

Original Research

Impact of social and medical factors on routine clinical practice in prostate exams of asymptomatic males

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Abstract

Objectives: To examine routine clinical practice in prostate health exams in asymptomatic males, and to identify which factors influence it. **Materials and methods:** Multicentre cross-sectional study in 1068 asymptomatic men aged 51-72. Groups: GA (n = 518): urban areas; GB (n = 550): rural areas. GA subgroups: GA1 (n = 364): prostate specific antigen (PSA) measured; GA2 (n = 154): PSA not measured. GB subgroups: GB1 (n = 346): PSA measured; GB2 (n = 204): PSA not measured. Variables: age, body mass index (BMI), digital rectal examination (DRE), PSA, prostate diagnosis, eating habits, physical exercise, marital status, number of children, occupational status, working hours, concomitant diseases and conditions, family history, attending physician. Descriptive statistics, Student's *t*-test, chi-square test, Fisher's exact test, ANOVA, Pearson and Spearman correlations were used. **Results:** Mean age 62.3 years (standard deviation: SD 5.12). Age in GA (60.89, SD 5.53) was lower than in GB (65.10, SD 5.03); age was higher in GA1 (61.22, SD 5.49) than in GA2 (59.04, SD 5.37). There was no difference in BMI between GA and GB. DRE: No exams were performed without prior PSA. No DRE were performed in GA; 11 (3.18%) were performed in GB1. GA1: 53 had PSA > 4 ng/mL, of whom 28 had no prostate disease, 17 had benign prostatic hyperplasia (BPH) and 8 had prostate cancer (PCa). PCa prevalence in men with PSA > 4 ng/mL was 9.24% in GA and 5.19% in GB. GA1: higher PSA was correlated with lower BMI, lower age, higher occupational status, and morning shifts; lower PSA was correlated with higher BMI, lower age, higher occupational status, and morning shifts; lower PSA was correlated with higher alcohol consumption; older patients worked shifts and consumed more alcohol; men with higher occupational status consumed less alcohol; more men were married in GA1 (n = 343, [94.23%]) than in GA2 (n = 100, [64.93%]). In GA1, there were more non-smoking men (n = 291, [80.11%]) and men who

smoked < 5 cigarettes/day ($n = 23$, [6.37%]), 6-10 cigarettes/day ($n = 15$, [4.05%]), and 11.20 cigarettes/day ($n = 27$, [7.33%]) than in GA2. Older men and men with higher occupational status consumed fewer cigarettes. Men who worked rotating shifts smoked more. There was no relationship between smoking and PSA level. There were more university-educated men in GA ($n = 309$, [59.65%]) than in GB ($n = 110$, [20%]). More men did not take physical exercise in GA2 ($n = 49$, [31.81%]) than in GA1 ($n = 75$, [23.90%]). GB1: PSA > 4 ng/mL in 89 patients, of whom 32 had PCa; younger men had higher PSA. PSA was higher in GB1 (mean 18.95 ng/mL, SD 12.93) than in GA1 (mean 1.61, SD 1.63). Men in GB ate more fast food than GA, with no difference between GA1 and GA2, or between GB1 and GB2. In GA there was variability in approach among the attending physicians; in GB there was no variability among attending physicians. **Conclusions:** PSA tests are routinely given to 70.27% of asymptomatic men who consult a doctor in urban environments and to 62.09% of men in rural environments. In urban areas, the decision is affected by the preferences of the attending physician and by whether the patient is married. Occupational category, working hours and educational level have no impact. The decision to undergo a prostate health exam is associated with healthy habits such as physical exercise. No relationship was found between prostate disorders in asymptomatic men and high BMI, dyslipidemia or diet.

Keywords

PSA; Benign prostatic hyperplasia; Medical factors; PCa factors; Prostate cancer

1. Introduction

The three most frequent disorders of the prostate are acute and chronic prostatitis, benign prostate hyperplasia (BPH), and prostate cancer (PCa). These disorders affect up to half of males over the age of 50, with incidence increasing with age [1–3]. Prostate cancer is the second most commonly diagnosed cancer in men [4].

Although research has been carried out on multiple factors which might influence the progression of PCa (such as ageing, levels of steroid hormones, inflammation of the prostate, genetic predisposition, factors associated with metabolic syndrome, race and socioeconomic status, obesity, diabetes mellitus and hyperinsulinemia, cardiovascular disease and high blood pressure, diet and physical activity, tobacco, alcohol, occupational risk factors, biological factors, physical factors, emotional factors and occupational stress, and exposure to chemicals or electromagnetic radiation), there is currently no justification for systematic screening for prostate cancer [5].

This study seeks to understand routine clinical practice in healthcare exams given to asymptomatic men in our community.

The aim of this study was to examine the usual clinical practice in asymptomatic men in a standard Healthcare Area in Spain and to identify the factors that influence it.

2. Methods

Multicentre cross-sectional study of examinations of prostate health in asymptomatic men between 50 and 70 years of age.

Groups: GA ($n = 518$): hospital workers in an urban area, examined by Occupational Health physicians; GB ($n = 550$): men in a rural area, examined by Primary Care Specialists.

GA subgroups: GA1 ($n = 364$): PSA was measured; and

GA2 ($n = 154$): PSA was not measured.

GB subgroups: GB1 ($n = 346$): PSA was measured; and GB2 ($n = 204$): PSA was not measured.

