Original article

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High risk of brain tumors in military personnel: a case control study

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Abstract

Scientific literature suggests a relationship between military occupation and the development of brain tumors, but no italian study has investigated on the impact of this job on the brain cancer morbidity.

In this a study information were obtained from patients recruited in the Neurosurgical Department of the University-Hospital of Pisa, Italy, from 1990 to 1999.

The study has been conducted as a case-control study. 161, newly diagnosed cases of brain tumors (glioma and meningiomas, histologically confirmed), were recruited, such as 483 controls (with other non tumoral neurologic diseases: trauma, hemorrhagic brain disorders, aneurism, etc), by matching cases and controls (1:3), for age (± 5 years) and gender.

Cases and controls were interviewed in the Neurosurgical Department, University-Hospital of Pisa, Italy, and the occupational histories of cases and controls were compared.

Cases and controls have showed a statistically significant difference, based on their occupation (military vs. non-military occupation). A statistically significant association was seen between brain tumors and military occupation among evaluated patients (p=0.013).

Further studies regarding this population group are needed, to determine the causes for the increased risk of this cancer. Furthermore, a subsequent reevaluation in other patients collected in more recent years will be needed to evaluate the trend of this association. ***Clin Ter 2017; 168(6):e376-379. doi: 10.7417/CT.2017.2037***

Key words*: brain tumors, military personnel, occupational exposure*

Introduction

The incidence and mortality of malignant tumors of nervous system is increased in different countries in the last decades. Being an important cause of death, many researches are focused on the study of the causes and the distribution of these tumors (1). An increasing incidence of brain tumors has been reported also in Tuscany (2).

There are two main groups in which the several types of brain cancer (about twenty) are divided: gliomas more diffuse in men; meningiomas more frequent in women (3, 4). Even though several factors are implicated in the appearence of brain tumors, the real etiological mechanisms remain unclear (5).

It has been suggested by several studies that military workers present a higher risk of mortality by some specific cancers, such as brain tumors. A first study (6) evaluated the exposure to microwave, or radar, of military workers, and the possibile effect of this exposure on their health, particularly in regard of hematopoietic system, brain, and breast. The study showed that microwave exposure is associated with an increased cancer incidence in these organs, and mortality.

Another study compared the cancer incidence of male United States Air Force (USAF) aircrew (342 cancers, 532,980.97 man-years), with that of non-flying Air Force officers (827 cancers, 1,084,370.08 man-years), between 1975–1989. The study detected notable excess aircrew cancer risk for cancers of the testis, urinary bladder, and all sites combined (7).

In a nested case-control study on the US Air Force population, the brain tumor risk was investigated in relation to a range of electromagnetic field exposures. In this study has been used a job-exposure matrix through which has been estimated the potential exposures of cumulative extremely low frequency, radiofrequency and microwave electromagnetic field. Personal dosimetry records were consulted to evaluate the ionizing radiation exposures. In this population extremely low frequency and radiofrequency/microwave electromagnetic field exposure resulted to be slightly associated to brain tumors, meanwhile ionizing radiation exposure was not associated to the development of brain tumors. The development of brain tumors was more frequent in officers, with respect to enlisted men [age-race-adjusted odds ratio (OR): 2.11; 95% confidence interval (CI): 1.48–3.01]. There was an increased risk in senior officers with respect to all other US Air Force members (age-race-adjusted OR: 3.30; 95% CI: 1.99–5.45) (8). These data suggested there was a consistent association between military rank and brain tumor risk.

To evaluate risk factors for primary brain tumors, a case-control study was carried out with all death certificates and corresponding occupational histories of males registered

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in the Brazilian Navy Insurance from 1991 to 1995. After adjustment of age, marital status, and socioeconomic status, more brain tumors were found among health personnel (OR: 2.13; 95% CI: 1.07–4.97) than in other occupational categories. Infantry servicemen engaged in combat training had borderline excess brain tumor mortality (OR: 2.30; 95% CI: 0.89–5.99) (9).

