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Original

Nutritional status and eating pattern in prostate cancer patients

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Abstract

Background: **Prostate cancer is the second most common cancer in men worldwide. Differences in prostate cancer incidence suggest a significant role of environmental factors in the aetiology: obesity, central adiposity and some dietary factors have been suggested as risk factors. This pilot study aimed to analyse the pattern of nutritional status, body fat, and the usual dietary intake among men diagnosed with prostate cancer, consecutively referred to the Radiotherapy Department of the University Hospital Santa Maria.**

Patients & methods: **Throughout 2006, 87 men with prostate cancer were included. Evaluations: weight & height to calculate body mass index (BMI), waist circumference, percentage body fat with bipolar hand–held bioimpedance analysis (BF-306®), Food Frequency Questionnaire validated for the Portuguese population to assess the usual dietary intake. Frequency analysis and Mann-Whitney U test were used to evaluate prevalence and associations.**

Results: **Mean age was 69 ± 7 (46-85) years; 74 (84.1%) patients were in stage II, 5 (5.7%) in stage I & 9 (10.2%) in stage III; 39(45%) patients had a Gleason score ≥ 7. Regarding nutritional status, 78 (89%) patients were overweight/obese, 84 (97%) had a body fat above the maximum limit (> 25%) and 43 (49%) had a waist circumference > 102 cm (prevalence analysis: $p < 0.05$). Univariate analysis did not show any association between Gleason Score, BMI, %body fat and waist circumference; by multivariate analysis there was an association between higher BMI, %body fat and aggressive Gleason scores ($p < 0.002$), such variables worsened with age. Food frequency analysis showed a low consumption of n-3 fatty acids sources as well as vegetables and whole grain cereals and a correlation between low yogurt and vegetables intake with more aggressive Gleason scores was found ($p < 0.05$).**

Conclusion: **Our findings show a high prevalence of obesity, excessive body and abdominal fat and diets defi-**

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ESTADO NUTRICIONAL Y TIPO DE ALIMENTACIÓN EN PACIENTES CON CÁNCER DE PRÓSTATA

Resumen

Introducción: **el cáncer de próstata es el segundo en frecuencia en hombres en el mundo. Las diferencias en la incidencia del cáncer de próstata sugieren un papel significativo de los factores ambientales en su etiología: se ha sugerido la obesidad, adiposidad central y algunos factores dietéticos como factores de riesgo.**

Objetivos: **este estudio piloto se proponía analizar el patrón del estado nutricional, la grasa corporal y el consumo dietético habitual en hombres diagnosticados de cáncer de próstata y remitidos de forma consecutiva al Servicio de Radioterapia del Hospital Universitario de Santa María.**

Pacientes y métodos: **a lo largo de 2.006, se incluyeron 87 hombres con cáncer de próstata. Evaluaciones: peso y talla para calcular el índice de masa corporal (IMC), la circunferencia de la cintura, el % de grasa corporal mediante análisis bipolar manual de bioimpedancia (BF-306®), el cuestionario Food Frequency Questionnaire validado en su versión portuguesa para valorar el consumo dietético habitual. Se emplearon los análisis de frecuencia y la prueba U de Mann-Whitney para evaluar la prevalencia y las asociaciones.**

Resultados y discusión: **la edad media fue de 69 ± 7 (46-85) años; 74 (84,1%) pacientes estaban en estadio II, 5 (5,7%), en estadio I y 9 (10,2%) en estadio III; 39 (45%) pacientes tenían una puntuación de Gleason ≥ 7. Con respecto al estado nutricional, 78 (89%) pacientes eran obesos o tenían sobrepeso, 84 (97%) tenían grasa corporal por encima del límite máximo (>25%) y en 43 (49%) la circunferencia de la cintura era > 102 cm (análisis de prevalencia: $p < 0,05$). El análisis univariable no mostró ninguna asociación entre la puntuación de Gleason, el IMC, el % de grasa corporal ni la circunferencia de la cintura; el análisis multivariado mostró una asociación entre un mayor IMC, el % de grasa corporal y puntuaciones de Gleason malas ($p < 0,002$); estas variables empeoraban con al edad. El análisis de frecuencia de alimentos mostró un consumo bajo de fuentes de ácidos grasos n-3 así como de vegetales y de cereales integrales, y se encontró una correlación entre un consumo bajo de yogur y vegetales y unas peores puntuaciones de Gleason ($p < 0,05$).**