Variables: age, body mass index (BMI), digital rectal examination (DRE), prostate-specific antigen (PSA), prostate diagnosis, eating habits, level of physical exercise, marital status, number of children, occupational status, work hours, concomitant diseases and conditions, family history, attending physician.

11 (3.18%) DRE were performed in GB1, of which 5 cases were normal and 6 cases suspected of malignancy.

PSA was measured in nanograms/millilitre. Levels of physical exercise was classified as: frequent/intense: 1, moderate: 2, infrequent/mild: 3, none: 4. Marital status was classified as: married, single, divorced, and "marital status not reported". Educational level was classified as: none, primary, secondary and university. Occupational status was coded according to current guidelines for social security contributions for common contingencies [6, 7]. Working hours: type of work schedule was ranked from most comfortable to harshest in morning: 1, afternoon: 2; duty shifts: 4 and rotating shifts: 5 [7]. The practitioners working in the Occupational Risk Prevention Service were coded as physicians "1", "2", and "3".

Statistical analysis

Data were analysed with the NSSS2006/GESS2007 automatic statistical calculator. Descriptive statistics, Student's *t*-test, chi-square test, Fisher's exact test, ANOVA (Scheffe's test for normal samples and Kruskal-Wallis for other distributions), Pearson and Spearman correlation. Statistical significance was accepted for $P < 0.05$.

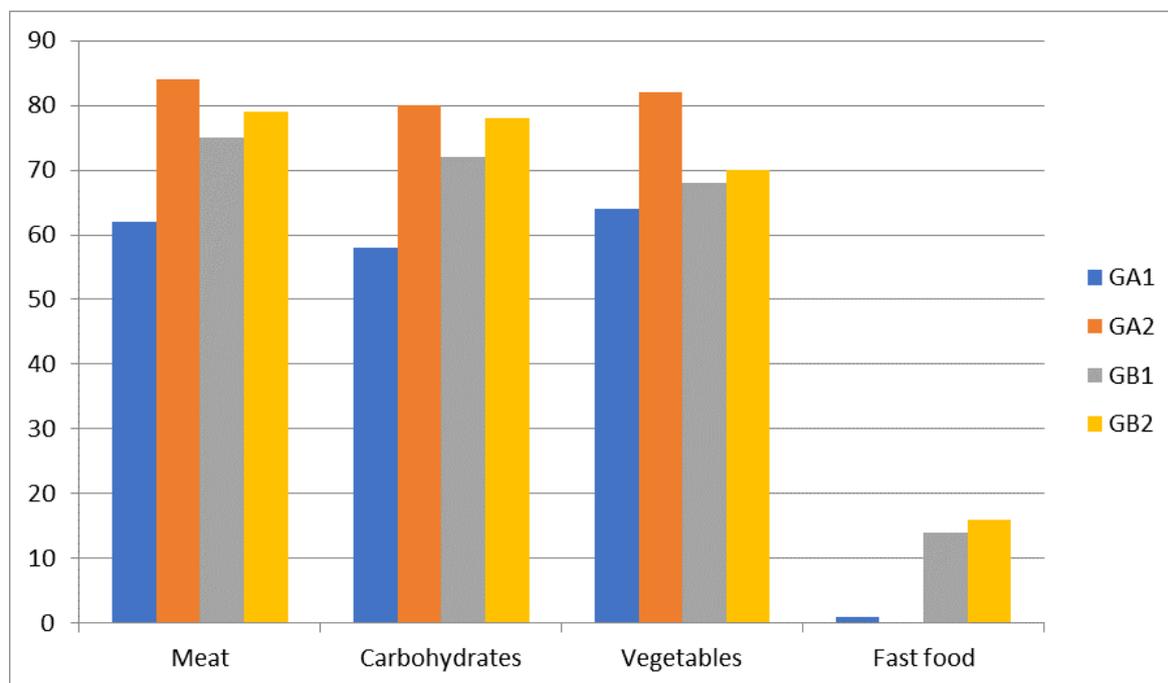


FIG. 1. Preferred foods consumed by asymptomatic individuals in which prostate health is investigated. GA1: with determination of PSA in an urban environment; GA2: no PSA determination in an urban environment; GB1: with determination of PSA in rural areas; GB2: without PSA determination in rural areas.

3. Results

Mean age was 62.3 years, SD 5.12. Age in GA was lower (mean 60.89, SD 5.53) than in GB (mean 65.10 years, SD 5.03) ($P = 0.003$); age was higher in GA1 (mean 61.22, SD 5.49) than in GA2 (mean 59.04 years, SD 5.37) ($P = 0.003$). There was no difference in age between GB1 (mean 66.08, SD 4.23) and GB2 (mean 64.99, SD 5.12) ($P = 0.520$).

There was no difference in mean body mass index (BMI) between GA (mean 27.39, SD 3.50) and GB (mean 26.41, SD 5.12) ($P = 0.412$).

There was no difference in BMI between GA1 (mean 27.44, SD 3.75) and GA2 (mean 27.27, SD 3.24) ($P = 0.729$). In GA1, BMI increased slightly in older patients (slope 0.0957, correlation 0.0595, coefficient of variation 0.0924). There was no difference in BMI between GB1 (mean 25.12, SD 4.02) and GB2 (mean 26.58, SD 4.76) ($P = 0.501$).

