Montréal, une étude d'ethnologie urbaine. Doctoral thesis (Ph.D.), Université de Montréal, 1988, 364 p.



Lastly, we collected a series of observations made inside patrol cars. Several photographs were taken. Once again, this is an exploratory study and time-restricted.

We felt it necessary to situate the results of our sociographic study in relation to a scientific reference point. This reference point is the conjuncture of a biomechanical approach to, and an orthopedic evaluation of, the context of the sitting position in patrol cars.

This exploratory study is based mainly on a general hypothesis: work-related low back pain in patrol officers is the consequence of a situation at once dependent on the passenger compartment, the equipment worn around the waist, the job content, and work organization. We excluded low back pain resulting from congenital malformation or accidents.

A secondary hypothesis involves more specifically a biomechanical approach. Taking for granted the complexity of the etiology of low back pain, we believe that the weight and distribution of the equipment worn by police officers cause a mechanical stress on the back and a harmful postural correction. Furthermore, the fact that a conventional seat provides no support, cannot be adjusted, and results in an incorrect sitting position, all combine to create a biomechanical situation favorable to low back pain and over the long term to back problems: joint inflammation, muscle spasms, irritation of the sciatic nerve, and injury to the intervertebral disks <sup>1</sup>.

<sup>1</sup> P. Branton. Behavior, Body Mechanics and Discomfort. Ergonomics, 12(2), 1969, pp. 316-327.

W.F. Floyd and J.S. Ward, Anthropometric and Physiological Considerations in School, Office and Factory Seating. Ergonomics, 12(2), 1969, pp. 132-139.

J.J. Keegan, Alterations of the Lumbar Curve Related to Posture and Seating. Journal of Bone and Joint Surgery, 35, 1953, pp. 589-603.

### 3. METHODOLOGY

To verify the general hypothesis, we decided to do a field study. We interviewed patrol officers about things directly related to their actual situation, namely the nature of their problems, what they felt were the causes, and the solutions they already were considering. We followed the same process with officers and union representatives.

To do this, we carried out direct interviews with individual and with groups. In the field, we extensively observed the work premises, equipment, and all aspects related to patrol officers' work (in Montréal and Québec), and collected all the internal documents available which could clarify the situation. To this program we added meetings with key persons involved in the dossier, such as people responsible for driver training, someone from the Bureau de normalisation du Québec (BNQ), people responsible for health and safety from municipalities, and a representative from GMC.

Overall, we visited 26 municipal police stations and 9 Sûreté du Québec police stations. The meetings in the stations generally lasted three hours. We carried out 30 interviews with participants from the police, municipalities, the CSST, the BNQ and GMC. At one of these meetings with participants, approximately 40 union representatives from the Québec region were present. Adding to this the 60 patrol officers who underwent the biomechanical team's tests, we can state that more than 600 people were involved in this study.

The limit number of stations involved and people interviewed was determined by information redundancy. In other words, when the field study produced no new information, the study could be stopped and the data analyzed.

The information collected was first grouped into broad categories, as for example: everything involving back pain, the offices, work relations, and vehicles. Next, we proceeded to analyze the content of this information.

With regard to the specific hypothesis concerning the biomechanical approach, sampling was limited to 60 police patrol officers. A first group (for studying the weight and distribution of equipment around the waist) was made up of 20 patrol officers with back problems and 20 without back problems, and was homogeneous with respect to sex, height, weight and the number of years of experience (10 and 15 years). Another group of 20 people, heterogeneous with respect to weight and height, participated in an evaluation of 3 seats: a new conventional seat, a used seat, and an orthopedic seat. We limited the seat study to one make, the Chevrolet Caprice, chosen because of the intention of most police stations to purchase it. The Montreal Urban Community Police Department took on the task of contacting participants and setting up meetings, taking into account the many constraints involved in such a procedure. This several-month project prevented the study team from proceeding with its investigations.

#### The Itinerary

The regions and the municipalities as well as the methods of operation were not chosen arbitrarily. The Advisory Committee, made up of people representing employers and unions in the organization of Quebec police departments, assigned three of its members the task of choosing the municipalities: Mr. Bonenfant, Health and Safety Director for the Sûreté du Québec; Mr. Serge Gascon, District Director for the Montreal Urban Community Police Department; and Mr. Claude Mélineau, Director General of the Joint Association, Municipal Affairs Section (APSAM).

This collaboration resulted in a list of people and places to visit from

Montréal to Lac St-Jean, Trois-Rivières, La Tuque, Saguenay, the North Shore to Baie Comeau, Matane to Québec City, the Eastern Townships, and finally the Laurentian region followed by Abitibi-Témiscamingue<sup>1</sup>.

The police directors whom we first reached by telephone, recognized the relevance, as well as the necessity for the study. By means of simple telephone communications, we observed regional and municipal characteristics, expectations, reservations and initiatives beginning to take shape. Because the research mandate was limited, it was not possible to thoroughly examine all the issues that were raised in these telephone calls.

In certain cities, there also was a health and safety committee made up of officers and patrol officers, which could be used for accessing information.

In the majority of cases, the meetings in police stations were carried out according to the following guidelines:

A. Meeting with Station Directors:

- Briefly state the background of the dossier;
- What are the problems encountered in the municipality?
- Ask for the file history on vehicle selection;
- What types of vehicles are actually being used at the station?
- If he claims to have no problems, how does he explain it in relation to the situation in other cities in his region?
- If he claims that he no longer has any problems, what solutions has he found? Ask whether there have been other changes during the same period: transfers, job changes, changes in management attitude, etc.;

---

<sup>1</sup> See the detailed itinerary in Appendix 2.

- How does he describe his relationship with his employees?
- What is his relationship with the CSST in the region?
- Has he already requested an expert study independently, or collectively with other cities in his region?
- If so, what were the conclusions of the investigation? Is he satisfied? Is it possible to obtain a copy of the report?

B. Meetings with Patrol Officers

- Briefly describe the dossier history and purpose of the Québec study tour;
- Collect comments on back pain and diagnostics, if applicable;
- Number of hours spent in the patrol car;
- What they think of their cars;
- Do they have their own solutions:
  - . Initiatives taken in everyday life,
  - . What they would like concerning changes in their vehicles;
- Note the equipment around the waist;
- How do they evaluate their relationship with the director?
- How do they evaluate their relationship with the CSST in the region?
- What are the main problems encountered in performing their work?

The methodology specific to the biomechanical approach is presented in the following chapter.

#### 4. RESULTS OF THE BIOMECHANICAL STUDY

The biomechanical study involves two aspects: 1) the characteristics of a standard patrol car now used by police departments and 2) the consequences of the equipment worn on police officers' belts on low back pain.

##### 4.1 Analysis of the Context of the Sitting Position in Patrol Cars

by Blaine Hoshizaki, Ph.D.

The etiology of back pain or discomfort has numerous facets; for this reason, it is rarely easy to pinpoint the so-called cause. This operation becomes more complicated due to the fact that the pain often takes the form of low intensity physical stress over a long period, until there is a sudden increase in stress or another incident increases the pain. These two reasons explain the confusion surrounding the identification and the subsequent correction of situations causing back problems. In our sample of 20- to 30-year old police officers, forty-seven (47) percent have stated that they have felt low back pain. This number increases to eighty (80) percent as the police officers age. Even if the low back pain seems less serious than other discomfort, it often leads to the loss of a greater number of workdays and the greatest long-term disability. The attenuated character of causes of back-related disability often results in administrations giving very little attention to the problem, even if the relationship between stress in the workplace and low back pain has been clearly established in the laboratory.

A multifaceted research program is required in order to understand the cause of police officers' back pain. However, considering the scope of a project of this nature, we adopted the strategy of first defining the context of the sitting position in police patrol cars. A comprehensive research program should eventually include an evaluation of the effectiveness of the seat, a time-movement analysis of the parameters of the behavior of the upper and

lower parts of the body during work in the patrol car, and lastly, an evaluation of the driver's field of vision. The context of the sitting position includes the pan and back of the seat, the pedals, the steering wheel, and the dashboard instruments, all comprising the work station. Our preliminary research aimed to establish the value of the research protocol in evaluating the context of the sitting position in police patrol cars.

### Method

A group of twenty male police officers, aged 20 to 30 years, participated in the study which was carried out in McGill University's biomechanical research laboratory. The three seats used in the evaluation during the project were:

1. a well-worn seat (used for twelve months) was used to study seat deterioration over time (Chevrolet Caprice)<sup>1</sup>;
2. a new seat (Chevrolet Caprice); and
3. a prototype to provide comparative data for the two other seats.

