

**HEALTH EFFECTS FROM EXPOSURE TO TRAFFIC  
RADAR UNITS IN MEMBERS OF THE RCMP**

**ASSESSING THE SAFETY AND POSSIBLE  
SIDE EFFECTS FROM THESE UNITS**

by

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A thesis submitted to the  
School of Graduate Studies and Research  
in partial fulfilment of the requirements for the  
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## ABSTRACT

Over the last few years the lay media have raised the question whether there may be a link between the use of police radar and the development of cancer. Radar has been used to measure traffic speed since the mid 1950's. Many of the published accounts of cancer in humans are anecdotal in nature while the majority of scientific work is animal or cell based. The purpose of this research study was to determine the profile of exposure and cancer outcomes in members of the Royal Canadian Mounted Police (RCMP) who have ever performed radar duties.

The design was a historical cohort study involving 4 cohorts. The target population was defined as all members of the RCMP who had been assigned to highway patrol from 1973 onward. Four cohorts of subjects were identified within this population and surveyed: pensioned members (n=1819), active members who had 30 or more consecutive days of sick leave (n=750), a sample of active members who had less than 30 consecutive days of sick leave (n=750) and the deceased members (n=146). The questionnaire ascertained police service, radar unit usage, diagnosis of cancer, risk factors for testicular cancer and socio-demographic information.

The overall response exceeded 70%. The data were analyzed for each cohort separately. Standardized incidence ratios were calculated using weighted data. The variables considered of primary importance among all of the cohorts included the exposure algorithm which was used to classify the amount of exposure to radar units, riskiness of the location of the radar unit when not pointed at a vehicle and cancer outcomes.

The results from this study provided the following information. The majority of respondents were male with the pensioners and the deceased exclusively male. The pensioner cohort reported that the number of years of police work ranged from 2 to 49 years of service with a median 26.0 years. Radar duty was performed by 78.1% of this cohort and the length of this duty ranged from one year to 33 years with a median of 7.0 years. Over half of the pensioners had their exposure level categorized as least exposed (54.5%).

The median number of years of police work did not differ between active cohorts and was equal to 18.0 years. The vast majority of the active member cohort with extended sick leave (98.4%) had performed radar duties. The median length of assignment to this job was 9.0 years with a minimum of less than a year to a maximum of 32 years. The classification of the exposure algorithm identified that 52.3% of these members were moderately exposed and an additional 35.9% were most exposed.

The cohort of active members without extended sick leave had a median of 7.5 years of radar use ranging from less than a year to 31.0 years. Over half of the members were classified in the moderately exposed level (56.2%) and less than a third were assigned to the most exposed (28.4%).

Regardless of the cohort membership as exposure increased to the highest levels, more members performed the riskiest behaviours with the radar unit.

Invasive cancers were reported by 7.4% of pensioners, 4.5% of active members with 30 or more consecutive days of sick leave and 1.5% of members without extended sick leave. Of the cancers diagnosed, testicular accounted for 5.2% of cancers reported by pensioners and 8.0% of cancers reported by the cohort of active members with extended sick leave. The most common primary cancer was melanoma (skin) accounting for 33.3% of cancers reported by the pensioners, 20% of cancers reported by members with extended sick leave and 50% of cancers among members without extended sick leave. The pensioner cohort had the bulk of cancer diagnoses (n=96), the active members with 30 or more days of sick leave reported 25 primary cancer sites and the active members without extended sick leave reported 6 cancer sites.

Proxy responses were received for 98 deceased RCMP members (69.0%). All members in this cohort were identified as male with a median age at death of 51.6 years. While 86.3% of this cohort performed radar duties, no attempt was made to estimate exposure. There were 41 positive reports of cancer (42.3%) with 43 primary sites. The most common organ group identified was the digestive organs (28.6%) followed by blood and lymph tissues (19.0%) which included six cases of cancer of the blood. There was one case of testicular cancer reported in this cohort.

In conclusion, based on the observed results, there is no conclusive evidence of adverse health effects from exposure to radar among these cohorts of RCMP members. The active members with extended sick leave were more exposed to radar units than any of the other cohorts. For all cohorts, as exposure increased so did the reporting of risky behaviours with respect to the radar unit location when not pointed at a vehicle. In comparisons with the 1971 standard Canadian male population, members of the RCMP who had been assigned to highway patrol did not have an excess of cancers diagnosed for all cancer types or for testicular cancer. However, an excess risk of developing melanoma of the skin (SIR = 7.8) and urinary tract cancers (SIR = 2.0) were identified.

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## 1. INTRODUCTION

Recently an increased awareness and concern has developed regarding the use of and exposure to common sources of man-made non-ionizing radiation (NIR). Exposure to low levels of NIR is part of everyday life. Some of these sources include radio frequencies such as AM or FM radiowaves, microwaves and electric heaters. Other sources of NIR are found in the workplace. Employment in the communications, security, medical, military, power and transportation fields to name a few may provide additional exposure to NIR.

Scientific research on the exposure to NIR has produced a plethora of opinions on the potential adverse effects from exposure to this type of radiation. In particular, law enforcement journals have reported anecdotal cases of cancer that have occurred in a small number of police officers who have operated radar units for the purpose of traffic control. Davis and Mostofi<sup>1</sup>, who studied clusters of cancers in police officers exposed to hand held radar, recommended that a full epidemiologic study be carried out.

An epidemiologic investigation was conducted to determine the profile of exposure and cancer outcome in four cohorts of Royal Canadian Mounted Police (RCMP) members who were assigned to highway patrol where radar duty was performed.

### 1.1. Background

#### 1.1.1. Non-ionizing Radiation

Non-ionizing radiation (NIR) has lower frequency (from 0 Hertz (Hz) to 3000 Gigahertz (GHz)) and longer wavelengths (from  $3 \times 10^8$  to  $3 \times 10^{10}$  meters) than ionizing radiation. It is these two types of radiation that form the electromagnetic radiation spectrum. Other than

our ability to see light (visible) and feel heat (infrared). humans are unable to detect most other forms of NIR.

Electromagnetic radiation is grouped in ascending order by wave frequency with the lowest being power lines and the highest ultraviolet light (Table 1)<sup>2,3</sup>. Radar (**R**adio **D**etecting **A**nd **R**anging) works by transmitting electromagnetic waves that are pulsed from the antenna and when these waves encounter a solid object they are reflected back and received by the unit. The pulsing of the signal means that the transmitted waves have greater amplitude than those received back.

**Table 1. Frequency Bands of Non-ionizing Radiation**

	FREQUENCY	WAVELENGTH	DESCRIPTION	EXAMPLES OF USES
RADIO WAVES	0 - 300 Hz	$> 10^8$ m	Extremely Low Frequency (ELF)	Electric power
	0.3 - 30 kHz	$> 10^4$ m	Very Low Frequency (VLF)	Voice, audio-frequencies
	30 - 300 kHz	$> 10^3$ m	Low Frequency (LF)	Military communications
	0.3 - 3 MHz	$> 10^2$ m	Medium Frequency (MF)	AM radio, communications, industrial RF equipment
	3 - 30 MHz	$> 10$ m	High Frequency (HF)	CB radios, diathermy, international communications
	30 - 300 MHz	$> 1$ m	Very High Frequency (VHF)	Police, etc. radios, radar, VHF- TV
	MICRO WAVES	0.3 - 3 GHz	$> 10^{-1}$ m	Ultra High Frequency (UHF)
3 - 30 GHz		$> 10^{-2}$ m	Super High Frequency (SHF)	Police radars, satellite communication
30 - 300 GHz		$> 10^{-3}$ m	Extremely High Frequency (EHF)	Satellite communication, radar, microwave relay
	0.3 - 400 THz	$> 10^{-6}$ m	Infrared Light (IR)	Terrestrial and solar spectrum
	400 - 800 THz	800 - 400 nm	Visible Light	
	800-3000THz	400 - 1000 nm	Ultraviolet Light (UV)	

Source: Adapted from Hankin<sup>2</sup> and Yost<sup>3</sup>

Radar units use microwaves (1 to 300 GHz) and belong to the radio waves part of the electromagnetic frequency spectrum. They are referred to as long wave, low frequency, low energy microwave and radiofrequency emissions.

## 1.2. Terminology

Numerous abbreviations and acronyms have been used throughout this thesis. These have been compiled and have been listed below.

ANSI	American National Standards Institute
CEU	Clinical Epidemiology Unit
CI	Confidence Interval
DNA	Deoxyribonucleic Acid
DL	Deceased Letter
DQ	Deceased Questionnaire
EHF	Extremely High Frequency
ELF	Extremely Low Frequency
Ghz	Gigahertz
HF	High Frequency
Hz	Hertz
IR	Infrared Light
LF	Low Frequency
m	metre
MF	Medium Frequency
Mhz	Megahertz
ML	Member (Active) Letter
MQ	Member (Active) Questionnaire
MW	Microwave
mW/cm <sup>2</sup>	milliwatts per centimetre squared
n	number
NIR	Non-ionizing Radiation
nm	nanometre
OR	Odds Ratio
PARADE	Personnel, Administration, Research and Development
PL	Pensioner Letter
PQ	Pensioner Questionnaire
RADAR	Radio Detecting and Ranging
RCMP	Royal Canadian Mounted Police
RF	Radiofrequency
SAR	Specific Absorption Rate
SD	Standard Deviation
SHF	Super High Frequency
SIR	Standardized Incidence Ratios
Thz	Terahertz

UHF	Ultra High Frequency
U.S.	United States
UV	Ultraviolet Light
VDT	Video Display Terminal
VHF	Very High Frequency
VLf	Very Low Frequency
W/kg	watts per kilogram

### 1.3. Radar Units

Since the mid 1950's police departments across Canada have used radar units for traffic control. The units are manufactured by a small number of companies in Canada and the United States (U.S.). The original models were operated from outside the police vehicle with the radar unit mounted on a tripod by the side of the road while the police officer worked in a concealed area away from the radar antenna. A second police officer was then radioed a description of the offender in order to issue the speeding ticket. As technology changed these radar units were replaced by units that could be operated in the police car and required only one police officer to enforce the speed limit. In general there are two types of radar units, those that are mounted in or on the vehicle and those that are hand held (radar guns). Prior to 1983, radar units regardless of type were x-band and emitted 10.525 GHz. In 1983 k-band (24.150 GHz), which emit a higher frequency wave, came into use. Testing in Canada<sup>4</sup> and the U.S.<sup>5</sup> has shown that under normal operating conditions police officers in their vehicle are exposed to levels between 0.02 and 0.05 mW/cm<sup>2</sup> which is well below the North American safety limit of 5.0 mW/cm<sup>2</sup>. Investigations into hotspots<sup>6</sup>, which may produce elevated levels, also indicate levels within safety limits with measured exposure levels less than 1.0 mW/cm<sup>2</sup>. More recently the newest technologies that are becoming available are photo-radar and laser radar. The latter, which does not emit NIR, is the subject of ongoing reports published in the law enforcement press.

## 2. LITERATURE REVIEW

### 2.1. Guidelines

Recommendations from governments on exposure levels historically have been set by consensus and are not enforceable<sup>3,7</sup>. These limits have been proposed for frequencies ranging from 10 kHz to 300 GHz. Discrepancies in limits set on exposure levels exist between North America<sup>8</sup> and Eastern Europe<sup>9</sup>, with the North American limits allowing up to a five hundred fold higher exposure than the Eastern European standard. Russian standards are based on an exposure that produces any biological effect whereas the American standard is established with a safety factor of 10 below where harmful biological effects may be measured. In 1982, the American National Standards Institute (ANSI) limited the exposure of workers exposed to radiofrequency and microwave (RF/MW) emissions (1.5 to 100 GHz) to a power density of 5.0 mW/cm<sup>2</sup> over a six minute time period for the radiofrequency protection guide<sup>10</sup>. ANSI revised their standard in 1988 and raised it to 10.0 mW/cm<sup>2</sup> for frequencies above 3 GHz<sup>11</sup>. Many countries, including Canada, have based their recommendations on the original ANSI standards. Studies use a measure of the effects of radar exposure on a body of tissue called the specific absorption rate (SAR) in watts per kilogram of body mass (W/kg). SARs cannot be directly measured in humans but can be calculated since it is proportional to power density of the NIR which can be measured. Guidelines always indicate an average over the entire body as the absorption of the energy varies according to body position, and properties of the body exposed to the RF/MW energy. Guidelines that have been established limit the whole body exposure to 0.4 W/kg. Stuchly states that the Canadian population, for the most part, are not exposed to the levels of the limits currently recommended in Canada and except for specific industrial exposures, such as industrial heaters, most occupational exposures are below the proposed limits<sup>7</sup>.

## **2.2. Biological Effects of Radiofrequency Waves and Microwaves**

Studies on exposure to RF/MW have identified two reactions: thermal and nonthermal. There appears to be consensus that the absorption of electromagnetic energy can cause thermal effects in living organisms<sup>12</sup>. The ability to warm tissue without deleterious effects has been turned into treatment such as diathermy and hyperthermia in the medical field<sup>13</sup>.

The existence of nonthermal effects, those not explained by the warming of tissues, has not been universally accepted<sup>12,13,14,15,16</sup>. The major dilemma in this area of research is the vast discordance in the published studies and the fact that many of the effects that are proposed to be related to exposure to NIR have not been replicated. This type of problem leads one to question the validity of the evidence found<sup>17</sup>.

Laboratory studies both in vitro and in vivo have produced the vast majority of findings. Although most of these studies have measured the effects of exposure to an electromagnetic field frequency of 2.45 GHz, which is different from those used in police radar, the specific absorption rate for the whole body exposure is a common marker throughout. Thermal changes have consistently been identified at SARs at or above 1.0 W/kg. Low level thermal and nonthermal effects are observed at SAR levels below 1.0 W/kg.

### **2.2.1. Thermal Effects of Exposure to NIRs (SAR $\geq$ 1.0 W/kg)**

Increases in body temperature, whether from NIR exposure or other sources, such as a fever, can cause death. Unlike exposure to direct heat sources there is no cutaneous perception of the heating of the tissues<sup>18</sup>. Intense increase in body temperatures have been associated with teratogenic effects in mice and rats (SARs greater than 4.0 W/kg)<sup>19,20</sup>.

Adverse effects identified with lower SARs (1.0 - 4.0 W/kg) also include increased body temperature and although it is less severe than above it is associated with changes in the neuroendocrine system in rats and rhesus monkeys<sup>21,22</sup>, immune system<sup>23,24,25</sup>, nervous system<sup>26</sup>, blood-brain barrier<sup>27</sup> in mice, and changes in behaviour in squirrel monkeys and rats<sup>28,29</sup>. There is considerable debate whether exposure to microwaves has an effect on the hematopoietic system, as mentioned by Michaelson<sup>30</sup>. Two areas that may have a greater immediate impact on human exposure are the thermal effect on the testes and on the eyes. The testes have a normal temperature a few degrees below body temperature, approximately 33-35° Celsius. Increasing testicular temperature to that of the body may cause sterility, and the killing of mature sperm<sup>17,31,32,33</sup>. Although cataracts have been linked to high levels of exposure in experimental animals, for example rabbits<sup>17</sup>, Kues<sup>34</sup> has shown that monkeys suffer corneal damage at low levels of exposure to pulsed waves.

### **2.2.2. Nonthermal Effects of Exposure to NIRs (SAR < 1.0 W/kg)**

The most significant findings linked to nonthermal effects of NIR exposure are those identified as neuroendocrinological and immunological in nature and those associated with pulsed waves.

Adey in his report to the Ad Hoc Subcommittee on Consumer and Environmental Affairs<sup>35</sup> stated that there is an interaction between extremely weak modulated electromagnetic fields and cells in vitro. The four main areas of research he points out are: the modification of calcium binding at cell surfaces in the brain; the effects on immune system cells - either cytotoxicity or the disruption of enzyme activity in lymphocytes; the modification of enzyme activity regulating cell growth; and DNA synthesis in cultured mammalian cells following exposure to increasing microwave fields at a constant temperature.

The hypothesized relationship between exposure to low level NIR and the development of cancer has not had unanimous support. In studies in mice<sup>36,37</sup> cancer development or promotion is reported but with little support from either animal or human studies.

Chou et al<sup>38</sup> report that pulsed waves can be heard by man. This effect is attributed to a thermal effect from modulated waves since the heating lasts only as long as the pulse and causes a thermoelastic expansion of tissues in the skull. This expansion in turn creates a pressure wave that is transmitted by the bone and detected by the cochlea .

### **2.3. Effects on Humans**

Many studies reporting on the outcomes from exposures to NIR have been carried out among various occupational groups with long-term exposure, notably radar workers. The research has included gonadic function, where differences in libido and alterations in spermatogenesis were found<sup>39</sup>, and hematological changes in the peripheral blood of workers exposed to chronic low-level microwaves<sup>40</sup>. Studies that did not uncover a difference between the exposed workers and controls included those that investigated the health status of workers<sup>41</sup> and the effects on the central nervous system<sup>42</sup>. These findings were also corroborated by Robinette et al who examined health effects in a Navy cohort<sup>43</sup> and by Lilienfeld who assessed those reported in the U.S. embassy staff in Moscow<sup>44</sup>.

Survey methodology has been used by Czerski et al in health surveillance of exposed workers, and although these surveys were far reaching, only an unusually high incidence in functional disturbances such as neurotic syndrome, disturbances in the digestive tract and cardio-circulatory abnormalities were found<sup>45,46</sup>. Appleton et al investigated eye damage

from microwave radiation in the military and, as with the other studies, no differences were found<sup>47</sup>. Michaelson, in his review of the literature, has found that there is no definite evidence that confirms that exposure to radiofrequency levels less than 4.0 W/kg has caused any increased mortality or morbidity in humans<sup>30</sup>.

Anecdotal reports of the adverse effects from exposure to radar abound in magazines, letters and reports<sup>48,49,50,51,52</sup>, some of which are widely available to police officers. Other controversial reports such as the Zapping of America<sup>53</sup>, to mention just one, are questionable from a scientific perspective. Information questioning the validity of these pronouncements has appeared in the police press<sup>54</sup>. This type of publicity and the lack of clear guidelines from the scientific community have provided the rationale for this thesis.

The research into adverse health effects from exposure to electromagnetic fields covers a broader spectrum of non-ionizing radiation. Far more studies have been undertaken in this field to study clusters, occupational exposures and community exposures. These studies have focused on childhood cancers<sup>55,56,57,58,59,60</sup> and on adult brain cancers and leukemias<sup>61,62,63,64</sup>. Although research in this area has been published over the last 20 years, there is little concurrence in these findings as to the effects of electromagnetic fields on the incidence of cancer<sup>65,66</sup>.

#### **2.4. Risk Factors for Testicular Cancer**

Testicular cancer is the most common neoplasm in men aged 15 to 35 and affects approximately 3 in 100,000 men of all ages annually in the U.S. In Canada the age-standardized rates show a high incidence in young men, but do not portray the bimodal distribution reported elsewhere (Table 2)<sup>67</sup>. Although the incidence has increased in the last

60 years, advances in diagnostic techniques, treatment and management have improved survival rates from 10% in the 1970s to 90% in the 1990s<sup>68,69,70</sup>.

**Table 2. Age-Standardized, Crude and Age-Specific Incidence Rates for Testicular Cancer in Canada (per 100,000)**

Age-Standardized*	4.6
Crude	4.7
0 - 24	2.2
25 - 34	10.1
35 - 44	8.0
45 - 54	3.3
55 - 64	2.4
65 - 74	1.4
75 - 84	1.8
85 +	2.4

\* Canada 1991 Census population  
Source: Cancer in Canada 1990<sup>67</sup>

In order to identify young men at increased risk, research has been directed to recognizing potential risk factors that could be identified and considered for early detection. Unfortunately, there is little concordance in the findings and many of those in agreement are reporting highly variable estimates (high point estimates with wide 95% confidence intervals). There is strong agreement that cryptorchidism is a risk factor for testicular cancer (odds ratio (OR) 2.5 to 17.12)<sup>68,71,72,73,74,75,76,77</sup>. Medical risk factors that may be potentially associated with this disease are inguinal hernia<sup>71,72,73</sup>, mumps and mumps orchitis<sup>74,75,76,77</sup>, testicular atrophy<sup>76</sup>, and in utero exposure to diethylstilbestrol (DES)<sup>71,73,76,77</sup>. Coldman et al<sup>72</sup>, and Haughey and colleagues<sup>76</sup> propose that testicular trauma may well be associated with the diagnosis of cancer. This trauma could be inflicted by activities such as bicycling, motorcycling, horseback riding and operating a truck or tractor. Others speculate that injury to the reproductive organs may not increase risk, but that it functions as a stimulus to seek

medical attention<sup>72,78</sup>. Elevated testicular temperature has also been implicated as a risk factor. Indicators for this increased temperature have been the taking of hot baths and the wearing of jockey shorts versus boxers<sup>76,77</sup>.

Demographic variables were also examined and have brought forth an abundance of opinions. The main focus of these are residence (rural or urban), education, socioeconomic status and occupation. Although these are all correlated and some of the associations are weak, the following hypotheses have been suggested. An increased risk of testicular tumours among rural residents has been proposed<sup>79,80,81,82,83</sup> but is also refuted by Coldman et al<sup>72</sup>, Ducatman et al<sup>84</sup> and Clemmesen<sup>85</sup>. Social factors that have been investigated include high social class, which has been reported by Swerdlow et al<sup>86</sup> and Pearce et al<sup>87</sup> among others to be at higher risk. The increased risk from higher education has also been described<sup>74,86,88</sup> along with a variety of occupations which are believed to have an effect on the risk of developing testicular cancer. Unfortunately there is a profusion of jobs that may or may not be associated with neoplasms. This high number certainly creates confusion as to whether an association actually exists or whether an element of chance has played a part in the reporting of such associations. Often what one researcher has found significant has been refuted in another publication. White collar employment<sup>72,87,88,89</sup>, for example managers, administrators, health professionals, has been implicated as a moderately elevated risk factor, but so has blue collar employment such as mechanics, naval aircraft repairmen, leather workers, labourers and sailors<sup>84,87,88,90,91</sup>. Also farmers, and oil and natural gas workers<sup>92,93,94</sup> have not been exempt from this scrutiny. In New Zealand, Pearce and colleagues<sup>87</sup> have found an increased odds ratio (2.74) for men working in the security field which includes the armed forces and police.

### **3. METHODS**

#### **3.1. Synopsis**

The purpose of this research study was to determine whether there are any adverse health effects in members of the RCMP who have ever performed radar duties. This was achieved by identifying which members performed radar duties while employed with the RCMP and mailing them a questionnaire inquiring about their radar duties and whether they have ever been diagnosed with cancer.

The design was a historical cohort study. The target population was defined as all members of the RCMP who had been assigned to highway patrol from 1973 onward. Four cohorts of subjects were identified within this population: active members with 30 or more consecutive days of sick leave, active members with less than 30 consecutive days of sick leave, pensioned members and deceased members.

The target population was identified by the RCMP Personnel, Administration, Research and Development (PARADE) database. Current information such as working status and detachment address for the active members is maintained in the PARADE database. Once pensioned, home address data are maintained by the pension office, under a pension number. Work histories are not transferred from PARADE and thus assignment to highway patrol is not available in the pension database. Therefore, to ascertain who was to be included in the study population a manual search of the pensioned members address list was undertaken to identify the pensioners and deceased who had highway patrol experience. A manual selection to identify the active members who did not have the extended sick leave marker was also performed.

### **3.2. General Design**

The purpose of this research study was to examine the occurrence of adverse health effects in members of the RCMP who have ever performed radar duties for traffic control. The specific objectives of the study were:

- 1) To characterize exposure to radar units in the RCMP in order to develop a classification system.
- 2) To survey the study population to determine the occurrence and types of cancer.
- 3) To ascertain whether there is any association between exposure to radar units and the diagnosis of cancer in each of the cohorts.

A historical cohort design was used. This use of a historical cohort design was chosen for a number of reasons. First, given the latency period, was the long time line that would be required to capture a sufficient number of cancers that would occur. Second was the efficiency with which the information on exposure and outcome could be collected. Although there is a potential for bias from the recall of exposure, it was felt that police officers are trained to have good recall skills and that this trait would help with the exposure measurement. If necessary, verification of the exposure information could be attempted by linking back to the PARADE database. Third, as exposure to radar units is inextricably linked to police work, it was possible to identify an exposed population by their assignment to specific work duties, thereby assuring that there were sufficient numbers of subjects in the exposed population. Lastly, since there were clusters of cancer suspected among police officers, it was anticipated that if cancers were more common within this occupation, there would be a sufficient number of cancers to allow for a comparison with respect to exposure.

The study population was composed of four distinct cohorts of RCMP members who had worked at least one day since 1973 and had been assigned to highway patrol. Four cohorts were chosen in order to provide a range of exposure levels, should they exist, among members of the RCMP. This range would be beneficial in the development of the exposure classification system. One cohort included all living pensioners while another was composed of proxy respondents (relatives of deceased members) who were receiving pension benefits from the RCMP. Two cohorts of active members were selected, one which was composed of members who had taken a leave of thirty or more consecutive sick days while the other included members who had not taken long term sick leave. This latter cohort was selected according to their regimental/employee number which was the next nearest to the regimental number belonging to a member with extended sick leave.