In 11 cases (3.18%) DRE were performed in GB1, of which 5 cases were normal and 6 cases suspected of malignancy.

3.1 Prostate-specific antigen (PSA) and outcome of prostate exam

In GA, PSA was investigated in 364 patients (70.27% of cases). 53 patients had PSA above 4 ng/mL, of whom 28 had no prostate disease, 17 were diagnosed with benign prostatic hyperplasia (BPH) and 8 were diagnosed with prostate cancer (PCa). 27 biopsies were carried out in these 53 men.

In GA1 mean PSA was 1.61, SD 1.63. In GA1, older patients had higher PSA (slope 1.0575, correlation 0.2861, coefficient of variation 0.1013); lower weight correlated with higher PSA (slope -0.0164, correlation -0.1142, coefficient of variation 1.0099); lower BMI correlated with higher PSA

(slope -0.0308, correlation -0.0647, coefficient of variation 1.0140); higher alcohol consumption correlated with lower PSA (slope -0.0021, correlation -0.0804, coefficient of variation 1.0147).

There was no relationship between PSA and level of physical exercise (slope -0.0388, correlation -0.0196, coefficient of variation 1.0160).

In GB, PSA was investigated in 346 patients (62.90% of cases). 89 patients had PSA > 4 ng/mL. 75 patients were biopsied. 32 patients had PCa. In GB1, younger men had lower PSA, both when the case with 122 ng/mL PSA was excluded (slope -0.3012, correlation -0.5120, coefficient of variation 0.0310) and included (slope -0.0730, correlation -0.5675).

The prevalence of PCa in men with PSA > 4 ng/mL was 9.24% in GA and 5.19% in GB.

Excluding a 57-year-old GB patient with a PSA of 122 ng/mL, PSA level was higher in GB1 (mean 6.07 ng/mL, SD 3.39) than in GA1 (mean 1.61, SD 1.63) ($P = 0.001$).

The predominant eating habits were 775 (72.56%) meat, 742 (69.47%) carbohydrates, 735 (68.82%) vegetables and 84 (7.86%) fast food. Men in GB ate more fast food than in GA ($P = 0.002$). There were no differences between GA1 and GA2 ($P = 0.4516$), nor between GB1 and GB2 ($P = 0.719$) (Fig. 1).

In GA, intense exercise ($n = 24$, [4.63%]), moderate ($n = 141$, [27.22%]) and no exercise ($n = 124$, [23.93%]) were more frequent than in GB (intense: $n = 5$, [0.90%], moderate: $n = 48$, [8.72%], none: $n = 41$, [7.45%]) ($P = 0.001$). Mild exercise was most frequent in both groups, with no differences (GA: $n = 229$, [44.20%], GB: $n = 224$, [40.72%]) ($P = 0.2650$). More men reported no physical exercise in GA2 ($n = 49$, [31.81%]) than in GA1 ($n = 75$, [23.90%]) ($P = 0.004$). There were

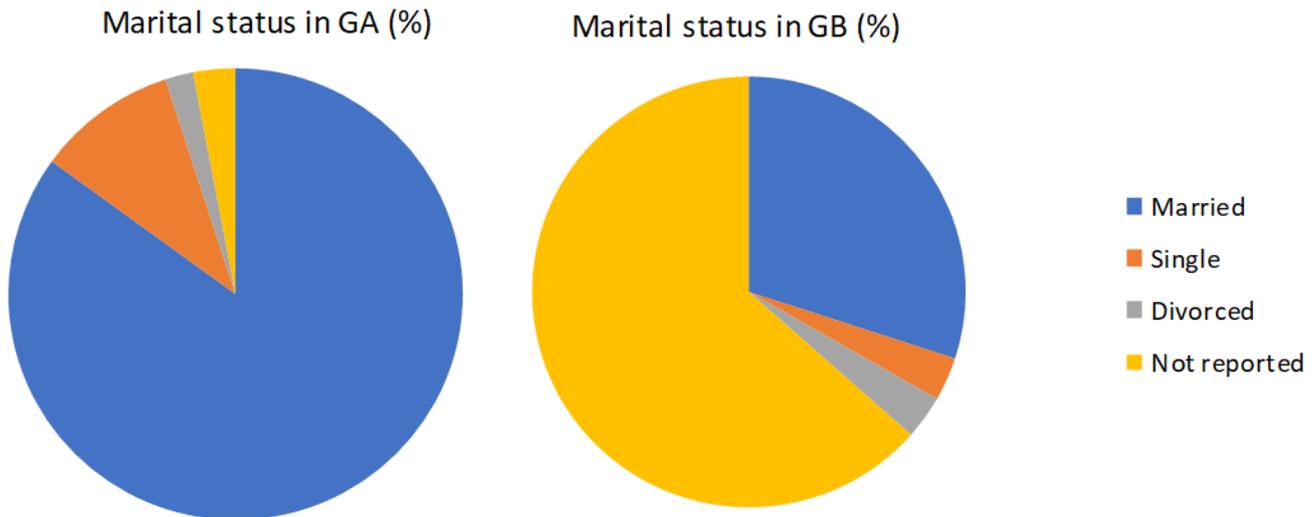


FIG. 2. Civil status of asymptomatic men who were given a prostate health exam. GA: in urban areas; GB: in rural areas.

no differences between GB1 (no physical exercise $n = 26$, [7.51%]) and GB2 (no physical exercise $n = 15$, [7.35%]) ($P = 1.000$).

