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Review

The Occupational Risk Factors of Prostate Cancer: A narrative Review

Mehrdad Mostaghaci[1*], Saleh Nasiri[2], Aezam Tavangarian[3]

[1] Department of Occupational Medicine, Isfahan University of Medical Sciences, Isfahan, Iran• [2] International Campus, ShahidSadoughi University of Medical Sciences, Yazd, Iran• [3] International Campus, ShahidSadoughi University of Medical Sciences, Yazd, Iran• Corresponding Author: Mehrdad Mostaghasi, Email: mehrdadmastaghaci@gmail.com, Tel: +98-9131147141

Abstract

Occupational cancers account for a major part of cancers. So far, various occupational factors have been recognized as a risk factor involved in the development of different occupational cancers. Prostate cancer is one of the cancers on which various studies have been carried out to examine the role of occupational exposures. The studies have introduced numerous occupational factors and jobs regarding this cancer. The results of studies in this regard have some contradictions. In this short review, occupational risk factors in the development of occupational cancers have been studied. The focus of this study is mainly on the factors, while occupations have not been examined in depth.

Keywords: Prostate cancer; Occupational exposure; Occupational epidemiology; Occupational diseases

Introduction

Prostate is a small gland which exists only in the body of men. Typically, from the age of 45 onwards, men may experience problems associated with prostate enlargement.[1] This enlargement is often harmless or benign, but a number of these cases transform into malignancy and prostate cancer, which do not develop any special early signs unless in the more advanced stages of the disease.[2] Prostate cancer is the most common cancer in men. In Iran, according to national report on recording cancer cases in 1388, prostate cancer with the age standardized rate (ASR) of 12.59 is ranked third among men.[3]According to Glubokan, in developing countries, its age specific incidence rate is 11.9%, while in advanced countries and the world at large, it is 61.7 and 27.9%, respectively. In this report, the peak age of prostate cancer has been stated as 75 to 80 years old.[4]

The definite cause of prostate cancer is still unknown, but research has associated the trend of prostate cancer malignancy with different factors. The endogenous hormones of testosterone and di-hydro testosterone are essential for natural growth and healthy function of prostate. It seems that some of these factors causes development of prostate cancer by altering these hormones.[5]In general, age, family background, race, diet, hormonal problems, as well as environmental and occupational factors can be mentioned among the risk factors for developing this cancer. Although so far, the effect of different occupational exposures has been examined on the incidence of this cancer, no uniform and consistent data has been obtained from these

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studies. Based on the results of different studies regarding the relationship between occupations and prostate cancer, conducting further research in this regard is essential. In this study we narratively reviewed the different occupational exposures related to prostate cancer.

Methods

We reviewed all available studies about occupational exposure and prostate cancer. We used different databases including Scopus, ISI Web of Science, Medline and CINAHL to search for the available literature on occupational exposure and prostate cancer in any language. Combination of MeSH and non-MeSH keywords related to prostate cancer/ neoplasms as the outcome of interest and occupational/workplace exposure as the exposure of interest was used to search selected databases. Abstracts, editorials, case reports, reviews, in-vitro and animal studies were excluded.

Results

Age, family background, race, and hormonal factors are among the most important non-occupational risk factors of prostate cancer. Meanwhile, aging is considered the most important risk factor of this cancer. With increased life expectancy in the society, the risk of death in response to prostate cancer also grows .[6]However, in some cases, age can be considered as a confounding factor in the incidence of cancer in response to occupational exposures. For instance, the concurrent effect of polymorphism of GSTP1 Ile105Va and PAHs in development of prostate cancer in ages below 60 years is far more intense.[7] Family background is another important risk factor of this disease. If a first-degree relative has prostate cancer, it increases the risk of its development in an individual by two to three times. The probability of contracting the disease and death in response to prostate cancer is significantly different across various races and countries. The incidence and fatality of the disease is higher in blacks, medium among the white, and the lowest among Asian men especially in China and Japan .[8] Alteration of the level of steroid hormones (testosterone and other androgens), which are important for the natural growth and function of adult men, can cause increased incidence of prostate cancer. However, these conditions can also be developed in response to exposure to various chemicals in the environment or occupational environments.

The role of nutritional behaviors and smoking has been taken into consideration in many cases as factors affecting development of prostate tumors. Vegetables and foods containing significant amounts of vitamins A, C, E, and tomato (due to lycopene) especially tomato sauce are among the protective factors against prostate cancer. On the other hand, foods containing saturated and animal fat, red meat, and calcium cause increased risk of incidence.[6]Many studies have been conducted in this regard, some of which have shown relationship between smoking and prostate cancer.[9]

Heavy metals

Occupational exposure to heavy metals mainly occurs via inhalation and during different processes such as welding, electroplating, mining, etc. Various studies have examined the relationship between exposure to these metals and working in metal industries and prostate cancer.[10-12] In a cohort study, the effect of occupational exposure to metal contaminants was examined in cases of incidence of prostate cancer between 1986 and 1995. The results of this study showed no significant relationship between occupational exposure to metal dust and the vapor of metals with the rate of incidence of prostate cancer.[10]Nevertheless, specifically, in a number of studies, it has been reported that the risk of prostate cancer has increased in the people exposed to cadmium.[11,13,14] Cadmium is a metal that is widely used in different industries. Exposure to this material occurs in occupations such as casting, mining, battery making, and rubber production. The findings about development of prostate tumors in rats exposed to cadmium suggest the importance of investigating this material. In a prospective study on 41089 individuals in