Conclusión: **nuestros hallazgos muestran un prevalencia elevada de obesidad, exceso de grasa corporal y abdominal y las dietas deficientes en nutrientes protectores.**

cient in protective nutrients. Further investigation is warranted as cancer rates in Portugal continue to increase!

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Key words: *Prostate cancer. Diet. Obesity. Body fat. Waist circumference.*

¡Se requieren investigaciones adicionales puesto que las tasas de cáncer en Portugal siguen aumentando!

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Palabras clave: *Cáncer de próstata. Dieta. Obesidad. Grasa corporal. Circunferencia de la cintura.*

Introduction

Prostate cancer currently represents the second most common form of cancer in men worldwide, with an increasing incidence rate.[1] Both genetic and environmental influences may be involved in its aetiology.

Growing evidence support the integral role of lifestyle factors such as nutrition, obesity, and diet in the prevention or slowed progression of prostate cancer. Obesity is a likely risk factor for several cancers including prostate,[2,3] some have reported a positive association[2] whereas other did not support those results.[4] Central obesity was also associated with an increased risk of prostate cancer[5] and with benign hypertrophy.[6]

Moreover, migrant epidemiological studies have shown that prostate cancer risk increases in men who move from countries with low incidence to Western countries, thereby implying that environmental factors such as nutrition may have a significant impact in cancer development.[7] Saturated fat,[8] red meat[9] and dairy products[10] are suggested to be risk factors for prostate cancer; protective factors include micronutrients such as isoflavones,[11] lycopene,[12] selenium,[13] vitamin E[14] and vitamin D,[15] though results are not consistent.

Based on this framework, this pilot study aimed to assess nutritional status focusing on BMI, % body fat, central obesity as well as in the usual dietary intake of men with prostate cancer, and to explore potential inter-relations between clinical and nutritional factors.

Patients and methods

This pilot cross-sectional study was carried out in the outpatient Radiotherapy Department of the University Hospital of Santa Maria in Lisbon throughout 2006, 87 men with histologically confirmed prostate cancer were consecutively included and evaluated. The study was approved by the University Hospital Ethics Committee and was conducted in accordance with the Helsinki Declaration, adopted by the World Medical Association in 1964, amended in 1975 and updated in 2002. After written informed consent, data were recorded in an individual form pre-constructed for statistical analysis. Data were collected by centrally trained and supervised interviewers. Data included demographics, clinical parameters, anthropometric measures, changes in weight and food intake over the previous 6 months, and the usual dietary intake. The Gleason score, which expresses the severity of prostate tumours according to histology and invasion,[16] was obtained from every record; a total Gleason score ≥ 7 is considered histologically aggressive, and Gleason scores < 7 are considered of low aggressiveness.[16]

Nutritional parameters

Patients' height was measured using a stadiometer and weight was measured using a SECA® floor scale; measurements were performed in the morning and all patients were in fasting, shoeless and wearing lightweight clothing. BMI was then calculated using the formula [weight(kg)/height(m)^2] and classified according to WHO's criteria as: normal weight when 18.5-24.9 kg/m^2, overweight if 25-29.9 kg/m^2 and obese if ≥ 30 kg/m^2.[17] Waist circumference was measured midway between the lower margin of the last rib and the iliac crest, in a horizontal plane using a non-stretchable flexible tape. Values were further categorised as normal if < 102 cm and as central obesity if ≥ 102 cm.[18] Body percentage of fat mass was determined using a hand-held bipolar bio-impedance instrument (Omron BF306, Omron Healthcare Europe BV, Hoofddorp, The Netherlands); measurements were further categorised into two groups: normal if < 25% and excessive body fat if ≥ 25%.[19]