### **3.3. Ascertainment of the Study Population**

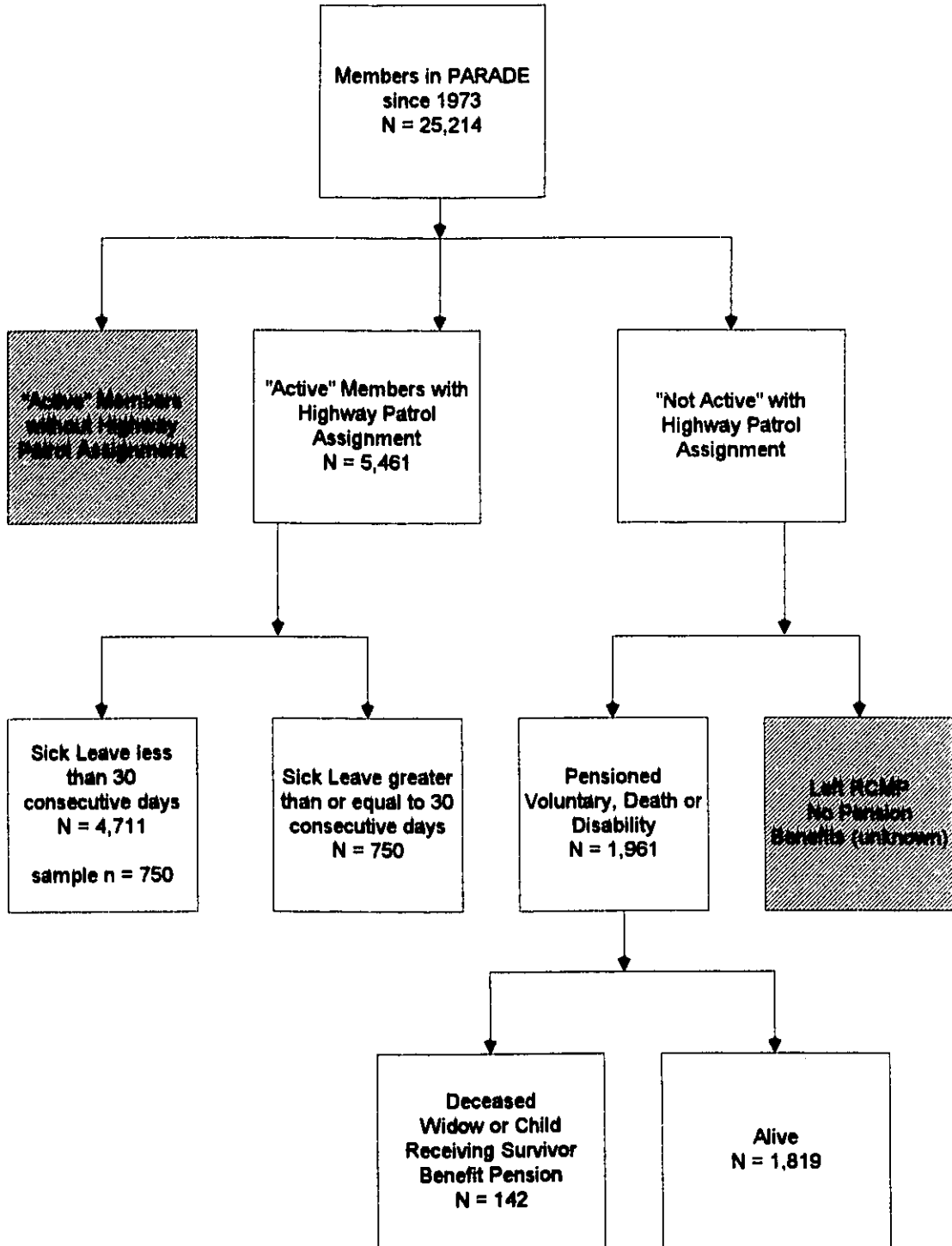
#### **3.3.1. Definition of the Study Population**

The target population was defined as all regular members as of 1973 and all new employees since that time. Members of the RCMP have diverse training and duties and only a portion of these members are trained and assigned to radar duty. The purpose of this study was to examine the health effects in members exposed to NIR, therefore the study population included only those members ever assigned to highway patrol, as this job has the greatest radar unit usage in the force. The use of this study population guaranteed that all pensioned members, both alive and dead, and a sample of active members with highway patrol exposure were included in this research study.

At the time of the survey the RCMP employed 15,139 regular members (i.e. employed in policing activities) and of these 5,461 had been assigned to highway patrol (Figure 1). This active cohort was considered to consist of two cohorts depending on whether or not the member had taken extended sick leave (defined as greater than 30 consecutive days of sick leave). Extended sick leave had been taken by 750 members, while 4,711 members had not taken such leave. This greater than or equal to 30 day period is a marker in PARADE for long term leave of absence due to illness. This variable was used to identify currently employed members who may have had a diagnosis of cancer and subsequently returned to work. Although hospital stays have been diminished for hospital interventions, until recently it was considered likely that a member with a diagnosis of cancer might miss a minimum of 30 consecutive days of work while undergoing diagnostic procedures, treatment and recovering from the interventions associated with his/her diagnosis of cancer prior to returning to work. A sample from those members not taking extended sick leave was selected as follows: a member who took extended sick leave was matched by regimental/employee number (closest number in active cohort) to a member who did not take extended sick leave. Matching by regimental number allowed for the identification of members who were hired during the same time period and possibly the same place as the member in the first cohort. They would also have had a similar length of service. This method of matching to identify members with similar service within this police force was supported by the Occupational Health Directorate as a convenient method to use to take a sample within PARADE and has been successfully used in the past in other epidemiologic studies<sup>95</sup>.

The 'not-active' cohort with highway patrol consisted of all the retired members or relatives of deceased members receiving a pension from the RCMP. The pensioned member cohort

**Figure 1: FLOW CHART OF RCMP MEMBERS**



for the purposes of the study comprised those members who had voluntarily retired from the force or who had retired and were receiving a disability pension. The RCMP also provided a pension to the deceased member's widow(er)s and/or adult children (18 to 26 years of age) who were in full time attendance at school. These relatives were proxy respondents for the deceased members.

### **3.3.2. Sources of Ascertainment**

The study population as defined above was identified through the RCMP database PARADE. This database has the full service records of all members (active and discharged) who have been employed for at least one day since 1973. Information is limited to employment data such as current posting, previous service and rank, and does not include medical files, personal addresses or socio-demographics data such as marital status and number of biological children. Once a member is discharged, the date of this event is recorded and no new information is added to the file. This database is constantly being updated and reflects the current status of the RCMP.

The RCMP pension office maintains a separate computer file for discharged members who are eligible to receive either a regular or disability pension and, when necessary, they also establish files to provide survivor benefit pensions. It is the pension database which maintains current information on pension recipients in order to ensure that pension benefits are issued. Once pensioned the member or surviving relative receives a pension number with which s/he is identified. This office has the ability to match pension and regimental numbers from the separate databases. As they issue monthly pension cheques, the pensioners' addresses are constantly being updated.

The members who were discharged and not eligible for pension benefits are not traceable. Some leave in order to accept jobs with other police forces or change careers, while others may be asked to leave. As no address information is kept by PARADE, there was no systematic method to trace these discharged members and unfortunately they could not be followed in this study. It was anticipated that members who have left to join other police forces will be surveyed in the national study.

Access to this information was provided through written requests to either the data manager of PARADE or the pension office. The information is protected and no access to their database by computer was permitted. The RCMP provided the information requested either on diskette, for non-nominal data, or as a paper print out. Therefore no abstraction forms were needed for this portion of the study. Regular contact was maintained to ensure that the correct members were identified.

### **3.4. Identifying the Study Population**

#### **3.4.1. Identifying the Active Member Population**

In order to determine the study population several steps were needed. First, separate computer lists were generated for all members, active and discharged who had ever been assigned to highway patrol. The active list included 5,461 members and according to the listing from PARADE, 850 were identified as having taken at least one period of extended sick leave. Information on sick leave is collected and maintained in PARADE. In order for a member to take a leave of absence due to illness of more than 48 hours, the member must be seen by a physician. It is this physician who determines

whether such leave is granted. This process is quite regulated and the appropriate forms must be completed and duly filed.

A computer list of all these active members was generated and an asterisk was placed next to the regimental number of those with extended sick leave. The length of sick leave in years was recorded as a numeric variable with two decimal places. The minimum cut off point of 0.08 of a year was set (approximately equivalent to 30 days). For the parameters of the study no maximum length of sick leave was necessary. In order to avoid any possible bias in the selection process, the computer list was in ascending order of regimental numbers and included only this number, the amount of sick leave and an asterisk. Unfortunately, approximately 100 members who had sick leave values less than 0.08 and were deemed to have taken a period of less than 30 days were given an asterisk. Verification of the start and end dates for the sick leave was done by the manager of PARADE. There was no known reason why these members were identified as having an extended sick leave and only those with an amount of 0.08 or greater were included in the cohort with extended sick leave, while those members with less than this amount were included in the pool of available members for the cohort without extended sick leave.

The assembly of this latter cohort was a two step procedure. The first was to select on a paper copy the next nearest regimental number to that of the member who had extended sick leave. The chosen regimental number could either be higher or lower depending on the nearest match; if two numbers were equidistant the lower number was used. Once this was completed, the second task was to produce a computer version (ASCII) of this list in order to produce the mailing labels.

There were 750 members in each of these two cohorts. This diskette was given to the RCMP to produce a set of labels and a paper copy. Unfortunately the lists that were provided had all members assigned to highway patrol and in order to prepare the mailing, another round of manual matching was performed prior to inserting the questionnaires and letters into the envelopes, affixing the address labels and sending them by mail. Four members were not initially found and were sent their questionnaire 10 days later (3 had retired during the 10 day delay and one was missed). The addresses used for these members were their detachment addresses.

#### **3.4.2. Identifying the Pensioner Population**

In order to identify the pensioners with highway patrol, a merging of information from two databases was necessary. PARADE provided a list of all discharged members with highway patrol duty regardless of pension status. This list included approximately 3,000 names ordered by discharge date. The second list, labels and hard copy, was generated by the pension office and included all persons receiving a pension from the RCMP, approximately 9,000. Since the pension office does not have access to the PARADE data, it was not possible to select only those who had the experience of interest. This was done after the last address update in January 1995 and the list consisted of the pension number, name and current address to which the pension cheque was mailed. This list was ordered by ascending pension number. A manual matching of pensioner names was done between the PARADE list and the pensioner list. There was an initial match of approximately 1900 members, including the families of the deceased members.

To ensure that all pensioned members with highway patrol were identified on the pension rolls, a RCMP auditor who was able to produce a listing of regimental numbers, pension numbers and names was contacted. This listing confirmed that the proper family member was identified for the deceased members and that the maximum number of discharged members with a pension was identified. After this verification step, approximately two months elapsed before the mailing was sent. During this time lapse a number of pensioners changed addresses, some died and there was an influx of new pensioners. The pension office provided new lists just prior to the actual mailing, a final manual search was done, an additional 110 labels were produced and the mailing was prepared. The mailing for the pensioner cohort consisted of 1819 pensioners and 147 relatives of the deceased.

### **3.5. The Mailing Preparation**

The mailings to the pensioners and to the active members were done separately. As the pensioner labels were ready, this cohort was prepared first and the active members second. The mailing process for both cohorts was identical once the labels were finalized.

Each mailing package included the appropriate questionnaire in English and French (Appendix A), the pensioner questionnaire (PQ), the relatives of the deceased questionnaire (DQ) or the active member questionnaire (MQ). This same strategy was applied to the covering letters ('PL', 'DL' and 'ML'), which were modified for each cohort in order to address the slight variations in instructions according to the differences in the version of the questionnaire with which they were being sent. The letters were printed back to back in both languages. A number 10 business reply envelope

addressed to the Clinical Epidemiology Unit (CEU) at the Ottawa Civic Hospital was also enclosed. This was inserted into a 9x12 white envelope with Judy Snider at the CEU as the return address. The subject's address label was affixed to the front of the envelope, which was then stamped by meter and mailed first class by the National Research Council. The pensioner mailing was sent a few of days before the mailing to the active members.

All envelopes returned by Canada Post as undeliverable were queried with either PARADE (for the active members) or the pension office (for the other cohorts) to determine whether a new address could be found. If a new address was found, then the mailing was sent to that address. Those who had no new address (either none on file or in the case of the deceased, the pension cheque had not been sent to the surviving family member for the last few years) were handled on an individual basis and are described in the response section in the results (section 4.2).

### **3.6. Instrument Development**

Brief and concise questionnaires were needed. As this population was being surveyed quite frequently, it was important for the members to buy into participating, whether or not they felt that exposure to radar might be hazardous to their health. It was also important to collect a few demographics to allow for generalizability of the exposure algorithm to all police in Canada. To ensure ease of completion, the questions were primarily closed form but open ended questions were included to allow for latitude in response when it was considered necessary. The questionnaire used self-coded responses wherever possible. This ensured that a minimum amount of coding was required, and it facilitated data entry.

Three versions of the questionnaire (Appendix A) were developed and translated. The instruments used for the pensioners and the active members were identical except for the inclusion of an additional time frame for "after leaving the force", which was appended to the activities or injuries deemed to be potential risk factors for testicular cancer. These questionnaires (MQ, PQ) will be discussed together. The questionnaire developed for use with the families of the deceased (DQ) was shorter and did not inquire about specifics of exposure to radar units, since such precise information would normally be unknown (or not reliably known) to family members.

### **3.6.1. Questionnaires for the Living Members**

The questionnaires for the living members were composed of three sections: work experience; health including cancer diagnosis(es) and risk factors; and demographics. The purpose of the work experience section was to collect all pertinent data necessary to develop the radar exposure algorithm. As some members of the RCMP may have worked for another police force, either prior to joining or after retirement, information was sought on their police service time. Three time periods were allowed for and the participants were instructed to list as many time periods as possible, specifically start and end dates. This allowed for reconstruction of the timeline of their police career. The same strategy was used for periods of duty during which radar was used. In this case, the members were given up to five time periods to complete. A filter question was used to allow all members who had never performed radar duties to skip to the health section. All those who had performed radar duties completed questions ascertaining the amount of training received prior to radar assignment and period(s) of work that included radar duties. Since many of the work assignments included radar

exposure but were not exclusively radar work the members were also asked to estimate the number of years, as well as the average number of days a week and hours per day of radar duty. Questions about the type of radar unit they used most often (mounted versus hand held) were also included in this section. The last question included in the work experience section was where the radar unit was kept when active but not pointed at a vehicle. This was to provide an indication of risky behaviour that might be associated with the use and placement of radar units.

The health section was designed to collect information on cancer diagnosis, specifically testicular cancer. A filter question at the beginning of this section inquired about whether the member had ever been told by their physician that they had cancer. All respondents who answered positively to this question continued by completing information on the type of cancer diagnosed, date of diagnosis, whether it had spread, and if so to which site and the corresponding date of diagnosis. Specific cancers listed in this section included leukemia, brain, melanoma of the eye or skin, thyroid, salivary gland and bone as they have been associated with exposure to various frequencies of the electromagnetic spectrum. Space was also left for free response to other cancers not included in the list. All those who responded negatively skipped the questions relating to cancer diagnosis and continued with the instructions for the risk factors potentially associated with testicular cancer. If the member was female, she was instructed to go to the next section.

Other components in this section focused on the putative risk factors for testicular cancer such as undescended testis, bicycling, horseback riding and severe trauma. Time periods were defined for the latter three risk factors and included "prior to joining

the force" and "during police service"; the pensioners also were asked about "after leaving the force". A positive response to testicular trauma led to the additional question of whether the member sought medical care.

The last section included the demographic questions, specifically date of birth, gender, marital status, progeny and rank.

### **3.6.2. Questionnaire for the Deceased**

The questionnaire for the deceased was designed to be asked of a proxy for the dead member. It was mailed out almost exclusively to the widows of deceased members. The initial information sought from the respondent was their relationship to the member and the member's date of death. The work experience section explored only if the member performed radar duties and did not attempt to collect the detailed information that would be used in the algorithm. The health and demographic sections were identical to those which were used in the pensioner questionnaire.

### **3.7. Data Management**

Questionnaires were returned by Canada Post in business reply envelopes addressed to the Clinical Epidemiology Unit (CEU) at the Ottawa Civic Hospital. The sealed envelopes were collected by the receptionist and kept in a locked drawer until they were picked up. The post office bundled all the envelopes received at one time in order to invoice the cost of the business reply service. The date the post office processed the envelopes is inscribed on the shipping slip. It was this date that was used as the date of receipt of the questionnaire at the CEU. As each envelope was opened, the

receipt date was written on the upper right hand corner of the cover page of the questionnaire. The questionnaire was then scanned to ensure it was completed and whether any special notes were included that required immediate action. Any questionnaire that included a request for a copy of the results was checked to determine whether a return address was written on the document or the envelope. The number of each type of questionnaire was recorded to maintain an ongoing count of questionnaires received. Due to budgetary constraints, it was decided, prior to the initiation of the study, that a 70% response rate would be the threshold beyond which the time and effort required to send out a second mailing outweighed the benefits. This decision was made on a consensus basis involving police and researchers, taking into consideration the costs and work required to complete this task.

### **3.7.1. Coding**

Decisions as to what questions required coding were as follows. If the regiment number was missing, it was transcribed from the master list for all pensioners or deceased members. If the active member chose not to include it, then this variable was set to missing as it was possible that another member from the detachment where the questionnaire was sent, completed it. For question 1, the police force with which the respondent was affiliated was set to "one" for the RCMP. In question 2, all active members had their working status set to "one" for currently working while all pensioners were coded as retired from the force.

In question 3, work periods were entered as recorded, with the following exceptions. First if a member had broken service then the dates had to be in an chronological order, with the most current period last. If this was not done, then the data entries were

re-ordered to ensure that these data were correctly entered. If the data were missing then each time period was entered as .C for missing data. No one had listed more than three working periods. All those who worked for one or two periods had not applicable (.A) inserted in the blank fields. If the member or pensioner ever worked for a police force other than the RCMP, the noted time period was entered into the database.

Question 4, the filter question on radar used, asked whether the respondent had ever used radar. The answer rarely required amending. When the response to this question did not make any sense when compared to the responses in the subsequent set of questions or if comments were made regarding the member's duties that did not match the answer to this question, modifications were made. Examples of circumstances which necessitated changes included: when the member reported "yes" to working with radar, but indicated in the comments that they were interceptors and never used radar, the response was set to "no"; or if the area was left blank but the subsequent questions recording the intensity of use over their career elicited a response, then the response was changed to "yes". If no sense could be made of the response then it was recorded as missing. The response to this question determined whether the respondent had any exposure to radar and where answers were changed to "no", the balance of questions regarding exposure to radar were set to Not Applicable (.A).

Question 5, which addressed the length of radar training sessions, posed few problems. If two or more responses were mentioned any comments that were recorded were taken into account before deciding on the coding. If it was difficult to determine the intended response the shorter training period was used.

In question 6, periods of radar use were dealt with in the same manner as the work periods noted above. Changes were made if the response was nonsensical due to a typographic error and if the change would instil logic into the response. This pertained mostly to responses that were out of range, for example errors in recording the decade. For example, where the member reported performing radar duties from 1979 to 1997, and the years reported was 8 years, then it was assumed that the end date should have been 1987. The maximum number of radar periods reported was 5. If the member worked as an interceptor only, this question was skipped.

Question 7 had three parts that required members to estimate three quantities. The first was the total number of years performing radar duties which refined the information from the previous question. Although they may have been assigned to jobs requiring radar duties, this variable allowed for a better estimate when radar was only performed for part of the year. The second part of the question focused on the approximate number of days a week the member did radar. The last section attempted to narrow down the number of hours a day the member performed radar duties.

This question caused a lot of problems. It was difficult for the members, both active and pensioned, to estimate. Some members only estimated their radar use for their maximum exposure (e.g. when on highway patrol) but still recorded the total number of years including non-highway patrol. This question required many coding and consensus decisions. For example, a response of 10 days lifetime (over 10 years of service) was coded as 0.02 days per year and the hours were coded as missing as there was no indication of the number of hours radar was done each day.

The following decision guidelines were made and followed in order to accurately code the number of days a week:

- a) a working year equals 45 weeks;
- b) a full week is 5 days;
- c) ■ "1/4 day per week" = 1 day a month and was coded as 0.25,  
■ "1/2 day per week" = 1 day every 2 weeks and was coded as 0.5;
- d) ■ "2/3 day per week" was considered to mean 2-3 days a week (this equalled 2.5 days a week when coding),  
■ "3/4 day per week" was considered to mean 3-4 days a week (this equalled 3.5 days a week when coding);
- e) all decimals were kept as they were recorded by the respondent.

The following decision rules were taken to code the number of hours a day:

- a) maximum number of hours per day that was deemed to be allowed was 12;
- b) any response of all day was coded as 7 hours;
- c) ■ "1/4 day" = 2 hours a day and was coded as 2.0,  
■ "1/2 day" = 3.5 hours a day and was coded as 3.5;
- d) ■ "8/12 hours per day" was considered to mean 8-12 hours per day (this equalled 10 hours a day when coding),  
■ "10/12 hours per day" was considered to mean 10-12 hours per day (this equalled 11 hours a day when coding);
- e) all decimals were kept as they were recorded by the respondent.

Additional coding decisions due to unique answers involving fractions or decimals were recorded in the coding manual with the original response and any changes.

Question 8 caused some problems for the respondents. These problems could have been remedied by the inclusion of a response for tripod mounted radar units, which were used by many of the older respondents. In most cases, manual notes were written along side the response options or in the comments section which allowed for easy coding of the proper response. A few subjects had circled both 1 and 2. Their responses were recoded as 3 indicating the response was the combination of 1 and 2. Any multiple responses in combination were deemed to be 3, which meant that they used both types of units (hand held and mounted).

The continuation of question 8 was not as clear as it should have been. A number of members responded to 8.a. and 8.b. when they only used one type of radar. These responses were changed to the skip pattern .A.

Question 8.a. caused some difficulty for members who used both types of radar for an equal amount of time. Those who noted that their exposure to the two types of radar units was evenly split, were coded as having used car mounted radar approximately 50 to 74% of the time (response 3. in Q 8.b.).

Responses to question 8.b. were also not consistent. The intent of the question was to measure the percent of time the main type of radar unit was used when the member reported using more than one type. It appears that this was not understood in all cases, and the amount reported appears in many cases to be a percent of the total time in the police force that any type of radar unit was used. This may be an indication of why there was a propensity to report usage less than 50% of the time.

The location in which the radar unit was kept when not pointed at a vehicle was captured in question 9. It was not clear when this question was missed, whether this was intentional or not. The majority of those who missed responding were those who used only one type of radar unit and skipped question 8. Any comments included with the questionnaire were considered in the coding of this question. These comments often changed missing data to usable data and only occasionally changed the coding from the response given by the member. There were approximately 190 individual codes generated by the single, double and triple combination of locations indicating where the radar unit was kept. These were entered into the database. Subsequent categorization collapsed these codes into 5 levels of risk of location with: most risky being next to the person; risky identified with positions where the member might be in the path of the radar beam; least risky where the member would typically not be in the path of the radar; not risky which covered most of the older models, such as the tripod units, that were never inside the police vehicle; and a final category of unknown risk for those descriptions that could not be classified elsewhere. It is this derived variable that was reported and used in the analyses involving risky behaviour.

All respondents were asked to answer question 10 which queried whether a doctor had ever told them that they have cancer. Response options for this question were "yes", "no" and "don't know". Of those who responded "don't know", some were in the midst of undergoing tests while others responded that they had never been tested. All positive cancer reports were independently reviewed by two oncologists. Both oncologists adjudicated the information provided in the questionnaires. If any of the responses indicated pre-malignant changes as opposed to a cancer diagnosis, the answer was recoded to "no" cancer. Where the disease process was not logical from

the adjudicators' point of view, the coding of the cancer type or spread was amended to make sense or was set to missing. Any multiple responses of "no" and "don't know", both circled, were set to "no".

Eight types of cancer that have been implicated in electromagnetic fields research were listed, along with a ninth open ended category of "other" in question 10.a. Thirty-seven different types of cancer were written in the "other" category and each was given an individual code. Non-specific responses, such as "carcinoma" were given a code number although they are most probably similar to the missing data code. These are quite different from those where "no primary was identified".

The majority of responses had dates of diagnosis inscribed. Responses with more than one date recorded were given either the earliest date (usually for skin lesion, non-melanoma) or in the case of uncertainty the midpoint was chosen (e.g. 84-86, the information used for data entry was 1985).

The companion question 10.b. which inquired whether the cancer had spread was completed by the majority of those with cancer. On the initial coding all those who did not complete this question were coded as missing regardless of the initial diagnosis. This decision was reviewed at the time of adjudication and, where reasonable, members with non-invasive skin cancers which were diagnosed a number of years ago were set to no spread. These changes were recorded in the editing log.

The next set of four questions (11 through 14) were to be completed only by the male members. They were included to provide a measure of potential risk factors for

testicular cancer. Rarely were these questions omitted, but where this occurred they were coded as missing. All female members were skipped (.A) through this section whether they answered it or not.

Although the wording of question 11 was prepared in consultation with an oncologist who specializes in genito-urinary cancers and had been discussed with urologists, being born with undescended testicles seemed to be confusing. This question generated a high number of "don't know" responses.

The bicycling set of two questions for the active members, or three questions for all the others was quite straight forward (question 12a, b, c). It was included to measure frequency of participation in this activity. As an individual's pattern of participation in this type of activity might change over a lifetime, an attempt was made to capture information on the respondent's activity level prior to joining the police force, during their service with the force and for the pensioners or the deceased after leaving the force. Modification to the answers was required only if the respondent wrote in motorcycling and circled "often" or "once in a while". In that case(s) the response was changed to "never" as this was not the intent of the question.

The horseback riding questions were set up identically to those for bicycling. The respondents were asked to exclude any recruit training or musical ride experience since, until recently, all members, at some point in their training, received some horseback riding training. Therefore changes in the response to this question were made where the respondent's comments indicated that the activity was performed only

during training or assignment to the musical ride. In this instance the response during police service was uniformly changed to "never".

Occasionally respondents changed the response options next to the numbers they circled for questions 12 and 13. These were dealt with according to the following rule. If "once in a while" was changed to "once" then the response option was changed to "never". Occasionally, in the deceased questionnaire the widow would write N/A in Q12.c. and Q13.c. which asked about frequency of participation since leaving the force. All those with this response were members who had died while in service and had not retired. All of these were correct and they were given the code of .A (skip).

Question 14 dealing with severe testicular trauma had a filter question and two subquestions for those with a positive response. This question seemed to pose no difficulty and rarely were the subquestions, asking when this occurred and whether medical advice was sought, missed. Additional coding responses were needed for those suffering multiple traumas at different stages of their life (same periods as those in questions 12 and 13).