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Sweden and their diet, it was found that the extent of intake of cadmium via eating can have a significant effect on increasing the rate of prostate cancer (relative risk=1.13).[14] However, there are also other studies negating this relationship.[15]

Solvents

Organic solvents are hydrocarbon based chemicals, which are usually liquid at room temperature. These materials are used for cleaning, degreasing, diluting, and as chemical intermediate in the production and formulation of other chemical products. Considering the volatility of these materials, the main route of adsorption in occupational exposures is inhalation, though due to solubility, they also have a considerable skin absorption. Christensen et al in a controlled case study, investigated the effect of contact with chlorate solvents on incidence of occupational cancers. They concluded that contact with perchloroethylene (the solvent typically used in dry cleaning) can increase the risk of incidence of prostate cancer in the exposed individuals (OR = 4.3; 95% CI: 1.4 to 13).[16] In a controlled case study, another selected risk was specified among nuclear energy employees, where exposure to higher amounts of chloroethylene had a relationship with high risk of prostate cancer (Adjusted OR=2.1,95%CI=2 - 3.9).[17]

Poly cyclic aromatic hydrocarbons

Poly cyclic aromatic hydrocarbons (PAHs) are among carcinogenic agents that are developed in response to incomplete combustion of fuels. By developing DNA adduct, these materials exert their carcinogenic effects.[18]This group of materials are also a potential risk factor for prostate cancer. Following exposure to PAHs, this compound is also developed in prostate, whose value is proportional to the histological structure of cells in people with prostate cancer .[19] It seems that exposure to PAHs and oil fuels increases the risk of incidence of prostate cancer .[20] Furthermore, in a study on exposure to exhaust gases of engines and mineral fuels as the sources of PAHs and investigating its relationship with prostate cancer, no statistically significant relationship was observed between these exposures and prostate cancer.[10]Another study reported a significantly greater risk of incidence of this cancer in laboratories workers (who are usually exposed to high amounts of these compounds).[21]Members of the Police Force are another group of individuals who are usually exposed to vehicles' exhaust pollutants especially PAHs. In a study on 58279 employees in Police station, increased risk of prostate cancer was also observed, though there was no statistically significant relationship.[20]In addition, the effect of genetics in this process can also be investigated as an influential factor. A study has shown that people carrying GSTP1 Ile105Val who are exposed to PAH are more at risk in comparison with other men; so in this study, PAHs had not been introduced as the only risk factor for prostate cancer.[7]

Pesticides

In a meta-analysis, Mæle et al concluded that the people who work in the field of pesticide production are more at risk of contracting and dying in response to prostate cancer.[23]Moreover, another research has underestimated the risk of incidence of prostate cancer in people exposed to pesticides .[10] Accordingly and considering the contradictory results of the studies regarding the relationship between different occupations with this cancer, conducting further research in this regard is essential. In a study conducted in 2003 by Settimi et al in Italy, investigation of prostate cancer and exposure to pesticides in agricultural environments among cancer patients was performed in 1990-1992, and the investigations revealed a relationship between prostate cancer and different occupations. In this research, 40% of increased risk was associated with farmers (OR = 1.4, 95%CI: 0.9 to 2.0). The extra risk observed for farmers is mainly related to application of pesticides in agriculture (OR= 1.6, 95%CI: 1.0 –2.4). Furthermore, in this study, the relationship between different types of insecticides and prostate cancer was examined, and an increased risk between farmers exposed to organo-

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chlorate pesticides and acaricides was observed (OR = 2.5, 95% CI: 1.4 to 4.2). This extra risk occurs when using DDT (OR= 2.1, 95% CI: 1.2 to 3.8) and dicophel (OR =2.8, 95% CI: 1.5 to 5.0) simultaneously.[24] In a retrospective cohort study conducted in 2004 by Boers et al, the effect of occupational exposure to insecticides was examined. In this study, a significant negative relationship was seen for exposure to insecticides and prostate cancer (RR= 0.60; 95% CI: 0.37 to 0.95) .[10] In addition, in a controlled case study in New Zealand conducted by Pearce et al in 1987, cases of prostate cancer which had been recorded since 1979 were investigated and it was found that the risk of incidence of prostate cancer had increased among farmers (OR = 1.08, 90% CI:0.86-1.36).[21]

Vibration

Most studies have demonstrated the risk of prostate cancer in people with the job of driving in comparison with others. In a study conducted by Nadalin et al. with the aim of investigating the relationship between prostate cancer and occupational exposure to whole body vibration on 447 patients suffering from prostate cancer and 532 control individuals in Canada, it was found that the risk of prostate cancer increased in drivers exposed to whole body vibration (OR=51.90, 95%CI: 1.07 -3.39). These results revealed that drivers of heavy vehicles as well as drivers in public transportation sector are at higher risk of incidence of prostate cancer.[25] A meta-analysis, however, indicated an insignificant and weak relationship between whole body vibration and prostate cancer.[26] It seems that further studies are required to specify the role of this factor. Exposure of drivers to poly cyclic aromatic compounds can be considered as a confounding factor for this study. Based on the findings of these studies, there is no robust evidence regarding higher risk of prostate cancer in people exposed to vibration. However, investigation of vibration as a risk factor in development of prostate cancer can be valuable in the future occupational status.