We prepared the subjects by determining anatomical markers that allowed us to obtain kinetic<sup>2</sup> and kinematic<sup>3</sup> data, which we analyzed according to the segmental-mass model of Dempster (1955). The following anatomical points were marked on each subject:

- left ear (meatus),
- sixth (6th) cervical vertebra,

---

<sup>1</sup> The Chevrolet Caprice seats were supplied by the MUC Police Department's car fleet.

<sup>2</sup> Kinetic: involving movement.

<sup>3</sup> Kinematic: the mechanical study of movement.

- superior lip of the glenoid fossa (a point on the shoulder blade);
- left acromial process (part of the shoulder blade);
- right acromial process;
- left anterior superior iliac spine (pelvic area);
- right anterior superior iliac spine;
- lumbar region;
- lumbar-sacral joint (on the last section of the spine);
- lateral epicondyle of the left humerus (at the elbow);
- left radial styloid process (at the wrist);
- left major trochanter (top of the thigh bone);
- left ischial tuberosity (hip joint);
- epicondyle of the left femur (at the ankle); and
- left lateral malleolus (boney protrusion of the ankle).

35 mm photographs of the front and sagittal views of each subject were taken immediately after they sat down and after 10 minutes in each of the three seats. The photographs were developed and subsequently numbered and analyzed using computers and software from the Biomechanical Laboratory (Dupuis, 1986). The following information was collected:

anterior-posterior lean, lateral trunk symmetry, hip angle, and the head and neck position<sup>1</sup>. The data were analyzed by comparing the three seats.

---

<sup>1</sup> The anterior-posterior balance was determined using the following formula: calculation of the centre of mass of the upper body and multiplying the perpendicular distance from this centre to the lumbar-sacral joint by the sum of the masses of the upper body times gravity. The lateral trunk asymmetry has been evaluated using the deviation from the horizontal of the left and right acromions. The hip angle has been determined by the angle formed by the torso, the major trochanter and the lateral epicondyle of the left femur. Lastly, the head and neck positions have been evaluated using the positions of the ear orifice and the sixth vertebra in relation to the back of the seats.



## Results

During the interviews, 46.7% of the police officers complained of back pain or the uncomfortableness of the seats, more particularly of lower back pain, middle and upper back soreness with occasional shoulder soreness, neck pain, and of numbness in the legs. In order to compensate for the uncomfortableness of the seats, the subjects resorted to various strategies such as sitting on their radios (walkie-talkies), on a cushion, or on something else, or sat at an angle on the seat. It is appropriate to emphasize that in their cars, the police officers wore equipment that could weigh up to 5.45 kg (12 lb), a 2.27-kg jacket, 0.257 kg handcuffs, a 0.135-kg bullet case, as well as a belt with flashlight, revolver and walkie-talkie weighing 1.34 kg.

Balance in the sitting position is very important from both a functional as well as a postural point of view. The stability of this position is essential for the upper body to carry out certain tasks with ease and efficiency. Furthermore, if the upper body is balanced, the muscles that support the torso are less utilized, thus reducing their fatigue. In addition, a good seat results in a proper sitting position. A proper sitting position reduces the use of the supporting muscles, as well as stress on the skeletal system. Therefore, an adequate seat reduces pain and fatigue in the supporting muscles, and also the physical stress on the skeletal system.

When we compared the used seat to the new one, we realized that the angle formed by the back and pan remained the same<sup>1</sup>. This was a surprise, given that a large number of police officers had complained that the more

---

<sup>1</sup> This data contradicts the results of the sociographic study. More than once we saw very slanted seats. The observations of other participants (i.e., outside expert evaluations) also confirm this. The seat provided for the study could possibly be an exception.

a seat is used, the more its backward lean increases. However, after having measured the horizontal lean of the seat pan, we observed that the edge nearest the door had sagged, the used seat was thus found to be inclined by 4.67°. The new seat had no such incline. By examining body lean from the front, we observed that the used seat led to the greatest asymmetry, followed by the new seat, and that the most symmetrical position was obtained by the subjects sitting on the prototype (see Figure 1). We must also stress that the asymmetry increased after ten minutes in the case of old and new seats, whereas it decreased in the case of the prototype. Anterior-posterior balance has been estimated by the position of the lumbar-sacral joint in relation to the centre of mass of the upper body. Figure 2 shows that the used seat resulted in the subjects leaning backwards, the new seat was second in this respect, whereas the prototype forced them to sit upright (ideal position). The centre of mass was located behind the lumbar-sacral joint in all cases where the subjects used the seat back for support. The sitting position was also a function of the hip angle as well as the head and neck position. The hip angle was almost the same for used and new seats (94°), but less than 93° for the prototype, the pelvis being in an ideally stable position at 90°.

When the subjects were seated, the head was balanced in the horizontal position. In the case of used and new seats, the subjects leaned backwards and therefore had to flex their spines forward to have their heads in a horizontal position. (See Figure 3.)

#### Summary and Conclusions

We must caution the reader that this is a pilot study, which does not provide the data necessary for decision-making purposes. We must also stress that the measures that it contains are only a few of the dependent variables that can and must be studied to adequately evaluate the sitting position in police patrol cars. Nevertheless, these data are sufficient to conclude that police

officers' sitting position is not adequate from the standpoint of stability and posture. We also observed that deterioration of the seat with use has a negative impact on its capacity to provide an appropriate place to sit. The inability of the car seats to provide adequate support clearly increases the police officers' risk of suffering back pain and disability. More extensive in-depth research should be carried out to evaluate the sitting position in police patrol cars in order to formulate appropriate recommendations for the manufacturers.