In GA there were more married men ($n = 443$, [85.52%]) and more single men ($n = 52$, [10.03%]) than in GB (married $n = 165$, [30%]; single $n = 18$, [3.27%]). Marital status not reported was most common in GB ($n = 349$, [63.45%]) than in GA ($n = 15$; [2.89%]), ($P = 0.001$) (Fig. 2). There was no difference in divorced between GA ($n = 8$, [1.54%]) and GB ($n = 18$, [3.27%]) ($P = 0.075$).

There were more married men in GA1 ($n = 343$, [94.23%]) than in GA2 ($n = 100$, [64.93%]) ($P = 0.001$), and more single men in GA2 ($n = 40$, [25.97%]) than in GA1 ($n = 12$, [3.29%]) ($P = 0.001$). There were no differences in married status between GB1 ($n = 95$, [27.45%]) and GB2 ($n = 70$, [34.31%]) ($P = 0.101$), nor single between GB1 ($n = 12$, [3.46%]) and GB2 ($n = 6$, [2.94%]) ($P = 0.097$).

Median number of children was higher in GB1 (median 3, range 0-5) than in GA1 (median 2, range 0-5), GA2 (median 2, range 0-4) and GB2 (median 2 range 0-4) ($P = 0.021$).

3.2 Educational level

More men had a university education in GA ($n = 309$, [59.65%]) than in GB ($n = 110$, [20%]) ($P = 0.001$). More men in GB had a primary-level education ($n = 249$, [45.27%]) or secondary-level education ($n = 161$, [29.27%]) than in GA (primary: $n = 84$, [16.26%], secondary: $n = 102$, [19.69%]) ($P = 0.003$). There were no differences in educational level between GA1 and GA2 ($P = 0.098$) or between GB1 and GB2 ($P = 0.153$) (Fig. 3).

3.3 Occupational status

In GA occupational status was: 69 labourers (13.32%); 83 hospital porters (16.02%); 26 hospital supply workers, boiler maintenance workers, photographers, technicians, nurse's aides, or management (5.01%); 48 secretaries, computer technicians, clinical research associates (9.26%);

51 nurses (9.84%); 25 non-attending physicians (4.82%); 161 consultants or attending physicians (31.08%); 25 heads of section (4.82%); 30 heads of department (5.79%).

In GB occupational status was: 69 retired labourers (12.54%), 31 labourers (5.63%), 180 retired farm workers (32.72%), 70 farm workers (12.72%), 31 retired administration workers (5.63%), 39 administration workers (7.09%), 32 retired private sector workers (5.81%), 48 private sector workers (8.72%), 30 retired foremen (5.45%), 20 foremen (3.63%) (Fig. 4).

Occupations in GA and GB were not comparable. Medical specialists predominated in GA ($n = 161$, [31.08%]), while retired farmers predominated in GB ($n = 180$, [32.72%]) (Fig. 4).

There was no difference in occupational category between GA1 (median 5, range 1-9) and GA2 (median 5, range 1-9) ($P = 0.860$), nor between GB1 (median 6, range 1-9) and GB2 (median 6, range 1-9) ($P = 0.571$).

In GA1, men with higher occupational status had higher PSA (slope 0.2648, correlation 0.1688, coefficient of variation 0.5242). In GB1 there was no relationship between occupational status and PSA ($P = 0.981$).

In GA1, younger men had higher occupational status (slope -0.1732, correlation -0.3728, coefficient of variation 0.4919).

In GA1, BMI was slightly higher in men with lower occupational status (slope -0.0134, correlation -0.0208, coefficient of variation 0.4337).

3.4 Working hours: type of work schedule

There was no difference in working hours between GA1 (median 1, range 1-6) and GA2 (median 1, range 1-5) ($P = 0.603$). There was no difference in working hours between GB1 (median 1, range 1-6) and GB2 (median 1, range 1-6). Morning or afternoon shifts were more common in GB (100%) than in GA (58.45%), where on-call (4.54%) and rotating shifts (37.01%) were more frequent ($P = 0.008$).

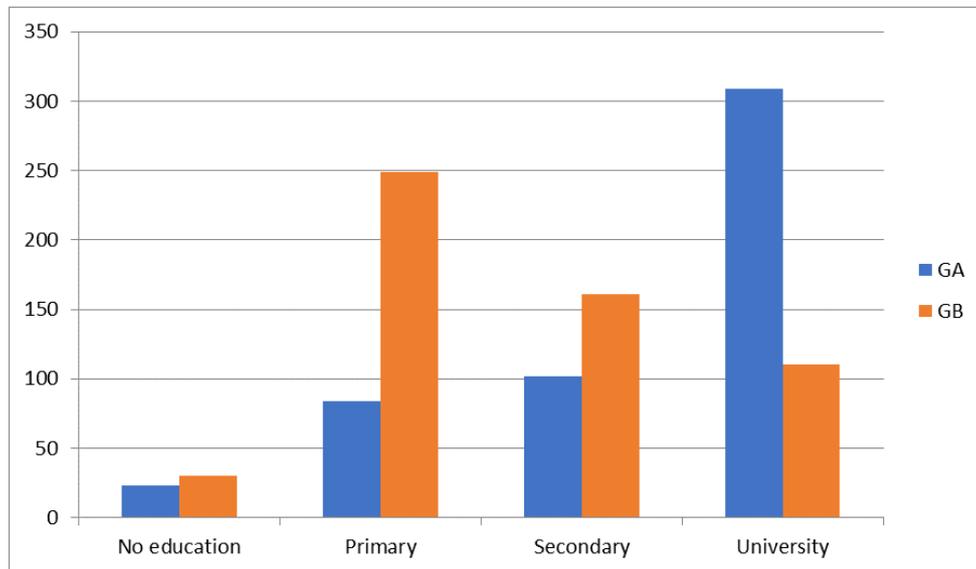


FIG. 3. Educational level in asymptomatic men who were given a prostate health exam. GA: in urban areas; GB: in rural areas.