In order to assess usual dietary intake, 77 participants completed a Food Frequency Questionnaire (FFQ) validated for the Portuguese population.[20] This comprises a detailed review of the usual intake throughout the previous year in what concerns: types of foods and the frequency of intake per day, week or month, and in what amount; open questions were applied to report and complete the evaluation with all foods not included in the questionnaire but consumed regularly and at least once a week. Further, the foods included in the questionnaire were grouped into broad categories such as dairy products, meat, fish & eggs, fats, sweets & desserts, vegetables, fresh & dried fruits and beverages. Within these categories, respondents' intakes were classified as low (≤ 1-3 times/week), moderate (4-6 times/week) or high (≥ 7 times/week or if consumed daily).

Statistical analysis

Statistical analyses were performed using the SPSS statistical software (SPSS for Windows 14.0). Frequency analysis was used to assess prevalences of nutritional status and also to evaluate food intake. Mann-Whitney U test was used to evaluate associations between parameters of nutritional status, tumour stage and Gleason scores. Bivariate correlations and Spearman correlation coefficient with 2 tailed test of significance, assessed correlations. A concordance analysis using the Kappa coefficient was calculated to measure the rate of agreement between parameters of nutritional status. A multivariate analysis of variance (ANOVA) adjusted for age and for potential errors given by the small sample size, was used to explore associations between various clinical and nutritional variables. Data are presented as numbers and percentages and *p* values ≤ 0.05 were considered statistically significant.

Results

Patients' mean age was 69 ± 7 (46-85) years and stage II was the most frequent ($p < 0.03$); additionally, 39 (45%) patients had aggressive tumours with Gleason scores ≥ 7 and 48 (55%) had prostate cancer with low aggressiveness ≤ 7 (table I). Nutritional status revealed that 51 (59%) patients were overweight and 27 (31%) were obese *vs* only 9 (10%) patients with an adequate BMI ($p < 0.001$); furthermore, 84 (97%) patients had a % body fat higher than 25% *vs* only 3 (3%) with a % body fat lower than the higher cut-off limit of 25% ($p < 0.001$). In 43 (49%) patients, waist circumference was higher than the maximum cut-off value of 102 cm (table II). To confirm consistency of evaluations by all methods, a concordance analysis was performed: we found an agreement between BMI % body fat (Kappa coefficient = 0.93, $p < 0.001$) and between BMI and waist circumference (Kappa coefficient = 0.44, $p < 0.005$).

Potential univariate associations between BMI, waist circumference, % body fat, Gleason score and tumour stage was tested through the non-parametric Mann-Whitney U test and Pearson correlation coefficient. No association nor correlation between the Gleason score or tumour stage with nutritional status was found ($p < 0.38$). However, by multivariate analysis of variance, there was an association between higher BMI, %body fat and aggressive Gleason scores ($p < 0.002$), and all these variables worsened with age.

Table III shows patients' poor dietary pattern. The analysis of the reported food frequency of usual intake showed that the majority of patients had low intakes of milk (70%) and yoghurt (52%), cheese was however consumed more often with 58% reporting moderate intake and daily intake in 22%. There was a generalized low intake of vegetables, less than 3 times per week, hence a poor intake of fibre, concomitantly with high and regular intake of simple carbohydrate food sources: 48% of patients consumed white bread on a daily basis; rice and baked potatoes were the next most commonly consumed starch products, with 61% and 78% of patients consuming those between 4-6 times per week respectively. There was also a reduced intake of foods rich in PUFA, mainly from dietary sources of n-3 fatty acids such as nuts (low in 80% of patients) and fatty fish (low in 66% of patients). Overall, the consumption of fresh fruit was moderate (72%). The most popular alcoholic beverage was wine which was consumed on a daily basis by 48% of the patients while 25% consumed wine between 4-6 times per week.

Potential associations between different components of the diet and prostate tumour aggressiveness (Gleason score ≥ 7) were explored, but no association was found; however, we did find a correlation between low consumption of yogurt ($p = 0.04$), broccolis ($p = 0.03$), cauliflower ($p = 0.01$) and brussels sprout ($p = 0.009$) with higher Gleason scores thus more aggressive cancers.

