

EPIDEMIOLOGICAL CHARACTERISTICS OF PROSTATE CANCER AND THE INFLUENCE OF NUTRITION

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Abstract

Prostate cancer is one of the most common malignancies affecting men and contributes significantly to their increased mortality rate globally. The primary goals of this research were to determine the development tendency and cyclical variations of prostate cancer according to the age of the patients, and what is the role of nutritional factors.

The data we used to conduct this research was scientific literature from 15 sources published in SCOPUS, EBSCO, etc. However, our primary data source was the research conducted by the Faculty of Food Technology and Nutrition at the University of Tetovo and VT Diet Club - Bitola (which covered the period from 01 January 2019 to 31 December 2021), and the data taken from the Institute of Public Health of Macedonia. That research included 1,137 respondents with prostate cancer (diagnosis C61), who are aged 40 to over 80 years. We have thoroughly analyzed 4 scientific studies on the impact of diet and the occurrence of prostate cancer. When analyzing these sources and previous results, the following statistical work methods were used: linear trend, seasonal index, rate of decline, and rate of increase.

Linear trend analysis indicated that prostate cancer showed a tendency to increase with increasing age. From the analysis of cyclical variations, it can be seen that prostate cancer in Macedonia is mostly represented from the age of 55 to the age of 74 in the male population. This age of 55 to 74 years is a critical age in which the risk of prostate cancer in men is the highest.

The main conclusion that can be adopted from the study is that men aged 55 to 74 should at least once a year have an examination with a urologist and a PSA

test for early detection of prostate cancer, and in terms of diet they should reduce their intake of foods high in fat, increase their intake of fruits and vegetables, and exercise more to reduce their risk of prostate cancer.

Key words: Cancer, Prostate, Men, Age, Trend, PSA, Nutrition.

1. Introduction

Prostate carcinoma is an individual and unpredictable disease whose malignant potential cannot always be predicted and as a slow-growing tumor, it takes 10 to 15 years for the first symptoms to manifest. Prostate cancer in Macedonia is on the rise, while awareness of timely examinations is very low. Every year, about 70 new patients fall ill from the disease, which is the second most common cause of death among men, and even 90% are discovered at a late stage when a complete cure is not possible. Prostate carcinoma, if detected early with timely therapy, leads to a cure in 98% of cases [1].

The primary goals of this research were to determine the development tendency and cyclical variations of prostate cancer according to the age of the patients, or more precisely to determine the development tendency of prostate cancer according to the age of the patients, and determine the cyclical variations of prostate cancer according to the age of the patients.

2. Materials and Methods

2.1 Research material

Prostate cancer is the second leading cause of death in the male population. Therefore we decided to examine the dynamics of prostate cancer. The research

was conducted by the Faculty of Food Technology and Nutrition at the University of Tetovo, and VT diet club - Bitola. The research covers the period from 01 January 2019 to 31 December 2021. This research was of a retrospective type. The data we used to conduct this research was taken from the Institute for Public Health of Macedonia - a survey covering 1,137 subjects with prostate cancer (diagnosis C61).

2.2 Research methodology

The survey included 1,137 newly registered cases of prostate cancer (diagnosis C61). To conduct this research, it was important to meet certain criteria as:

- The study should include cases of prostate cancer (diagnosis C61);
- The age of the respondents should be from 40 to over 80 years old.

2.3 Statistical method of data processing

As statistical methods of work, a trend was used to determine the development tendency of prostate cancer according to the age of the subjects, as well as a seasonal index to determine the cyclical variations of prostate cancer according to the age of the subjects. Also, the rate of decline and rate of increase have been used as secondary statistical methods of work.

3. Results and Discussion

Table 1 shows the data on the number of newly registered cancer cases prostate (diagnosis C61) from 2019 to 2021. Data has been downloaded from the Institute for Public Health of Macedonia [2].

From Table 1, it can be concluded that the largest number of newly registered cases of prostate cancer was in 2019 - 452 newly registered cases. In 2020, a decrease in the number of newly registered cases of prostate cancer was detected. The rate of decline in prostate cancer in 2020 was 25.9% compared to 2019. While in 2021 a slight increase in the number of newly

registered cases of prostate cancer is detected. The rate of increase (growth) in prostate cancer in 2021 was 4.5% compared to 2020 (see Table 2).