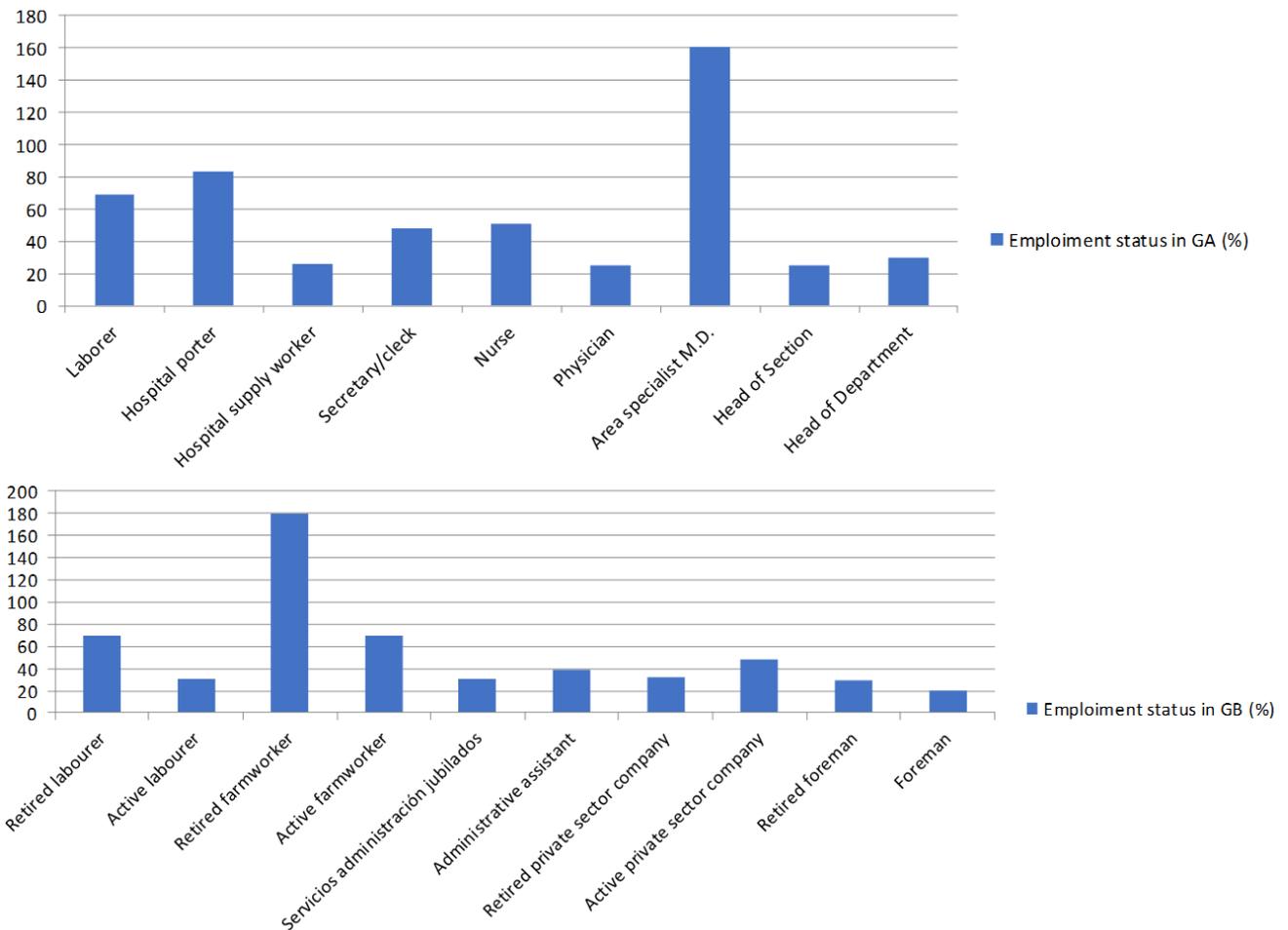


FIG. 4. Occupational status of asymptomatic men given prostate health exams. GA: urban areas; GB: rural areas

In GA1, men with morning shifts had higher PSA levels (slope -0.1613, correlation -0.1422, coefficient of variation 0.7016). This finding was related to the fact that in GA1, morning shifts are more frequent in older men, while in younger men afternoon or rotating shifts are more frequent

(slope -1.1680, correlation -0.3915, coefficient of variation 0.0852).