Table I
Patients' tumour characteristics

	N (%)
Tumour Stage	
I	4 (4.6%)
II	74 (85.1%)
III	9 (10.3%)
Gleason score	
< 7	48 (55.2%)
≥ 7	39 (44.8%)

Data are presented as numbers and percentages of patients.

Table II
Categories of BMI, % body fat and waist circumference

	N (%)
BMI (kg/m^2)	
< 24.9	9 (10%)
25-29.9	51 (59%)
= 30	27 (31%)
% body fat	
< 25%	3 (3%)
= 25%	84 (97%)
Waist circumference (cm)	
< 102	44 (51%)
= 102	43 (49%)

Data are presented as numbers and percentages of patients. For BMI, % body fat and waist circumference, the patients are distributed according to international reference values and cut-offs[17-19].

Table III
Frequency of food intake

Foods	*Low intake*		*Moderate intake*		*High intake*	
Dairy products						
Milk	54	70%	14	18%	9	12%
Yoghurt	40	52%	30	39%	7	9%
Cheese	15	20%	45	58%	17	22%
Meat, Fish & Egg						
Chicken	60	78%	17	22%	0	0%
Turkey/rabbit	69	89%	8	10%	0	0%
Beef/Pork	55	71%	21	27%	0	0%
Ham/Sausage	76	98%	1	1.%	0	0%
Fatty Fish	46	59%	30	39%	1	1%
Lean Fish	36	47%	37	48%	0	0%
Seafood	75	97%	2	3%	0	0%
Eggs	43	56%	33	43%	1	1%
Fats						
Olive Oil	1	1%	32	42%	44	57%
Sunflower/Soy Oil	65	84%	11	14%	1	1%
Butter	45	58%	25	32%	7	9%
Starchy foods						
White Bread	25	32%	15	19%	37	48%
Whole Bread/Cereal	38	49%	12	15%	27	35%
Rice	27	35%	47	61%	2	2%
Pasta	45	58%	30	38%	0	0%
French Fried Potato	64	83.12%	13	16%	0	0%
Baked Potato	17	22.08%	60	78%	0	0%
Biscuits	62	81%	13	17%	1	1%
Sweet & Deserts						
Ice Cream	70	91%	6	8%	1	1%
Croissant/Cake/Chocolate	52	68%	20	26%	5	6%
Sugar	29	37%	21	27%	26	37%
Vegetables						
Cabbage	60	78%	15	19%	1	1%
Broccoli/Spinach/Turnip	55	71%	20	26%	1	1%
Common Beans	44	57%	31	40%	1	1%
Carrot						
Fresh Tomato	24	31%	51	66%	1	1%
Beans/Pea	62	80%	14	18%	1	1%
Legume Soup	5	6%	65	84%	6	8%
Fresh & Dry Fruits						
Apple	11	14%	46	59%	17	22%
Orange/Kiwi	27	35%	29	37%	7	9%
Strawberry/ Cherry	30	39%	35	45%	12	15%
Peach	17	22%	42	54%	17	22%
Grapes	33	43%	30	39%	13	17%
Nuts	72	94%	3	4%	1	1%
Olives	58	75%	12	15%	6	8%
Beverages						
Wine	20	26%	19	25%	37	48%
Beer	63	82%	10	13%	3	4%
Coke	72	94%	3	4%	1	1%
Coffee	29	37%	28	36%	19	25%
Black Tea	72	93%	4	5%	0	0%

Data are presented as numbers and percentages of patients; low intake: 1-3 times/week; moderate intake: 5-6 times/week and high intake: ≥ 7 times/week or if consumed daily

Discussion

In 2004, cancer accounted for more than 13% of all deaths worldwide and the World Health Organisation predicts an increase to almost 18% by 2030.[21] In the 1980's, the Europe against Cancer programme fixed the goal of reducing cancer mortality by 15% in Europe by the year 2000. Evaluation of the outcomes of the programme revealed that Portugal and Spain are among a limited number of European countries that showed an increased number of cancer deaths compared to those predicted.[22] Nonetheless, the World Cancer Research Fund states that cancer is a preventable disease; a review of the past 30 years of authoritative estimates of the role of food, nutrition and lifestyles in the prevention of cancer, have suggested that approximately 30% of cancers are preventable.[1] Prostate cancer is no exception.