All respondents were instructed to complete the personal information section. This section had 5 questions numbered 15 to 19. All questions were self coded with the exception of question 19 which was open ended. Therefore coding was only required if the questions were not answered and needed the missing code inserted, or to assign a code to the highest rank obtained while working for a police force.

Rank seemed to cause the greatest concern. A coding decision was required to deal with those members who were "acting" but had not attained the promoted rank or when a member recorded a rank not associated with the RCMP. Acting ranks were given the lower rank if they had not specified their actual rank on the questionnaire.

The comment section was used most often by the pensioners. These comments were used to clarify their responses, where necessary. There was never any intention to perform any qualitative analysis on these responses and they were merely regarded as anecdotal. Many of the respondents from all three cohorts requested a copy of the results when they become available.

### **3.7.2. Adjudication of Cancers**

The purpose of these reviews was to include only the self-reports of cancer and to confirm that the primary and the reported spread was consistent with medical knowledge. Each oncologist reviewed the questionnaires independently with the first review occurring during the coding and data entry phase and the second during the editing phase of the data processing. Both adjudicators agreed on the malignant versus pre-malignant reports. A few minor differences were identified in the coding of the primary sites and the subsequent spread. These differences were dealt with on a case by case basis and are listed below. The major changes included the addition of a code to distinguish invasive from non-invasive cervical cancer and the recoding of some of the missing data for spread to "no spread". It was also felt that for those who responded that their leukemia had not spread, it should be referred to as "in remission" due to the systemic nature of this cancer. This latter point did not affect the coding or analysis of the data.

A summary of the changes made is as follows:

- a) One case of non-invasive cervical cancer was recoded to invasive based on the comments regarding the surgery that was performed.
- b) One cancer described as ampulla of vater was moved from spread to primary.
- c) One cancer coded as a non-invasive skin cancer that had two locations was recoded as two primaries, one with the original coding and a second with cancer of the lip as the location.
- d) One case had a second primary of the same type; non-invasive skin cancer was added due to the difference in dates between the two reported cancers.
- e) Three "spreads" were recoded from no spread to a spread of the same type of cancer of which two were melanomas and one was a lymphoma.
- f) One "spread" was set to missing.
- g) Ten "spreads" coded as missing were coded as no spread, due to the nature of the primary and the length of time that had elapsed since the original diagnosis was made. These changes had dates entered where possible or they were set to missing.
- h) Six cases where a recoding was originally suggested for the "spreads", were discussed and agreement was reached that no coding changes should be made.

### **3.7.3. Data Entry**

All questionnaires that were returned were coded and entered into a database. The questionnaires for the living members were contracted to a local data entry firm, while those from the deceased cohort were entered directly into a SAS database on the UNIX system at the CEU. This latter cohort had over 50% double entered as a form of verification.

The data entry was performed externally and due to the time constraints and the cost, single entry was done. The data were then saved in two ASCII files with comma delimited fields and transferred on separate disks to the CEU, where these two files

were copied onto the UNIX system. After visually scanning the data, programs were written to ensure that the data were in the correct fields. Any questionable fields were manually checked in the original questionnaires and if corrections were required they were made at that time. Errors that were identified were missing commas at the end of the occasional field and one entire variable that had been to missing. The latter problem was corrected as the data entry firm had the data on file and was able to provide it on disk to be added to the data file. Once the data were determined to be complete, the two files were combined into one dataset.

At this stage the data were imported into SAS<sup>96</sup> so that the data would appear on forms that were designed to be identical to the questionnaire format. Any questionnaires that were received after this point in time were entered into a separate dataset and were added to the main database in a batch mode.

The questionnaires for the deceased were entered directly into the SAS<sup>96</sup> database that, as above, was designed to appear identical to the questionnaire format. Fifty percent of cases were double entered for verification purpose. Upon comparing the two entries, only a couple of errors were detected in the original entry. These were amended to reflect the original answers from the respondents.

#### **3.7.4. Data Editing, Logic Checks and Cleaning Procedures**

Programs were written to look for errors in the data entry of the questionnaires. These checked for problems on three levels: the first searched for out of range responses; the second assessed missing values; and the third consisted of logic checks that verified whether skip patterns were correct. The first level of checks was performed variable by

variable and any discrepancies for values out of range were manually reviewed. Any problems were modified in the database and these were marked on the printouts. The second level of checks identified missing values for all variables in the dataset. These were again manually checked for errors either in coding or in entry. The third level of checks searched for errors in two directions. The first verified that skip patterns were followed. For example, if one never performed radar duties then s/he should have the skip missing value in all the exposure variables for radar duties. Conversely, if radar was used then there should be valid values in all the appropriate variables; if the data were missing, the "refused" value was inserted. Any problems that were identified were manually reviewed. The wrong missing value was inserted for one variable and this was corrected by using a batch quality control program. Once corrected, a sample of 10% of questionnaires were re-evaluated to ensure that the change was correct. Care was taken to ensure that skip patterns that were nested within other skip patterns were correctly entered.

At the completion of these steps, the dataset was deemed to be complete, clean and ready for the insertion of a variable to denote whether the active member had taken 30 or more consecutive days of sick leave or not. This was performed by merging the information in separate databases. The first database contained the questionnaire information while the second, provided by the RCMP, contained the member's regimental number and the extended sick leave designation marker as assigned many months prior. One hundred and twenty-three of the records in the study database did not match any of the regimental numbers supplied by the RCMP. The majority of these were from members who did not provide their regimental number on their questionnaire.

Where regimental numbers provided did not match, a manual check of the original mailing list was done. The list contained the questionnaire number and regimental number of the member to whom the questionnaire was sent. Two of the records had been sent in error at the time of mailing and these were deleted. Thirty-three additional records were deleted as they were completed by members of the RCMP who were not selected to be included in the study. Ten of the records were kept in the database as the errors in the entry of the regimental numbers were due to keying errors or to the member having both a regimental and an officer number. It was the latter number that was used in the original listing from the PARADE database.

For those (78) not providing regimental numbers on the questionnaire, additional identifying information was requested from the RCMP. A request was made for date of birth, gender, rank, start date with the RCMP and a broken service identifier for all regimental numbers that they provided that did not have a match in the database. Upon receipt of these data another comparison was made between this information and that held within the study database. A correct match for date of birth, gender and start date was made in fifty-four of the cases. Of these matches fifty-three were kept in the database. One was rejected as the neither the start date nor rank matched and upon rechecking the original lists there were two members at the same detachment who had the same birth date. Year of birth, gender and start date matched in another ten records. Age was given by two respondents and by calculation their year of birth along with gender and start date matched. One was a case of reversing day and month in reporting the date of birth, with all other pertinent data correct. Of the eleven additional questionnaires that were rejected in this process, four had missing data for

date of birth and gender, two had missing date of birth information and five had date of birth information that did not agree with the RCMP data. The final tally of rejected questionnaires was 47.

### **3.7.5. Missing Values**

The number of missing values ranged from none to a count of 120 (6%) for the location the radar unit was kept. Missing values in the demographic information were below 1% for sex, marital status and biological children. Both questions asking about date of birth and highest rank obtained had a higher percentage (2%) of missing values. Valid information from the date of birth was used to derive the age variable which had 55 missing values (2%).

There were no missing responses for the variable radar, which determined whether the respondent was ever exposed to radar during their career. The variables used to derive the exposure algorithm had a range of missing values of 1% to 3%. More of the pension cohort had missing data when asked to estimate the number of days a week and hours per day they performed radar. These missing data contributed to the pensioners having 6% of their respondents missing a value for their exposure to radar units whereas the active member had only 3% missing.

Missing responses accounted for 0.7% of the responses to the cancer question and they were, for the most part, from the pensioners. Only two positive cancers did not have a primary cancer site recorded. The risk factors for testicular cancers had from less than 1% to 3% of the data missing. The pensioners had a slightly higher rate of missing data than the active members for this set of questions.

### 3.7.6. Derived Variables

Derived variables were calculated in three instances. The first was to allow for the calculation of the exposure algorithm. The second was to create useful variables from the reporting of specific date information such as date of birth or number of years of radar service derived from year service started and ended. The third type of variable was needed to categorize data for use in contingency tables or logistic regressions or to order the text data collected in open ended questions.

The variable *exposur1* was computed using the exposure algorithm. This formula comprised the product of the variables for the estimated years of radar duty (*radaryr*), days per week of radar duty (*radarday*) and hours per day of radar duty (*radarhrs*) as reported by the respondents.

The vast majority of derived variables were created to report the date or year. In order to capture information regarding the total number of years of police service or radar duty, subvariables were defined to calculate the number of years of either police service (*worksum1*, *worksum2* and *worksum3*) or radar duty (*radarsm1*, *radarsm2*, *radarsm3*, *radarsm4*, *radarsm5*) for each period stated. The total number of years of police service (*totwork*) was defined as the sum of all valid responses for each of the work intervals. The same process was performed to calculate the total number of years of radar duties (*totradar*). Age to date of receipt for the respondents was defined using a similar process whereby year, month and day of birth were computed and assembled into a numerical value.

The final type of derived variables were those designed to transform either original or derived continuous or nominal data into a categorical format for use in various analyses (Table 3). Five levels of exposure were decided upon as this had previously been used in the electrical worker study of occupational exposure to EMF and cancer by Thériault et al.<sup>97</sup> These were defined as follows: less than the 25th percentile, 25th percentile to less than the 50th percentile, 50th percentile to less than 75th percentile, 75th percentile to less than 90th percentile, and greater than or equal to the 90th percentile of exposed. Univariate statistics were carried out on the entire study sample to determine individual cutpoints for each variable.

**Table 3. Derived Exposure Variables**

Derived Variable	Formula for valid values of the source variables only.	Source Variables
exposur1	Product of:	radaryr, radarday, radarhrs
worksum1	Difference between:	work1_2, work1_1
worksum2	Difference between:	work2_2, work2_1
worksum3	Difference between:	work3_2, work3_1
radarsm1	Difference between:	radar1_2, radar1_1
radarsm2	Difference between:	radar2_2, radar2_1
radarsm3	Difference between:	radar3_2, radar3_1
radarsm4	Difference between:	radar4_2, radar4_1
radarsm5	Difference between:	radar5_2, radar5_1
totwork	Sum:	worksum1, worksum2, worksum3
totradar	Sum:	radarsm1, radarsm2, radarsm3, radarsm4, radarsm5
age	SAS algorithm	date of birth, date of receipt (day, month, year)
radexp	Cutpoint set from percentiles (25, 50, 75, 90) of the source variable	totradar
radyexp	Cutpoint set from percentiles (25, 50, 75, 90) of the source variable	radaryr
exposr1a	Cutpoint set from percentiles (25, 50, 75, 90) of the source variable	exposur1
rdexp	Standardized cutpoints (5, 10, 15 & 20 years of exposure)	totradar
rdyexp	Standardized cutpoints (5, 10, 15 & 20 years of exposure)	radaryr
exposr2a	Collapsing of source variable into 3 levels of exposure	exposr1a

Transformed data for the variables *totradar*, *radaryr* and *exposur1* were set into new variables (*radexp*, *radyrexp* and *exposr1a*). From the frequency distributions, the cutpoints for *totradar*, in years, were computed as 4, 9, 14 and 20, whereas for *radaryr* they were 3.5, 8, 14 and 20. As the distribution of both those variables was quite similar it was decided that a single set of cutpoints that would be common to both variables should be chosen and therefore intuitive standard cutpoints were set at 5, 10, 15 and 20 years. These were used to define new variables called *rdexp* and *rdyrexp*.

The categorized exposure algorithm variable (*exposr1a*) underwent further collapsing to three levels (*exposr2a*), least exposed, moderately exposed and most exposed. The least exposed was composed of all RCMP who had no exposure or were in the less than 25 percentile group. The moderately exposed group was composed of those who were in the groups that had 25 to 75 percent of the exposure, while the most exposed were those with 75 percent or more exposure. Variables for the cohorts of pensioners and members were also defined (*exposr1p*, *exposr1m*, *exposr2p*, *exposr2m*).

For deriving age, although the study date was common to all surveyed members, the date of receipt was used as its impact would be minuscule. The delay from the time of mailing to the time of receipt was at most three months.

The open ended question which asked about location of the radar unit when not pointed at a car (question 9) had 190 individual responses. These were collapsed into five degrees of riskiness of location (*locrisk*) (Table 4). When there were multiple locations the response was coded according to the riskiest behaviour being performed.

No attempt was made to weight the different locations listed within one answer. The levels of response were defined as most risky, risky, least risky, not risky and unknown risk. In order to use these data in further analysis they were further collapsed into two risk levels (*locrisk2*), the first being most risky which was identical to the value label in the variable *locrisk* and other risky which combined all other levels with the exception of the unknown risk.

The last set of derived variables to be defined were three that involved the outcome measure of cancer (Table 4). The first, *nucancer*, collapsed the responses of "don't know" with the response of "no", so that "yes" means any definite cancer. The second outcome variable to be derived was *nucan2* which removed the non-invasive skin and cervical cancers and converted them into negative responses for cancer. The third and final outcome variable *testca* was computed by maintaining all positive testicular cancer reports as entered and recoding all other cancers to negative for testicular cancer.

**Table 4. Derived Risk And Cancer Variables**

Derived Variable	Formula for valid values of the source variables only.	Source Variables
<i>locrisk</i>	Categorization of	<i>location</i>
<i>locrisk2</i>	Collapsing of source variable into 2 levels:	<i>locrisk</i>
<i>nucancer</i>	Collapsing of source variable	<i>cancer</i>
<i>nucan2</i>	Excluding non-invasive cancers	<i>nucancer</i>
<i>testca</i>	Recoding of all invasive cancers excluding testicular	<i>nucan2</i>

### 3.8. Exposure Assessment

As with many occupational studies, exposure is the most difficult component to measure. Crude estimates can often be extracted, but these may apply only to groups

of employees and cannot be individualized to personal exposure. This problem is especially true if the exposure is deemed to be harmless as is the case with police radar units used to measure vehicular speed. Manufacturers and government agencies have conducted tests to determine the exact emissions from radar units, but it is often difficult to apply these findings to actual exposure in workers as their behaviour with these units varies on an individual basis.

Difficulties arise with the measurement of this type of exposure as individual dosimetry is not performed. The employer maintains records of employment and duty assignment for each worker, but once again these do not contain distinct enough information to enable reconstruction of individual exposures. Often long periods of time have passed since this duty was performed or the duty may have been performed either continuously or sporadically over a long period of time. Either of these conditions may alter the consistent reporting of exposure from employment records. It was also not possible to account for the type of radar units (make, model, etc.) used by the members during his/her assignment to highway patrol. Therefore emphasis was placed on where the unit was kept as opposed to what unit was used. Even with these potential difficulties, the approach that was taken for this study was to use self reported work histories for the estimation of exposure, as there was no alternative available.

### **3.8.1. Estimating Work Exposures**

The questionnaire used in this study asked the subject to provide two types of exposure time related information. The first was to state the start and end dates for each working period during which radar was used. Although some members used all three time periods to report this information, a small proportion of members provided up

to five work periods of radar use. Aside from contributing years of potential exposure this information can also place the exposure in a specific time period. The second type of information had the RCMP member estimate the number of years of radar exposure, as the information in the previous question may have overestimated exposure, since assignment to duties including radar and the actual performance of radar duty may differ substantially. To add further precision to this estimate the respondents were asked to estimate the number of days a week and hours a day they used a radar unit.

Qualitative information was also sought on a number of items associated with radar use, such as the type of radar unit used (defined as hand held or mounted units including tripod units) and the location of the radar unit while it was active but not pointed at traffic.

### **3.8.2. Confounding Exposures**

Known and potential risk factors for the primary cancer of interest, testicular cancer, were included in the questionnaire. There was no attempt to identify and measure any other confounding exposures as there would have been too many variables to include in light of the number of cancers on which information was sought. Also, there was concern that additional questions would add to the length of the instrument, might be seen by the members of the RCMP as irrelevant to the intent of the study and would be difficult to measure. It is almost a certainty that there are a number of current smokers employed by the RCMP, and it is conceivable that a number of the respondents are obese. These questions were not included because of a concern that the increased burden of the questionnaire might increase the non-response rate from the members. It is also unlikely that obesity and smoking would be different between respondents and

non-respondents. Another factor that would have been impossible to accurately measure was competing electromagnetic field emissions from such devices as car heaters, air conditioners, video display terminal screens (VDTs), police radios and cellular phones.

### **3.9. Analytical Methods**

Descriptive analyses was planned and carried out to address the first two objectives for this thesis, and tests of hypothesis were performed to address the third objective.

Univariate procedures were used for all continuous variables providing medians, minimum and maximum values, and frequency distributions. Frequency distributions were computed for the nominal and ordinal variables. Only those cancers that were identified as invasive cancers are reported in this study. For the outcome of cancer, the responses of "don't know" were grouped with "no" as it would be unlikely that anyone with a positive diagnosis of cancer would be unsure of this when asked directly.

Chi-square procedures were used to evaluate associations between: radar exposure and outcome; risk factors and cancer, and radar exposure and risky behaviour with the radar unit. The full contingency tables (5 x 5) for exposure by risky behaviour had a number of small cells and were subsequently collapsed to 2 x 3 tables using the derived variables for three levels of exposure and two levels of risky location. Logistic regression techniques were used to control for potential confounding and determine the association between radar exposure and cancer.

The likelihood ratio test was used to assess an interaction effect of exposure and risky location that may mask the relationship between cancer and radar exposure. The full model including the interaction term for the joint effect of exposure and risky location, and the reduced model without this term were compared using an approximate large sample chi-square test with one degree of freedom. If the difference between the log likelihood statistic of the models was less than 2.7 (corresponding to  $p=0.10$ ) then it was deemed that the interaction term was not significant and it was not included in the interpretation.

The second application of logistic regression modelling was to assess the association between radar exposure and cancer controlling for potential confounders. For the analysis the continuous exposure variable (*exposurt*) was considered in 1000 hour units. Covariates were chosen for one of the following reasons: identified in the objectives of the study (exposure algorithm and riskiness of exposure); or biologically known to be associated with the outcome of cancer (age); or might be confounders (total years of work in police service). As the logistic regressions were modelled for all cancers, the specific testicular risk factor variables were not included in these analyses. If the interaction of exposure and risky behaviour was found to be insignificant, it would not be included in the model.

Standardized incidence ratios (SIR) for all cancers, testicular cancer and other types of cancers found to be significant are presented to compare all living RCMP members in the study population to the 1971 standard Canadian male population. The method used was indirect standardization.

Cancer incidence rates for the Canadian male population were computed from data maintained at Health Canada<sup>98</sup> and were categorized into age specific groups. The rates were for the time period 1969 to 1992. This time period corresponds to the time frame when most of the cancers were diagnosed among the RCMP respondents.

The determination of person-years was performed using the following information from the study database: date of birth, employment start date and date of diagnosis. The data from the cohort of active members without extended sick leave were weighted to represent the group of members from which they were sampled, i.e. both observed cancers and person-years for this group were multiplied by 6.28 (4,711 members/750 in the sample). This weighting permits the generalization of the SIR findings to all RCMP members with highway patrol experience. Unfortunately a small number of members did not provide some or all of the variables and they were therefore not included in this calculation. Members contributed person-years from the start of employment until 1995 or date of diagnosis of cancer. Since the population was not static, each member progressed through the age groups (15-19, 20-29, 30-39, 40-49, 50-59, 60-69 and 70-79) over time.

Age specific expected numbers were calculated and summed using the technique described by Monson<sup>99</sup>. The formula used for the SIRs was the ratio of the observed cancers to the expected. The confidence intervals were derived using "tabulated values of 95% confidence limit factors for estimating a Poisson-distributed variable" provided by Breslow and Day<sup>100</sup>.

## **4. RESULTS**

### **4.1. Synopsis**

The first part of the results section focuses on a description of the response rates among the four cohorts of the RCMP (pensioners, active members with extended sick leave, active members without extended sick leave and deceased members).

For each of the cohorts, the demographic data are presented first, followed by all pertinent exposure data including the computed algorithm and potential risky behaviours with regards to radar unit use (except for the deceased where exposure data were not measured). This is followed by the reported cancers, the risk factors for testicular cancer, and the data describing the effects of radar on cancer.

A comparison of the findings between the cohorts of the living members (pensioner, active members with and without extended sick leave) and where applicable with the deceased cohort is presented. Standardized incidence ratios are presented. As testicular cancer was of primary interest, a case series report concludes this section.

### **4.2. Response Rates**

Questionnaires were mailed to 147 relatives of deceased members, 1502 active members and 1819 pensioned members. Three questionnaires were sent in error, one to a family of a deceased with no highway patrol experience and two to active members who were not part of the selection of members who had been assigned to highway patrol. All three of these questionnaires were returned completed but were removed

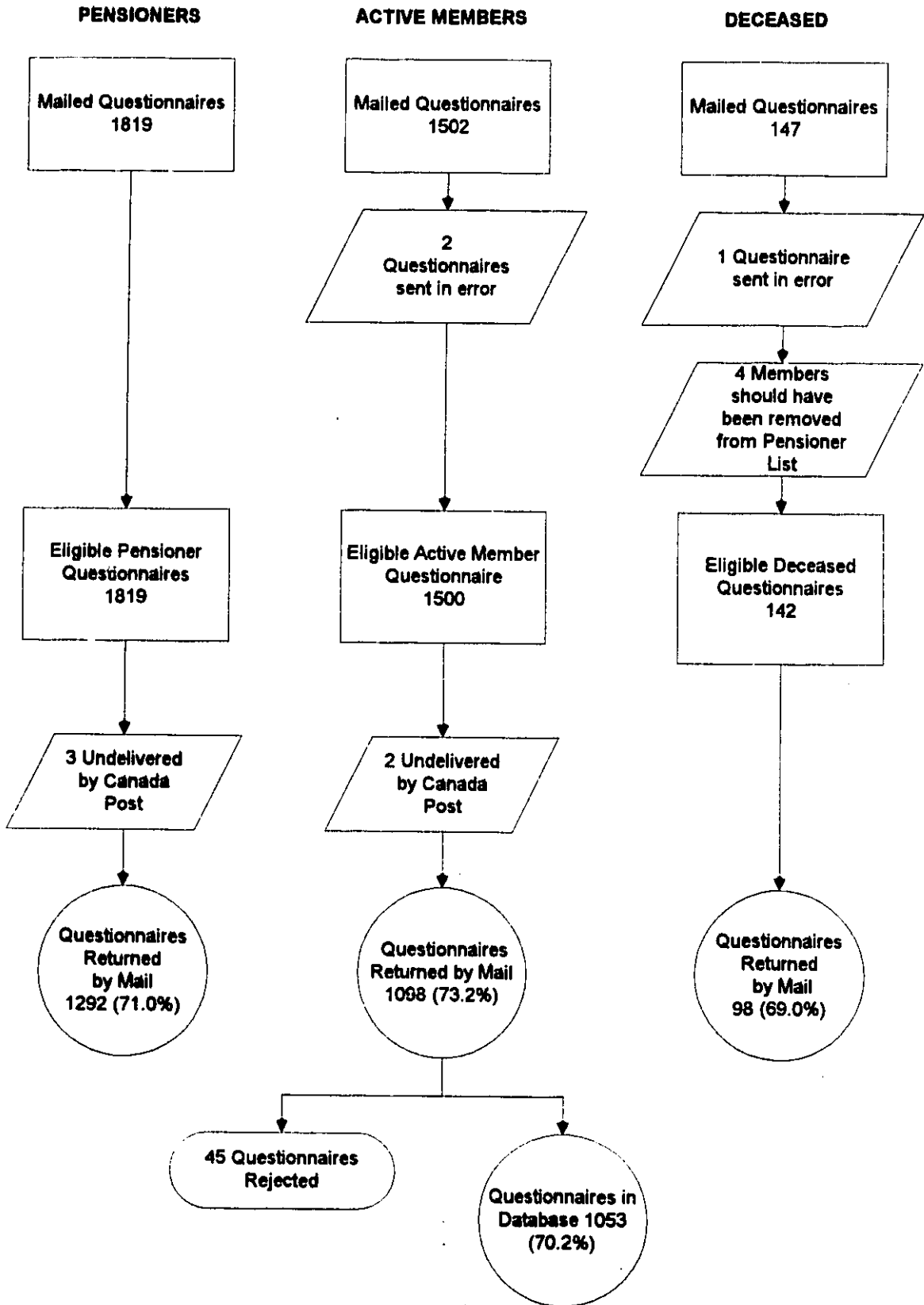
from the database. Therefore, the potential numbers of questionnaires that have been used for this study are 146 deceased (DL), 1500 members (ML) and 1819 pensioners (PL) (Figure 2.).

Subsequently, nine questionnaires were deemed to be undeliverable, as they were returned by Canada Post and new addresses could not be found in order to re-mail them. Of these, four belonged to the deceased cohort and on investigation with the pension office, it was determined that pension cheques had not been issued to any of these families for over a year. Therefore, these four subjects should not have been on the mailing list, should not have been included in the mailing and were ineligible for the purposes of the study. This reduced the number of deceased questionnaires that could have been completed to 142.

Three undelivered questionnaires were sent to members of the pensioner cohort and verification revealed that the pension office had the same addresses that were used to mail the surveys. The final two envelopes returned undelivered belonged active members. After numerous attempts to locate and follow a telephone trail of RCMP divisions to which they were or might have been assigned, no new addresses could be obtained in order to re-mail the questionnaires. These five subjects were not removed from their cohort's denominator since to the best of our knowledge they are living and technically should be receiving mail at the addresses used.

Within a week of mailing, the business reply envelopes were being received. All questionnaires returned by the end of September 1995 were included in the study.

**Figure 2: FLOW CHART OF THE RESPONSE RATES**



Relatives of the deceased RCMP members returned 98 questionnaires for a response rate of 69.0%, the pensioner cohort returned 1292 questionnaires (71.0%) and the active members returned 1098 questionnaires (73.2%).