A meta analysis evaluated cancer risk among flight personnel. The health risks for flight personnel may be due to the exposition to cosmic radiation, or other physical or chemical agents. The combined relative risks (RR) (adjusted for socioeconomic status) were elevated among male pilots for mortality from: a) brain cancer (1.49; 95% CI: 0.89–2.20); b) melanoma (11.97; CI: 1.02–3.82). Furthermore, there was an increased incidence of prostate cancer (1.65; CI: 1.19–2.29), and of brain cancer (1.74; CI: 0.87–3.30). Regarding female flight attendants, it has been seen an increase for incidence of all cancers (1.29; CI: 0.98–1.70), and in particular melanoma (11.54; CI: 0.83–2.87), and breast cancer (1.35; CI:1.00–1.83) (10). Different types of cancer seem to be increased in flight personnel. This increased risk could be caused both by occupational and non-occupational risk factors. In order to better control contradictory factors, and to identify the main exposures (to promote preventive measures), further studies should be carried out comparing risks within cohorts regarding: work history, flight routes, exposure to cosmic and UV radiation, electromagnetic fields and chemical substances (10).

A study on Brazilian navy servicemen (aged 19 or more in the period of 1991 to 1995) reported an increased mortality by different types of cancer, with data extracted from death certificates and occupational histories. The referent population was from Rio de Janeiro (Brazil), because 70% of all navy servicemen were concentrated in this city (11). The cause of death in servicemen was higher in case of brain neoplasm [age-adjusted cancer proportionate mortality ratio (ACPMR): 339.27], prostate cancer (ACPMR: 135.04), and non-Hodgkin lymphoma (ACPMR: 152.28) with respect to the referent population. An excess of brain neoplasm "(OR: 2.7; 95% CI: 1.1–6.5) and liver cancer (OR: 2.9; 95% CI: 1.1–7.8); was observed in health-related occupations (11).

A case-control study, evaluated occupation as a risk factor for meningioma and acoustic neuroma, acquiring information on the lifetime job history of cases and controls, enrolled from three hospitals in the United States between 1994 and 1998. They compared 197 cases of meningioma, 96 cases of acoustic neuroma and 799 controls with non-malignant diseases. Elevated risk of meningioma was observed for individuals who had ever worked in the below reported occupational groups: auto body painters, designers and decorators, military occupations, industrial production supervisors, teachers, and managers. As regard the acoustic neuroma, increased risk was observed for having worked as an athlete, gas station attendant, purchasing agent, sales representative, or teacher (12).

More recently a systematic review aimed to investigate the association between the occupational exposure to radiofrequencies and clinical outcome of head and neck cancers, showing a weak association with incidence of larynx tumor in three studies: RR: 1.46 (CI: 1.05–2.43) for all electronic workers; RR: 1.4 (CI: 1.2–1.6) for male electrical workers; and a significant standardized incidence ratio (SIR) for electrical workers: 1.39 (CI: 1.08–1.76) (13).

The aim of our study was to conduct a case control study to evaluate whether or not the military occupation could be considered a risk factor for developing brain malignant tumors in Italy.

Methods

Study population

During 1990 to 1999, newly diagnosed cases of brain malignant tumors (glioma and meningiomas, histologically confirmed), were recruited, such as controls (with other non tumoral neurologic diseases: trauma, hemorrhagic brain disorders, aneurism, etc), by matching cases and controls (1:3), by age (± 5 years) and gender.

The information of this case–control study were obtained in the Neurosurgical Department of the Hospital of Pisa, Italy, from 1990 to 1999.

The interview was performed before the surgical operation. If histological examination did not confirm the presurgical diagnosis cases were excluded. In line with the 10th revision of International Classification of Diseases and Related Health Problems (ICD-10), the above-mentioned tumors were classified as: malignant neoplasm of cerebral meninges (C70.0), malignant neoplasm of brain (C71.0–C71.9). Also were excluded controls for which the postsurgical histology revealed the presence of malignancy (for example metastases), and individuals whose occupational history was unclear or incomplete. In that period, 161 newly diagnosed cases of brain malignant tumors (glioma and meningiomas) were recruited, and compared with 483 consecutively recruited controls (with other non tumoral neurologic diseases), see Table 1.