Figure 1

**BODY LEAN  
(Front view)**

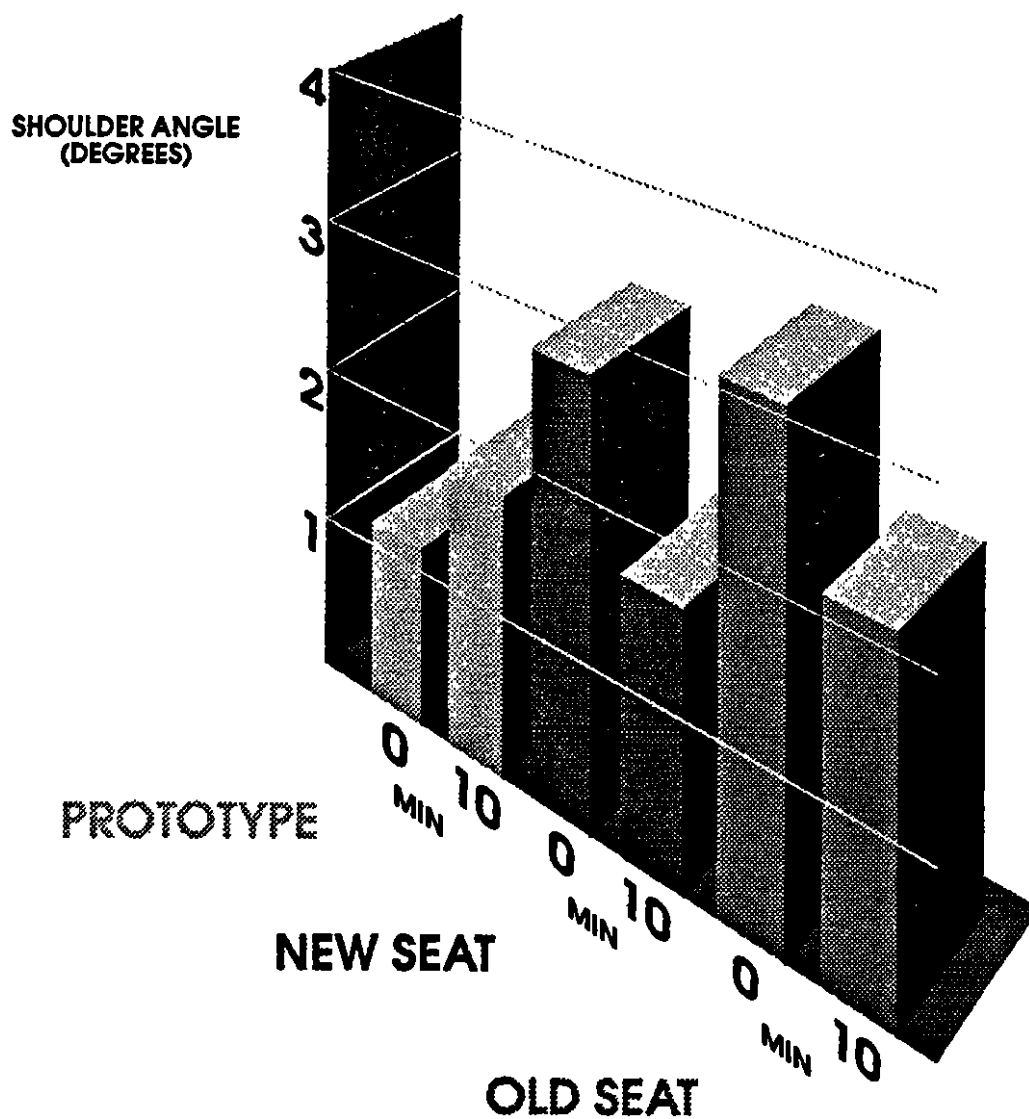


Figure 2

### ANTERIOR - POSTERIOR BALANCE

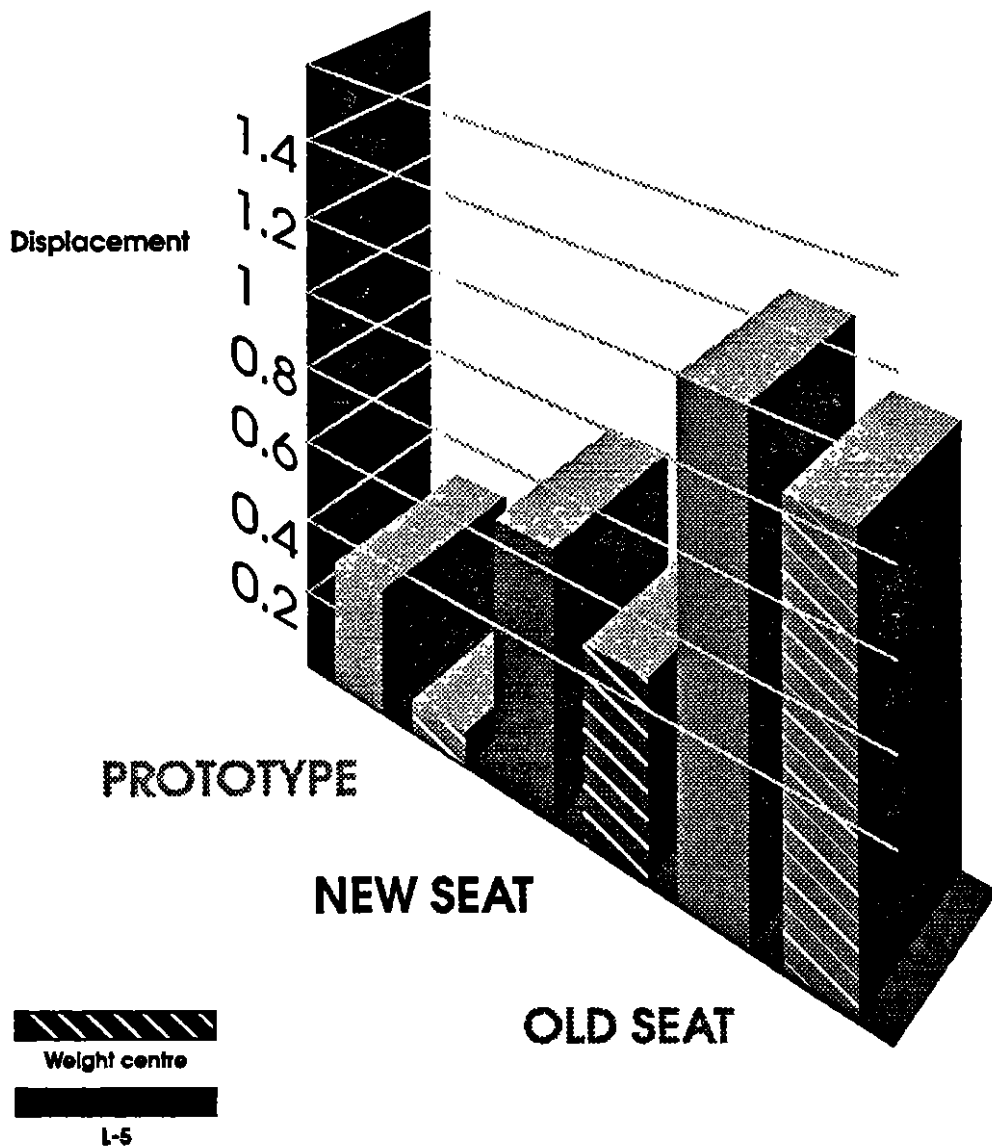
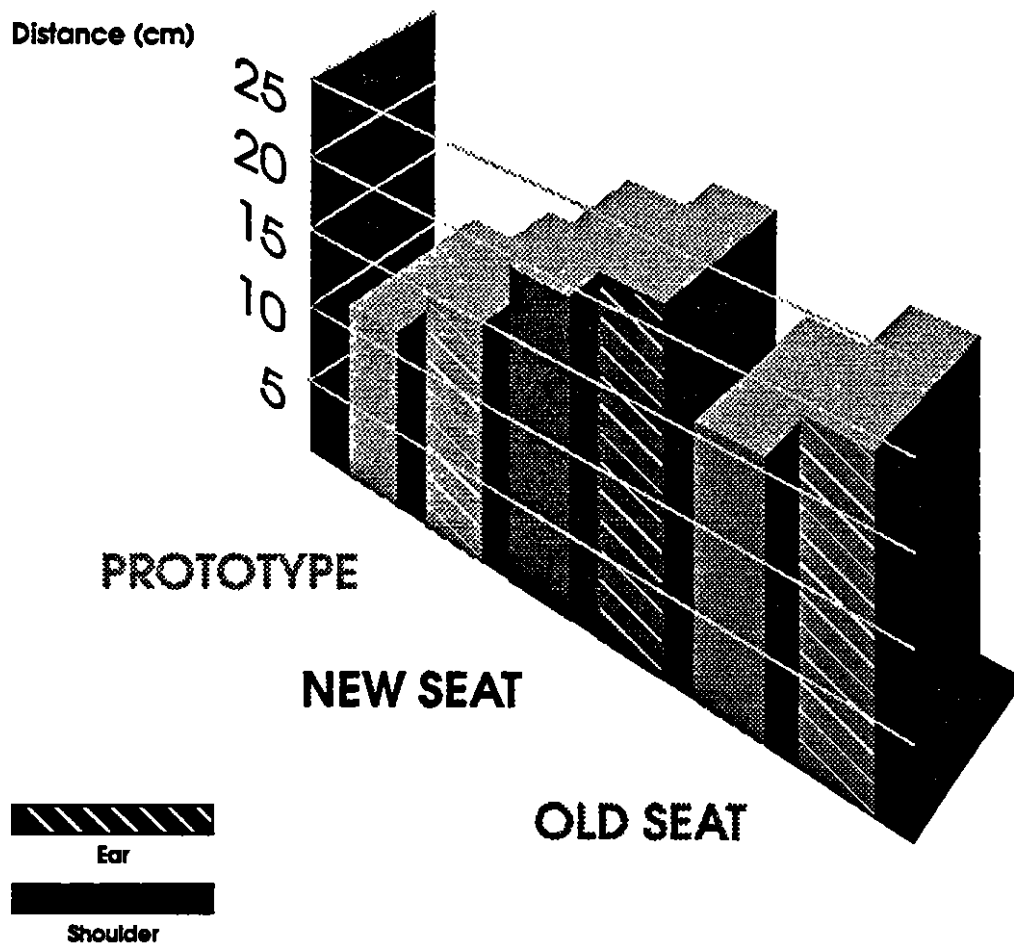


Figure 3

### HEAD - NECK POSTURE (Distance from seat)



#### 4.2 Impact of Belt-attached Equipment on Police Officers' Low Back Pain

by Mary-Ann Dalzell, M.Sc., Ph.Th.

Characterized by a slow onset of symptoms rather than a sudden acute injury, low back pain does not prohibit the majority of police officers from carrying out their daily tasks. The pain is most often localized to the lower lumbar region and is associated with muscle spasm and by general discomfort. Movements are painful only when they are made suddenly or in an extreme of range.

The police officers themselves frequently correlate their back pain with the distribution of belt-attached equipment. This equipment, which by regulation includes a revolver, handcuffs, a walkie-talkie as well as a flashlight, weighs a total of ten (10) to twelve (12) pounds or approximately 4.5 kg, and as a consequence, exerts a significant force on the spine. When combined with abdominal and paraspinal weakness, inflexibility in the key muscles that control the inclination of the pelvis, and poor general physical conditioning, the predisposition of the spine to injury is significant.