Epidemiological studies on the relationship between obesity and prostate cancer are somewhat conflicting: a Swedish cohort study showed a positive association between high BMI and prostate cancer incidence,[2] yet the Netherlands Cohort study conducted in 58,000 men over 6 years of follow up, found no overall association.[4] In our cross-sectional pilot study of 87 men with prostate cancer, 89% of patients were overweight/obese and 97% of them had a body fat greater than the maximum cut-off value of 25%, and half of these patients had central obesity; however, univariate analysis did not show any association between BMI, central obesity, % fat mass and Gleason score. Although a Type II error cannot be ruled out, when data were examined by a multivariate analysis of variance adjusted for the small sample size, we did find a significant association between higher BMI, increased % body fat and aggressive Gleason scores, and all these variables worsened with age. Additionally, it is noteworthy that the majority of patients did not lose weight over the preceding year. It is tempting to speculate that the link between obesity and prostate cancer may be based on obesity related hormonal changes.[23] Excessive central adiposity has been associated with a 3-fold increased risk of prostate cancer and benign hypertrophy;[5,6] moreover serum leptin was higher among men with prostate cancer, and was associated with higher Gleason scores and more advanced tumours.[24-26] Obesity is associated with increased levels of insulin-like growth factor (IGF-1), which stimulates cell proliferation[27] and higher serum levels of IGF-1 seem to increase the risk of prostate cancer.[28] So, obesity *per se* may be less relevant than associated metabolic changes which may play a role in the progression to more aggressive cancer. Nevertheless, the role of BMI in prostate cancer risk is hard to judge due to the long latency period of the disease; the recorded history of BMI over decades prior to diagnosis might help to determine the real impact of BMI on prostate cancer risk.

Exposure to inadequate diets throughout life may influence prostate cancer progression due to the long pre-clinical stage.[1] The literature suggests various associations between dietary intake and risk of prostate cancer: increased intake of calcium and meat with increased risk, whilst high lycopene, vitamin E and selenium intake with a decreased risk.[14,29] Some support an association between saturated fat, red meat and dairy products with increased cancer risk, but results are not consistent.[10] Other studies show inverse associations between dietary intake of plant foods including cereals, fruits and vegetables and reduced prostate cancer risk,[30] others found no association.[31] In the current study, whilst not possible to quantitatively assess nutrients, the analysis of the frequency of food intake demonstrated a low consumption of vegetables, nuts, and selenium, lycopene and phytochemicals rich foods, which are consistent with an increased risk of prostate cancer. We also evaluated potential associations between diet and Gleason score; no association was found, though a positive correlation between tumour aggressiveness (Gleason score ≥ 7) and poor yogurt and vegetable intake was observed.

In conclusion, despite this study many limiting factors, e.g small patient cohort, food intake over the past year may not be indicative of their intake in former decades, we do however consider the results relevant, since this is the first study of nutritional variables among Portuguese men with prostate cancer, the most frequent cancer among men in Portugal. Our findings show an alarmingly high prevalence of excess body weight, body fat and the metabolically more active central obesity concomitantly with unbalanced diets poor in protective foods and nutrients. Furthermore, cancer rates in Portugal have increased by 17% in the 20 year period to 2003[32] and are not responding to European Health Promotion Initiatives in the same manner as other countries in the European Community. The World Cancer Research Fund have declared almost one third of cancers to be preventable through healthy diet and lifestyles.[1] Greater focus on prevention is essential for Health Systems to cope with the financial costs of an ageing population, mainly because prostate cancer predominantly affects men over 50. Future research should therefore focus not only on possible diet related risk factors for cancer, but also on how to encourage the adoption of protective diets and life styles by the general population which would concomitantly help to reduce obesity.

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