3.4.1 Concomitant diseases and health conditions

In GA1 there was more dyslipidemia ($n = 49$, [13.51%]), high blood pressure ($n = 78$, [21.42%]) and obesity ($n = 136$, [37.45%]), and fewer cases of diabetes mellitus (DM) ($n = 21$; [5.79%]) and osteoarticular disorder ($n = 44$, [11.96%]) in comparison to GA2 (dyslipidemia: $n = 0$, high blood pressure (HBP): $n = 0$, obesity: $n = 4$, [2.59%], DM: $n = 18$, [11.68%], osteoarticular disorder: $n = 42$, [27.27%]) ($P = 0.001$).

There was no difference in the number of patients with dyslipidemia between GB1 ($n = 150$, [43.35%]) and GB2 ($n = 95$, [46.56%]) ($P = 0.478$), high blood pressure between GB1 ($n = 67$, [19.36%]) and GB2 ($n = 44$, [21.56%]) ($P = 0.582$), obesity between GB1 ($n = 121$, [34.97%]) and GB2 ($n = 73$ [35.78%]) ($P = 0.853$), DM between GB1 ($n = 17$, [4.91%]) and GB2 ($n = 13$, [6.37%]) ($P = 0.560$), and osteoarticular disorder between GB1 ($n = 37$, [10.69%]) and GB2 ($n = 25$, [12.25%]) ($P = 0.579$).

In GA1, younger men had fewer concomitant diseases (slope -0.6981, correlation: -0.1036, coefficient of variation: 0.0921). The same relationship was found in GB1: (slope -0.5713, correlation: -0.0997, coefficient of variation: 0.0839).

In GA1, a mean 46.33 grams of alcohol were consumed per week, SD 58.60. In GA1, individuals with morning shifts consumed more alcohol (slope -0.0013, correlation -0.0442, coefficient of variation 0.7101). In GA1 older men consumed more alcohol (slope 0.0094, correlation 0.1055). In GA1, men with higher occupational status consumed slightly less alcohol (slope -1.2425, correlation -0.0537). In GA1, men who consumed higher quantities of alcohol had slightly lower PSA (slope -0.0020, correlation -0.0736, coefficient of variation 1.0150).

In GA2, a mean 45.71 (SD 69.81) grams of alcohol were consumed per week.

There was no difference in alcohol consumption between GB1 and GB2 ($P = 0.319$).

3.4.2 Cigarette smoking

Men in GA1 smoked a mean of 2.46 (SD 6.34) cigarettes per day. Older men smoked fewer cigarettes (slope -0.0452, correlation -0.0517); men with higher occupational status smoked fewer cigarettes (slope -0.2841, correlation -0.1147); there was a very slight trend for increased cigarette consumption in men with rotating shifts (slope 0.1463, correlation 0.0427). There was no relationship between cigarette smoking and PSA in GA1 (slope -0.0060, correlation -0.0232, coefficient of variation 1.0190).

Men in GA2 smoked a mean of 3.25 (SD 6.60) cigarettes per day. Older men smoked more cigarettes (slope +0.0612, correlation +0.0712); men with higher occupational status smoked fewer cigarettes (slope -0.1903, correlation -0.0978); there was a trend for increased cigarette consumption in men with rotating shifts (slope 0.1802, correlation 0.0518).

There was no difference in non-smoking status between GA1 ($n = 291$, [80.11%]) and GA2 ($n = 124$, [80.51%]) ($P = 1.000$); < 5 cigarettes per day between GA1 ($n = 23$, [6.37%]) and GA2 ($n = 10$, [6.49%]) ($P = 1.000$); 6-10 cigarettes per day between GA1 ($n = 15$, [4.05%]) and GA2 ($n = 6$, [3.89%])

($P = 1.000$); 11-20 cigarettes per day between GA1 ($n = 27$, [7.33%]) and GA2 ($n = 11$, [7.14%]) ($P = 1.000$); nor in the number of men smoking more than 20 cigarettes per day between GA1 ($n = 8$, [2.12%]) and GA2 ($n = 3$, [1.94%]) ($P = 1.000$).

Men in GB1 smoked a mean of 2.01 (SD 5.06) cigarettes per day. Older men smoked fewer cigarettes (slope -0.0601, correlation -0.0410); men with higher occupational status smoked more cigarettes (slope +0.1987, correlation +0.0997); there was a very slight trend for increased cigarette consumption in labourers (slope 0.0955, correlation 0.0350). There was no relationship between cigarette smoking and PSA in GB1 (slope -0.0180, correlation -0.0197, coefficient of variation 0.8874).

Men in GB2 smoked a mean of 3.06 (SD 5.32) cigarettes per day. Older men smoked fewer cigarettes (slope -0.0579, correlation -0.0688); men with higher occupational status smoked more cigarettes (slope +0.1785, correlation +0.0887); a trend for increased cigarette consumption in men with rotating shifts was not found (slope 0.00001, correlation 0.000001).

There was no difference in non-smoking status between GB1 ($n = 130$, [37.57%]) and GB2 ($n = 72$, [35.29%]) ($P = 0.647$); < 5 cigarettes per day between GB1 ($n = 114$, [32.94%]) and GB2 ($n = 70$, [34.31%]) ($P = 0.779$); 6-10 cigarettes per day between GB1 ($n = 95$, [27.45%]) and GB2 ($n = 46$, [22.54%]) ($P = 0.225$); 11-20 cigarettes per day between GB1 ($n = 24$, [6.93%]) and GB2 ($n = 14$, [6.86%]) ($P = 1.000$); nor in the number of men smoking more than 20 cigarettes per day between GB1 ($n = 53$, [15.31%]) and GB2 ($n = 32$, [15.68%]) ($P = 0.903$).