The overall objective of our preliminary research was to establish a correlation between the extrinsic forces of the belt-attached equipment and the intrinsic postural adaptations associated with these forces. More specifically, we wished to evaluate the postural alterations associated with changing the position and balance of equipment to determine whether the adaptations were permanent or transient and only present when the equipment was being worn. Lastly, the study attempted to determine whether these adaptations correlated with the development of low back pain in each of the subjects.

### Methodology

Sampling in the preliminary research included 37 patrol officers from the Montreal Urban Community Police Department, all having between 10 and 20 years of service.

As we had no access to their medical files, it was impossible to choose our sample in such a way as to obtain half with back problems and half without back problems.

The group was made up of the following:

- 10 had a significant and documented history of back problems;
- 18 had chronic problems with low back pain; and
- 9 had no symptoms of back problems.

Three of the subjects were thus replaced by patrol officers with fewer years of seniority, which resulted in a somewhat limited comparison of these data with data from the older group.

The examination protocol included:

1. a clinical evaluation of the spine including active and passive movement, special tests for pathology, and the flexibility and strength of key muscles;
2. identification of boney landmarks, using reflecting stickers and plastizote projections, which enabled us to objectively evaluate spinal deviations;
3. taking photographs of each subject when standing on a platform capable



of pivoting 180°, with and without the equipment attached to the belt. Using a 35 mm camera with 400 ASA film, we took a total of eight (8) photographs per subject, namely from the front, the back, and each side, with and without the previously mentioned equipment;

4. each of the subjects was weighed with and without the equipment to determine in each case the total weight of the accessories attached to the belt.

Analysis and treatment of the data were carried out using software developed specifically for this study. Each slide was digitized manually in a set sequence and mathematical formulae used to calculate linear and angular displacements in relation to the line of gravity with and without belt-attached equipment.

### Results

The great majority of the subjects in the study (91.7%) wore their revolver on one side and the remainder of the equipment on the opposite side. This practice is based mainly on accessibility of the revolver. However, among this group, 28 balanced all their equipment on the lateral aspect of the pelvis (Figure 4), and a small number (3) displaced the flashlight, walkie-talkie and handcuffs anteriorly (Figure 5) to allow them to sit in the patrol car without the need to rearrange their equipment. This anterior shift of belt-attached equipment was associated with increased lumbar lordosis (anterior angulation of the pelvis), and this resulted in a higher incidence of back problems (66.7%) when compared to the subjects who took greater care to evenly distribute the equipment on their belts (28.6%).

Furthermore, two (2) subjects chose to wear all the equipment, the revolver included, on the anterior aspect of the belt (Figure 6) which resulted not

only in low back pain, but more significantly, in diagnosed disk problems which led to prolonged absences from work. In contrast, three (3) subjects chose to distribute the equipment evenly on both sides, and none of the latter had experienced any work-related back symptoms.

The intrinsic postural changes associated with wearing belt-attached equipment were significant ( $p=.01$ ) in all subjects despite the fact that the majority of participating police officers had 10 to 20 years of service. Furthermore, among the small number of police officers with fewer than ten years of service (three years on average), the postural shift was more pronounced when they wore their equipment ( $p=.001$ ).

The most common postural compensation for equipment placed with a concentration of weight on one side (8 pounds: 2 pounds) was side-flexion (Figure 7). A few subjects compensated by side-flexion to the side with the heavier weight and this resulted in a higher incidence of back pain (66%).

The most innocuous form of compensation was rotation of the pelvis and trunk in a clockwise direction about the transverse axis in order to bring the heavier equipment into better alignment with the centre of gravity. Only 25% of these police officers had any back symptoms.

The compensation profile associated with the highest risk was once again the "military posture" or increased lordosis. Of the ten (10) subjects in this group, five (5) had diagnosed sciatic nerve, disk, and facet joint problems, which resulted in absences from work.

The above-mentioned results can be best interpreted by analyzing the forces acting on the spine with the equipment placed in various positions. The ratio of forces associated with the most common equipment balance presented in Figure 4 is 5.93 Nm: 2.57 Nm in the frontal plane and 6.96 Nm: 3.02 Nm in the

lateral plane. Of these subjects, 28.6% had low back pain. Furthermore, the ratio of forces on the spine in the lateral plane for subjects wearing their equipment more anteriorly (Figure 6) is 9.98 Nm: 0 Nm. There is no counterbalance of forces to regulate the degree of strain on the pelvis and lumbar spine, and in our opinion this appears to create a higher preponderance of back problems (50%).

The severity of back problems as well as the level of musculoskeletal conditioning in the sample were determined by clinical evaluations. A fact to be noted is that a large majority of the subjects had very weak abdominals, poor endurance in their paraspinal musculature, and inflexible hamstrings, all of which contribute to the development of back problems. These findings correlate with the fact that the majority of the subjects had experienced some work-related back discomfort. It should be noted, however, that three of the subjects trained regularly, and had insignificant postural shift when wearing the equipment. In addition, none of the latter had low back pain.

#### Summary and Conclusions

Despite the rather limited sample in terms of the number of subjects studied, the results of this preliminary research show that postural alterations in the lumbar spine and pelvis occur in response to wearing belt-attached equipment. In addition, there is a correlation between the direction and degree of shift and the balance of equipment worn on the belt.

There were fewer postural changes with equipment evenly balanced on the belt than with equipment concentrated in weight on one side or in front of the pelvis. In the latter subjects, there also appeared to be a correlation between the postural compensation detected and the incidence and severity of low back pain. However, in contrast to these findings, the few police

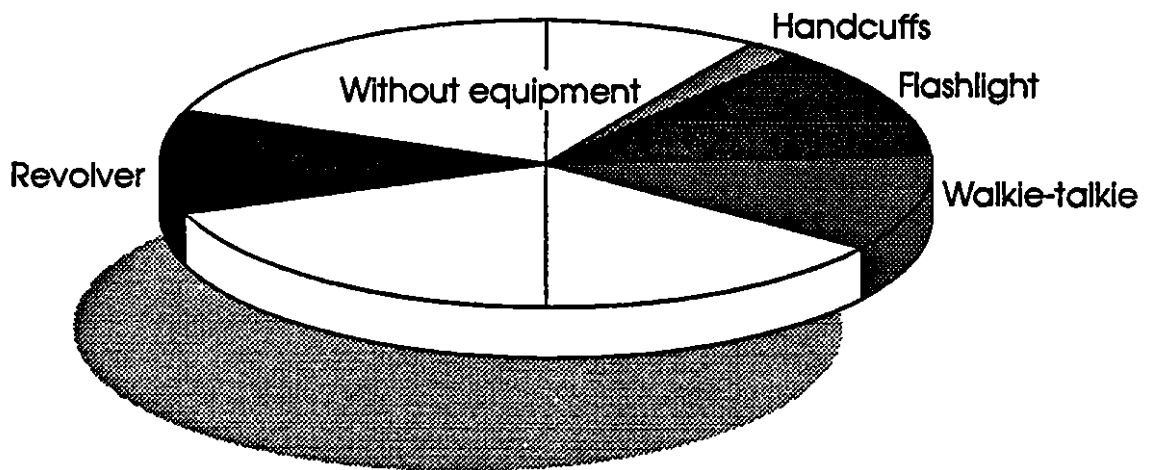
officers who trained regularly and had good strength, endurance and flexibility, had no back problems and a minimal postural shift when they wore the belt-attached equipment.

Considering the limitations of our sample from the standpoint of age and gender, and the problems encountered in selecting a control group without low back pain, it is very difficult for us to conclude with certainty that the pathologies identified in the subjects were caused mainly by the equipment worn on the belt.

As previously mentioned, the etiologies underlying the development of low back pain are multifactorial. Nevertheless, this pilot study shed light on the contribution of belt-attached equipment to the problem. It is proposed that a long-term prospective study to document the development of low back pain in police officers be implemented, and that simultaneously, a preventive program of counselling on the placement of belt-attached equipment and a physical training program be evaluated in order to reduce the high incidence of low back pain in police officers.