Table 1. Gender and age distribution of cases and controls.

	males	age	females	age	total	age
cases	107	52±16	54	53±16	161	53±17
controls	321	54±14	162	53±15	483	54±15

Study variables

In the study were included the following indipendent variables: ethnicity (white or nonwhite), level of schooling (without any education; 1–5, 5–10, 8–11, and >11 years of schooling), age (divided by classes 18–29, 30–39, 40–49, 50–59, 60–69, 70–79 years and above 80 years), residence area. The use of mobiles was not recorded, since until 1995 their use in Italy was sporadic.

Statistical analysis

We have performed a descriptive analysis of the frequency of independent variables, and we have used a chi-square (X^2) evaluating feasible differences between cases and controls. Adjusted OR was evaluated for different variables such as ethnicity, age and residence, by unconditional logistical regression.

Results

The study included 161 cases and 483 controls. The distribution of genders was similar in cases and controls because of the matching procedure (cases: 107 males, 54 females; controls: 321 males, 162 females).

The distribution sites for malignant brain neoplasms were: 97.3% of the brain, 1.7% of cranial nerves and 1.0% of the cerebral meninges.

The distribution for age was similar in cases and controls (Table 2), such as the distribution about ethnicity. Among cases 9 out of 161 (5.6%) were military, while in controls 9 out of 483 (2%) were in the military occupation. Cases and controls showed a statistically significant difference, based on their occupation (military occupation, vs. non-military workers) with a significant adjusted OR ($p<0.05$) (Table 3).

Table 3. Adjusted odds ratio, for occupation, gender, age and ethnicity between cases and controls.

Variables	Adjusted OR (95%CI)
Exposure	
Non military personnel (reference)	1
Military personnel	3.11 (1.11-8.71)
Gender	
Males (reference)	1
Females	1.00 (0.67-1.48)
Age	
>50 years (reference)	1
< 50 years	0.91 (0.60-1.56)
Ethnicity	
Non white (reference)	1
White	1.18 (0.55-2.61)

Discussion

The studies on a possible association between military occupation and the development of brain tumors are not conclusive.

The results obtained in our study are similar to those of other analytical case–control studies, that demonstrate a higher risk of brain tumors in military occupation.

Other studies suggest a slight association between extremely low frequency and radiofrequency/microwave electromagnetic field exposure and increased risk of brain cancer in the US Air Force population (8).

Despite this, flight personnel seem to have an higher risk for different types of cancer (10). Occupational exposures and well-established non-occupational risk factors can contribute to increase this risk. In order to better control contradictory factors and to identify exposures potentially manageable to preventive measures, further studies should be carried out comparing risks within cohorts regarding: work history, flight routes, exposure to cosmic and UV radiation, different electromagnetic fields, and some chemicals.

Other studies have suggested that military of Navy Force have a different cancer mortality profile with respect to general population (9,11). However, further evaluations about risk factors for cancer are required, by using more specific diagnosis and occupational-related exposure data. Even though several factors are implicated in the appearence of brain tumors, the real mechanisms remain unclear (5).

Furthermore, Italians studies are lacking.

There are many limitations in this study, such as the ability to establish a causal relationship, as regard the exposure to cosmic, or UV radiation, electromagnetic fields, chemical substances, and the related increase in risk of brain cancer in the military personnel. Also the absence of personal information about the habit to smoke, to consume alcohol, and about diet are limiting the results of the studies, because they could

Table 2. Age, ethnicity and occupational distribution of cases and controls.

	Cases	%	Controls	%	P value Mantel-Haenszel
Age					
<50 years	47	29%	151	31%	0.810
>50 years	114	71%	332	69%	
Ethnicity					
White	151	93.8%	448	92.8%	0.655
Not White	10	6.2%	35	7.2%	
Exposure					
Military	9	5.6%	9	2%	0.013
No Military	152	94.4%	473	98%	

be important risk factors. Therefore, from the results of our study, it is inferable only that they are military personnel, but not their environmental exposures. Another critical point is the difficulty to separate occupational exposures by other factors of everyday life.

In conclusion, in this study, a statistically significant association between brain cancer and the military occupation was observed. Further studies regarding this population group are needed, to determine the causes that increased the cancer risk.

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