Concomitant diseases and conditions in asymptomatic individuals given prostate exams are shown in Table 1. Family history of BPH was found in 8 patients (1.54%) in GA and in 25 patients (4.54%) in GB ($P = 0.007$). Family history of prostate cancer was found in 30 patients (5.79%) in GA and in 38 patients (6.90%) in GB ($P = 0.531$).

3.4.3 Health centre and attending practitioner

There were differences in prostate health investigation between the practitioners working in the Occupational Risk Prevention Service: Physician "1": always requests serum PSA test. Physician "2": never requests serum PSA test. Physician "3": requests serum PSA test according to family history and patient age ($P = 0.001$).

There were no differences in prostate health investigation between the physicians who examined the patients in GB ($P = 0.201$).

4. Discussion

Much controversy currently surrounds the practice of prostate health exams, from experts who advise against systematic screening [3] to healthcare events which saturate the system, such as the current COVID pandemic, and thus restrict routine care.

Our study found that men in rural areas had more family history of BPH or cancer when compared to individuals from

TABLE 1. Concomitant diseases and conditions in asymptomatic individuals given prostate exams.

Concomitant diseases and conditions	Group				Significance <i>P</i>	
	GA n = 518	%	GB n = 550	%		
Allergy	5	0.96	91	16.54	0.0001	
Dyslipidemia	70	13.51	245	44.54	0.0001	
DM	30	5.79	73	13.27	0.0001	
HBP	111	21.42	132	24	0.3426	
Obesity	194	37.45	99	18	0.0001	
Cardiovascular disease	18	3.47	193	35.09	0.0001	
Osteoarticular disorder	62	11.96	224	40.72	0.0001	
Respiratory disorder	36	6.94	182	33.09	0.0001	
	Zero	124	23.93	180	32.72	0.0018
	≤ 20	210	40.54	75	13.63	0.0001
Alcohol consumption (g/week)	21-80	90	17.37	93	16.90	0.8711
	81-200	71	13.70	118	21.45	0.0010
	> 200	23	4.44	84	15.27	0.0001
Smoking	Zero	415	80.11	202	36.72	0.0001
(cigarettes/day)	< 5	33	6.37	184	33.45	0.0001
	6-10	21	4.05	141	25.63	0.0001
	11-20	38	7.33	38	6.90	0.8126
	> 20	11	2.12	85	15.45	0.0001
	Father with BPH	3	0.57	8	1.45	0.5807
	Father underwent surgery for BPH	3	0.57	10	1.81	0.3012
	Brother underwent surgery for BPH	2	0.38	7	1.27	0.1796
	Father with prostate cancer	25	4.82	30	5.45	0.6794
Family history	Brother with prostate cancer	5	0.96	7	1.27	0.7744
	Paternal grandfather with prostate cancer	2	0.38	1	0.18	0.6137
	None	198	38.22	278	50.54	0.0001
	Unknown	334	64.47	209	38	0.0001

Concomitant diseases and conditions in asymptomatic individuals given prostate exams. GA: individuals from urban areas; GB: individuals from rural areas. DM: diabetes mellitus, HBP: high blood pressure. BPH: benign prostatic hyperplasia.

urban areas. This is a very novel finding of our study, since so far it is only known that the hereditary BPH is responsible for 9% of surgically-treated BPH in men over sixty, and for 50% of surgically-treated BPH in men under sixty [8]. Therefore, so far, this is the first information on the influence of heredity in the development of prostate pathology considering the factor of rural or urban environment.

Our study found more obesity in urban areas (37.45%) than in rural areas (18%), while dyslipidemia was diagnosed more commonly in rural areas (44.54%) than in urban areas (13.51%). These results may reflect the finding that, although in general individuals of urban and rural areas have similar eating habits in our study, there were more men who eat fast food in rural areas. This agrees with the fact that the consumption of unsaturated fats is related to the suffering of dyslipidemia [9].

In urban areas, BMI was higher in individuals with lower occupational status. There was no association between obesity and prostate conditions, whether benign or malignant. This contrasts with what was reported by other authors, who found that controlling obesity and avoiding a sedentary lifestyle and high-calorie diets may delay the progress of BPH [10, 11].

Moderate levels of physical exercise predominated in our study, which is logical if one considers that the patients are

men over 50 who either work in a hospital or live in rural areas. Conditions were more favourable in rural areas, where there was no difference between GB1 and GB2. Sedentary lifestyles (no physical exercise) are more common in men from urban areas whose PSA is not measured (GA2). In general, active lifestyles are recommended, because a sedentary lifestyle, which affects pelvic floor function, may aggravate symptoms in the lower urinary tract [11]. Our study points to the hypothesis that men who have less physical activity, those who have a less active life, do not bother to test the PSA to know the state of their prostate. Which is new information provided by our study.

Intensive tobacco use, at over 20 cigarettes per day, was more prevalent in rural areas. 36% of men in rural areas and in 80% of men in urban areas were non-smokers, in line with the trend towards decreasing tobacco use in developed countries, while in less developed countries tobacco use is increasing. In men given PSA test, older individuals smoked fewer cigarettes. This may be connected to increased care or vigilance in matters of general health. Men with higher occupational status also smoked less, which might also be related to increased vigilance of prostate health. There was a trend towards increased tobacco use in men who work rotating shifts; this may be related to occupational stress.