**FIGURE 4**

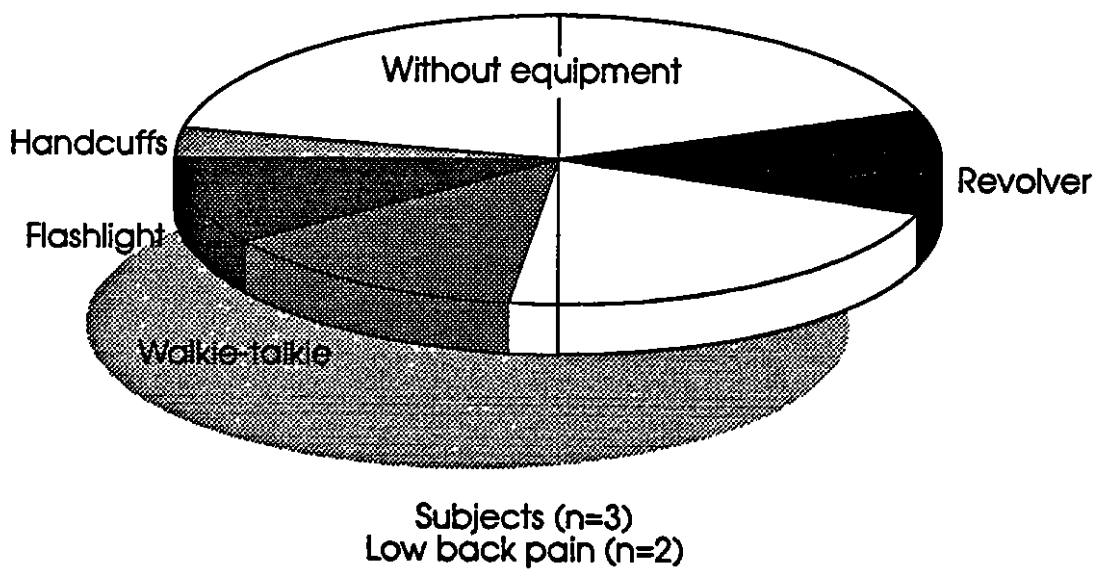
**EQUIPMENT PLACEMENT**  
(Left side - counterbalanced)



Subjects (n=20)  
Low back pain (n=8)

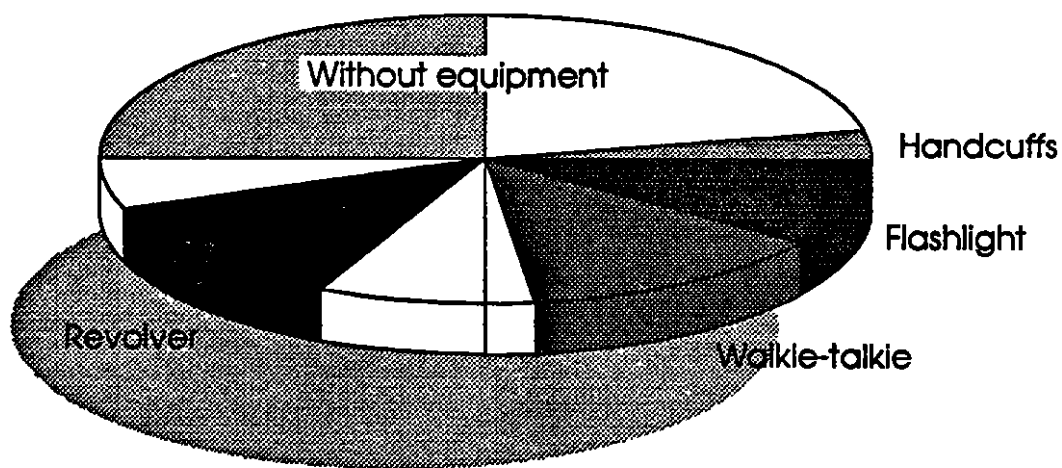
**FIGURE 5**

**EQUIPMENT PLACEMENT  
(Anterior-Counterbalanced)**



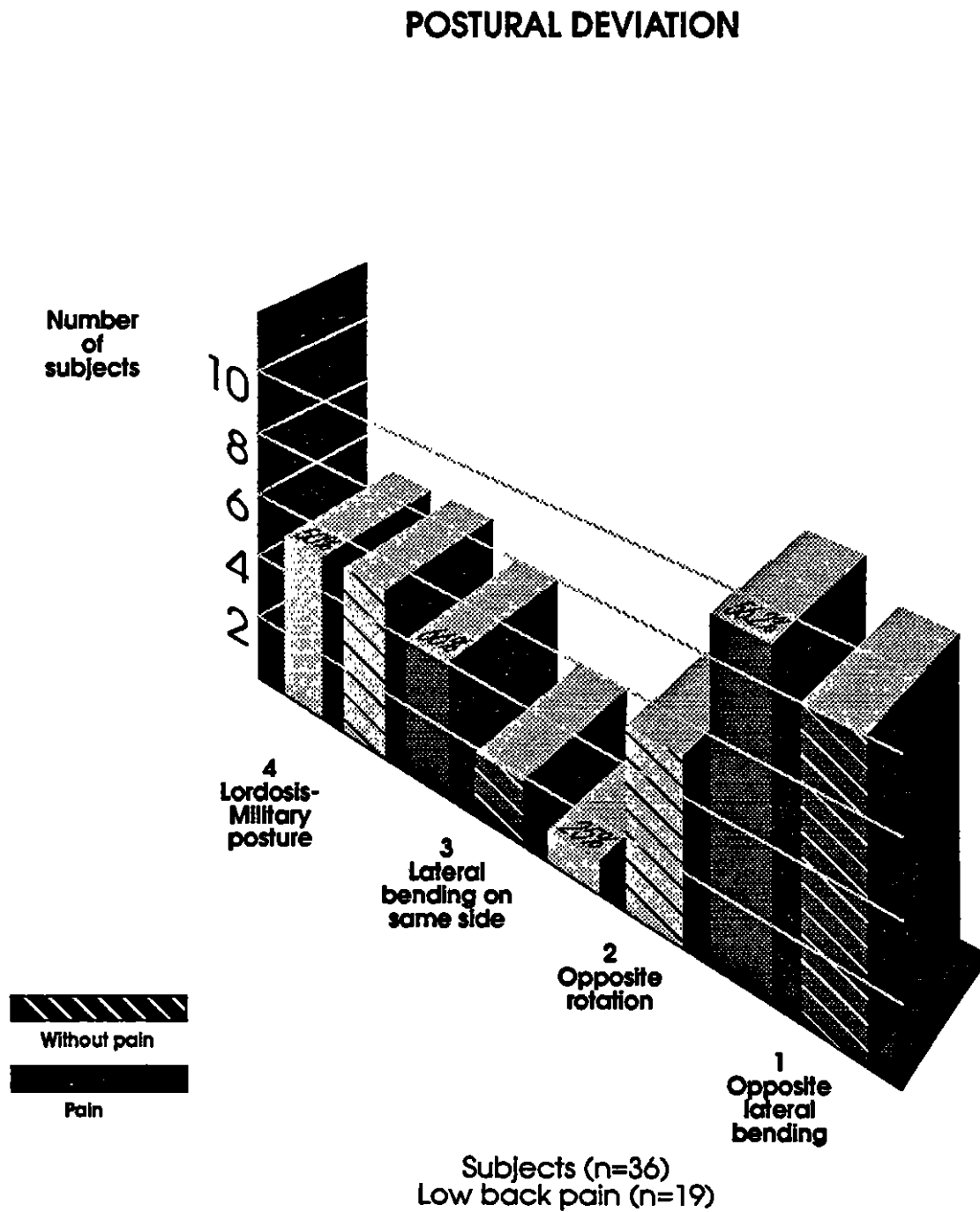
**FIGURE 6**

**EQUIPMENT PLACEMENT  
(Anterior view)**



Subjects (n=2)  
Low back pain (n=2)

FIGURE 7





## 5. RESULTS OF THE SOCIOGRAPHIC STUDY

We grouped the results into 7 different points.

### 5.1 Back Pain, A Subject Hardly Discussed

The results of the sociographic study confirm that all the statistics that we have on low back pain in the police environment underestimate the problem. Police officers talk about the quality of seats in patrol cars but complain very little of low back pain. They complain very little, not because they aren't suffering, but because they have reservations about voicing their complaints.

From the beginning of his career, a police officer learns not to show his emotions and suffering in public. He is a person who is expected to control events, judge them and act. Complaining leads to undesired labels such as "cry-baby" (complainer) and "system exploiter". Undoubtedly, there are persons who take advantage of the system, and also persons who complain, and it is thought best not to belong to this group.

Furthermore, many remain silent from fear of reprisals and other undesirable consequences. We don't know what type of reprisals are involved, but several considered it a risk even to write the researchers, and a good number of patrol officers did not want to identify themselves during the meetings.

As an example, the MUC Police Department had referred 36 patrol officers for the orthopedic investigation. According to its information, 3 of them stated that they had back problems. After clinical examination and the accompanying interview, 28 out of the 36 were found to have such problems.

Individual complaints to an organization such as the CSST, apart from accidents, are rare. Appeals, presented collectively, go through representatives of health and safety committees or the union. Appeals are usually supported by a CSST inspection, a study requested of an outside firm, an in-house investigation or a chiropractor's recommendation.