Since the active members received their questionnaires at their work address, it was conceivable that the questionnaire may not have been completed by the addressee. To address this potential problem, verification of the respondent's regimental number, where available, with the original data from the RCMP was done. There were 45 questionnaires rejected where the regimental number did not match the information provided on the original listing from PARADE. These records were removed from the database. Once these verification steps were completed the study had 1053 member questionnaires (70.2%) in the database. This corresponded to 514 members (68.5%) with 30 or more consecutive days of sick leave and 539 members (71.9%) without extended sick leave.

### **4.3. Pensioner Cohort**

The pensioner cohort consisted of 1292 respondents from a census of discharged members who were receiving a pension and who had been assigned to highway patrol duties.

#### **4.3.1. Demographics**

All pensioners who responded to the questionnaire were male, which was representative of this cohort. The median age was 57.0 years and ranged from 37.1 years to almost 78.6 years. Since this cohort includes medical pensions, it was not

unreasonable that there were a small number (approximately 1%) who were 42 years of age or less. The vast majority (92.4%) of pensioners were currently married or in a common law relationship. The language of choice for response was 99.1% English. Commissioned officers corresponded to 8.7% of this cohort. Among the non-commissioned ranks 4.7% indicated that they were constables, 17.5% corporals, 32.4% sergeants and 35.8% staff sergeants.

Although retired from the ranks of the RCMP, 2.1% reported being employed with another police force. The total years of police work ranged from 2.0 to 49.0 years with a median of 26.0 years, with 95% of respondents having 20 or more years of service. In this cohort 21.9% (283) had never performed radar duties.

#### **4.3.2. Exposure and Risk**

Pensioners who used radar estimated that they were assigned to this duty for a median of 7.0 years ranging from 0.0 to 33.0 years. This figure does not differ from the derived number of years calculated from the reported duty periods that had a median of 7.0 years and ranged from 0.0 to 34.0 years. The pensioners reported performing radar duties approximately 2.5 days a week (median) ranging from 0.0 to 7.0 days. The median number of hours a day was 4.5 hours with a minimum of 0.0 and a maximum of 12.0 hours. The wide range of exposure may well be explained by the personal notes inscribed on the questionnaires explaining how radar equipment was shared between detachments in the early years following its introduction.

#### 4.3.2.1.Exposure Algorithm

From the derived algorithm, pensioners had the lowest overall median of lifetime hours of exposure with 3,240.0 lifetime hours and exposure ranging from 0.0 to 51,840.0 hours.

**Table 5. Distribution of Pensioners by the Exposure Algorithm**

	Frequency	Percent	Cumulative Percent
No Exposure	284	23.0	23.0
≤ 25th Percentile	389	31.5	54.2
> 25th and ≤ 50th Percentile	218	17.7	72.1
> 50th and ≤ 75th Percentile	184	14.9	87.0
> 75th and ≤ 90th Percentile	112	9.1	96.1
> 90th Percentile	48	3.9	100.0
<b>Total</b>	<b>1235</b>		

(missing = 57)

The cutpoints for the percentiles of exposure were determined for the 4 cohorts as a whole, therefore the distribution of the pensioners among the percentiles of exposure was quite skewed to the lower exposure levels (Table 5). This was evident with 72.1% of pensioners in the 50 percentile or less groups. These data were also collapsed into three levels and are shown in Table 6. The shift in the distribution was also evident in the collapsed table, with over half of the pensioners were in the least exposed group.

**Table 6. Distribution of Pensioners by the Three Levels of Exposure**

	Frequency	Percent	Cumulative Percent
Least Exposed	673	54.5	54.5
Moderately Exposed	402	32.6	87.0
Most Exposed	160	13.0	100.0
<b>Total</b>	<b>1235</b>		

(missing = 57)

#### 4.3.2.2.Radar Units and Location Risks

Pensioners were fairly evenly divided on the reporting of the type of radar unit used, with 53.9% using mounted units only and 44.9% using both mounted and hand held

units. A large number of those using mounted units only used the tripod mounted radar which had the operator located quite a distance from the radar unit. This can be observed by the distribution of riskiness of where the radar unit was kept. Of the total 248 living members who kept the unit in a "not risky" location, 217 were pensioners. This figure represents 23% of pensioners who responded to this question. The distribution of location behaviour can be seen in Table 7 and only 25% of pensioners reported keeping the radar units in what was termed as the most risky areas, next to their bodies.

**Table 7. Distribution of Risky Behaviour With Radar Units by Pensioners**

	Frequency	Percent	Cumulative Percent
Most Risky	237	25.1	25.1
Risky	187	19.8	44.9
Least Risky	291	30.8	75.7
Not Risky	217	23.0	98.7
Unknown	12	1.3	100.0
Total	944	100.0	

(missing = 348)

The large contingency table of the exposure algorithm by the risky behaviours is given in Appendix B, Table B1 and the relationship is significant (chi-square test,  $p < 0.001$ ). The pattern that emerged for all exposure levels from greater than the 25th percentile was bimodal, with peaks in the most risky (ranging from 26.1% to 44.7%) and least risky behaviours (ranging from 31.4% to 36.4%). The height of the peaks was slightly greater for the least risky behaviours for those members reporting less than the 50th percentile of exposure. For those above the 90th percentile, members cluster around the most risky category.

### 4.3.3. Cancers

Of the 122 cancers reported by the pensioners, 96 cancers in 95 persons were determined to be invasive. The vast majority of all reported invasive cancers were in this cohort, with 7.4% diagnosed with an invasive cancer. There were 35 reported primary non-invasive skin cancers. Twelve pensioners did not know whether they had been told they had cancer. Table 8 displays the distribution of cancer by organ system for the pensioner cohort.

**Table 8. Distribution of Primary Invasive Cancer Sites Among Pensioners**

	Frequency	Percent of all Reported Cancer Sites
<b>Blood &amp; Lymph Tissues</b>	<b>9</b>	<b>9.4</b>
Blood	2	2.1
Hodgkin's Disease	3	3.1
Lymphoma and Non-Hodgkin's	4	4.2
<b>Bone Tissue &amp; Skin</b>	<b>35</b>	<b>36.5</b>
Bone (unspecified)	2	2.1
Sarcoma	1	1.0
Melanoma	32	33.3
<b>Brain</b>	<b>2</b>	<b>2.1</b>
<b>Digestive Organs</b>	<b>12</b>	<b>12.5</b>
Bowel	2	2.1
Colon	7	7.3
Esophagus	1	1.0
Rectum	1	1.0
Stomach	1	1.0
<b>Genital Organs</b>	<b>18</b>	<b>18.8</b>
Penis	1	1.0
Prostate	12	12.5
Testicular	5	5.2
<b>Head &amp; Neck</b>	<b>2</b>	<b>2.1</b>
Lip	1	1.0
Throat	1	1.0
<b>Respiratory System - Lung</b>	<b>4</b>	<b>4.2</b>
<b>Urinary Organs</b>	<b>12</b>	<b>12.5</b>
Bladder	4	4.2
Kidney	7	7.3
Ureter	1	1.0
<b>All Other &amp; Unspecified</b>	<b>2</b>	<b>2.1</b>
Adenocarcinoma of the Axilla	1	1.0
Unspecified Carcinoma	1	1.0
<b>Total</b>	<b>96</b>	<b>100</b>

#### **4.3.4. Risk Factors for Testicular Cancer**

The reporting of activity related to risk factors for testicular cancer had an added time frame for the period after leaving the force. The percent of pensioners stating that they had undescended testis was 2.8%. Bicycling prior to joining the force was reported by 98.2% of pensioners which decreased to 70.3% while serving and 64.3% after leaving the force. Horseback riding was not as popular a pastime with 62.0% participating prior to joining the force, 56.5% during their service and a large drop in this activity after retiring with only 20.7% riding.

Severe testicular trauma was reported by 14.1% of pensioners. Approximately half (51.5%) of these incidents occurred exclusively during their police service while just over one third (35.2%) happened prior to joining the force and 8.5% reported that severe trauma occurred on repeated occasions prior, during and after their police service. Trauma after leaving the force was reported by 4.8% of those suffering trauma. The pensioners sought medical care in 59.3% of the cases.

Among the risk factors for testicular cancer, the only statistically significant association was between bicycling prior to joining the force and the diagnosis of testicular cancer, with a chi-square value of 9.42 and a  $p=0.009$ .

#### 4.3.5. Effects of Radar Unit Usage on Cancer

There appears to be a consistent 6 to 7 percent rate of diagnosed cancer regardless of the level of exposure to radar. The sole aberration to this was that 9.5% of pensioners who had no exposure were diagnosed with cancer (Table 9).

**Table 9. Occurrence of Cancers by the Exposure Algorithm Among Pensioners**

	Number of Cancers	Denominator (n)	Percent with Cancer
No Exposure	26	275	9.5
≤ 25th Percentile	27	389	6.9
> 25th and ≤ 50th Percentile	13	215	6.0
> 50th and ≤ 75th Percentile	13	183	7.1
> 75th and ≤ 90th Percentile	7	110	6.4
> 90th Percentile	3	48	6.3
<b>Total</b>	<b>89</b>	<b>1220</b>	<b>6.9</b>

(missing = 6 cancers, 72 denominator)

Although the majority of pensioners reported using mounted radar exclusively, approximately 25.1% of pensioners, regardless of whether they had cancer or not, performed the most risky behaviours with the unit. It can be noted from Table 10 that as exposure increased the proportion of cancers decreased. This tables does not include any pensioners who had never been assigned to radar duty nor those with missing exposure data.

**Table 10. Occurrence of Cancers by the Three Levels of Exposure Among Pensioners**

	Number of Cancers	Denominator (n)	Percent with Cancer
Least Exposed	26	349	7.4%
Moderately Exposed	26	375	6.9%
Most Exposed	10	153	6.5%
<b>Total</b>	<b>62</b>	<b>877</b>	<b>7.1%</b>

(missing = 27 cancers, 343 denominator)

An examination of exposure and risky behaviours identified a pattern of increasing risky behaviours with higher levels of exposure (Appendix B, Table B1).

Logistic regression was performed in an effort to evaluate any interaction between exposure and risky behaviour. The difference between the log likelihood statistic ( $-2 \ln L$ ) of the full model and the reduced model was 0.2 ( $p=0.6547$ ). This difference did not approach the chi-square value of 2.7 ( $p=0.10$ ) used as the benchmark for including the interaction variable in further analyses.

An investigation of the association between exposure to radar units and cancer after controlling for the effect of potential confounders (Appendix B, Table B2) was performed using logistic regression. The findings from this analysis identified that there was no increase or decrease in the odds of developing cancer as exposure to radar units increased by 1000 hour units (OR = 1.00 (95% CI 0.969, 1.039)). The Hosmer-Lemeshow statistic is used as a summary statistic to determine the goodness of fit of the model. The value  $p=0.427$  confirmed that the model fit reasonably well and that there were no large discrepancies between the observed and the expected values within each decile of risk.

#### **4.4. Active Member Cohort With 30 or More Consecutive Days of Sick Leave**

The active cohort with 30 or more consecutive days of sick leave included 514 respondents. This cohort was selected on the basis that their exposure to radar units might differ from members without extended sick leave. They represented 13.7% of all active members with highway patrol experience.

#### **4.4.1. Demographics**

The active members who had extended sick leave had a median age of 40.8 years, (ranging from 24.3 years to 59.2 years of age) and 78.9% were male. Most were married or living common law (85.9%), while 4.5% had never married, 9.0% were divorced or separated and 0.6% were widowed. This cohort had by far the greatest number of separated or divorced members of all the cohorts surveyed. Approximately 83.5% of the respondents had biological children.

Regarding rank, 99.4% of the respondents were non-commissioned. The distribution of ranks was as follows: 66.1% constables; 21.1% corporals; 9.2% sergeants; and 3.0% staff sergeants. Less than 1% of respondents were commissioned officers with the rank of inspector or superintendent.

The median reported number of years of police service was 18.0 years and this ranged from 2.0 to 37.0 years. Radar duty was performed by 98.4% of these respondents.

#### **4.4.2. Exposure and Risk**

The active members with extended sick leave had a calculated median number of years of radar duty of 11.0 years and a range from 0.0 to 33.0 years. This derived estimate was slightly higher than their estimated number of years of radar duty which had a median of 9.0 years (ranged from 0.12 years to 32.0 years). Because the difference was 2 years, a review of all charts with differences of 2 years or greater was undertaken. The main reason for the noted difference was values attributed to the

years used in the calculation of the variable *totradar*. These values were integers and were rounded up to the nearest year.

The members of this cohort reported that the median number of hours per day performing radar duties was 6.0 and ranged from 0.75 to 12.0 hours. The median reported number of days per week was 5 with a minimum of 0.5 days and a maximum of 7.0 days.

#### 4.4.2.1. Exposure Algorithm

The median exposure for the cohort with extended sick leave was 9,000.0 hours lifetime and the range extended from 0 to 50,400 hours. These data were collapsed into tabular form (Table 11). Of the 10 who had no exposure, 8 members never did radar and two had performed radar but had no measurable amount of exposure to radar units. The latter two having answered that they had performed radar duty were included in the less than the 25th percentile of exposure group. The distribution of exposure is slightly skewed with a higher proportion of members having greater exposure levels.

**Table 11. Distribution of Active Members With Extended Sick Leave by the Exposure Algorithm**

	Frequency	Percent	Cumulative Percent
No Exposure	8	1.6	1.6
≤ 25th Percentile	51	10.2	11.8
> 25th and ≤ 50th Percentile	125	25.1	36.9
> 50th and ≤ 75th Percentile	136	27.3	64.1
> 75th and ≤ 90th Percentile	98	19.6	83.8
> 90th Percentile	81	16.2	100.0
<b>Total</b>	<b>499</b>		
(missing = 15)			

Further collapsing of the table shows that over half of these members were moderately exposed and slightly more than a third were most exposed (Table 12).

**Table 12. Distribution of Active Members With Extended Sick Leave By The Three Levels of Exposure**

	Frequency	Percent	Cumulative Percent
Least Exposed	59	11.8	11.8
Moderately Exposed	261	52.3	64.1
Most Exposed	179	35.9	100.0
Total	499		

(missing = 15)

#### 4.4.2.2. Radar Units and Location Risks

A minority of respondents reported using only one type of radar unit, with 0.8% using only hand held units and 25.5% using solely mounted units. Of those who used both types (73.7%), 89.9% reported using car mounted units for the majority of the time.

The distribution of risky behaviour with respect to where the members kept the radar unit when not pointed at a vehicle was bimodal. The peaks corresponded to the most risky (42.3%) and least risky (45.4%) behaviours. Only 8.2% reported risky behaviour in their use of radar units.

A bimodal pattern emerged from the crosstabulation of the 5 levels of the exposure algorithm and 5 levels of risky behaviour for this cohort. For each exposure level, the majority of members reported activities in the most risky and least risky categories. Data supporting this finding can be seen in Appendix B, Table B3.

#### 4.4.3. Cancers

There were 26 positive responses to cancer which represented 5.1% of the 512 members who responded (2 missing). These responses provided details on 28 primary cancers including 2 non-invasive skin cancers, 1 non-invasive cervical cancer and 25 invasive cancers. These invasive cancers were noted by 23 members with extended sick leave (4.5%) of those who answered the questionnaire. The cancers were once again grouped by sites and are displayed in Table 13.

**Table 13. Distribution of Primary Invasive Cancer Sites Among Active Members with Extended Sick Leave**

	Frequency	Percent of all Reported Cancer Sites
<b>Blood &amp; Lymph Tissues</b>	<b>6</b>	<b>24.0</b>
Blood	2	8.0
Myeloma	1	4.0
Hodgkin's Disease	2	8.0
Lymphoma and Non-Hodgkin's	1	4.0
<b>Bone Tissue &amp; Skin</b>	<b>5</b>	<b>20.0</b>
Melanoma	5	20.0
<b>Brain</b>	<b>1</b>	<b>4.0</b>
<b>Digestive Organs</b>	<b>2</b>	<b>8.0</b>
Colon	2	8.0
<b>Genital Organs</b>	<b>4</b>	<b>16.0</b>
Prostate	2	8.0
Testicular	2	8.0
<b>Head &amp; Neck</b>	<b>2</b>	<b>8.0</b>
Lip	1	4.0
Sinus	1	4.0
<b>Urinary Organs</b>	<b>3</b>	<b>12.0</b>
Kidney	3	12.0
<b>All Other &amp; Unspecified</b>	<b>2</b>	<b>8.0</b>
Thyroid	1	4.0
Unspecified Carcinoma	1	4.0
<b>Total</b>	<b>25</b>	<b>100</b>

Cancer of the blood and lymph tissues was the most reported site (24%), followed by bone, tissue and skin cancers, of which all were melanomas (20%), and genital organs with 16% were in third place. Both cases of testicular cancer among active members

were reported by this cohort and are included in the case series report at the end of the section. Kidney cancer (12%) was the sole urinary tract cancer reported in this cohort.

#### **4.4.4. Risk Factors for Testicular Cancer**

The reporting of the risk factor information was only obtained from the male members. Undescended testicles were reported by 3.0% of the active members with extended sick leave. There was a high number who did not know whether, in fact, they had been born with this anomaly (19.8%). Bicycle riding was reported by 98.8% of these respondents for the period prior to joining the force (46.5% often and 52.3% occasionally). This figure dropped to 85.9% responding positively to bicycling during their service. Horseback riding was not as popular among the active members as it was among the pensioners, with only 56.5% of this cohort riding prior to joining the force and 41.2% riding during their police careers. Severe testicular trauma was indicated by 15.1% of this cohort of active members with 40.0% of these incidents occurring prior to joining the force, 52.7% while serving with the force and the balance occurred both prior to and during their service. Over two thirds (67.8%) saw a physician for medical attention.

Due to the small number of testicular cancers reported in this cohort (n=2), statistical tests for the contingency tables for each of the risk factors and cancer were not constructed.

#### 4.4.5. Effects of Radar Unit Usage on Cancer

A reversed dose response effect should be noted when looking at the effects of radar unit exposure on cancer (Table 14). The exception to this pattern occurred for those in the highest exposure category where 5.0% reported being diagnosed with cancer.

**Table 14. Occurrence of Cancers by the Exposure Algorithm Among Active Members with Extended Sick Leave**

	Number of Cancers	Denominator (n)	Percent with Cancer
No Exposure	0	7	0.0
≤ 25th Percentile	5	51	9.8
> 25th and ≤ 50th Percentile	9	125	7.2
> 50th and ≤ 75th Percentile	4	136	2.9
> 75th and ≤ 90th Percentile	0	98	0.0
> 90th Percentile	4	80	5.0
<b>Total</b>	<b>22</b>	<b>497</b>	<b>4.4</b>

(missing = 1 cancer, 17 denominator)

A further crosstabulation was performed after collapsing the exposure algorithm (Table 15). Once again the pattern of increased cancer reported among members with the least exposure was seen.

**Table 15. Occurrence of Cancers by the Three Levels of Exposure Among Active Members with Extended Sick Leave**

	Number of Cancers	Denominator (n)	Percent with Cancer
Least Exposed	5	49	10.2%
Moderately Exposed	12	240	5.0%
Most Exposed	4	171	2.3%
<b>Total</b>	<b>21</b>	<b>460</b>	<b>4.6%</b>

(missing = 2 cancers, 54 denominator)

The investigation of an interaction effect between exposure and riskiness of location for cancer was also undertaken for this cohort. The log likelihood statistic was 5.7 for the full model with the interaction variable and 4.5 for the model without the interaction variable. The difference between these two statistics was 1.2 ( $p=0.2733$ ). This result

did not exceed the critical value of 2.7 corresponding to the chi-square with 1 degree of freedom. Therefore the interaction term was not included in further analyses.

The logistic regression modelling procedure to control for confounding was performed (Appendix B, Tables B4). The odds ratio of 0.94 for radar exposure reached statistical significance (95% CI 0.88, 0.996). Therefore exposure might be slightly protective for these members for each additional 1000 hours of exposure to radar units. No other variables in the model had statistically significant odds ratios. The point estimate for riskiness of location of the radar unit (OR = 1.57 (95% CI 0.96, 2.55)) indicates that keeping the unit in a riskier location may increase the member's odds of developing cancer. The p value for the Hosmer-Lemeshow statistic indicating the goodness of fit of the model was 0.452.

#### **4.5. Active Member Cohort With Less Than 30 Consecutive Days of Sick Leave**

The active cohort with less than 30 consecutive days of sick leave included 539 respondents. These members were chosen for their assignment to highway patrol duty (proxy for radar exposure) in order to evaluate the exposure pattern among members who have not taken 30 or more consecutive sick days. They are a sample of all highway patrol members who have not taken extended sick leave (15.9%).

##### **4.5.1. Demographics**

The active members who did not have an extended sick leave ranged in age from 26.0 to 59.2 years with a median age of 44.3 years. Once again the vast majority of this cohort was male (85.1%). Compared to the active cohort with 30 or more consecutive days of sick leave, a lower percentage of this active cohort were married or living in

common law relationships (84.2%), while their rate of never married was more than double that of any other cohort (9.3%). This cohort also had the lowest percentage of members responding that they had biological children (72.8%).

The reported ranks indicated that 98.9% of the respondents were non-commissioned. The distribution of ranks in this active cohort as compared to the cohort of members with extended sick leave was slightly different in the breakdown of the lowest ranks. They were noted as follows: 54.1% constables; 31.0% corporals; 10.0% sergeants; 3.8% staff sergeants and staff sergeant majors. The small number of commissioned officers represented approximately 1% of respondents and included inspectors, superintendents and chief superintendents.

Police service for this cohort was reported as a median of 18.0 years and ranged from 2.0 to 40.0 years. Almost all respondents (98.9%) stated that they performed radar duties.

#### **4.5.2. Exposure and Risk**

The difference between the calculated and estimated time doing radar work reflected the same pattern described earlier with the calculated median number of years of radar duty being 9.0 years and ranging from 0 to 31 years. The estimated years ranged from 0.16 to 31.0 with a median of 7.5 years. Similar to the other active cohort, they worked with radar approximately 6.0 hours a day (median) with a minimum of 0.0 and a maximum of 12.0 hours. They estimated performing radar duties a median of 5.0 days per week and ranged from 0.0 to 7.0 days.

#### 4.5.2.1.Exposure Algorithm

The median exposure was 6,885.0 lifetime hours with a minimum of 0.0 and a maximum of 48,938.5 hours. Once again the information was collapsed into 5 levels of exposure (Table 16). Only one of the members who was classified as having no exposure had been assigned to radar duties but had no measurable amount of exposure.

**Table 16. Distribution of Active Members without Extended Sick Leave by the Exposure Algorithm**

	Frequency	Percent	Cumulative Percent
No Exposure	7	1.3	1.3
≤ 25th Percentile	73	14.0	15.4
> 25th and ≤ 50th Percentile	141	27.1	42.4
> 50th and ≤ 75th Percentile	152	29.2	71.6
> 75th and ≤ 90th Percentile	98	18.8	90.4
> 90th Percentile	50	9.6	100.0
<b>Total</b>	<b>521</b>		

(missing = 18)

Upon collapsing the exposure algorithm into three levels there was a slight shift towards the lesser exposure in this cohort (Table 17).

**Table 17. Distribution of Active Members Without Extended Sick Leave by the Three Levels of Exposure**

	Frequency	Percent	Cumulative Percent
Least Exposed	80	15.4	15.4
Moderately Exposed	293	56.2	71.6
Most Exposed	148	28.4	100.0
<b>Total</b>	<b>521</b>		

(missing = 18)

#### 4.5.2.2.Radar Units and Location Risks

The reporting of the types of radar units used indicated that almost three quarters (70.2%) used both types with 87.7% using the car mounted most often. The balance of

members responded that they used only one type of radar unit, with 28.9% having used car mounted and 0.9% having used exclusively hand held units.

Slightly fewer members of this cohort practised the most risky behaviours with their radar units (38.7%) while more (47.4%) reported using least risky locations for keeping their radar unit. The other three categories each had frequencies of less than 10% (risky 8.3%; not risky 3.4% and unknown risk 2.2%).

The crosstabulation of exposure and risky behaviour is presented in Appendix B, Table B5. The bimodal distribution was also present in this cohort.

#### 4.5.3. Cancers

Twelve members of this cohort reported being told by a physician that they had cancer. Of these cancers, 3 were non-invasive skin cancers and 1 was a non-invasive cervical cancer. The 8 remaining cancers were deemed to be invasive, but only six sites were recorded in the questionnaires and melanoma was reported as 50% of those sites. These are listed in Table 18.

**Table 18. Distribution of Primary Invasive Cancer Sites Among Active Members without Extended Sick Leave**

	Frequency	Percent of all Reported Cancer Sites
<b>Bone Tissue &amp; Skin</b>	<b>3</b>	<b>50.0</b>
Melanoma	3	50.0
<b>Genital Organs</b>	<b>1</b>	<b>16.7</b>
Cervical (invasive)	1	16.7
<b>Urinary Organs</b>	<b>2</b>	<b>33.3</b>
Bladder	2	33.3
<b>Total</b>	<b>6</b>	<b>100</b>

#### 4.5.4. Risk Factors for Testicular Cancer

The male members who responded to the questionnaires reported the following information on the testicular cancer risk factors. Two percent reported being born with undescended testicles, while 21.5% did not know whether or not they had this anomaly. Bicycle riding was a popular activity and was enjoyed by 97.8% of respondents for the period prior to joining the force (44.6% often and 53.2% occasionally). About 89.8% continued to bicycle during their service as members of the force (18.6% often and 71.2% occasionally). With respect to horseback riding activities prior to joining the force, 54.7% of this group ever rode a horse (7.9% often and 46.8% occasionally). This activity was not as common once employed with the force with only 28.7% (4.9% often and 33.8% once in a while). Reports of testicular trauma were present in 8.8% of male questionnaires, and 55.3% sought medical care for this injury. Members reported 8.1% of these injuries occurred both prior and during their service and 45.9% stated that these incidents occurred either before joining the force or during their service.