Physical activity

So far, preventive effect of physical activity on different cancers has been investigated. However, the preventive effect of physical activity on prostate cancer is still doubted.[27,28]Moreover, it seems that factors such as problem in accurate measurement of working load in retrospective studies as well as the use of mortality data instead of rate of incidence in cohort studies are among the reasons for these findings. The findings indicate that the intensity of physical activity and walking has a significant effect on incidence of prostate cancer, where with increased occupational activity, the chance of incidence of prostate cancer increases (OR=6.7,95%CI; 1.3-35.1).[29] However, the effect of this factor on prostate cancer is weak and indirect.[28] In a study conducted by Kortsak et al in 2007, occupational risk factors of prostate cancer were examined and it was found that physical activity increases the risk of incidence of prostate cancer.[20] Teachers are usually the group with a lower level of physical activity in comparison with other occupations. The study by Marik et al in 1986 on 58279 men, with the aim of investigating the relationship between occupation and risk of incidence of prostate cancer, reported diminished risk of prostate cancer in the clergy and teachers, though no significant relationship was observed.[22]Moreover, in another controlled case study conducted in New Zealand by Pearce et al in 1987, the cases of prostate cancer recorded since 1979 were examined and it was found that the risk of incidence of prostate cancer is greater among teachers than other occupations (OR= 244, 90% CI; 0.5 - 5.70).[21] It seems that, occupations such as agriculture, due to greater energy demand, require the use of higher calorie diets such as fat and with less consumption of fruits. On the other hand, the study by Hsing et al showed opposite results and stated that prostate cancer is greater in individuals with less physical activity.[27]

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Table 1.A sample of occupations and exposures as risk factors in incidence of prostate cancer

Source	Exposures	At-risk occupational group
(30-35)	Pesticides, unhealthy diet, work load	Farmers
(36)	PAHs, heavy work load	Firefighters
(37,23)	Exposure to organic solvents, synthesis of pesticides, exposure to PAHs	-Workers in chemical industries
(38,36)	Exposure to PAHs, heavy work load	Railway workers
(40,39,10)	Exposure to metal dusts and fumes including cadmium	Workers in contact with metals
(41, 42)	Poly carbonated biphenyls, electromagnetic fields	Electricians
(26)	Vibration, chemical compounds resulting from combustion of diesel engines	Drivers

Prostate cancer in selected Occupations

Various studies have stated different occupations as the jobs at risk of prostate cancer based on different classifications of occupations. However, lack of uniform classification of occupations across different studies can complicate the interpretation of such results. For instance, many studies have mentioned greater risk of prostate cancer in farmers more than control groups. By 2012, around 60 epidemiological studies were performed regarding the relationship between agricultural activities and prostate cancer.[14,30-35]On the other hand, there are also a few number of studies that have underestimated this risk among farmers. In this case, it seems that not defining the occupation of agriculture precisely and lack of an accurate classification of individuals in farmer and non-farmer groups are the causes of such contradiction. Such contradictory results also exist in other occupations as well. For instance, in the study by Marik et al. in 1986, diminished risk of prostate cancer was observed among firefighters, though no significant relationship was found.[22]In addition, in a controlled case study in the US by Krstev et al. in 1998, a higher risk of incidence of prostate cancer was observed in this group.[28]The results obtained from investigation of the occupational titles and incidence of cancer in epidemiological studies suggest that the use of occupations as factors defining exposure to risk factors of incidence of occupational cancers cannot be a suitable option in studies. Table 1 has presented a sample of occupations and relevant exposures which can be considered as risk factors in incidence of prostate cancer.

Conclusion

So far, different studies have shown the effect of occupation on the risk of incidence of prostate cancer. Based on these studies, it can be inferred that employment in some sectors including agriculture can enhance this risk. Moreover, the precise mechanism of these processes is not well known and even in some cases, some contradictory results have been obtained. It seems that different design methods of studies and classification of occupations are among the factors causing incongruence in the studies. Based on the investigations, it was found that a wide range of occupations can be considered as at risk occupations in future studies, and thus their relationship with increased risk of incidence of prostate cancer can be investigated. Consideration of interfering factors in the studies is also another point that can help in improving the results. Usage of suitable occupational exposure matrices with each of the harmful factors is a far more suitable option in these studies. However, development of suitable occupational exposure matrices with each of the mentioned factors is time-consuming and requires more time and higher costs. Overall, it can be stated that a factor-oriented view in investigating the relationship between occupation and cancers especially prostate cancer will offer more harmonious results in comparison with the occupation-oriented view.

Conflict of interest

The authors declare no conflict of interest.

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