Patrol officers and police management distinguish two broad categories of low back pain: first, those related to an accident or an illness: sprain, strain, tear, elongation, dislocation, contusion, fracture, sacro-coccygeal cyst, problems with intervertebral disks, irritation of the sciatic nerve, joint inflammation, and muscle spasms. These back problems require visits to a doctor or chiropractor, medication and treatment. They often result in a reclassification into another job or another category, which is called a PRMT at the MUC Police Department for "policier en restriction médicale temporaire" (temporary medically restricted police officers), or PRMP for permanent medically restricted police officer. This means, for all practical purposes, the end of a career.

The second category is chronic low back pain which they call fatigue and which many people consider as normal and related to their work. Some improve their situation by practicing a sport, using an orthopedic cushion (we observed 4 different types) or by a series of chiropractic treatments. There is even a small municipal police force that supplies the orthopedic cushion when it purchases its vehicles. The cushion improves comfort but remains a cumbersome device for police work. For the purposes of this report, we use the term low back pain to describe this low back fatigue or chronic pain.

Patrol officers and police management associate low back pain with various causes: the poor quality and deterioration of the seats, passenger compartment constraints, poor physical condition, sequelae from an old injury, the number of hours spent in the vehicle, the equipment, personal stress, and the

number of years of experience, although there is no consensus on this last point.

## 5.2 Low Back Pain and Car Seats

The study, through its sociographic information directly related to patrol officers, confirms the existence of low back pain problems of which an indeterminate number are related to poor seat quality. We noted: the lack of thigh and back support, the too-low headrest, and the short lifetime of the seats on the door sides. In fact, and particularly for the Chevrolet Caprice, the angle of the seat back increases and the seat sags on the door side after only a few months of use.

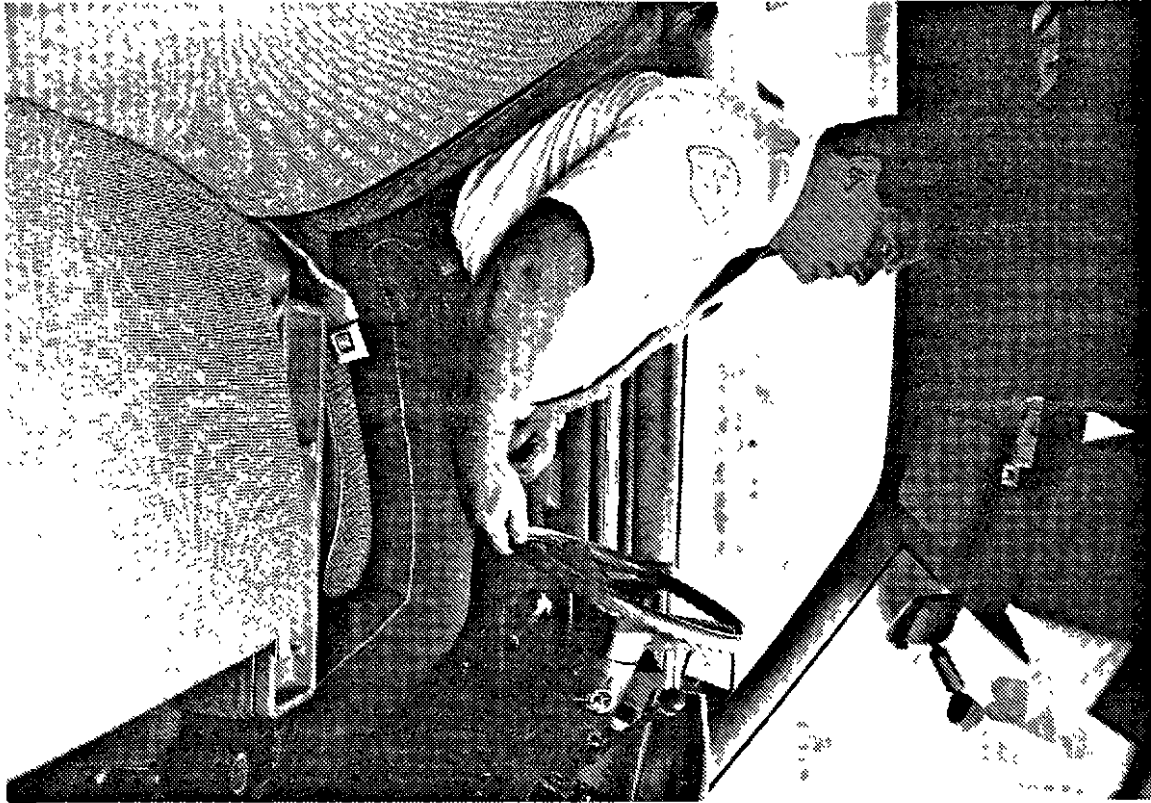
According to comments from police officers, police management, and Mr. Fernand Leclerc, the representative of the Bureau des normes du Québec, these seats are of poor quality and do not meet the requirements of police work to the point that some police officers have the seats stuffed and/or request external technical evaluations from the department.

The temptation is great to make modifications to the vehicle, namely: increasing space by moving the bench-seat guide rails backwards and increasing comfort by replacing the bench seat by one of another make.

We recommend such a practice, subject to its compliance with Canadian law which prohibits manufacturers from making modifications to a vehicle unless all safety tests are redone (NSVAC, Chap. 1038, Art. 6, 7, and 10 in: Motor Vehicle Safety Act). If applicable, we suggest that information be obtained from the person in charge of inspecting modified vehicles in Canada<sup>1</sup>.

---

<sup>1</sup> Mr. Raymond Sékaly, Government of Canada, Compliance Audit Inspection (613) 998-2336.



Patrol officers, their representatives, and managers of departments such as the motor vehicle fleet and driver training, are unanimous on the characteristics of a good seat. From the users' point of view, it should consist of:

- an adjustable reclining seat (within a certain angle);
- a seat back that is high enough to support the upper part of the back (Photograph 1);
- headrests that provide protection in the event of an accident. For medium-sized police officers, the headrests should reach the middle of the shoulders (Photograph 2);
- adjustable lumbar support;
- light bulging on the seat back and pan to hold the body in place while leaving room for equipment worn around the waist;
- adequate and resistant padding.

Policies concerning the purchase and disposal of vehicles vary from one municipality to another. In general, new marked patrol cars are assigned to the regular patrol, and after 2 years, used cars are used as reserves or for other purposes. The Montreal car fleet aims for a vehicle lifetime of 125,000 kilometres or 42 months, whereas the Sûreté du Québec aims for 180,000 km. The shortest disposal time among the stations visited was 70,000 km and the longest was 190,000 km.

### 5.3 The Patrol Car

Patrol cars used in Québec are purchased on the North American market, except for the municipalities of Ste-Agathe and Ste-Adèle, who use a European-made Volvo.

Traditionally, the three major American manufacturers, General Motors, Chrysler and Ford, dominate the patrol car market. Actually, the majority of cars are Plymouth Caravelles, Dodge Diplomats, Ford Crown Victorias, and the Chevrolet Caprice. There is also the Ford LTD, the Pontiac Parisienne, the Chevrolet Impala, the Pontiac V2000, and the Ford Taurus. The Reliant K is purchased but is not used as a patrol car.

The majority of 1987 and 1988 purchases were for the Chevrolet Caprice. According to Mr. St-Onge of General Motors, this car takes 40% of the entire North American patrol car market. For some time now, several police departments have been trying vans. The three major manufacturers are represented: General Motors, Ford Aerostar, and Chrysler Voyager.

Quebec patrol cars are not pleasure vehicles. They must meet the specific standards of the Bureau de normalisation du Québec (BNQ), standards established for a particular context. We will return to this later in the document.

Seat problems have never been dealt with separately from other aspects of the passenger compartment, namely: legroom, accessibility of safety belts, lighting, the position of the 12-gauge shotgun, the walkie-talkie, the non-adjustable and often off-center steering wheel, the suspension, the lack of space for the attaché case and the bodyguard partition.

Overall, some vehicles are more appreciated than others. The Ford Crown

Victoria with the 50/50 seats and arm supports is appreciated by police officers mainly when they have long distances to cover. In cities, opinions are divided, not on the quality of the vehicle, but on its size and driving ease in the maze of little streets. The Chevrolet Caprice is appreciated for its mechanical systems but hardly at all for its seat. In vans, the Chrysler Voyager is appreciated for the space in the passenger compartment and the driving ease for all sizes of men and women. This vehicle has satisfactorily passed the road-holding and performance tests in emergency situations carried out by the driver training department of the MUC Police Department.