#### 4.5.5. Effects of Radar Unit Usage on Cancer

The low number of cancers in this cohort has prevented the identification of a pattern as reported in the other cohorts. There was evidence of fewer cancers in those who had an exposure level of less than 50th percentile (Table 19).

**Table 19. Occurrence of Cancers by the Exposure Algorithm Among Active Members without Extended Sick Leave**

	Number of Cancers	Denominator (n)	Percent with Cancer
No Exposure	0	7	0.0
≤ 25th Percentile	2	73	2.7
> 25th and ≤ 50th Percentile	0	141	0.0
> 50th and ≤ 75th Percentile	2	152	1.3
> 75th and ≤ 90th Percentile	3	98	3.1
> 90th Percentile	1	50	2.0
<b>Total</b>	<b>8</b>	<b>521</b>	<b>1.5</b>

(missing = 18 denominator)

The collapsing of the above noted table confirmed that there was not the reversed dose response that had been identified in the other cohorts (Table 20).

**Table 20. Occurrence of Cancers by the Three Levels of Exposure Among Active Members without Extended Sick Leave**

	Number of Cancers	Denominator (n)	Percent with Cancer
Least Exposed	1	63	1.6%
Moderately Exposed	2	271	0.7%
Most Exposed	4	142	2.8%
Total	7	476	1.5%

(missing = 1 cancer, 63 denominator)

The likelihood ratio test was performed to assess whether the joint effect of exposure and risky behaviour was confounding the results in this cohort. The findings from this procedure were similar to these found in the other two cohorts. The difference between the log likelihood statistic of the full model (1.8) and the reduced model (0.5) was 1.3 ( $p = 0.2542$ ).

The logistic regression modelling to control for confounding from the covariates was performed without the inclusion of any interaction terms. Once again statistical significance was not achieved for any of the variables included in the model (Appendix B, Tables B6). With the exception of age, the point estimate for the odds ratio for all the other variables was above unity. The  $p$  value for the Hosmer-Lemeshow statistic was 0.567 for the model.

#### **4.6. Deceased Cohort**

Information was collected from 98 relatives of deceased RCMP members. This cohort was a census of all members who during their service were assigned to highway patrol,

have died and have survivor benefits paid to their family members.

#### **4.6.1. Demographics**

Respondents to this questionnaire were exclusively the widows of the RCMP members. There were very few missing data. Most remarkable were the 8 missing responses for age (8.2%), three missing responses for radar use (3.1%), one missing for the cancer outcome (1.0%), while bicycling and riding prior to joining the force had six (6.1%) and five (5.1%) with comments of not knowing their husbands during their childhood.

All deceased members were male. Language of the deceased member could not be determined by the language of the returned questionnaire as it was completed by a proxy. Therefore these rates are not reported. The age at time of death ranged from 27.1 to 70.7 years of age with a median age of 51.6. Most were married or living in a common law relationship (96.9%) and 3.1% were separated or divorced at their time of death. Positive responses to the member having biological children occurred in 87.8% of the questionnaires. The highest ranks attained among the non-commissioned deceased members (96.9%) were staff sergeant major (2.0%), staff sergeant (32.7%), sergeant (23.5%), corporal (29.6%) and constable (9.2%). The commissioned officers consisted of 3 members who reached the rank of superintendent (3.1%). Approximately 86.3% of the deceased members performed radar duties during their service.

#### **4.6.2. Cancers**

There were 41 positive reports of cancer (42.3%) with 42 primary invasive cancers and 1 non-invasive skin cancer identified. Table 21 displays the distribution of cancers

among deceased members. Three organ groups accounted for over half of the cancers reported for this cohort, digestive organs, blood and lymph tissues and the urinary organs. Melanomas did not figure prominently in this cohort, whereas blood was the most commonly reported primary cancer.

**Table 21. Distribution of Primary Invasive Cancer Sites Among Deceased Members**

	Frequency	Percent of all Reported Cancer Sites
<b>Blood &amp; Lymph Tissues</b>	<b>8</b>	<b>19.0</b>
Blood	6	14.3
Hodgkin's Disease	1	2.4
Lymphoma and Non-Hodgkin's	1	2.4
<b>Bone Tissue &amp; Skin</b>	<b>3</b>	<b>7.1</b>
Liposarcoma	1	2.4
Melanoma	2	4.8
<b>Brain</b>	<b>4</b>	<b>9.5</b>
<b>Digestive Organs</b>	<b>12</b>	<b>28.6</b>
Bowel	1	2.4
Colon	5	11.9
Esophagus	2	4.8
Pancreas	2	4.8
Stomach	2	4.8
<b>Genital Organs</b>	<b>2</b>	<b>4.8</b>
Prostate	1	2.4
Testicular	1	2.4
<b>Head &amp; Neck</b>	<b>2</b>	<b>4.8</b>
Larynx	1	2.4
Salivary Gland	1	2.4
<b>Respiratory System</b>	<b>4</b>	<b>9.5</b>
Lung	3	7.1
Oat Cell	1	2.4
<b>Urinary Organs</b>	<b>5</b>	<b>11.9</b>
Bladder	2	4.8
Kidney	2	4.8
Ureter	1	2.4
<b>All Other &amp; Unspecified</b>	<b>2</b>	<b>4.8</b>
Neuroendocrine	1	2.4
Unknown Primary	1	2.4
<b>Total</b>	<b>42</b>	<b>100</b>

### **4.6.3. Risk Factors for Testicular Cancer**

The reporting of risk factor information was obtained from the widows of the deceased RCMP members. Among the 97 responses to the question regarding undescended testicles, there were only 2 positive reports (2.0%) but there were 27 responses of don't know (27.6%). Prior to joining the force 89.1% had biked (26.1% often and 63.0% occasionally) and 47.3% had ridden (4.3% often and 43.0% occasionally). During police service, the proportion bicycling dropped to 58.3% (9.4% often and 49.0% occasionally) while riding declined slightly to 44.3% (6.2% often and 38.1% occasionally). Almost 32.7% of the members died while in active service and therefore were removed from the denominator for activities after leaving the force. The percentage of members bicycling and riding after leaving the force was 38.5% (7.7% often and 30.8% occasionally) and 17.2% (1.6% often and 15.6% occasionally) respectively. Severe testicular trauma was reported for 6.2% of the deceased. Of these, 5 (83.3%) instances were during police service and the other was prior to joining the force. Medical care was also sought in five (83.3%) of the cases.

## **4.7. Comparison Between Cohorts of the RCMP**

### **4.7.1. Demographics**

#### **4.7.1.1. Pensioners Compared to Others**

Differences identified between the cohorts are displayed in Table 22. The pensioners had the oldest median age. The pensioners and the deceased included only male respondents as compared to the active cohorts. This feature was not due to a selection bias of the respondents, but reflects the make up of the force a number of years ago. The pensioners had the greatest number of members married or in

common law relationships when looking at the living cohorts and the greatest percentage of members with biological children of all cohorts. The pensioned cohort had the least number of constables and corporals among their ranks. Approximately one third of pensioners were sergeants or staff sergeants. Pensioners included the highest number of commissioned officers as compared to the other cohorts surveyed.

#### **4.7.1.2.Active Members With and Without Extended Sick**

##### **Leave**

Although the members of the cohort with less than 30 consecutive days of sick leave were chosen with the next nearest regimental number to the member with extended sick leave, a number of differences should be noted. The median age is greater in the cohort without extended sick leave. There were more female members in the active cohort with extended sick leave (21.1%) as compared to the cohort without extended sick leave (14.9%). The difference in the proportion of females in each of the member cohorts was tested using the two sided Fisher's exact test and was statistically significant ( $p=0.0099$ ). Verification that maternity leave was not included as sick leave was confirmed with PARADE management and they stated that maternity leave has an entirely separate coding. There were more than twice as many members who have never been married in the active cohort without extended leave (9.3% versus 4.5%) and fewer of these members have had children. There were differences in the highest rank obtained as well. Two-thirds of the members with extended sick leave were constables but only 54.1% of those without extended sick leave were at this rank. It appears that the majority of these latter members have been promoted to corporal. No difference was seen at higher ranks.

#### 4.7.2. Exposure Comparisons

Proportionally fewer pensioners performed radar duties than any other cohort (Table 23). Pensioners' total work time in policing was one and a half times as long as the either of the active cohorts. The active member cohort with extended sick leave had the greatest median number of radar years. There was no difference in reporting of days per week and hours per day. When combined into the algorithm for exposure, the median number of hours reported by the members with extended sick leave was 1.31 times more hours of lifetime exposure than the active cohort without extended leave and 2.78 times more hours of exposure than the pensioner cohort.

**Table 22. Demographics for all the Cohorts**

	Pensioners	Active ≥ 30 Days Sick Leave	Active <30 Days Sick Leave	Deceased Members
Median age (years)	57.0	40.8	44.3	51.6
Language (%)				
• English	99.1	96.3	94.6	n/a
• French	0.9	3.7	5.4	n/a
Gender (%)				
• Male	100.0	78.9	85.1	100.0
• Female	0.0	21.1	14.9	0.0
Marital status (%)				
• Never Married	0.5	4.5	9.3	0.0
• Married/Com. Law	92.0	85.9	84.2	96.9
• Separated/Divorced	6.2	9.0	6.5	3.1
• Widowed	1.4	0.6	0.0	0.0
Biological children (%)				
• Yes	90.8	83.5	72.8	87.8
• No	9.2	16.5	27.2	12.2
Rank (%)				
• Constable	4.7	66.1	54.1	9.2
• Corporal	17.5	21.2	31.0	29.6
• Sergeant	32.4	9.2	10.0	23.5
• Staff Sergeant	35.8	3.0	3.6	32.7
• Staff Sergeant Major	0.8	0.0	0.2	2.0
• Inspector	3.5	0.4	0.6	0.0
• Superintendent	3.5	0.2	0.4	3.1
• Chief Superintendent	1.2	0.0	0.2	0.0
• Assistant Commissioner	0.5	0.0	0.0	0.0
• Deputy Commissioner	0.1	0.0	0.0	0.0

**Table 23. Work Histories for all the Cohorts**

	Pensioners	Active ≥ 30 Days Sick Leave	Active <30 Days Sick Leave	Deceased Members
Total years in police work	26.0	18.0	18.0	n/a
Ever radar (%)				
• Yes	78.1	98.4	98.9	86.3
• No	21.9	1.6	1.1	13.7
Years of radar	7.0	9.0	7.5	n/a
Days per week of radar	2.5	5.0	5.0	n/a
Hours per day of radar	4.5	6.0	6.1	n/a

The comparison of the distribution of exposure between cohorts showed a different pattern in the pensioner cohort, where over half of these members (54.5%) were in the least exposed group and another third (32.6%) were moderately exposed. This pattern was vastly different when compared to the active cohorts where, for both cohorts, over 50% were moderately exposed and in the cohort with extended sick leave an additional third were in the most exposed (Table 24).

**Table 24. Exposure Algorithm Compared Between the Cohorts**

	Pensioners	Active Members with Extended Sick Leave	Active Members without Extended Sick Leave
Least Exposed	54.5%	11.8%	15.4%
Moderately Exposed	32.6%	52.3%	56.2%
Most Exposed	13.0%	35.9%	28.4%
Total (N)	1235	499	521

(missing = 57 pensioners, 15 with sick leave, 18 without sick leave)

#### 4.7.3. Risky Location versus Exposure

The large crosstabulations exhibited a bimodal pattern between least risky and most risky behaviours for all cohorts of the living. The important point to note in all these cohorts was that as exposure increases to the highest levels, more members performed the riskiest behaviours.

#### 4.7.4. Cancer

Invasive cancers were reported by 7.4% of pensioners, 4.5% of active members with 30 or more consecutive days of sick leave and 1.5% of members without extended sick leave. Invasive cancer was diagnosed in 42.9% of the deceased.

The organ group that included bone tissue and skin ranked first among pensioners and active members without long term sick leave and second among active members with extended sick leave. This was mostly due to the number of melanomas diagnosed in these cohorts (pensioners with 32 (33.3%), active members with extended sick leave with 5 (20.0%) and active members without extended sick leave with 3 (50.0%)). Genital cancers were the second most common among the pensioners and in third place for both active cohorts. The most commonly reported cancers in this grouping of sites included prostate (pensioners with 12 (12.5%) and active members with extended sick leave with 2 (8.0%)) and testicular (active members with extended sick leave with 2 (8%) and pensioners with 5 (5.2%)). Among the members without sick leave the sole genital cancer was an invasive cervical cancer. Urinary tract cancers were prominent in all cohorts of the living members as well as in the deceased. These members reported mostly kidney and bladder cancers.

Digestive tract cancers were the most prominent in the deceased cohort and were ranked third in the pensioner cohort with colon cancer being the most common site. These cancers were rare in the active members. Blood and lymph tissues were ranked first among organ groupings in the active members with extended sick leave and were the second most common site among the deceased. All four lung cancers were

diagnosed in the pensioner cohort (4.2%), while the deceased cohort also reported 4 cancers of the respiratory system (9.5%).

#### **4.7.5. Standardized Incidence Ratios**

SIRs were calculated for the living cohort based on the 1971 Canadian male population. This population is often used as the standard by which comparisons are made. As some of the members joined the force at age 18, the age categorization was required to start with the first age grouping being 15-19 years of age. As the oldest living member was 79 years of age, the Canadian population rates were truncated at that age. SIRs were calculated using data that was weighted to represent all members pensioned and active that have been assigned to highway patrol.

There was no excess in the number of cancers diagnosed (after joining the force) as compared to the expected. This would have increased had the information required for the person year calculation been available for the additional 10 cancers that were excluded. This result did not achieve statistical significance as the 95% CI for the SIR was 0.85,1.19 and included 1 (Table 25).

The findings are reported for major composite organ sites (Table 25), and for a few specific organs (such as testicular which was the original site of interest), melanoma and kidney cancer (due to the high number of reported cases) (full details for the calculations of all the SIRs are included in Appendix B, Table B7 to B19). The most notable results for the composite organ sites were for the digestive organs which was less than the expected (SIR = 0.42 (95% CI 0.23, 0.71)) and urinary organs which was greater than expected (SIR = 1.96 (95% CI 1.32, 2.87)). Both of these findings were

statistically significant. Individual organ SIRs worth noting included testicular cancer with a SIR of 0.84 but it was not significantly different from 1.0 (95% CI 0.31, 1.82).

**Table 25. Standardized Incidence Ratios for the RCMP**

	Observed	Expected	SIR (O/E)	95% Confidence Interval	
				Lower	Upper
All Invasive Cancers	147.68	147.46	1.00	0.85	1.19
Blood & Lymph Tissues	13	21.01	0.62	0.33	1.06
Melanoma	53.84	6.87	7.84 *	5.82	10.35
Brain	3	5.83	0.51 *	0.11	0.79
Digestive Organs	14	33.19	0.42 *	0.23	0.71
Colorectal	12	18.52	0.65	0.34	1.13
Male Genital Organs	21	16.24	1.29	0.80	1.98
Prostate	14	8.70	1.61	0.88	2.70
Testicular	6	7.18	0.84	0.31	1.82
Respiratory System - Lung	3	28.14	0.11 *	0.02	0.31
Urinary Organs	27.56	13.93	1.98 *	1.32	2.87
Kidney	10	5.51	1.82	0.87	3.34
Non Melanoma Skin	53.84	25.53	2.11 *	1.56	2.78

An excess of melanoma was detected. Information was missing on two of the melanoma cases. Even without these cases included in the observed incidence, the SIR for melanoma was 7.84 and was statistically significant (95% CI 5.82, 10.35). The SIRs for lung cancer was 0.11 (95% CI 0.02, 0.31) and brain cancer was 0.51 (95% CI 0.11, 0.79) were well below the expected. The low number of observed cases for these cancers may be due to the short duration from diagnosis to death from these types of cancer. It is quite possible that the affected members have died and did not have family members receiving survivor benefits. Although some of the other cancers that were investigated had SIRs that differed from 1, none reached statistical significance.

Due to the high SIR for melanoma skin cancer, the analysis was repeated for non-melanoma skin cancers. The results from this indicate that there is also an excess of these types of cancer (2.11 95% CI 1.56, 2.78) among the members of the RCMP.

#### 4.7.6. Risk Factors for Testicular Cancer

The reporting of undescended testicles did vary slightly between cohorts (Table 26) with the widows stating that 2.0% of their spouses were born with this anomaly. This cohort also had the highest proportion of "don't know" responses (27.6%). Active members with extended sick leave reported the highest proportion of undescended testicles (3.0%).

**Table 26. Risk Factors for Testicular Cancer for all the Cohorts**

	Pensioners	Active ≥ 30 Days Sick Leave	Active <30 Days Sick Leave	Deceased Members
Undescended Testicles (%)				
• Yes	2.8	3.0	2.0	2.0
• No	79.7	77.3	76.5	70.4
• Don't Know	17.5	19.8	21.5	27.6
Testicular Trauma (%)				
• Yes	14.1	15.1	8.8	6.2
• No	83.5	83.4	89.0	16.5
• Don't Know	2.4	1.5	2.2	77.3
Saw a Doctor for Trauma (%)				
• Yes	59.3	67.8	55.3	83.3
• No	40.7	32.2	44.7	16.7
When Trauma Occurred (%)				
• Prior	35.2	40.0	45.9	83.3
• During	51.5	52.7	45.9	16.7
• After	4.8	n/a	n/a	0.0
• Prior & During	7.3	7.3	8.1	0.0
• During & After	0.6	n/a	n/a	0.0
• Prior, During & After	0.6	n/a	n/a	0.0

Trauma to the testis(es) was reported almost twice as often by the pensioners and active members with 30 or more consecutive days of sick leave than by either of the other cohorts (Table 26). All of the cohorts, except the dead (83.3%), reported almost two thirds of members seeking medical care for the injury. The widows reported a high proportion of "don't know" for the trauma question (77.3%) as well as the activity questions.

All members of the living cohort reported riding bicycles and horses prior to joining the force than during their service (Table 27). Although more pensioners reported riding bicycles often before joining the force (60.4%), this activity dropped off once they joined the force (5.8%). Both the active member cohorts and the deceased also declined, but the difference was not as stark. Compared to all other cohorts, the pensioners reported more horseback riding during their service, excluding recruit training and assignment to the musical ride, than any of the other respondent cohorts. The intensity of decline between the time frames of prior to police service and during service for all cohorts excluding pensioners was not as remarkable for horseback riding. Participation in these activities continued to dwindle into as they entered into retirement.

#### **4.7.7. Effects of Radar Units on Cancer**

Among the pensioners a drop in the percentage of cancers was noted from 9.5% in the no exposure group to between 6.1% and 7.1% for all other exposure levels. Among the active members with extended sick leave, a decreasing dose response can be seen from the lowest exposure level (9.8%) to the 75th to 100th percentile of exposure (5.0%). The low number of cancers in the active cohort without sick leave was

expected and precludes the detection of a pattern in the relationship between exposure levels and cancer diagnosis.

**Table 27. Risk Factors (Activities) for Testicular Cancer for all the Cohorts**

	Pensioners	Active ≥ 30 Days Sick Leave	Active <30 Days Sick Leave	Deceased Members
Bicycling Prior to Service (%)				
• Often	60.4	46.5	44.6	26.1
• Once in a While	37.8	52.3	53.2	63.0
• Never	1.8	1.3	2.2	10.9
Bicycling During Service (%)				
• Often	5.8	16.5	18.6	9.4
• Once in a While	64.5	69.4	71.2	49.0
• Never	29.7	14.0	10.2	41.6
Bicycling After Service (%)				
• Often	10.6	n/a	n/a	7.7
• Once in a While	53.6			30.8
• Never	35.7			61.5
Riding Prior to Service (%)				
• Often	14.5	6.5	7.9	4.3
• Once in a While	47.5	50.0	46.8	43.0
• Never	38.0	43.5	45.3	52.7
Riding During Service (%)				
• Often	10.1	3.0	4.9	6.2
• Once in a While	46.4	38.2	33.8	38.1
• Never	43.5	58.8	61.4	55.7
Riding After Service (%)				
• Often	1.8	n/a	n/a	1.6
• Once in a While	18.9			15.6
• Never	79.3			82.8

#### **4.8. Case Series for the Reporting of Testicular Cancers**

As testicular cancer was the primary outcome of interest, the case series is presented for the seven cases in the living members (5 pensioners and 2 members who took 30 or more consecutive days of sick leave) and the one case among the deceased members. The inclusion of the deceased member's testicular cancer was not agreed

upon in the adjudication process. Both adjudicators agreed that it appeared to be clinically unlikely that it was a primary testicular tumour as this member had numerous primary sites, but on a methodological basis it could not be discounted since proof of diagnosis was not required from any of the respondents regardless of site(s). Although risk factor information was described in for all of the cohorts except the active members who did not have extended sick leave, it is presented below case by case for the eight RCMP members with testicular cancer. It is important to note that the population selected for this study were all assigned to highway patrol and the majority of the members have experience using radar units.

#### Case 1

This 55 year old pensioner served with the RCMP for 26 years starting in 1959. He was a sergeant when he retired. He did not use radar as part of his duties. At 24 years of age he was diagnosed with testicular cancer and as indicated on the questionnaire, it did not spread. He stated he was born with undescended testicles. He did not ride horses at any time but rode a bicycle frequently prior to joining the force, occasionally while serving and never after leaving the force. He did not have any severe testicular trauma.

#### Case 2

This 49 year old pensioner indicated that he began working for the RCMP in 1968 and retired in 1986 at the rank of constable. His total years of work was reported as 18 years. He was assigned to radar duty from 1970 to 1983, and estimated 13 years. During this time he performed radar duties approximately 6 hours per day, 3 days per week. According to the exposure algorithm calculation he was in the 50 - 75th

percentile of exposure. He used both hand held and car mounted units. He reported keeping the radar unit in his lap, on the dash or mounted on the rear left window. These locations were categorized in the highest risk group due to the resting of the unit in his lap.

In 1991 this pensioner, then 45 years of age, was diagnosed with testicular cancer. He indicated that there was spread to the lungs in the same year. He was not born with undescended testicles, and rode a bicycle occasionally throughout his life. Although he did not ride a horse prior to joining the force, he reported riding once in a while during his police service and after leaving the force. There was no reported testicular trauma.

### Case 3

This 56 year old pensioner was employed by the RCMP for 28 years from 1959 to 1987. He attained the rank of sergeant. He did two periods of radar duty, the first for 2 years starting in 1962, and the second lasting 7 years from 1978 to 1985. On average he only did radar one day a week for approximately 3 hours. He was assigned to the 25 - 50th percentile of exposure according to the algorithm. He used both types of units and rested the hand held unit on the seat beside him while the car mounted unit was left in its bracket. Resting the unit by his side was considered to be one of the most risky behaviours.

In 1984, at age 44, he was diagnosed with testicular cancer that did not spread. He did not know whether he was born with undescended testicles. Prior to joining the force he bicycled often and rode a horse occasionally. Both these activities were reported as

occasional during his service. After leaving the force he did not ride a horse but continued to bike once in a while. He did not report any severe testicular trauma.

#### Case 4

This 48 year old pensioner joined the RCMP in 1968 , and served for 25 years rising to the rank of corporal. He was assigned to radar duties from 1989 to 1993 and estimated this to be 5 years. When he performed radar duties it was for approximately 8 hours a day, 3.5 days a week. This resulted in an exposure level of less than the 25th percentile. He reported using both types of radar and indicated that he mostly used car mounted radar. The radar unit was kept mounted on the dash when not pointed at a car. This location was ranked as a least risky behaviour.

In 1982, prior to be assigned to radar duty, he was diagnosed with testicular cancer. At that time he was 35 years of age. He reported that there was no spread. He was not born with undescended testicles. His bicycling and horseback riding activities followed the same pattern, once in a while prior to joining the force and during his service. These activities were not continued once he left the force. He did report testicular trauma requiring medical attention during his police service.

#### Case 5

This 47 year old pensioner was an active member of the RCMP for 24 years starting in 1970 and achieved the rank of corporal. He performed radar duties for approximately 16 years starting in 1972. On average he operated a radar unit 5 hours a day, 4 days a week. His exposure was estimated to be in the 75 - 90th percentile. Although he reported using both types of radar units, he mentioned that he kept the hand held unit

in his lap when not pointed at a car. This was one of the places that was classified as most risky.

In 1990, he was diagnosed with testicular cancer that did not spread. He was 41 years of age. He was not born with undescended testicles, never rode a bicycle or a horse and did not report any severe testicular trauma.

#### Case 6

This 38 year old active member joined the force in 1977 and had served 18 years. He reported being a constable. He served three periods of radar duty from: 1980 to 1983; 1986 to 1989; and 1989 to 1991. He estimated that he performed 8 years of radar duty, 3 days a week and 2 hours a day. He was classified as being in the 25 - 50th percentile of exposure. When not measuring traffic speed, he kept the unit pointed away from him specifying that if it was hand held it was in the front seat area. This location was considered most risky, although he stated that the unit was always in the standby mode when not pointed at a car.

He was 34 years of age in 1991 when he was diagnosed with testicular cancer. It did not spread. He was not born with undescended testicles. He often rode a bicycle prior to joining the force and during his service. Although he never rode a horse prior to becoming a member of the RCMP, he did ride once in a while after joining the force. He did report severe testicular trauma during his childhood but did not seek medical attention.

#### Case 7

This 38 year old constable had been a member of the RCMP for 10 years, since 1985. He had been assigned to radar duty for his entire career since 1986. He estimated that he performs 10 hours of radar a day, 5 days a week. He was assigned to the 25 - 50th percentile of exposure. He used both hand held and mounted radar units. The mounted unit was pointed out the windshield but the hand held was kept in his lap or beside him.

In 1984, prior to joining the RCMP and being assigned to radar, he was diagnosed with testicular cancer. He was 26 years old at the time of diagnosis. Spread was reported to the lungs and groin in 1986. He reported that he often bicycled and never rode a horse. He did not report any severe testicular trauma.