Figure 1 shows the number of newly registered cases of prostate cancer (diagnosis C61) in the period from 2019 to 2021 distributed by age [2].

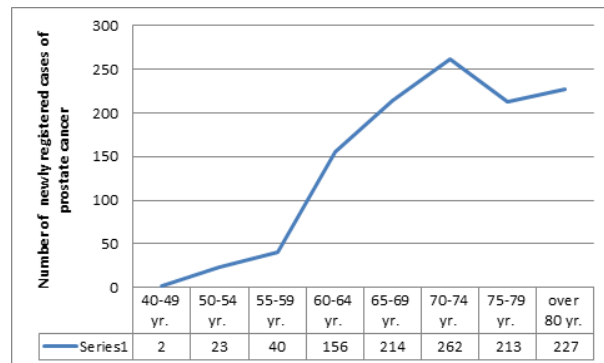


Figure 1. Number of newly registered cases of prostate cancer (diagnosis C61) in the period 2019 - 2021 distributed by age

From Figure 1, it can be concluded that the majority of newly registered cases of prostate cancer (diagnosis C61) in the period from 2019 to 2021 were aged 70-74 (262 patients).

From the line diagram (Figure 1), one cannot see the development tendency of prostate cancer according to the age of the patients. To determine the development tendency of the analyzed phenomenon, a trend was created. There are several types of trends: linear, parabolic, logarithmic, etc. The line trend is mostly used. It is made according to the formula:

$$y = a + bx$$

Where: y represents the trend value, a and b are trend coefficients, and x represents time (in our case, the age of prostate cancer patients).

Table 1. Newly registered cancer cases prostate (diagnosis C61) in the period 2019 - 2021

Year	Number of newly registered cases of prostate cancer (diagnosis C61)
2019	452
2020	335
2021	350
In total	1,137

Table 2. Declining pace and rate of increase

Declining pace Year : N°	Rate of increase Year : N°
2019: 452	2020: 335
2020: 335	2021: 350
Declining: 117/452 x 100 = 25.9%	Increase: 15/335 x 100 = 4.5%

The formulas below determine the value of the trend coefficients:

$$a = \frac{\sum y}{N}$$

$$b = \frac{\sum xy}{\sum x^2}$$

Where: N represents the number of values.

Table 3 shows the procedure for determining a linear trend. In Table 3, the time values (X) are determined in such a way that the average age (60-64 years) in the analyzed period is marked with zero (X = 0). The values of X above zero are marked as: -1, -2, -3, and below zero 1, 2, 3, 4. Y shows the individual frequencies of prostate cancer in the analyzed period. The individual products are shown with X x Y, and when deriving the sum, attention should be paid to the negative sign.

By replacing the corresponding values, the values of the trend coefficients, as well as the trend itself, are determined:

$$a = \frac{\sum y}{N} = \frac{1137}{8} = 142.13$$

$$b = \frac{\sum xy}{\sum x^2} = \frac{2193}{44} = 49.84$$

Table 3. Determination of linear trend

Age (years)	X	Y	X x Y	X ²
40-49	-3	2	-6	9
50-54	-2	23	-46	4
55-59	-1	40	-40	1
60-64	0	156	0	0
65-69	1	214	214	1
70-74	2	262	524	4
75-79	3	213	639	9
Above 80	4	227	908	16
Σ		1,137	2193	44

Table 4. Determination of trend values for each age in prostate cancer patients

Age (years)	$y = a + bx = 142.13 + 49.84x$
40 - 49 (x = -3)	$y = 142.13 + 49.84 \times (-3) = -7.39$
50-54 (x = -2)	$y = 142.13 + 49.84 \times (-2) = 42.45$
55-59 (x = -1)	$y = 142.13 + 49.84 \times (-1) = 92.29$
60-64 (x = 0)	$y = 142.13 + 49.84 \times 0 = 142.13$
65-69 (x = 1)	$y = 142.13 + 49.84 \times 1 = 191.97$
70-74 (x = 2)	$y = 142.13 + 49.84 \times 2 = 241.81$
75-79 (x = 3)	$y = 142.13 + 49.84 \times 3 = 291.65$
Above 80 (x = 4)	$y = 142.13 + 49.84 \times 4 = 341.49$

$$y = a + bx = 142.13 + 49.84x$$

Further elaboration determines the trend values for each age (see Table 4).