#### 5.4 Work Organization

Another indefinite part of back pain is related to work organization:

- schedules that do not take into account court appearances
- the number of forms to be filled out in the vehicle
- policies regarding vehicle maintenance and use
- policies regarding visibility in the vehicle
- the number of vehicle users
- the absence of a prevention program
- certain police officers' lack of respect for Department equipment
- a significant problem in the decision-making process concerning vehicle evaluation and purchase.

Work organization shows that the formal (official) definition of work tasks does not correspond to the real task of the police patrol officer, and as a result, his needs are underestimated. Messrs. Dolan and Mélineau also brought up this point at the annual conference of APSAM in November 1988.

### 5.5 The Argument of Responsibility

All of the causes of low back pain and back pain identified during our meetings are generally related to the question of responsibility. The relationship is clear between the recognition of responsibility and of being in a position to make changes. A situation that does not evolve positively is considered to be one where there is a lack of intent to improve it.

Responsibility can be individual or collective: collective police administrations, police patrol officers as a group of individuals, and elected officials.

#### 5.5.1 Individual Responsibility

In the majority of cases, police officers or their representatives feel responsible for their low back pain. Good posture, practicing a sport, and proper nutrition are often identified as ways of improving their situation, and even of preventing low back pain. An accident, not necessarily at work, also could be a cause. Many associate low back pain with their number of years of service. Others qualify their views by specifying that, regardless of their physical condition and age, a poor quality seat does not result in good posture and creates discomfort. An uncomfortable seat is associated with the responsibility of police department managements. The reasons given to excuse managements of responsibility are a lack of funds and the absence of a clearly-defined standard from the BNQ.

The captain of a team at a Montréal police station carried out an in-house survey. 102 out of the 150 persons comprising the back-up personnel answered the survey. The following questions were asked:

1. Number of years of service.
2. Have you ever had an accident involving your back?



3. Have you ever had back problems?
4. Have you ever taken medication for your back pain?
5. Have you ever had treatment for your back pain?

The answers were computerized and processed using software from the BMDP Company. Overall, 29.4% of the police patrol officers questioned answered "yes" or "occasionally" to having had back problems. 26.5% stated that they had had an accident. Only 7.8% of the patrol officers took medication and 10.8% had had back treatments.

Contrary to all expectations, 52% of the respondents had between 1 and 5 years of experience and represented 78.6% of those who answered "yes" to back problems, 31.3% of those who occasionally suffered back problems, and 40.7% of those who have had an accident. However, the questionnaire identified particular patrol officers, and as has been seen, this affects the survey answers. The most experienced are less talkative or else state that they have occasionally suffered back pain.

#### 5.5.2 Collective Responsibility

Low back pain has various causes. Some low back pain results from the organization of the work and its management. Here we touch on aspects related to the collective responsibility of police administrations. Some of these responsibilities directly involve the vehicle and others are of a more general nature.

With regard to vehicles, patrol officers associate deterioration of cars with the number of users. In certain police stations, patrol activities are not divided into sectors, and as a result, the vehicles are not exclusively used by a small number of people. In this case, there is a limited feeling of personal ownership and responsibility towards the equipment. Consequently,

such a situation leads to more rapid deterioration of the equipment. Patrol officers also attribute to police administrations the responsibility for maintenance and repair of patrol cars as well as for the too frequent use of back-up vehicles for regular patrols.

More general responsibilities involve: work schedules, meals at irregular hours, and the lack of a prevention program.

Nevertheless, the great majority of police administrations recognize that the design of the patrol car passenger compartment and more specifically the seat, do not meet the requirements of the police officer's work.

The responsibility of the government, represented by its departments, is important because funding and standardization are dealt with at this level. Good seats aren't available because the lowest tenders are accepted and because there is no standard that obliges anyone to consider health and safety matters in relation to low back pain. We will return to this in section 5.6.

### 5.5.3 Elected Officials and the Management of Police Departments

Reflections regarding the municipality's impact on department management are the outcome of many discussions with Mr. Jean-Noël Tremblay, career administrator and consultant at the IRSST. Mr. Tremblay participated on several occasions in our research field activities.

Collective responsibility has been discussed previously and this responsibility refers us to administration levels in the municipal and provincial governments. In small municipalities, the municipal council plays a primary role in the purchase of equipment. Within the limitations of the study's observations, it is believed that the situation is more critical when

municipal councils assume complete decision-making responsibility for vehicle purchase on the basis of criteria that are quite unrelated to the workers' needs. These criteria result from the participants' assessment of the situation as well as from the management model.

The assessment can be based either on a series of preconceptions, be the result of a decision-making process, or be the result of both at the same time. In the most exaggerated preconception, the bureaucrat sees low back pain complaints as a strategy for police officers to get paid holidays, or even that patrol officers, for obscure reasons, willfully damage vehicle seats. Should this be the case, discussions to improve passenger compartments, including those in patrol cars will be difficult and often unproductive.

The most common situation remains the management decision-making process. Briefly, it can have two characteristics: it can be subdivided and it can be circumstantial. In this sense, it cannot be distinguished from what we often see occurring in business. It is subdivided because bureaucracy often places solid barriers between administrative levels. There is often little dialogue between decision-makers as well as a lack of direct access to basic information.

It is circumstantial because the decision-making process is a reaction to complaints and requests that happen in a specific sociopolitical and economic context, and also, not because there is a lack of good will, but because the process deals with limitations that are difficult to avoid. The three most frequent administrative limitations are: the administrative bid procedure, budget restrictions, and market availability. As a result, in the case of this study, the decision-making process encountered was rarely based on the rationale of securing adequate equipment, and even less on worker health and safety. This circumstantial decision-making process results in the

elimination of everything that falls within the realm of a common-sense approach.

By this we mean that people from the police environment recognize a certain number of problems related to the quality and characteristics of car seats. These problems end up not being considered because of administrative constraints that block access to equipment that is satisfactory to everyone.

Private interests, those of the dealerships, are also involved: their profit margins, their maintenance contracts and their monopoly. These interests also target a sociopolitical context that promotes a certain type of purchasing policy. When this policy favors the lowest bidder rather than a quality-price relationship, or even the intermediate bidder as in the case of Sweden, it can lead to all types of abuses.

At the other extreme, finding an ideal situation that satisfies all workers would be equivalent to seeking perfection which would only increase the need for expert evaluations without any way of ratifying their conclusions. The goal must be to establish health and safety standards, and to respect them.

### 5.6 Bureau de normalisation du Québec

As has been mentioned, even if scientific expertise is very limited, it is thought that the equipment supplied to patrol officers constitutes part of the many variables responsible for low back pain. One of the questions resulting from the study is: Why isn't it possible to have an adequate car seat? Some say lack of money, others talk about the lack of specific standards that manufacturers should respect. This last sub-chapter provides a short summary of this dossier in the Bureau de normalisation du Québec (BNQ).

The leaders in vehicle standards are: the International Standards Organization (ISO) in Geneva, and the Society of Automotive Engineers (SAE) in New York. The Bureau de normalisation du Québec established its standards for patrol cars in 1983 from SAE standard J1100a-1975 and ISO standard 4131-1979. There were few members on the Committee: 4 representatives from American automobile manufacturers (Ford of Canada Ltd, GMC Ltd., Chrysler Canada Ltd., and AMC Inc.), 1 representative from the Police Commission, and one from the BNQ acting as secretary. In the document produced (BNQ 1000-800), there is no reference to the intrinsic characteristics of a bench seat for police use.

In 1984, the Committee grew significantly, with marketing competition being established: 3 representatives from GMC, 2 from Chrysler, 3 from Ford and 1 from AMC, 2 representatives from the Sûreté du Québec, and 5 from the Government of Quebec's purchasing department, and of course, the representative from the BNQ. This massive participation suggests the importance that the main participants in the case assigned to establishing standards.

Paragraph 6.9.5 concerns seats and states

"that front seats must be divided (type 50/50, 55/45, 60/40, 40/40 or 45/45) and be individually adjustable or, depending on the purchase order, be either vinyl bucket seats or a full-width bench seat\*, of extra-durable construction, with foam rubber padding on the seat bench and back. Headrests, if adjustable, must not be removable. Bucket seats are excluded."<sup>1, 2</sup>

The asterisk directs us to a note at the bottom of the page stating that: "One must check with the manufacturers to find out what types of seats are available". There is no note to direct us to Appendix D of the document entitled: "Gouvernement du Québec - Spécifications d'achat (SAG no. 248)". Concerning seats, the government's policy called for:

SEATS: A divided durable front bench seat (50/50, 55/45, 60/40, 45/45 or 40/40, individually and electrically adjustable to 6 positions; regular rear bench seat, full width. Washable fabric for the surface in contact with the passengers. Fabric for front seat of the reinforced "police pack" type; rear-seat fabric of the regular type supplied by the manufacturer. Headrests, if adjustable, are nonremovable.