#### Case 8

This member was 63 years of age when he died. During his career with the RCMP he did perform radar, but no exposure information was collected to estimate the amount of radar duty performed. He attained the rank of corporal.

He was diagnosed with testicular cancer in 1984 at age 62. Upon adjudication by an oncologist, the information on cancer spread was set to missing. He was not born with undescended testicles. He rode a bicycle occasionally throughout his lifetime. He did horseback ride once in a while except during his police service when it was stated as never. He did not suffer any severe testicular trauma.

## 5. DISCUSSION

### 5.1. Study Outcomes

#### 5.1.1. Demographics

The demographic data appear to vary between cohorts. The older age of pensioners compared to the two cohorts of active members (approximately 13 - 16 years) was not surprising. The difference measured between the pensioner cohort (approximately 5 years older) and the deceased cohort might be explained by the fact that approximately one third of the deceased died while in active service.

Not unlike other police forces, the RCMP, until fairly recently, employed only men as regular members. Therefore it was not surprising that there were no females among the pensioners. This historical recruitment pattern may also explain why there were no females among the deceased cohort. There was a greater proportion of females among the members with extended sick leave (21.9%) as compared to those without sick leave (14.9%). The explanation for this was unclear, given the manner by which these active cohorts were selected. Verification that maternity leave was not included as sick leave was confirmed with PARADE management and they indicated that maternity leave has an entirely separate coding. The vast majority of RCMP members lived in a married or common law relationship, with the pensioner and the deceased cohort reporting 92.0% and 96.9% respectively. There were differences in the single status of members. There were more than twice as many never married members among the active members without extended sick leave (9.3%) as among those with such leave (4.5%). This pattern reverses for members who were separated or divorced.

Variation in reported rank among the non-commissioned members abound. The use of rank as a proxy for socio economic status has its limitations. These are mostly due to the constraints associated with joining the commissioned ranks such as a potential reduction in pay (officers are not paid for overtime) and an increase in the number of years to retirement (from 25 to 35 years of service). Specific differences among the cohorts include that the retired members and the deceased members had fewer members at the constable rank (4.7% and 9.2% respectively). It would seem reasonable to expect that as members remain with the force to their retirement they would progress through the ranks to either non-commissioned or commissioned officers. The most common ranks among the pensioner cohort were sergeant and staff sergeant. These ranks along with corporal were the most common among the deceased. Over 85% of the members who were currently active reported that they were either constables or corporals with the RCMP. Of those that had extended sick leave, almost two-thirds were constables (66.1%) whereas just over half (54.1%) of those without sick leave were constables.

#### **5.1.2. Exposure**

On first thought, one would expect the pensioner cohort to have more exposure since they had the greatest number of years of police service. In fact, this cohort had the fewest number of years of radar duty, as well as the lowest proportion of members ever performing radar duties. This was due in part to the fact that radar was only introduced in the 1950's and that a number of these members were not involved in highway patrol at the time of its inauguration. Also, until radar units for speed control became common, these units were shared between detachments during the year. As a result,

they were only available for short periods of time each year. The initial units required one member to monitor the speed readings while others, also assigned to highway patrol, were responsible to "pick-up" the speeding motorists down the road. These members reported that they were not trained for radar duties nor were they ever assigned to use radar units for these rotations. This type of set up was phased out as radar units were placed in or on police vehicles.

The exposure algorithm was calculated for all living members who provided complete information, based on the number of years of radar duties, days per week and hours per day. As mentioned previously, there was no attempt to incorporate the type of radar unit used into the algorithm calculation. Although radar has been used to measure traffic speed for approximately 40 years, there is no scientific evidence that exposure from different types of units produce different health outcomes. There have also not been any scientific studies comparing hand held radar units to car mounted radar units.

Pensioners had the least exposure from both frequency and intensity of exposure to radar units. Members with extended sick leave had the highest median exposure of all the cohorts. They also had the highest median exposure for each of the components in the algorithm. When combined into the algorithm for exposure, these members had 1.31 times more hours of lifetime exposure than the active cohort without extended leave and 2.78 times more than the pensioner cohort. Whether this was due to rank, constables with the RCMP performing more and longer rotations of radar duties, it was not possible to ascertain. The fact that these members had worked a similar number of years in policing duties and were absent for at least 30 working days should not

facilitate their increased accumulation of radar exposure. The main difference between both active cohorts of members was the number of years of radar duty.

### **5.1.3. Risky Location versus Exposure**

The pensioner cohort performed fewer risky behaviours than either of the active cohorts. This pattern may be due to the type of units that were available to them during their period of radar service. This cohort used the most mounted units that were described as tripod units or were kept in the trunk of their car. Use of these units guaranteed that the operator would be performing fewer risky or not risky behaviours with the radar unit. As the units became obsolete, replacement units were either hand-held or mounted. Mounted units often had a bracket where the radar unit could be kept. These units were fully operational if the member chose to hold the unit, versus mounting it in its bracket. Active members in both cohorts performed riskier behaviour with the radar units than the pensioned cohort, but the members with extended sick leave had a higher proportion of risky behaviour at a lower exposure level than any of the other cohorts. One important point to note in all these cohorts was that as exposure increased to the higher levels, more members performed riskier behaviours. This may well relate to an increased comfort level with operating the unit which might lead one to become lackadaisical with the unit over time.

### **5.1.4. Cancer**

As the risk of developing cancer increases with age, it was not surprising that the pensioner cohort had a higher incidence of invasive cancer (7.4%) than the active member cohorts with and without 30 or more consecutive days of sick leave (4.5% and

1.5%). The fact that there was a three fold differential between the active cohorts may be cautiously interpreted to indicate that the use of the 30 or more consecutive days of sick leave did identify a group of members who had a different medical profile, diagnosis of cancer, as well as a slightly different exposure profile. It is worth noting that the diagnosis of invasive cancer was indicated in over 40% of the responses from the widows of the deceased.

The most common single type of cancer diagnosed in the living members was melanoma (most common for the pension cohort and active cohort without extended sick leave). This cancer has one known risk factor, UV exposure<sup>101</sup>, especially during childhood, although other exposures, such as NIR, have been investigated<sup>102</sup>. Although members of the RCMP were exposed to both of these risk factors and without adequate warnings about solar exposure, which have only been in effect recently, this type of association might well be worthy of its own epidemiologic investigation. Another concern that must be mentioned is the possibility of overreporting of melanomas. In order to properly determine the cell morphology of the reported skin cancers, a chart review of their medical files would be necessary.

Active members with long term sick leave had blood and lymph tissue cancer as their top ranking neoplasm diagnosis and this most likely would have contributed to their extended leaves of absence.

The digestive tract cancers were the most common among the deceased and ranked third among pensioners with colon cancer being the site most often mentioned.

The second most common cancer to strike the pensioners involved the prostate. The incidence of this cancer is increasing in Canada. Although the etiology is not understood, the risk of developing this cancer increases with age. As members were often pensioned from the RCMP in their mid-forties to early fifties, this cohort approaches the age range to be at risk of developing and being diagnosed with this type of cancer.

#### **5.1.5. The Effects of Radar Unit Usage on Cancer**

A pattern of decreasing occurrence of cancer as exposure increased was noted for both the pensioner cohort and the cohort of active members with 30 or more consecutive days of sick leave. Further analyses were done to control for potential confounding which might have been responsible for the above noted effect. The initial results were confirmed with logistic regression procedures which, for the active group with extended sick leave, produced statistically significant odds ratios for the exposure algorithm being protective for cancer. Although the direction does not seem biologically plausible, it would seem possible for this to occur in this cohort due to its extensive use of radar. Both of the other cohorts had less exposure, with the pensioners having the lowest median exposure and not statistically significant odds ratio for cancer and exposure greater than unity. The cohort of members without extended sick leave had the point estimate of the odds ratio for exposure less than 1 but was also not statistically significant.

#### **5.1.6. Standardized Incidence Ratios**

Comparisons of cancer incidence between the living cohort of the RCMP and the standard Canadian male population indicated that, for certain cancers, there was a

measurable excess. There was no statistically significant excess risk among the RCMP with highway patrol assignment from either all cancers or testicular cancer. It is important to remember that the living cohort cannot be generalized to the RCMP as a whole.

Bearing in mind this caveat, there was a statistically significant differential measured for melanoma and urinary tract cancer (excess) as well as for cancer of the digestive organs, brain and lung cancer (decreased). There appears to be a 7.8 fold increased risk for melanoma and 2.0 fold increase risk for cancers of the urinary tract in these members. Further investigation into the risk factors surrounding these two cancer types is needed to confirm this finding and to evaluate whether there are any measures that should be taken in order to reduce the incidence of these cancers among the members of the RCMP.

It is worth noting that it was not possible, due to the lack of exposure data, to include the deceased cohort's experience (person-years and cancer incidence) in the reconstruction of this segment of the force's experience. Had the data for this cohort (incidence 42.3%) been available and included in the calculations the SIRs would have been higher.

It seems unusual that there was no healthy worker effect measured among the members of the RCMP. In order to maintain employment with the force, members must undergo physical examinations every two years. This should have a positive impact on ensuring that a healthy worker effect is occurring. It is important to remember that there were almost 1,300 pensioned members (voluntary and disability)

who responded to the survey and that many of these pensioners are no longer employed in the workforce. Inclusion of this cohort may be one reason a healthy worker effect was not apparent. Another reason may be the impact of the large excesses of melanoma reported among the members.

#### **5.1.7. Risk Factors for Testicular Cancer**

The reporting of undescended testicles was low compared to a recent Danish study<sup>103</sup> (case-control study of testicular cancer which identified cryptorchidism based on a hospital case series) which reported 7.0% of males were born with this condition and high when compared to reported incidences which were estimated to be 1.1%<sup>71</sup>. This may be partially explained by the high proportion of "don't know" responses. The published rates for comparison were also determined from case-control studies where the estimates were derived from hospital surgical records.

Participating in the activities potentially associated with the development of testicular cancer and the occurrence of trauma were reported with little consistency by the widows of the deceased. They also reported a high proportion of "don't know" responses which were often accompanied by notes stating that they did not know their spouse at that time in their life. It would seem reasonable to consider these data less reliable when collected from proxy respondents than from the actual members. All members reported a higher frequency of riding bicycles and horses prior to joining the force than during their service. Participation in these activities continued to dwindle as members entered into retirement.

Trauma to the testis(es) appeared to be fairly common among the respondents. This type of injury was reported almost twice as often by the pensioners and active members with 30 or more consecutive days of sick leave than by either of the other cohorts. Although the analyses to assess whether the association between testicular cancer and severe testicular trauma was not significant, it is interesting to note that it was the members in the cohorts that reported the most trauma that also had the majority of the testicular tumours. This finding may support the previously stated opinion which noted that it is injury to this area that coincides with the detection of testicular cancer.

## **5.2. Methodological Issues**

A number of methodological issues, both strengths and weaknesses of the study, have been identified and are presented in this section.

### **5.2.1. Identification of the Study Population**

The target population was identified through the RCMP PARADE database. It was possible to select a target population which consisted of all members who had ever been assigned to highway patrol. This assignment was a good proxy for exposure to radar units. Having access to these RCMP members provided a broad range of exposure levels to develop the exposure classification system.

It is important to note that the members of the RCMP may be unique in many factors that attract them to this police force. There may be a self-selection bias for horseback riding as members may have joined the force because they were attracted by the

equestrian traditions associated with the force. This may account for the high levels of members, specifically pensioners, who have ridden horses prior to and during their careers excluding any job related assignment. Another concern that arose was the paucity of French questionnaires returned by the respondents. This may be due to the force's responsibilities across the country. The RCMP contracts as the provincial police force in all provinces except Ontario and Quebec. Therefore a great many Francophone recruits work in English and may well have responded in English.

Selecting a cohort of active members with highway patrol experience and extended sick leave was unconventional. The use of the 30 or more consecutive days of sick leave marker effectively over-sampled cancer patients among the RCMP active members. The members in this cohort reported three times more cancers than the members in the active cohort without sick leave. Although a weighted analysis was done for the SIRs, the inclusion in the study of an excess of active members with a cancer diagnosis may have contributed to the observed increase in the SIRs for the force and reduced the potential for a healthy worker effect.

It should also be noted that the cohort of members with 30 or more consecutive days of sick leave had a greater exposure to radar units than any of the other cohorts. The reason for this difference is not known but it may be that the members with extended sick leave are different from other members of the RCMP. Although this observation has not been fully examined, it may also be seen in the differences measured by the socio-demographic status questions.

### **5.2.2. Ability to Assess Losses to Follow-up**

The initial list of discharged members with highway patrol assignment provided by the RCMP included approximately 3,800 names. This list included members who would be included on the pensioner rolls (due to retirement, disability or death) and those who have left the force without a pension (for reasons such as insufficient time with the force to draw a pension, disciplinary action and job opportunities elsewhere). It was only possible to follow those discharged members who were included in the pensioner database. This reduced the eligible number of pensioners including the deceased to 1961 subjects. There was no attempt to examine exposure to radar units among those lost to follow-up as these members had left the force over the last 22 years and cancer outcomes could not be reconciled to the exposure. The loss of these potential subjects may bias the results as it was impossible to determine what had happened to them since leaving the force.

### **5.2.3. Response Rate**

The response to the questionnaire was excellent. A single mailing to the members of the force received a better than 70% response rate. This result may well be related to the type of person who chooses policing as his/her career as well as the training s/he received. Inquiries were received from members who wished to be included in this study and asking what they might do. Aside from the excellent response to the survey, each of the questionnaires was well completed. Many of the pensioners included hand written comments and notes explaining what radar was like when it was first introduced. The historical value of these comments was excellent and provided further clarification of their responses, where these respondents were unsure of how to answer a question. Although RCMP management had concerns about the inclusion of the socio-

demographic questions, specifically highest rank attained, it did not appear to cause much consternation among the rank and file.

#### **5.2.4. Linking to PARADE**

The ability to link back to the PARADE database ensured that the active members who received their questionnaires at the office were indeed the respondents who completed the returned questionnaires. This verification of regimental numbers and/or demographic and employment data was done to ensure that only the members selected for participation in the study were included in the database used for the analyses. As indicated in the results section, 123 questionnaires were scrutinized to ensure the appropriate member responded and 47 questionnaires were rejected when this could not be verified.

#### **5.2.5. Exposure Assessment**

The use of the self-reported estimate of time performing radar duties was chosen as a proxy measure for NIR exposure, as no exposure measurement was available from employment records. Radar unit use was not regulated by any health protection agencies and therefore personal dosimeters have not been available to measure exposure to these frequencies of the electromagnetic spectrum. Employment records for the members contain their work assignments but do not have any detailed information as to duties performed. It was therefore not possible to reconstruct their exposure history from these data.

By using the member's estimates, exposure to NIR was quantified. The output from the exposure algorithm was then classified according to the percentile of exposure over the member's career. This method of classifying exposure has been used in previously published research involving occupational exposures to electromagnetic fields<sup>97</sup>.

In order to fully assess the use of different radar units among members of the force, an extensive personal interview focusing on the types of units used and describing the units use over the years would be necessary. At the study's inception, it was explained that the force changed radar units in an orderly fashion and that this information would be available. Unfortunately, as documentation was accrued, it became apparent that that units were replaced when it was no longer cost effective to repair them and that this information was not available. Therefore, reconstruction of radar unit types used over time was not feasible, but it was not felt that this was a major flaw in the study. Radar units have been tested, both in Canada and the United States, and little difference in the amount of NIR had been observed. In fact, the emission levels that have been measured were extremely low and do not approach the acceptable safe levels for human exposure.

#### **5.2.6. Classification of Risky Behaviours**

To further aid in characterizing the level of exposure a classification system of the locations for the radar unit was developed. This classification system was developed from the responses provided in the questionnaires as described in the methodology. From the literature<sup>4,5,6</sup>, if the unit was in contact with the member then it was deemed to be the most risky behaviour that could be identified. The levels of riskiness and the assignment to each of the groups were done on a qualitative level. Unfortunately

there was no quantitative measure of the amount of time a radar unit was kept in the member's lap versus in the holder. Using the riskiest location to classifying the member's behaviour into four levels of riskiness and one for unknown risk may have influenced the patterns observed in the results. There was no indication of frequency or duration of each of the practices in order to weight the responses accordingly. The decision to use the most risky behaviour as opposed to the middle or least risky location mentioned was made so as not to miss potential relationships that might exist. This decision may have caused more members to be classified at most risk, thereby clustering them at the top end of the riskiness scale as opposed to spreading them over the other levels of risk. Each analysis of exposure by riskiness of location, regardless of the population produced a bimodal pattern with peaks for most risky behaviour and least risky behaviour.

It was still of interest to note though that the members with the highest exposures did perform the riskiest behaviours with their radar units when they did not have them pointed at a vehicle.

### **5.2.7. Cancer**

Upon adjudication, discussion arose about the cancer category of bone cancer. It was felt that with the number of metastatic bone cancers further information regarding type should have been included in the primary cancer specifications and should have been included in the question. Although one of the three positive responses to bone cancer included type (sarcoma), the additional specification would not have had any impact on the outcome of the study had it been included in the original design.

### 5.2.8. Confounding Risk Factors

There were numerous confounders that were not or could not be included in the survey which might have affected the frequency of cancers among the target population. Additional exposures the members could not avoid and for which there were no estimates include other sources of electromagnetic fields. In the police vehicle this would include emissions from the police radio, computers on board (VDTs), the heaters and air conditioners. Non vehicular exposures might also include personal computers (VDTs) and cellular phones. Increased risks might result from excessive sun exposure, for melanomas and occupational chemical exposures from other policing duties. Personal habits such as smoking and high fat diets would ideally also need to be assessed in order to reduce the potential confounding of the results.

### 5.3. Bias

The findings of this type of survey may be influenced by bias. A comprehensive list of biases has been assembled by Sackett<sup>104</sup>. These biases may have been introduced in many ways including the method of selecting the sample, the respondents and their ability to recall their exposure and the misclassification of either exposure and/or cancer outcomes. As it is not possible to statistically adjust for bias, planning must take place in order to minimize its potential effects, and when these effects may occur they must be recognised and discussed.

### **5.3.1. Non-response Bias**

The effect of non-response bias was difficult to predict as there was no information available about either the exposure to radar units or the diagnosis of cancer among the members who did not return the survey. Information that might be used for comparison would include gender, date of birth, current rank and work history while serving with the RCMP. Work histories outside the RCMP which have been captured from the respondents may cause inequality of reporting between these two cohorts and this could further cloud the issues. It is possible that a better response was received from members with either a diagnosis of cancer or high exposure levels to radar units or both.

### **5.3.2. Neyman Bias**

Neyman bias or prevalence-incidence bias must be considered as a potential confounder of the results, as it was highly possible that cancers have not been diagnosed as they were either in the early stages or were asymptomatic at the time of survey or alternatively members have died of the disease after a short latency period. It was not possible to discern how many members, who did not have survivor pension benefits, died of cancer prior to initiation of the study. This bias is further implicated as a couple of respondents included comments on their questionnaire stating that they were undergoing medical investigations to rule out the diagnosis of cancer. These responses were coded as negative for cancer as the diagnosis had not yet been made. Therefore there was a possibility of an underreporting of cancers among this population.

### **5.3.3. Latency Bias**

Since latency for the majority of cancers linked to an occupational exposure require 20 to 30 years to onset, there was a possibility of an underestimation of cancers due to a latency bias. Although this bias might influence all ages it would mostly occur in the active members as they were the youngest to be surveyed. It was not inconceivable that the effect of this bias might also be important among the deceased as they may not have survived long enough for cancer from their occupational exposures to have developed.

### **5.3.4. Unmasking Bias**

The results may also have been influenced by an unmasking bias. This bias would have caused the members to seek medical advice to detect a potential cancer upon receiving the questionnaire. It was unlikely that this had any effect as the cancer reports were received in a uniformly dispersed manner over time and not towards the end of the data collection period as would be expected if diagnostic testing was undertaken after receiving the survey in the mail or an overall excess of cancer was found.

### **5.3.5. Recall Bias**

Although recall bias is a potential confounder in any study that is retrospective, attempts were made to keep this bias at a minimum. Exposure information was collected from members of a police force, who were noted for their good recall skills, and the fact that all respondents had been assigned to radar duty by the RCMP (this assignment has the greatest amount of exposure of any assignment in the force). This

selection process for inclusion in the survey has hopefully prevented any potential effect from this bias. It was anticipated that all members regardless of whether or not they had been diagnosed with cancer would report some level of exposure. Although arrangements could potentially be made to compare estimates of radar use to data in the PARADE database, it would be unlikely that this comparison would be an accurate or effective match as this database does not contain radar use information.

There was no intention to collect exposure data from the proxies for the deceased. This decision was made at the initial stages of the questionnaire design since asking about exposure from the proxies would, for a number of these members, be difficult for the family members to estimate and might have impinged on the quality of responses in that cohort.

#### **5.4. Misclassification**

Misclassification problems are a major concern in this type of study. This type of error must be identified and accounted for as non-differential or differential misclassification as it may bias the results either towards or away from the null. The major sources of misclassification may occur in the estimation of exposure, classification of the radar unit's risky location when not pointed at a vehicle and the outcome of cancer. A second source of misclassification which cannot be assessed may arise from the confounders such as other sources of EMF that have not been measured.

#### 5.4.1. Misclassification of Exposure

It was unlikely that differential misclassification of exposed versus not exposed has occurred. As the questionnaires were coded in a batch with both cancers and no cancers mixed and as all members were exposed with the exception of a small percentage who were assigned to highway patrol but never used radar as part of their job, it was unlikely that bias was introduced by calculating the algorithm differentially between those with cancer and those without.

The most likely problems may have been introduced by the self report of the members. Efforts to control this potential problem with a validity check, included using two questions in the instrument, the first asking time periods of assignment to radar duty and the second asking the member to estimate the number of years total. Although differences (less than a year) were identified between the two measures, these were deemed to be unimportant. In the calculation of the exposure algorithm, the estimate of total years of exposure, which was the lesser amount of reported years of exposure, was used. This variable may have underestimated exposure, but this would, for the most part, amount to a small difference. Error may also have been introduced in the interpretation of the members reporting of days per week and hours per day of radar duty. The logic used to decipher their reporting has been described previously, but efforts were made not to overestimate exposure regardless of the variable. The effect of underestimating exposure would be non-differential and would bias the results towards the mean.

#### **5.4.2. Misclassification of Riskiness of Location of the Radar Unit**

Errors in the categorization of most risky, risky, least risky, not risky and unknown risk for the location the radar unit was kept when not pointed at a vehicle have been reviewed earlier. Misclassification of the risk may well have produced an overestimation for those who only rarely performed risky behaviours because the length of time performing risky behaviours was not included in the questionnaire. Unfortunately those who performed these risky behaviours were at the upper end of the exposure scale and therefore this misclassification may be differential across the exposure levels.

#### **5.4.3. Misclassification of Outcome**

Efforts to prevent disease misclassification included using two independent adjudicators to review all responses. Unfortunately, it was not possible to access the members' medical files to ensure that no misclassification from self-report has taken place. Additional misclassification may have arisen in the members who were still undergoing tests to diagnose their ongoing health problems. This scenario would not be interpreted as misclassification since at the time of mailing the diagnosis was not final.

## 6. CONCLUSIONS

Based on the observed results, there was no conclusive evidence of adverse health effects from exposure to radar units although there does appear to be an elevation in the incidence of melanoma and urinary tract cancer among the respondents. These increased rates may be due to a number of risk factors which may have confounded the findings, especially exposure to ultraviolet radiation (sunlight)<sup>101</sup> for the melanoma.

The lack of significant findings with respect to the association between exposure and outcome was in accord with the scientific literature. The most recent publications, from articles in the police literature and the peer reviewed literature<sup>1,49,50,54,64,66,97</sup> were inconsistent in their findings. There have been no definitive studies that have produced statistically significant associations that can be replicated to conclusively link the exposure to electromagnetic fields to the outcome of cancer. There is certainly the need to measure the potential confounding from external forces to be able to ascertain what risk if any exists from exposure to radar units.

The data indicated that the members with 30 or more consecutive days of sick leave had a greater lifetime exposure to radar units than any of the other cohorts. It was also noted that the proportion of members keeping the radar units in the most risky locations when not pointed at a vehicle increased with higher levels of exposure. Pensioners reported a higher incidence of cancer (7.4%) than either the cohort of active members with 30 or more consecutive days of sick leave (4.5%) or the cohort of members without extended sick leave (1.5%). Widows of the deceased reported that 42.3% of their spouses had a cancer diagnosis at some time in their life.

Recommendations for future research would include the following:

- a) Refinement of the exposure algorithm. Validation studies using prospectively collected exposure information on radar duties should be considered.
- b) Examination of other adverse health effects that might be related to the long term use of radar units. This could be an essential ingredient that needs to be considered in formulating a corporate policy with respect to the use of radar to measure traffic speed.
- c) Further studies to provide a more detailed assessment of the relationship between the exposure to radar units and risk factors for cancer, in particular melanoma and urinary tract cancers, among members of the RCMP.

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## **Appendix A**

### **Questionnaires**

**LOEB MEDICAL RESEARCH INSTITUTE  
INSTITUT DE RECHERCHE MÉDICALE LOEB**

OTTAWA CIVIC HOSPITAL  
HÔPITAL CIVIC D'OTTAWA



UNIVERSITÉ D'OTTAWA  
UNIVERSITY OF OTTAWA

June 1, 1995

Dear RCMP Member,

You have probably seen some of the media coverage surrounding the question of whether there might be a link between using police radar and the development of cancer.

We are conducting an investigation to determine whether there is any substance to the claim of a link between radar use and cancer among police officers and former police officers. You have been identified as having been assigned to highway patrol, which uses radar to measure traffic speed.


Enclosed please find a brief questionnaire (English and French) and a pre-addressed stamped envelope. Please answer only one copy of the questionnaire in your preferred language. Completing the questionnaire will only take a few minutes of your time, and the results from this study will be very useful to the RCMP and police forces across Canada.

All information received will be kept completely confidential. No results will be released that could identify you personally.