Obtained individual trend values for the examined ages are applied to a coordinate system (Figure 2) [3].

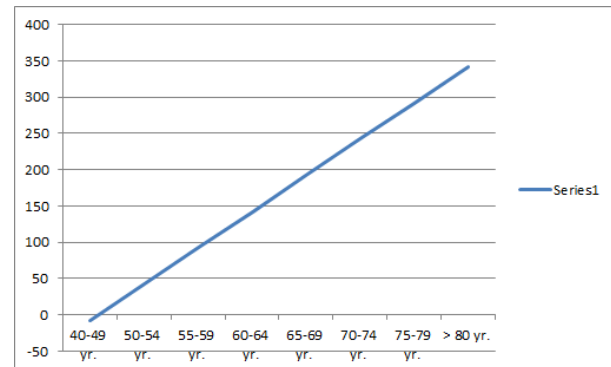


Figure 2. Linear trend for prostate cancer

Figure 2 shows that prostate cancer tends to grow with increasing age.

To determine the cyclical variations of prostate cancer according to the age of the patients, we used the seasonal index statistical operation, which we slightly modified according to the results obtained from the Institute of Public Health of Macedonia. The creation of the seasonal index in our study followed these steps:

- Data for each age group from each year were tabulated.

- The individual values for each age group for each year of the examined period were collected and an average value was determined.
- The average values for the age groups were added, the sum of the average values was divided by 8, and the resulting number (value) represents the average for the age groups for each year in the examined period.
- By dividing the average value for each age group by the average for the age groups for each year, a seasonal index was obtained for each age group, which can be expressed as an absolute number or as a percentage (Table 5).

The average age group for all years of the analyzed period is calculated according to the following formula:

$$X' = \frac{\sum 379}{8} = 47.375$$

and it is established that this value is 47.375. Figure 3 shows the seasonal index for prostate cancer in Macedonia for the analyzed period of 2019 until 2021.

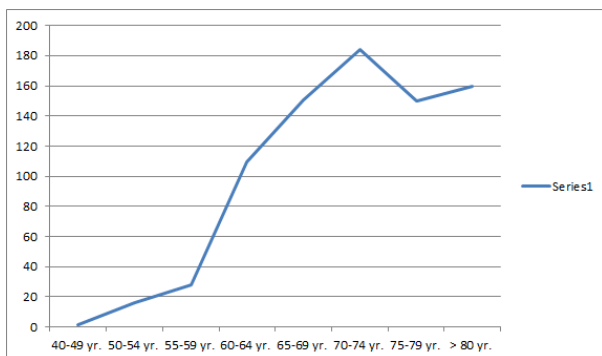


Figure 3. Seasonal index for prostate cancer in Macedonia for the period 2019- 2021

From the graphic display (Figure 3) of the seasonal indices for the analyzed period, it can be seen that prostate cancer in Macedonia is mostly represented from the age of 55 to the age of 74 among the respondents. This age of 55 to 74 years is a critical

age in which the risk of prostate cancer in the male population is the highest.

The main conclusion that can be adopted from the study is that men aged 55 to 74 should at least once a year have an examination with a urologist and a PSA test for early detection of prostate cancer, and in terms of diet they should reduce their intake of foods high in fat, increase their intake of fruits and vegetables, and exercise more to reduce their risk of prostate cancer.