The meeting held in 1986, for 1987 models, marked another stage in the development of the standardization dossier. The committee was composed of 23 people, including many representatives of municipalities, and for the first time, the unions. Representation was as follows:

- . 7 representatives from the manufacturers: 2 from GMC, 3 from Chrysler, and 2 from Ford;
- . 9 representatives from the municipalities: 2 from each of the cities of Montreal, Laval, Quebec City, and Sherbrooke; and 1 representative from Sainte-Foy;

<sup>1</sup> The contradiction concerning bucket seats is in the original text.

<sup>2</sup> Quotes from BNQ documents have been translated from French.

. 5 association representatives: Association des policiers provinciaux, the Fédération des policiers municipaux du Québec, two representatives from the Fraternité des policiers de la CUM, and one representative from the Association des chefs de police et pompiers du Québec.

And of course, there were also representatives from the Police Commission and the BNQ. No one from the government's purchasing department and the Sûreté du Québec participated in this meeting. The rules of the game had changed. No meetings were held in 1987, and none were planned for 1988.

Paragraph 7.8.4.1 describes the seat as follows:

#### Types of seats\*

Depending on the purchase order, front seats must be separate or of a bucket type, individually adjustable. They must be of sturdy construction and padded with foam rubber on the pan and back. Headrests, if adjustable, must not be removable.

The asterisk directs us to a note at the bottom of the page stating that this option must be specified in the order. In Appendix G are the Quebec Government specifications, namely:

#### SEATS

Depending on the purchase order, a divided front bench seat: 50/50 or bucket seats, individually adjustable; full-width rear bench seat. Washable fabric for the surface in contact with the passengers. Regular rear seat construction and fabric from the manufacturer. Headrests, if adjustable, are nonremovable.

As this brief history shows, the BNQ not only assumes the role of developing standards but also that of intermediary between manufacturers, buyers and users. The authority relationship does not, however, aim at quality and the prevention of accidents and occupational illnesses. These facts appear problematical to the researchers. A neutral position for the BNQ is suggested, where it can set standards below which negotiations with private

interests can no longer occur. This situation is not specific nor exclusive to the BNQ. A recent article in Usine Nouvelle (December 1988) on standardization in Europe discusses a puzzle, a hypothetical battle, between protectionism, communication problems, and the necessity of sensitizing industry.

In Québec, it is clear that it is difficult to think of being able to obtain patrol cars and equipment that will meet the needs of police work and at the same time that target occupational health and safety concerns.

As we have already mentioned, patrol officers and their associates generously participated in this study, but they indicated they had very little hope that things would change.

The study team therefore encountered a deteriorating working climate that directly challenges Quebec society and its government.



## DISCUSSION

This preliminary research confirms the complexity of the problem of low back pain. The general hypothesis has been proven. In fact, low back pain related to police patrol officers' work is the result of a context involving the passenger compartment, the equipment worn at the waist, job content, and work organization. However, we are not in a position to evaluate the relative importance of each of these factors.

Analysis of the discussions reveals that the concerns of police patrol officers goes well beyond low back pain. Police officers express their stress through a discussion of low back pain, the organization of the patrol car, the organization of work schedules, and the consumption of medication (analgesics, amphetamines, and sleeping pills).

The patrol officers, their representatives, and managers of departments such as the car fleet and driver training, are unanimous on the characteristics of a good seat. From the users' point of view, it should consist of an adjustable reclining seat (within a certain angle); a seat back that is high enough to support the upper part of the back; headrests that provide protection in an accident; adjustable lumbar support; light padding on the seat back and pan to hold the body in place, while leaving room for the equipment worn around the waist; and adequate and resistant padding.

The external expert evaluations requested by the police departments or done by the CSST do not contradict the users' comments and suggestions. In both cases, the seat problem has never been dealt with separately from other aspects of the passenger compartment, namely legroom, accessibility of the safety belt, lighting, the position of the 12-gauge shotgun and the walkie-talkie, the position and adjustment of the steering wheel, the suspension, etc.

Using only one brand of seat, we briefly checked the characteristics of a standard seat used by police forces. The biomechanical study, despite its limitations, concluded that police officers do not have a proper sitting position from the standpoint of stability and posture. It was also observed that the deterioration of the seat with use has a negative impact on its capacity to provide an appropriate place to sit. The failure of the seats to provide adequate support clearly increases a police officer's risk of suffering back pain and disability.

Furthermore, patrol officers, like many other workers, have to wear a certain amount of equipment around their waists that is necessary for their job. Can the weight worn around the waist also cause back problems? Despite a rather limited sample, the results of this preliminary research show that postural changes in the lumbar vertebrae and the pelvis occur as a result of the impact of the equipment worn on the police officer's belt. In addition, there is a correlation between the direction and degree of deviation and the balance in the equipment held by the belt. The etiology relating to the development of low back pain is due to many other factors. However, this preliminary study further clarified the contribution of the equipment worn on the belt to the problem.

Finally, we observed that as a result of the government's actual purchasing policies and market availabilities, it is not possible to have a passenger compartment that meets the patrol officers' needs.

We feel it is necessary to develop and extend the study of low back pain as it relates to police officers. In spite of the complexity of the problem and our inability to determine the relative importance of each of the factors in the dossier, we recognize that police patrol officers do not have equipment that is appropriate for carrying out their tasks.

APPENDIX 1

LIST OF ADVISORY COMMITTEE MEMBERS

## Appendix 1

## PATROL CAR PROJECT

## LIST OF ADVISORY COMMITTEE MEMBERS

Mr. Claude Méryneau Director General APSAM	Mr. Marcel Bonenfant Sûreté du Québec Personnel Relations Department
Mr. André Nadon Vice President Fédération des policiers du Québec	Ms. Ghislaine Tougas, Ergonomist St-Luc Hospital Community Health Department
Mr. Georges Painchaud Director Technical Services Fraternité des policiers de la CUM	Ms. Michèle Tremblay, M.D. St. Luc Hospital Community Health Department
Mr. Guy Bilodeau Association des policiers de la Sûreté du Québec	Dr. Serge Bouchard Director Work Organization and Safety-Ergonomics Program
Mr. Serge Gascon District Director SPCUM	Ms. Marguerite-Michelle Côté, Ph.D. Project Director IRSST
Mr. Pierre Trudeau Director St-Hubert Police Department	
Mr. Robert Loranger APSSAP	

APPENDIX 2

SCHEDULE OF ACTIVITIES

SCHEDULE OF ACTIVITIES - AUGUST 1988

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
08	09	10 AM St-Jérôme MUNI. PM St-Sauveur MUNI.	11	12	13	14
15	16 AM Grand-Mère MUNI. PM La Tuque MUNI.	17 AM Roberval MUNI. PM Roberval SQ	18 AM Alma SQ PM Jonquière MUNI.	19 AM Chicoutimi MUNI. PM Chicoutimi SQ	20 AM La Baie MUNI.	21
22 AM Forestville SQ AM Baie Comeau SQ PM Baie Comeau MUNI	23 AM Matane SQ PM Mont-Joli MUNI.	24 AM Rimouski MUNI. PM Rimouski SQ	25 AM Rivière-du-Loup MUNI. PM Rivière-du-Loup SQ	26 PM Quebec MUNI.	27 AM Charlesbourg MUNI.	28 PM Sherbrooke MUNI.
29 AM Sherbrooke MUNI. PM Cowansville SQ	30	31 AM Trois-Rivières MUNI. PM Shawinigan-Sud MUNI.	01	02		

MUNI.: Municipality  
SQ : Sûreté du Québec

SCHEDULE OF ACTIVITIES - SEPTEMBER 1988

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
			01	02	03	04
05	06	07	08	09	10	11 AM & PM Station 32 Montreal
		PM St-Hubert MUNI.				
12	13	14	15	16	17	18 AM & PM Station 22 Montreal
19	20	21	22 PM Val d'Or MUNI.	23	24	25 AM Rouyn-Noranda MUNI.

MUNI.: Municipality  
 -SQ : Sûreté du Québec

SCHEDULE OF ACTIVITIES - OCTOBER 1988

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
					01	02 AM & PM Station 33 Montreal
03	04	05 PM St-Hubert MUNI.	06	07	08	09 AM & PM Station 55 Montreal
10	11	12	13	14	15	16
17	18	19	20	21	22	23

MUNI. : Municipality