This study is being undertaken by the University of Ottawa's Clinical Epidemiology Unit at the Ottawa Civic Hospital in cooperation with the Canadian Police Research Centre and the Health Services Directorate of the RCMP. Should you have any questions please do not hesitate to call me in Ottawa at (613) 798-5555, extension 5182.

Thank you very much for your help and prompt reply.

Sincerely yours,



Judy Snider  
Study Coordinator



George Wells MSc, PhD.  
Associate Director

**Clinical Epidemiology Unit / Unité d'épidémiologie clinique**  
1053 Carling Avenue, Ottawa, Ontario K1Y 4E9  
Tel: (613) 761-5165 Fax: (613) 761-5351

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# RCMP RADAR HEALTH STUDY

## **INSTRUCTIONS:**

**THIS QUESTIONNAIRE HAS 3 SECTIONS: SECTION 1 RELATES TO YOUR WORK EXPERIENCE AS A MEMBER OF THE RCMP, SECTION 2 INQUIRES ABOUT YOUR HEALTH AND ACTIVITIES, AND SECTION 3 PROVIDES US WITH BACKGROUND INFORMATION ABOUT MEMBERS OF THE RCMP AS A WORK FORCE. AS SOME QUESTIONS MAY NOT APPLY SPECIFICALLY TO YOU, PLEASE FOLLOW THE INSTRUCTIONS AND IF DIRECTED TO DO SO, SKIP THOSE QUESTIONS THAT DO NOT APPLY TO YOU. IF YOU ARE NOT ADVISED TO SKIP A SET OF QUESTIONS, EVEN IF YOU DO NOT THINK THAT THEY APPLY TO YOU, PLEASE ANSWER THEM TO THE BEST OF YOUR KNOWLEDGE. PLEASE CIRCLE THE NUMBER NEXT TO THE RESPONSE THAT BEST MATCHES YOUR ANSWER OR WRITE IN YOUR ANSWER WHERE YOU ARE ASKED TO SPECIFY IT.**

The purpose of this survey is to determine whether there is an occupational risk of cancer among certain police officers. Your assistance will be important to other police officers. Please help us by answering the following questions.

**SECTION 1 - POLICE WORK**

Regiment #: \_\_\_\_\_

1. Please specify the police force of which you are currently a member?

**Specify:** \_\_\_\_\_

2. What is your current working status?

1. Working as a police officer or member of the RCMP
2. Retired from police work

3. Please indicate the period(s) during which you worked as member of a police force. If you have served for more than one period of time, please indicate as many time periods as necessary to best describe your time of service.

**Specify:** From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

4. Have you ever used radar as part of your job?

1. Yes
2. No → **PLEASE GO TO SECTION 2**

IF YOU DID ANY RADAR, PLEASE ANSWER THE FOLLOWING QUESTIONS

5. How long was your first training session before using radar in your work?

1. Received no standard training
2. Less than a day
3. 1 - 3 days
4. More than 3 days but less than a week
5. A week or more

6. Please indicate the period(s) during which you performed radar duties. If you did radar as part of your police work for more than one period of time, please indicate as many time periods as necessary.

**Specify:** From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

7. For the entire time you did radar					
7.a	Approximately how many years did you perform radar duties?	7.b	Approximately how many days a week did you perform radar duties?	7.c	Approximately how many hours a day was the radar unit turned on?
Specify: _____ years		Specify: _____ days per week		Specify: _____ hours per day	

8. What types of radar units did you use on a "regular basis"?

1. Only hand held radar units
2. Only mounted radar units
3. Both hand held and mounted radar units

<b>→→ If you used both types, please indicate which type of radar unit you used most often and about how much time you used it.</b>	
<p>8a. Type of unit used most often:</p> <ol style="list-style-type: none"> <li>1. Hand held radar unit</li> <li>2. Car mounted radar unit</li> </ol>	<p>8b. During the time you were using radar, about how much time was spent operating the unit you mentioned using the most?</p> <ol style="list-style-type: none"> <li>1. More than 90% of the time</li> <li>2. 75 to 89% of the time</li> <li>3. 50 to 74% of the time</li> <li>4. Less than 50% of the time</li> </ol>

9. While the unit was active, where did you keep the radar unit when not pointed at a car?

Specify: \_\_\_\_\_

## **SECTION 2 - HEALTH AND ACTIVITIES**

10. Has a doctor ever told you that you had cancer?

1. Yes
2. No → PLEASE GO TO QUESTION 11
3. Don't know

<p>IF YOU HAVE BEEN DIAGNOSED WITH CANCER, PLEASE ANSWER THE FOLLOWING QUESTIONS BY CIRCLING THE NUMBER BESIDE THE TYPE(S) OF CANCER YOU HAVE HAD.</p>
--

10.a. What kind of cancer were you diagnosed with and when were you first told?		10.b. Where did the cancer <b>SPREAD</b> (if anywhere)?	
	WHEN (YEAR)?		WHEN (YEAR)?
1. Blood (leukemia)	19_____	0. Did Not Spread	
2. Bone	19_____	1. Blood (leukemia)	19_____
3. Brain	19_____	2. Bone	19_____
4. Eye	19_____	3. Brain	19_____
5. Melanoma	19_____	4. Eye	19_____
6. Salivary gland	19_____	5. Melanoma	19_____
7. Testicular	19_____	6. Salivary gland	19_____
8. Thyroid	19_____	7. Testicular	19_____
9. Other (please specify)		8. Thyroid	19_____
_____	19_____	9. Other (please specify)	
_____	19_____	_____	19_____
		_____	19_____

IF YOU ARE **FEMALE**, PLEASE GO TO SECTION 3. IF YOU ARE **MALE** PLEASE CONTINUE AND ANSWER ALL THE QUESTIONS THAT FOLLOW.

11. Were you born with undescended testicle(s)?

1. Yes
2. No
8. Don't know

12. For each of the following time periods, please indicate how often you have bicycled.	
12.a. Prior to joining the police force	12.b. During your police service
1. Often	1. Often
2. Once in a while	2. Once in a while
3. Never	3. Never

13. For each of the following time periods, <b>excluding</b> recruit training, please indicate how often you have ridden a horse.	
13.a. Prior to joining the police force	13.b. During your police service
1. Often	1. Often
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OTTAWA CIVIC HOSPITAL  
HÔPITAL CIVIC D'OTTAWA



UNIVERSITÉ D'OTTAWA  
UNIVERSITY OF OTTAWA

June 1, 1995

Dear RCMP Pensioner,

You have probably seen some of the media coverage surrounding the question of whether there might be a link between using police radar and the development of cancer.

We are conducting an investigation to determine whether there is any substance to the claim of a link between radar use and cancer among police officers and former police officers. You have been identified as having been assigned to highway patrol, which uses radar to measure traffic speed, while with the RCMP.


Enclosed please find a brief questionnaire (English and French) and a pre-addressed stamped envelope. Please answer only one copy of the questionnaire in your preferred language. Completing the questionnaire will only take a few minutes of your time, and the results from this study will be very useful to the RCMP and police forces across Canada.


All information received will be kept completely confidential. No results will be released that could identify you personally.

This study is being undertaken by the University of Ottawa's Clinical Epidemiology Unit at the Ottawa Civic Hospital in cooperation with the Canadian Police Research Centre and the Health Services Directorate of the RCMP. Should you have any questions please do not hesitate to call me in Ottawa at (613) 798-5555, extension 5182.

Thank you very much for your help and prompt reply.

Sincerely yours,

  
Judy Snider  
Study Coordinator

  
George Wells MSc, PhD.  
Associate Director

PL 95-E

**Clinical Epidemiology Unit / Unité d'épidémiologie clinique**  
1053 Carling Avenue, Ottawa, Ontario K1Y 4E9  
Tel: (613) 761-5165 Fax: (613) 761-5351

# RCMP RADAR HEALTH STUDY

## **INSTRUCTIONS:**

**THIS QUESTIONNAIRE HAS 3 SECTIONS: SECTION 1 RELATES TO YOUR WORK EXPERIENCE AS A MEMBER OF THE RCMP, SECTION 2 INQUIRES ABOUT YOUR HEALTH AND ACTIVITIES, AND SECTION 3 PROVIDES US WITH BACKGROUND INFORMATION ABOUT MEMBERS OF THE RCMP AS A WORK FORCE. AS SOME QUESTIONS MAY NOT APPLY SPECIFICALLY TO YOU, PLEASE FOLLOW THE INSTRUCTIONS AND IF DIRECTED TO DO SO, SKIP THOSE QUESTIONS THAT DO NOT APPLY TO YOU. IF YOU ARE NOT ADVISED TO SKIP A SET OF QUESTIONS, EVEN IF YOU DO NOT THINK THAT THEY APPLY TO YOU, PLEASE ANSWER THEM TO THE BEST OF YOUR KNOWLEDGE. PLEASE CIRCLE THE NUMBER NEXT TO THE RESPONSE THAT BEST MATCHES YOUR ANSWER OR WRITE IN YOUR ANSWER WHERE YOU ARE ASKED TO SPECIFY IT.**

The purpose of this survey is to determine whether there is an occupational risk of cancer among certain police officers. Your assistance will be important to other police officers. Please help us by answering the following questions.

**SECTION 1 - POLICE WORK**

Regiment #: \_\_\_\_\_

1. Please specify the police force of which you are currently a member?

**Specify:** \_\_\_\_\_

2. What is your current working status?

1. Working as a police officer or member of the RCMP
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3. Please indicate the period(s) during which you worked as member of a police force. If you have served for more than one period of time, please indicate as many time periods as necessary to best describe your time of service.

**Specify:** From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

From 19\_\_\_\_\_ to 19\_\_\_\_\_.

4. Have you ever used radar as part of your job?

1. Yes
2. No → **PLEASE GO TO SECTION 2**

IF YOU DID ANY RADAR, PLEASE ANSWER THE FOLLOWING QUESTIONS

5. How long was your first training session before using radar in your work?

1. Received no standard training
2. Less than a day
3. 1 - 3 days
4. More than 3 days but less than a week
5. A week or more

6. Please indicate the period(s) during which you performed radar duties. If you did radar as part of your police work for more than one period of time, please indicate as many time periods as necessary.

**Specify:** From 19\_\_\_\_\_ to 19\_\_\_\_\_.

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7. For the entire time you did radar					
7.a	Approximately how many years did you perform radar duties?	7.b	Approximately how many days a week did you perform radar duties?	7.c	Approximately how many hours a day was the radar unit turned on?
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8. What types of radar units did you use on a "regular basis"?

1. Only hand held radar units
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<b>→→ If you used both types, please indicate which type of radar unit you used most often and about how much time you used it.</b>	
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9. While the unit was active, where did you keep the radar unit when not pointed at a car?

**Specify:** \_\_\_\_\_

**SECTION 2 - HEALTH AND ACTIVITIES**

10. Has a doctor ever told you that you had cancer?

1. Yes
2. No → **PLEASE GO TO QUESTION 11**
8. Don't know

<p>IF YOU HAVE BEEN DIAGNOSED WITH CANCER, PLEASE ANSWER THE FOLLOWING QUESTIONS BY CIRCLING THE NUMBER BESIDE THE TYPE(S) OF CANCER YOU HAVE HAD.</p>
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6. Salivary gland	19_____	5. Melanoma	19_____
7. Testicular	19_____	6. Salivary gland	19_____
8. Thyroid	19_____	7. Testicular	19_____
9. Other (please specify)		8. Thyroid	19_____
_____	19_____	9. Other (please specify)	
_____	19_____	_____	19_____
		_____	19_____

IF YOU ARE **FEMALE**, PLEASE GO TO SECTION 3. IF YOU ARE **MALE** PLEASE CONTINUE AND ANSWER ALL THE QUESTIONS THAT FOLLOW.

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2. Once in a while	2. Once in a while	2. Once in a while
3. Never	3. Never	3. Never

13. For each of the following time periods, <b>excluding</b> recruit training, please indicate how often you have ridden a horse.		
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INSTITUT DE RECHERCHE MÉDICALE LOEB**

OTTAWA CIVIC HOSPITAL  
HÔPITAL CIVIC D'OTTAWA



UNIVERSITÉ D'OTTAWA  
UNIVERSITY OF OTTAWA

June 1, 1995

Dear RCMP Associate,

You have probably seen some of the media coverage surrounding the question of whether there might be a link between using police radar and the development of cancer.

We are conducting an investigation to determine whether there is any substance to the claim of a link between radar use and cancer among police officers and former police officers. Your spouse or relative has been identified as having been assigned to highway patrol, which uses radar to measure traffic speed, while with the RCMP.

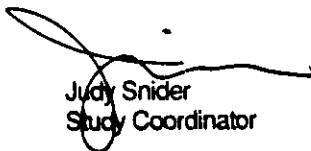
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All information received will be kept completely confidential. No results will be released that could identify you or your spouse or relative personally.

This study is being undertaken by the University of Ottawa's Clinical Epidemiology Unit at the Ottawa Civic Hospital in cooperation with the Canadian Police Research Centre and the Health Services Directorate of the RCMP. Should you have any questions please do not hesitate to call me in Ottawa at (613) 798-5555, extension 5182.

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Judy Snider  
Study Coordinator



George Wells MSc, PhD.  
Associate Director

DL 95-E

**Clinical Epidemiology Unit / Unité d'épidémiologie clinique**  
1053 Carling Avenue, Ottawa, Ontario K1Y 4E9  
Tel: (613) 761-5165 Fax: (613) 761-5351

# RCMP RADAR HEALTH STUDY

## **INSTRUCTIONS:**

THIS QUESTIONNAIRE HAS 3 SECTIONS: SECTION 1 RELATES TO YOUR SPOUSE OR RELATIVE'S WORK EXPERIENCE AS A MEMBER OF THE RCMP, SECTION 2 INQUIRES ABOUT HIS/HER HEALTH AND ACTIVITIES PRIOR TO DEATH, AND SECTION 3 PROVIDES US WITH BACKGROUND INFORMATION ABOUT THE MEMBERS OF THE RCMP AS A WORK FORCE. AS SOME QUESTIONS MAY NOT SPECIFICALLY APPLY, PLEASE FOLLOW THE INSTRUCTIONS AND IF DIRECTED TO DO SO, SKIP THOSE QUESTIONS THAT DO NOT APPLY. IF YOU ARE NOT ADVISED TO SKIP A SET OF QUESTIONS, EVEN IF YOU DO NOT THINK THAT THEY APPLY, PLEASE ANSWER THEM TO THE BEST OF YOUR KNOWLEDGE. PLEASE CIRCLE THE NUMBER NEXT TO THE RESPONSE THAT BEST MATCHES YOUR ANSWER OR WRITE IN YOUR ANSWER WHERE YOU ARE ASKED TO SPECIFY IT.

The purpose of this survey is to determine whether there is an occupational risk of cancer among certain police officers. Your assistance, as a spouse or relative of a deceased RCMP member, will be important to other police officers. Please help us by answering the following questions.

1. What is your relationship to the deceased RCMP member?

1. Widow
2. Widower
3. Daughter
4. Son
5. Other (Please specify) \_\_\_\_\_

2. When did the RCMP member die?

**Specify:**        \_\_\_\_\_ / \_\_\_\_\_ / 19 \_\_\_\_\_  
                          day                    month                    year

3. What was the RCMP member's regiment number?

**Specify:**        \_\_\_\_\_

#### **SECTION 1 - POLICE WORK**

4. Did the RCMP member ever use radar in his/her job?

1. Yes
2. No

#### **SECTION 2 - HEALTH AND ACTIVITIES**

5. Did a doctor ever tell the RCMP member that s/he had cancer?

1. Yes
2. No → PLEASE GO TO QUESTION 6
8. Don't know

IF S/HE WAS EVER DIAGNOSED WITH CANCER, PLEASE ANSWER THE FOLLOWING QUESTIONS BY CIRCLING THE NUMBER BESIDE THE TYPE(S) OF CANCER S/HE HAD.

5.a What kind of cancer was s/he diagnosed with and when was s/he first told?		5.b. Where did the cancer SPREAD (if anywhere)?	
	WHEN (YEAR)?		WHEN (YEAR)?
1. Blood (leukemia)	19_____	0. Did Not Spread	
2. Bone	19_____	1. Blood (leukemia)	19_____
3. Brain	19_____	2. Bone	19_____
4. Eye	19_____	3. Brain	19_____
5. Melanoma	19_____	4. Eye	19_____
6. Salivary gland	19_____	5. Melanoma	19_____
7. Testicular	19_____	6. Salivary gland	19_____
8. Thyroid	19_____	7. Testicular	19_____
9. Other (please specify)		8. Thyroid	19_____
_____	19_____	9. Other (please specify)	
_____	19_____	_____	19_____
		_____	19_____

IF THE RCMP MEMBER WAS **FEMALE**, PLEASE GO TO SECTION 3. IF **MALE** PLEASE CONTINUE AND ANSWER ALL THE QUESTIONS THAT FOLLOW.

6. Was he born with undescended testicle(s)?

1. Yes
2. No
8. Don't know

7. For each of the following time periods, please indicate how often he bicycled.		
7.a Prior to joining the police force	7.b During his police service	7.c After leaving the police force
1. Often	1. Often	1. Often
2. Once in a while	2. Once in a while	2. Once in a while
3. Never	3. Never	3. Never



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INSTITUT DE RECHERCHE MÉDICALE LOEB**

OTTAWA CIVIC HOSPITAL  
HÔPITAL CIVIC D'OTTAWA



UNIVERSITÉ D'OTTAWA  
UNIVERSITY OF OTTAWA

Le 1<sup>er</sup> juin 1995

Cher membre de la GRC,

Vous avez probablement déjà vu des reportages qui discutent l'existence d'un lien entre l'utilisation du radar et le cancer chez les policiers.

Nous procédons actuellement à une étude qui vise à déterminer la validité d'une telle hypothèse. Vous faites partie du groupe des membres de la GRC affectés à la patrouille routière et vous vous êtes probablement déjà servi du détecteur de vitesse radar.


Vous trouverez ci-joint un questionnaire (français et anglais) et une enveloppe pré-adressée affranchie. Veuillez s'il vous plaît répondre à une copie du questionnaire dans la langue de votre choix. Il ne vous faudra que quelques minutes pour répondre aux questions et les résultats de l'étude seront d'une très utiles à la Gendarmerie et aux services de police partout au Canada.

Tous les renseignements seront gardés strictement confidentiels. Les données publiées ne permettront pas de vous identifier.


L'étude est menée par l'Unité d'Épidémiologie Clinique de l'Université d'Ottawa, à l'Hôpital Civic, avec la collaboration du Centre Canadien de Recherches Policières et la Direction des Services de Santé de la GRC. Pour de plus amples renseignements, n'hésitez pas à nous contacter à Ottawa, au (613) 798-5555, poste 5182.

Nous vous remercions de votre collaboration,

Veuillez agréer, Monsieur, Madame, l'expression de nos sentiments les meilleurs.



Judy Snider  
Coordinatrice de l'étude



George Wells MSc, PhD.  
Directeur Adjoint

ML 95-F

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# ÉTUDE SUR LA SANTÉ ET LE RADAR À LA GRC

## **INSTRUCTIONS:**

LE QUESTIONNAIRE COMPREND TROIS SECTIONS: LA SECTION 1 PORTE SUR VOTRE EXPÉRIENCE DE TRAVAIL EN TANT QUE MEMBRE DE LA GRC, LA SECTION 2 TRAITE DE VOTRE SANTÉ ET DE VOS ACTIVITÉS ET LA SECTION 3 FOURNIT DES RENSEIGNEMENTS GÉNÉRAUX SUR LES MEMBRES DE LA GRC EN TANT QUE GROUPE DE TRAVAIL. CERTAINES QUESTIONS NE S'APPLIQUENT PEUT-ÊTRE PAS PRÉCISEMENT À VOUS. SUIVEZ LES INSTRUCTIONS ET SI ON VOUS DEMANDE DE LE FAIRE, SAUTEZ LES QUESTIONS QUI NE S'APPLIQUENT PAS À VOTRE CAS. SI ON VOUS DEMANDE DE RÉPONDRE À DES QUESTIONS QUI À VOTRE AVIS NE S'APPLIQUENT PAS À VOTRE CAS, VEUILLEZ QUAND MÊME Y RÉPONDRE DE VOTRE MIEUX. ENCERCLEZ LE NUMÉRO À CÔTÉ DE L'ÉNONCÉ QUI CORRESPOND LE MIEUX À VOTRE RÉPONSE OU ÉCRIVEZ VOTRE RÉPONSE À L'ENDROIT INDIQUÉ.

Le but du présent sondage est de déterminer s'il existe un risque de cancer lié au travail pour les membres de forces de polices. Votre collaboration sera précieuse et utile à d'autres policiers. Veuillez nous aider en répondant aux questions suivantes:

**SECTION 1 - TRAVAIL AU SEIN DE LA FORCE**

# de matricule \_\_\_\_\_

1. Précisez de quelle force de police êtes-vous courramment membre?

**Précisez:** \_\_\_\_\_

2. Quelle est votre status d'emploi actuel?

1. Employé(e) comme policier(ière) ou membre de la GRC
2. Retraité(e) d'un emploi de policier

3. Veuillez indiquer la période durant laquelle vous avez travaillé comme membre d'une force. Si vous avez été policier(ière) pendant plus d'une période, veuillez indiquer autant de périodes que nécessaire pour décrire la durée de votre service.

**Précisez:** De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

4. Durant votre service, vous êtes-vous servi(e) d'un radar?

1. Oui
2. Non **PRIÈRE DE PASSER À LA SECTION 2**

SI VOUS AVEZ TRAVAILLÉ AVEC UN RADAR, VEUILLEZ RÉPONDRE AUX QUESTIONS SUIVANTES

5. Quelle a été la durée de votre formation au travail avant d'avoir utiliser un radar?

1. Aucune formation officielle
2. Moins d'un jour
3. 1 à 3 jours
4. Plus de trois jours, mais moins d'une semaine
5. Une semaine ou plus

6. Veuillez indiquer la période durant laquelle vous avez travaillé avec un radar. Si vous vous êtes servi(e) d'un radar pendant plus d'une période de service dans la force, veuillez indiquer autant de périodes que nécessaire.

**Précisez:** De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

De 19 \_\_\_\_\_ à 19 \_\_\_\_\_.

7. En tenant compte de toutes les périodes pendant lesquelles vous avez travaillé avec un radar:		
7.a Environ combien d'années avez-vous utilisé un radar?  <b>Précisez:</b> _____ années	7.b Environ combien de jours par semaine avez-vous utilisé un radar?  <b>Précisez:</b> _____ jours par semaine	7.c Environ combien d'heures par jour le radar était-il allumé?  <b>Précisez:</b> _____ heures par jour

8. Quels genres de radars utilisiez-vous habituellement?

1. Seulement des pistolets radars (pistolets cinémométriques)
2. Seulement des radars installé à bord de l'automobile
3. Les deux genres

<b>→→ Si vous utilisiez les deux genres d'appareils, veuillez indiquer lequel vous utilisiez le plus souvent et à peu près dans quelle proportion.</b>	
8.a. Genre de radar utilisé le plus fréquemment:  1. Pistolet radar 2. Radar installé à bord de l'automobile	8.b. Pendant la période où vous faisiez usage d'un radar, environ combien de temps passiez-vous à utiliser le genre de radar que vous avez mentionné avoir utilisé le plus souvent.  1. Plus de 90% du temps 2. De 75 à 89% du temps 3. De 50 à 74% du temps 4. Moins de 50% du temps

9. Pendant que l'appareil était allumé, où gardiez-vous le radar lorsqu'il n'était pas braqué sur une voiture?

**Précisez:** \_\_\_\_\_

## **SECTION 2 - SANTÉ ET ACTIVITÉS**

10. Un médecin vous a-t-il déjà dit que vous aviez un cancer?

1. Oui
2. Non → **PRIÈRE DE PASSER À LA QUESTION 11**
8. Ne sais pas

SI ON VOUS A DIT QUE VOUS ÉTIEZ ATTEINT D'UN CANCER, VEUILLEZ RÉPONDRE AUX QUESTIONS SUIVANTES EN ENCERCLANT LE NUMÉRO CORRESPONDANT AU(X) GENRE(S) DE CANCER DIAGNOSTIQUÉ(S).

10.a. De quel genre de cancer vous a-t-on dit que vous étiez atteint et quand vous l'a-t-on annoncé pour la première fois?		10.b. Où le cancer s'est-il PROPAGÉ (le cas échéant)?	
	QUAND (ANNÉE)?		QUAND (ANNÉE)?
1. Sang (leucémie)	19_____	0. Ne s'est pas propagé	
2. Os	19_____	1. Sang (leucémie)	19_____
3. Cerveau	19_____	2. Os	19_____
4. Oeil	19_____	3. Cerveau	19_____
5. Mélanome	19_____	4. Oeil	19_____
6. Glandes salivaires	19_____	5. Mélanome	19_____
7. Testicules	19_____	6. Glandes salivaires	19_____
8. Glande thyroïde	19_____	7. Testicules	19_____
9. Autre (précisez)		8. Glande thyroïde	19_____
_____	19_____	9. Autre (précisez)	
_____	19_____	_____	19_____
		_____	19_____

SI VOUS ÊTES UNE **FEMME**, VEUILLEZ PASSER À LA **SECTION 3**. SI VOUS ÊTES UN **HOMME**, VEUILLEZ CONTINUER ET RÉPONDRE À TOUTES LES QUESTIONS QUI SUIVENT.

11. À la naissance, votre (vos) testicule(s) étai(en)t-elle(s) dans le scrotum?
2. Oui  
 1. Non  
 8. Ne sais pas

12. Pour chacune des périodes suivantes, veuillez dire à quelle fréquence vous avez fait de la bicyclette?	
12.a Avant de joindre les rangs de la force	12.b Durant vos années de service policier
1. Souvent	1. Souvent
2. De temps en temps	2. De temps en temps
3. Jamais	3. Jamais

13. Pour chacune de ces périodes, à l'exception de la période de formation au recrutement, veuillez indiquer à quelle fréquence vous êtes montés à cheval.	
13.a Avant de joindre les rangs de la force	13.b Durant vos années de service policier
1. Souvent	1. Souvent
2. De temps en temps	2. De temps en temps
3. Jamais	3. Jamais

14. Avez-vous jamais eu une blessure grave ou un traumatisme aux testicules?

1. Oui →  
2. Non  
8. Ne sais pas

14 a. Dans l'affirmative, quand?