Prostate cancer is the most common type of cancer in men, and second only to lung cancer according to the number of deaths caused annually [4]. According to the scientific literature, more than 160,000 new cases of prostate cancer are diagnosed in the United States every year [5]. Based on Globocan 2018 estimates, 1,276 106 new cases of prostate cancer were reported worldwide in 2018, with a higher prevalence in developed countries [6]. When it comes to the countries of our environment, we would like to mention that prostate cancer in Bulgaria is in second place according to the number of newly registered cases in 2020 (13.7%) [13], while Croatia is still in the top 10 countries in terms of the number of deaths from prostate cancer in Europe [14]. If prostate cancer is diagnosed early enough, the outlook for treatment is good. Symptoms do not necessarily appear, especially if they are non-specific, and if present, include problems with urination. Regular check-ups are the best way to detect prostate cancer.

Prostate cancer usually develops slowly, so there may be no symptoms for years. Symptoms only appear after the prostate becomes so large that it interferes with the function of the urethra (the tubular organ that carries urine from the bladder to the penis). When this happens, patients may notice an increased need to urinate, straining to urinate, or a feeling that the bladder is not empty [4].

In our study covering the period 2019 - 2021, it was detected that the highest number of newly registered

Table 5. Determining the seasonal index for prostate cancer in Macedonia for the period 2019 - 2021

Age group	Year			X'	Seasonal index	
	2019	2020	2021		A	%
40-49	2	0	0	0.7	0.015	1.5
50-54	8	7	8	7.7	0.163	16.3
55-59	18	15	7	13.3	0.281	28.1
60-64	71	37	48	52	1.098	109.8
65-69	82	53	79	71.3	1.505	150.5
70-74	111	69	82	87.3	1.843	184.3
75-79	85	62	66	71	1.499	149.9
Over 80	75	92	60	75.7	1.598	159.8

cases of prostate cancer was in 2019 (452 newly registered cases). It is interesting to note that in 2020 a decrease in the number of newly registered cases of prostate cancer is detected. The rate of decline in prostate cancer in 2020 was 25.9% compared to 2019. Such a result is because in 2020 the COVID-19 pandemic was current. At the height of the COVID-19 pandemic, there was a neglect of all other diseases and the fight was directed only against COVID-19 within the health system, while already in 2021, a slight increase in the number of newly registered cases of prostate cancer was detected. The rate of increase (growth) in prostate cancer in 2021 was 4.5% compared to 2020.

According to the results of the scientific study by Silvia Garcia Barrares and her team, in 2020 there were fewer urological consultations (35,160 compared to 40,225 in 2019). In 2019, 53.1% (N = 264) of biopsies were positive for prostate cancer versus 47.2% (N = 137) in 2020 ($p = 0.104$). However, it is concerning that according to the results of this study the mean PSA was significantly higher (14.3 vs. 9.9 ng/dL in 2019). Also, more patients with metastases appeared in 2020 (7.3% vs. 1.9%, $p = 0.009$). This is because in 2020 the waiting time for prostate biopsy was longer due to the COVID-19 pandemic (42.1 vs. 35.3 days in 2019, $p = 0.019$) [16].

In our study, we found that prostate cancer shows a tendency to grow with increasing age. According to modern genetic studies, mutations of certain genes are associated with the onset, progression, and metastasis of prostate cancer [7]. With age, the duration of exposure and the accumulation of cancer risks increase. Aging and cancer have some features in common. The transition from normal to cancer cells is a multifocal process that involves the accumulation of damage and mutations that occur over time along with disruption of repair systems and cell growth regulation [8].

Diet plays a big role in these changes. For example, foods that are high in saturated fat as well as trans fat cause changes in DNA methylation patterns that result in a higher risk of prostate cancer. Alcohol, processed food, and pesticide residues that can be found in food have a similar effect [17].

According to the results of our study, we can state that prostate cancer in Macedonia is mostly represented from the age of 55 to the age of 74. This age of 55 to 74 years is a critical age in which the risk of prostate cancer in the male population is the highest. According to scientific literature, prostate cancer is more common in men over 65 years of age [9]. Our recommendation for all people who are in the so-called critical age (as well as the elderly) is to visit a urologist once a year

and do a prostate-specific antigen found in the blood (PSA) laboratory analysis. PSA can show the presence or absence of prostate cancer with great accuracy. The PSA test is one of the best indicators for early detection of prostate cancer. Normal blood PSA values are 0 - 4 ng/mL. According to the data from the Institute for Public Health of the Republic of Macedonia PSA values of 4 to 10 ng/mL are a "gray zone" in which the probability of cancer is 25 - 35%. PSA values above 10 ng/mL indicate the probability of cancer in the range of 50 - 80% [10]. The scientific literature recommends screening at age 45 for men with a family history of prostate cancer, as well as for African Americans (African American men have the highest incidence rates and a more aggressive type of prostate cancer compared to white men) [6]. To make an accurate diagnosis and determine the prognosis of the disease, it is necessary to perform the following tests: digital rectal examination, PSA, free PSA, PAP, ultrasound findings, cystoscopy, and biopsy [18].

Through a thorough analysis of scientific literature and scientific papers indexed in SCOPUS, EBSCO, etc. which are listed in the references, we determined that diet is one of the key factors for the development of prostate cancer, and it is also of essential importance for its prevention. A few years ago, only age, race, and family history were known risk factors for this disease. Today, however, great progress has been made toward uncovering nutritional and hormonal risk factors for prostate cancer. Biomarkers, including testosterone and insulin-like growth factor (IGF-1), and nutritional factors, particularly meat, fat, and dairy intake, have been associated with increased risk of this disease [11]. Frequent consumption of meat, fat, and dairy products leads to a higher synthesis of IGF-1. It has been established that high levels of IGF-1 in the blood plasma are associated with a higher risk of prostate cancer [15]. Also, saturated fats (especially fats that are rich in stearic and palmitic acid) found in red meat and its products, as well as in dairy products with a high concentration of fat (butter, cream, cheese, etc.), can act on the work, that is, on the expression of our genes, leading to long-term changes in our epigenome. These epigenetic changes further increase the risk of certain diseases, including prostate cancer [12]. On the other hand, higher consumption of selenium and vitamin E, fructose (fruit), and lycopene (tomatoes) are associated with a reduced occurrence of prostate cancer, but still their efficacy for prevention remains unproven [11]. It is interesting to note that in 1950, prostate cancer mortality was 40 times higher in the United States than in Japan. This was primarily due to the Japanese diet in the 1950s, which was low in protein compared to the Western diet, and particularly low in animal protein. Another epidemiological study from 1980 indicates that mortality from prostate cancer is significantly

lower in countries in which the so-called quasi-vegan diet is applied as opposed to countries where the omnivorous diet was dominant. The Japanese diet that was used in 1950 can be characterized as a quasi-vegan diet (a pesco-vegan diet) with moderate consumption of fish, soy, and green tea. This nature of the Japanese diet of that period played a key role in their incredibly low risk of prostate cancer [15]. That is why our recommendations for people who are in the so-called critical years (55-74 years) to reduce the risk of prostate cancer are to: reduce the intake of food rich in fat; increase the intake of fruits and vegetables; and exercise more [6].

4. Conclusions

Finally, we will sublimate all the conclusions that resulted from the preparation of this scientific paper:

- In the period 2019-2021, it was detected that the largest number of newly registered cases of prostate cancer occurred in 2019 (452 newly registered cases) in Macedonia. In 2020, a decrease in the number of newly registered cases of prostate cancer was detected. The rate of decline in prostate cancer in 2020 is 25.9% compared to 2019. Such a result is because in 2020 the COVID-19 pandemic was current. At the height of the COVID-19 pandemic, there was a neglect of all other diseases and the fight was directed only against COVID-19 within the health system. While in 2021 a slight increase in the number of newly registered cases of prostate cancer was detected. The rate of increase (growth) in prostate cancer in 2021 was 4.5% compared to 2020.

- Prostate cancer in Macedonia is mostly represented in the male population between the ages of 55 and 74. This age (55 to 74 years) is a critical age, in which the risk of prostate cancer in men is the highest. We recommend that all men who are in the range of the so-called critical age (55 - 74 years) have at least an annual examination by a urologist and a PSA test for early detection of prostate cancer. As for nutrition, our recommendation for people who are in the so-called critical years (55 - 74 years) to reduce the risk of prostate cancer is to reduce the intake of foods rich in fat, increase the intake of fruits and vegetables, and exercise more.

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