1. Avant de joindre les rangs de la force  
2. Durant vos années de service policier

14 b. Avez vous consulté un médecin?

1. Oui  
2. Non

### **SECTION 3 - RENSEIGNEMENTS PERSONNELS**

15. Quel est votre date de naissance?

**Précisez:**                    /                    /                    19  
    jour                                    mois                                    année

16. Êtes-vous:

1. Homme?  
2. Femme?

17. Quel est votre état civil actuel?

1. Célibataire (jamais marié(e))  
2. Marié(e) (ou conjoint de fait)  
3. Séparé(e) ou divorcé(e)  
4. Veuf (veuve)

18. Avez-vous des enfants biologiques?

1. Oui  
2. Non

19. Quel a été votre rang le plus élevé dans la force?

**Précisez:** \_\_\_\_\_

Commentaires \_\_\_\_\_

\_\_\_\_\_

Nous vous remercions de votre collaboration. Veuillez retourner le questionnaire dûment rempli dans l'enveloppe ci-jointe affranchie et libellée à l'adresse suivante :

Judy Snider, Unité d'épidémiologie clinique,  
Hôpital Civic d'Ottawa F-6, 1053 avenue Carling, Ottawa, ON K1Y 4E9

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Le 1<sup>er</sup> juin 1995

Cher membre retraité de la GRC,

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Nous procédons actuellement à une étude qui vise à déterminer la validité d'une telle hypothèse. Vous faites partie du groupe des membres de la GRC affectés à la patrouille routière et vous vous êtes probablement déjà servi du détecteur de vitesse radar.

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Judy Snider  
Coordinatrice de l'étude

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George Wells MSc, PhD.  
Directeur Adjoint

PL 95-F

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# de matricule \_\_\_\_\_

1. Précisez de quelle force de police êtes-vous courramment membre?

**Précisez:** \_\_\_\_\_

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3. Veuillez indiquer la période durant laquelle vous avez travaillé comme membre d'une force. Si vous avez été policier(ière) pendant plus d'une période, veuillez indiquer autant de périodes que nécessaire pour décrire la durée de votre service.

**Précisez:** De 19\_\_\_\_\_ à 19\_\_\_\_\_.

De 19\_\_\_\_\_ à 19\_\_\_\_\_.

De 19\_\_\_\_\_ à 19\_\_\_\_\_.

4. Durant votre service, vous êtes-vous servi(e) d'un radar?

1. Oui
2. Non **PRIÈRE DE PASSER À LA SECTION 2**

SI VOUS AVEZ TRAVAILLÉ AVEC UN RADAR, VEUILLEZ RÉPONDRE AUX QUESTIONS SUIVANTES

5. Quelle a été la durée de votre formation au travail avant d'avoir utiliser un radar?

1. Aucune formation officielle
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3. 1 à 3 jours
4. Plus de trois jours, mais moins d'une semaine
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**Précisez:** De 19\_\_\_\_\_ à 19\_\_\_\_\_.

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7. En tenant compte de toutes les périodes pendant lesquelles vous avez travaillé avec un radar:		
7.a Environ combien d'années avez-vous utilisé un radar?  Précisez: _____ années	7.b Environ combien de jours par semaine avez-vous utilisé un radar?  Précisez: _____ jours par semaine	7.c Environ combien d'heures par jour le radar était-il allumé?  Précisez: _____ heures par jour

8. Quels genres de radars utilisiez-vous habituellement?

1. Seulement des pistolets radars (pistolets cinémométriques)
2. Seulement des radars installés à bord de l'automobile
3. Les deux genres

<b>→→ Si vous utilisiez les deux genres d'appareils, veuillez indiquer lequel vous utilisiez le plus souvent et à peu près dans quelle proportion.</b>	
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9. Pendant que l'appareil était allumé, où gardiez-vous le radar lorsqu'il n'était pas braqué sur une voiture?

Précisez: \_\_\_\_\_

## SECTION 2 - SANTÉ ET ACTIVITÉS

10. Un médecin vous a-t-il déjà dit que vous aviez un cancer?

1. Oui
2. Non → **PRIÈRE DE PASSER À LA QUESTION 11**
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10.a. De quel genre de cancer vous a-t-on dit que vous étiez atteint et quand vous l'a-t-on annoncé pour la première fois?		10.b. Où le cancer s'est-il PROPAGÉ (le cas échéant)?	
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2. Os	19_____	1. Sang (leucémie)	19_____
3. Cerveau	19_____	2. Os	19_____
4. Oeil	19_____	3. Cerveau	19_____
5. Mélanome	19_____	4. Oeil	19_____
6. Glandes salivaires	19_____	5. Mélanome	19_____
7. Testicules	19_____	6. Glandes salivaires	19_____
8. Glande thyroïde	19_____	7. Testicules	19_____
9. Autre (précisez)		8. Glande thyroïde	19_____
_____	19_____	9. Autre (précisez)	
_____	19_____	_____	19_____
		_____	19_____

SI VOUS ÊTES UNE **FEMME**, VEUILLEZ PASSER À LA **SECTION 3**. SI VOUS ÊTES UN **HOMME**, VEUILLEZ CONTINUER ET RÉPONDRE À TOUTES LES QUESTIONS QUI SUIVENT.

11. À la naissance, votre (vos) testicule(s) étai(en)t-elle(s) dans le scrotum?

2. Oui  
 1. Non  
 8. Ne sais pas

12. Pour chacune des périodes suivantes, veuillez dire à quelle fréquence vous avez fait de la bicyclette?		
12.a Avant de joindre les rangs de la force	12.b Durant vos années de service policier	12.c Après avoir quitté la force
1. Souvent 2. De temps en temps 3. Jamais	1. Souvent 2. De temps en temps 3. Jamais	1. Souvent 2. De temps en temps 3. Jamais

13. Pour chacune de ces périodes, à l'exception de la période de formation au recrutement, veuillez indiquer à quelle fréquence vous êtes montés à cheval.		
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UNIVERSITY OF OTTAWA

Le 1<sup>er</sup> juin 1995

**Cher(e) associé(e) de la GRC,**

**Vous avez probablement déjà vu des reportages qui discutent l'existence d'un lien entre l'utilisation du radar et le cancer chez les policiers.**

**Nous procédons actuellement à une étude qui vise à déterminer la validité d'une telle hypothèse. Votre époux(se) ou parent faisait partie du groupe des membres de la GRC affectés à la patrouille routière et il(elle) s'était probablement servi du détecteur de vitesse radar.**

**Vous trouverez ci-joint un questionnaire (français et anglais) et une enveloppe pré-adressée affranchie. Veuillez s'il vous plaît répondre à une copie du questionnaire dans la langue de votre choix. Il ne vous faudra que quelques minutes pour répondre aux questions et les résultats de l'étude seront très utiles à la Gendarmerie et aux services de police partout au Canada.**

**Tous les renseignements seront gardés strictement confidentiels. Les données publiées ne permettront pas de vous identifier ou d'identifier votre époux(e) ou parent.**


**L'étude est menée par l'Unité d'Épidémiologie Clinique de l'Université d'Ottawa, à l'Hôpital Civic, avec la collaboration du Centre Canadien de Recherches Policières et la Direction des Services de Santé de la GRC. Pour de plus amples renseignements, n'hésitez pas à nous contacter à Ottawa, au (613) 798-5555, poste 5182.**

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**Clinical Epidemiology Unit / Unité d'épidémiologie clinique  
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# ÉTUDE SUR LA SANTÉ ET LE RADAR À LA GRC

## **INSTRUCTIONS:**

LE QUESTIONNAIRE COMPREND TROIS SECTIONS: LA SECTION 1 PORTE SUR L'EXPÉRIENCE DE TRAVAIL DE VOTRE ÉPOUX(SE) OU PARENT EN TANT QUE MEMBRE DE LA GRC, LA SECTION 2 TRAITE DE SA SANTÉ ET DE SES ACTIVITÉS ET LA SECTION 3 FOURNIT DES RENSEIGNEMENTS GÉNÉRAUX SUR LES MEMBRES DE LA GRC EN TANT QUE GROUPE DE TRAVAIL. CERTAINES QUESTIONS NE S'APPLIQUENT PEUT-ÊTRE PAS PRÉCISEMENT À VOTRE ÉPOUX(SE) OU PARENT. SUIVEZ LES INSTRUCTIONS ET SI ON VOUS DEMANDE DE LE FAIRE, SAUTEZ LES QUESTIONS QUI NE S'APPLIQUENT PAS À SON CAS. SI ON VOUS DEMANDE DE RÉPONDRE À DES QUESTIONS QUI À VOTRE AVIS NE S'APPLIQUENT PAS À SON CAS, VEUILLEZ QUAND MÊME Y RÉPONDRE DE VOTRE MIEUX. ENCERCLEZ LE NUMÉRO À CÔTÉ DE L'ÉNONCÉ QUI CORRESPOND LE MIEUX À VOTRE RÉPONSE OU ÉCRIVEZ VOTRE RÉPONSE À L'ENDROIT INDIQUÉ.

Le but du présent sondage est de déterminer s'il existe un risque de cancer lié au travail pour les membres de forces de polices. Votre collaboration sera précieuse et utile à d'autres policiers. Veuillez nous aider en répondant aux questions suivantes:

1. Quel est votre lien de parenté avec le membre de la GRC qui est décédé?

1. Veuve
2. Veuf
3. Fille
4. Fils
5. Autre (precisez) \_\_\_\_\_

2. Quel est la date de décès du membre de la GRC?

Précisez: \_\_\_\_\_ / \_\_\_\_\_ / 19\_\_\_\_  
                  jour           mois           année

3. Quel est le numéro de matricule du membre de la GRC?

Précisez: \_\_\_\_\_

#### **SECTION 1 - TRAVAIL AU SEIN DE LA FORCE**

4. Durant son service dans la force, s'était-il(elle) servi(e) d'un radar?

1. Oui
2. Non

#### **SECTION 2 - SANTÉ ET ACTIVITÉS DU MEMBRE DE LA GRC**

5. Un médecin lui avait-t-il(elle) dit qu'il(elle) avait un cancer?

1. Oui
2. Non → PRIÈRE DE PASSER À LA QUESTION 6
8. Ne sais pas

SI ON LUI AVAIT DIT QU'IL(ELLE) ÉTAIT ATTEINT(E) D'UN CANCER, VEUILLEZ RÉPONDRE AUX QUESTIONS SUIVANTES EN ENCERCLANT LE NUMÉRO CORRESPONDANT AU(X) GENRE(S) DE CANCER DIAGNOSTIQUÉ(S).
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5.a De quel genre de cancer lui avait-t-on dit qu' il (elle) était atteint(e) et quand lui avait-t-on annoncé pour la première fois?		5.b Où le cancer s'était-il PROPAGÉ (le cas échéant)?	
	QUAND (ANNÉE)?		QUAND (ANNÉE)?
1. Sang (leucémie)	19 _____	0. Ne s'était pas propagé	
2. Os	19 _____	1. Sang (leucémie)	19 _____
3. Cerveau	19 _____	2. Os	19 _____
4. Oeil	19 _____	3. Cerveau	19 _____
5. Mélanome	19 _____	4. Oeil	19 _____
6. Glandes salivaires	19 _____	5. Mélanome	19 _____
7. Testicules	19 _____	6. Glandes salivaires	19 _____
8. Thyroïde	19 _____	7. Testicules	19 _____
9. Autre (précisez)		8. Thyroïde	19 _____
_____	19 _____	9. Autre (précisez)	
_____	19 _____	_____	19 _____
		_____	19 _____

SI ELLE ÉTAIT UNE **FEMME**, VEUILLEZ PASSER À LA **SECTION 3**. SI IL ÉTAIT UN **HOMME**, VEUILLEZ CONTINUER ET RÉPONDRE À TOUTES LES QUESTIONS QUI SUIVENT.

6. À la naissance, ses testicule(s) étai(en)t-elle(s) dans le scrotum?

- 2. Oui
- 1. Non
- 8. Ne sais pas

7. Pour chacune des périodes suivantes, veuillez indiquer à quelle fréquence il avait fait de la bicyclette?		
7.a Avant de joindre les rangs de la force	7.b Durant ses années de service policier	7.c Après avoir quitté la force
1. Souvent	1. Souvent	1. Souvent
2. De temps en temps	2. De temps en temps	2. De temps en temps
3. Jamais	3. Jamais	3. Jamais

8. Pour chacune de ces périodes, à l'exception de la formation au recrutement, veuillez indiquer à quelle fréquence il était monté à cheval.		
8.a Avant de joindre les rangs de la force	8.b Durant ses années de service policier	8.c Après avoir quitté la force
1. Souvent	1. Souvent	1. Souvent
2. De temps en temps	2. De temps en temps	2. De temps en temps
3. Jamais	3. Jamais	3. Jamais

9. Avait-il jamais eu une blessure grave ou un traumatisme aux testicules?

- 1. Oui →
- 2. Non
- 8. Ne sais pas

<p>9.a. Dans l'affirmative, quand?</p> <ul style="list-style-type: none"><li>1. Avant de joindre les rangs de la force</li><li>2. Durant ses années de service policier</li><li>3. Après avoir quitté la force</li></ul>	<p>9.b. Avait-il consulté un médecin?</p> <ul style="list-style-type: none"><li>1. Oui</li><li>2. Non</li></ul>
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**SECTION 3 - RENSEIGNEMENTS PERSONNELS SUR LE MEMBRE DE LA GRC**

10. Quel était sa date de naissance?

Précisez: \_\_\_\_\_ / \_\_\_\_\_ / 19\_\_\_\_  
                                  jour                                    mois                                    année

11. Était -il/elle:

- 1. Homme?
- 2. Femme?

12. Au moment de sa mort, quel était son état civil?

- 1. Célibataire (jamais marié(e))
- 2. Marié(e) (union de fait comprise)
- 3. Separé(e) ou divorcé(e)
- 4. Veuf (veuve)

13. Avait-il(elle) des enfants biologiques?

- 1. Oui
- 2. Non

14. Quel était son rang plus élevé dans la force?

Précisez: \_\_\_\_\_

Commentaires \_\_\_\_\_  
\_\_\_\_\_

Nous vous remercions de votre collaboration. Veuillez retourner le questionnaire dûment rempli dans l'enveloppe ci-jointe affranchie et libellée à l'adresse suivante :

Judy Snider, Unité d'épidémiologie clinique,  
Hôpital Civic d'Ottawa F-6, 1053 avenue Carling, Ottawa, O1N K1Y 4E9

## **Appendix B**

### **Additional Tables from the Analysis of the Dataset**

**Table B1. Exposure Algorithm by Riskiness of Location for the Pensioner Cohort**

	Most Risky	Risky	Least risky	Not Risky	Unknown Risk	Total (N)
≤ 25%ile	14.53 (%)	16.24	29.34	39.32	0.57	351
25 < - ≤ 50 %ile	26.09 (%)	22.71	31.40	17.87	1.93	207
50 < - ≤ 75 %ile	34.44 (%)	23.89	31.67	7.78	2.22	180
75 < - ≤ 90 %ile	34.55 (%)	20.91	36.36	6.36	1.82	110
> 90%ile	44.68 (%)	19.15	34.04	2.13	0.00	47

Chi-square = 129.521 with 16 degrees of freedom  
 p < 0.001

**Table B2. Logistic Regression Modelling of Cancer with Exposure and Covariates in the Pensioner Cohort**

Variable	Odds Ratio (OR)	95% Confidence Interval
Age	1.020	(0.973, 1.070)
Risky Location	0.903	(0.705, 1.157)
Exposure (per 1,000 hours)	1.003	(0.969, 1.039)
Total Work in Years	0.994	(0.945, 1.046)

Hosmer-Lemeshow Statistic  $p = 0.427$

**Table B3. Exposure Algorithm by Riskiness of Location for the Cohort of Members with Extended Sick Leave**

	Most Risky	Risky	Least risky	Not Risky	Unknown Risk	Total (N)
≤ 25%ile (%)	32.00	12.00	50.00	4.00	2.00	50
25 < - ≤ 50 %ile (%)	41.44	8.11	45.05	5.41	0.00	111
50 < - ≤ 75 %ile (%)	36.36	6.06	53.03	2.27	2.27	132
75 < - ≤ 90 %ile (%)	48.42	7.37	41.05	3.16	0.00	95
> 90%ile (%)	50.63	10.13	36.71	0.00	2.53	79

Chi-square = 19.948 with 16 degrees of freedom  
 p = 0.223

**Table B4. Logistic Regression Modelling of Cancer with Exposure and Covariates in the Cohort of Members with Extended Sick Leave**

Variable	Odds Ratio (OR)	95% Confidence Interval
Age	1.115	(0.976, 1.273)
Risky Location	1.566	(0.960, 2.553)
Exposure (per 1,000 hours)	0.939	(0.884, 0.996)
Total Work in Years	1.113	(0.987, 1.256)

Hosmer-Lemeshow Statistic  $p = 0.452$

**Table B5. Exposure Algorithm by Riskiness of Location for the Cohort of Members without Extended Sick Leave**

	Most Risky	Risky	Least risky	Not Risky	Unknown Risk	Total (N)
≤ 25%ile	31.25	10.94	50.00	4.69	3.13	64
25 < - ≤ 50 %ile	39.85	7.52	49.62	3.01	0.00	133
50 < - ≤ 75 %ile	37.32	9.15	47.18	3.52	2.82	142
75 < - ≤ 90 %ile	42.11	6.32	47.37	4.21	0.00	95
> 90%ile	53.06	8.16	34.69	0.00	4.08	49

N.B. 1 member with no measurable exposure reported that his/her radar unit was kept in a least risky location. This has been omitted from this table and the analysis generated from this table.

Chi-square = 16.584 with 16 degrees of freedom  
 p = 0.4130

**Table B6. Logistic Regression Modelling of Cancer with Exposure and Covariates in the Cohort of Members without Extended Sick Leave**

Variable	Odds Ratio (OR)	95% Confidence Interval
Age	0.760	(0.481, 1.199)
Risky Location	1.415	(0.644, 3.110)
Exposure (per 1,000 hours)	1.037	(0.968, 1.111)
Total Work in Years	1.292	(0.843, 1.980)

Hosmer-Lemeshow Statistic  $p = 0.567$

**Table B7. Standardized Incidence Ratios - All Cancers**

Age	Person-Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	950.24	1	18.41	0.17
20-29	40476.02	18.56	30.27	12.25
30-39	42828.30	24.28	59.66	25.55
40-49	22207.32	44.56	171.28	38.04
50-59	8797.88	41.28	550.42	48.43
60-69	1588	17	1381.24	21.93
70-79	43	1	2522.11	1.08
<b>Total</b>	<b>116890.8</b>	<b>147.68</b>		<b>147.46</b>

10 cancers missing information to allow for inclusion in the table

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 1.00 \quad \text{CI} = 0.85, 1.19$$

**Table B8. Standardized Incidence Ratios - Blood & Lymph Tissues**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	8.04	0.08
20-29	40721.58	3	9.82	4.00
30-39	43140.58	1	13.14	5.67
40-49	22559.84	4	23.34	5.27
50-59	9105.72	4	46.86	4.27
60-69	1710.00	1	96.20	1.65
70-79	52.00	0	172.89	0.09
<b>Total</b>	<b>118253.2</b>	<b>13</b>		<b>21.03</b>

2 cancers missing information to allow for inclusion in the table

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.62 \quad \text{CI} = 1.33, 1.06$$

**Table B9. Standardized Incidence Ratios - Malignant Melanoma**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	961.52	0	0.60	0.01
20-29	40717.58	0	2.41	0.98
30-39	43129.02	12.28	5.85	2.41
40-49	22487.56	17.28	8.96	2.01
50-59	8974.88	21.28	12.87	1.16
60-69	1671	3	17.48	0.29
70-79	52	0	22.08	0.01
<b>Total</b>	<b>117993.6</b>	<b>53.84</b>		<b>6.87</b>

2 cancers missing information to allow for inclusion in the table

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 7.84 \quad \text{CI} = 5.82, 10.35$$

**Table B10. Standardized Incidence Ratios - Brain Cancer**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	2.01	0.02
20-29	40737.58	0	2.31	0.94
30-39	43178.58	0	4.00	1.73
40-49	22599.84	2	7.09	1.60
50-59	9130.72	1	12.90	1.18
60-69	1716	0	20.42	0.35
70-79	52	0	21.17	0.01
<b>Total</b>	<b>118378.2</b>	<b>3</b>		<b>5.83</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.51 \quad \text{CI} = 0.11, 0.79$$

**Table B11. Standardized Incidence Ratios - Digestive Organs**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	0.56	0.01
20-29	40737.58	0	1.80	0.73
30-39	43178.58	0	8.98	3.88
40-49	22600.84	4	41.26	9.33
50-59	9096.72	6	142.82	12.99
60-69	1687	4	350.70	5.92
70-79	52	0	652.11	0.34
<b>Total</b>	<b>118316.2</b>	<b>14</b>		<b>33.20</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.42 \quad \text{CI} = 0.23, 0.71$$

**Table B12. Standardized Incidence Ratios - Colorectal Cancer**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	0.29	0.00
20-29	40737.58	0	0.98	0.40
30-39	43178.58	0	5.03	2.17
40-49	22600.84	4	22.97	5.19
50-59	9102.72	4	79.25	7.21
60-69	1696	4	197.25	3.35
70-79	52	0	367.31	0.19
<b>Total</b>	<b>118331.2</b>	<b>12</b>		<b>18.51</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.65 \quad \text{CI} = 0.34, 1.13$$

**Table B13. Standardized Incidence Ratios - Male Genital Organs**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	1.97	0.02
20-29	40727.58	2	6.69	2.72
30-39	43142.58	2	7.80	3.37
40-49	22560.84	4	7.96	1.80
50-59	9104.72	7	43.53	3.96
60-69	1702	5	240.17	4.09
70-79	45	1	635.81	0.29
<b>Total</b>	<b>118246.2</b>	<b>21</b>		<b>16.25</b>

1 testicular cancer excluded as cancer was diagnosed prior to joining the force

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 1.29 \quad \text{CI} = 0.80, 1.98$$

**Table B14. Standardized Incidence Ratios - Prostate Cancer**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	950.96	0	0.02	0.00
20-29	40304.26	0	0.05	0.02
30-39	43241.38	0	0.17	0.07
40-49	22811.08	1	2.55	0.58
50-59	9269.44	7	39.64	3.67
60-69	1727.12	5	235.26	4.06
70-79	45	1	628.27	0.28
<b>Total</b>	<b>118349.2</b>	<b>14</b>		<b>8.68</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 1.61 \quad \text{CI} = 0.88, 2.70$$

**Table B15. Standardized Incidence Ratios - Testicular Cancer**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	1.89	0.02
20-29	40729.58	1	6.56	2.67
30-39	43152.58	2	7.40	3.19
40-49	22573.84	3	4.62	1.04
50-59	9119.72	0	2.39	0.22
60-69	1716	0	1.74	0.03
70-79	52	0	1.88	0.00
<b>Total</b>	<b>118307.2</b>	<b>6</b>		<b>7.17</b>

1 cancer excluded as cancer was diagnosed prior to joining the force

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.84 \quad \text{CI} = 0.31 \text{ } 1.82$$

**Table B16. Standardized Incidence Ratios - Respiratory System - Lung**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	945.96	0	0.14	0.00
20-29	40294.26	0	0.41	0.17
30-39	43233.38	0	3.66	1.58
40-49	22814.08	0	30.71	7.01
50-59	9279.44	1	141.12	13.10
60-69	1740.12	2	346.09	6.02
70-79	52	0	521.48	0.27
<b>Total</b>	<b>118359.2</b>	<b>3</b>		<b>28.15</b>

1 cancer missing information to allow for inclusion in the table

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 0.11 \quad \text{CI} = 0.02, 0.31$$

**Table B17. Standardized Incidence Ratios - Urinary Organs**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	0.27	0.00
20-29	40712.46	1	1.01	0.41
30-39	43134.46	5	4.59	1.98
40-49	22571.84	4	17.91	4.04
50-59	9102.72	3	55.98	5.10
60-69	1698.00	3	134.27	2.28
70-79	49.00	1	243.35	0.12
<b>Total</b>	<b>118232.0</b>	<b>17</b>		<b>13.93</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 1.98 \quad \text{CI} = 1.32, 2.87$$

**Table B18. Standardized Incidence Ratios - Kidney Cancer**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	963.52	0	0.11	0.00
20-29	40737.58	0	0.33	0.13
30-39	43159.58	5	1.95	0.84
40-49	22573.84	2	8.12	1.83
50-59	9104.72	2	21.43	1.95
60-69	1712	1	41.76	0.72
70-79	52	0	63.57	0.03
<b>Total</b>	<b>118303.2</b>	<b>10</b>		<b>5.50</b>

$$\text{SIR} = \frac{\text{Observed}}{\text{Expected}} = 1.82 \quad \text{CI} = 0.87, 3.34$$

**Table B19. Standardized Incidence Ratios - Non Melanoma Skin Cancers**

Age	Person Years	Observed Incidence	Cdn Incidence Rates('000)	Expected Incidence
15-19	969.80	0	0.45	0.00
20-29	40907.14	0	2.41	0.99
30-39	43328.58	14.56	12.1	5.24
40-49	22693.60	10	36.16	8.21
50-59	9121.00	22.28	85.46	7.79
60-69	1704.00	7	133.79	3.13
70-79	50.00	0	334.63	0.17
<b>Total</b>	<b>118774.1</b>	<b>53.84</b>		<b>25.53</b>

SIR =  $\frac{\text{Observed}}{\text{Expected}}$  = 2.11    CI = 1.56, 2.78