In relation to other published studies with conflicting find-

ings: smoking has been found to both protect from [12–14] and favour [15] the appearance of BPH, in our study we found no relationship between cigarette consumption and PSA level. This is a very topical finding and is contrary to a recent publication that maintains that cigarette smoking is associated with a higher PSA [16].

We have found that in urban areas, moderate alcohol consumption (< 20 g per day) is most frequent than in rural area. Men who work morning shifts, aged, or who have a lower occupational status, consume more alcohol in urban area. This contrasts with tobacco consumption, which is more closely linked with rotating shifts. Alcohol is associated to social life, and morning working hours favour social drinking. Alcohol consumption was lower in rural areas than in urban areas, with no differences between men where PSA was monitored and those where it was not.

While some studies have found an inverse relationship between risk of BPH and alcohol consumption [13–15, 17, 18] other have found no relationship [12]. Our study shows lower PSA levels in alcohol consumers from urban environment. Therefore, it is the first relationship found between alcohol consumption, PSA level, and the individual's urban or rural environment, which is a new finding.

By using stratified analysis was used to eliminate bias from correlation between age and occupational status, we found that younger men had both higher occupational status and higher PSA. Additionally, occupational status was not correlated with the decision to test PSA. In rural area, no relationship was found between PSA level and occupational status, being PSA levels higher in men who work morning shifts. Other authors have investigated the relationship between working conditions **and** the risk of suffering BPH requiring surgery [19]. In our study, urban men worked in a hospital without risk factors for developing BPH or prostate cancer. In rural area, risk exposure to polycyclic hydrocarbons, pesticides or fertilizers was not associated with more prostate pathology, these findings being in line with those of other authors [19].

4.1 Diagnosis of prostate disease

Taking into account that all the patients were asymptomatic, the physicians took into account the PSA threshold value of 4 ng/mL to consider it normal or pathological, according to the usual clinical practice in our environment [20].

Both in rural and in urban areas, PSA level increases with age, which agrees with what has been published by other authors [21]. In our study, men from rural areas had higher PSA comparing with men of urban area, which is a new finding since there are no studies that compare PSA levels in men who live in rural area compared to men who live in urban area in our environment. In urban area, men whose PSA was not measured had more rotating and duty shifts than men whose PSA was measured, who had more morning shifts. This data indicates that men with working hours in rotating shifts take less care of themselves, a detail evidenced in the non-determination of PSA to know the status of their prostate. In urban areas, higher PSA levels correlated with

morning shifts in older men, with a higher occupational status in younger men. All the subjects in our study were men over 50 years of age, that is, susceptible to prostate cancer. Therefore, this is a significant finding and innovative information that appears in the results of our study, because until now, the relationship between the level of PSA and the type of working hours of men in our environment has been unknown until now.

On the other hand, according with the existing literature [22], our study found that in urban areas, higher BMI correlates with lower PSA.

Among the attending physicians, those in a rural environment showed no difference in tendency to order PSA tests, while in the urban environment three physicians with different behaviours: one always requests a PSA determination, another never did request and the third physician requests the PSA according to family history and age. It's known that the variation in general practitioner PSA testing practices is strongly related to their approach to overdiagnosis and underdiagnosis of prostate cancer. Men receive very different care depending on their general practitioner's reasoning and practice preferences [23]. Our study has the novelty that it is the first time that the practice of medical doctors specialists in occupational hazards has been investigated, since until now it had only been investigated in general practitioners.

Previous research in our setting found no differences between in digital rectal examination (DRE) in patients with PSA < 4 ng/mL or > 4 ng/mL. DRE had a positive predictive value of 62%, negative predictive value of 71%, sensibility of 43%, and specificity of 84%. We therefore often begin testing for prostate cancer when PSA is elevated [24]. This could be one of the reasons for the low practice of DRE in rural areas by general practitioners in our study. Medical doctors specialist in occupational risk do not perform DRE, as they consider it an invasive examination. There are no published data on the prevalence of the practice of DRE as part of the routine health examination carried out by medical doctors specialists in occupational hazards. Therefore, our study is the first investigation into the role of the DRE in the health examination by medical doctors specialists in occupational hazards.

Other authors have found that digital rectal examinations (DRE) have low sensitivity and high specificity (approximately 82%) with a positive predictive value of 6%–39% when used in prostate cancer screening programs [25, 26]. When diagnosing organ-confined disease, DRE has a sensitivity of only 50%, lower in patients with low PSA. Because of this, DRE cannot detect the clinical stage with precision, and should not be the sole tool for diagnosis and staging [27].

4.2 Analysis of prostate health monitoring

Our study found that PSA was measured in 70.27% of men in urban areas and in 62.90% of men in rural areas, while DRE was performed more rarely as its low sensitivity is known [24]. The decision to measure PSA did not correlate with the patient's family or personal medical history, but did correlate with the of the attending physician.

Early disease detection may be defined as the clinical examination of asymptomatic patients with the aim of distinguishing between healthy patients and those affected by a particular disease [28]. Early detection techniques are also known as screening.

Before determining PSA, patient and physician must agree as to whether early detection will in fact reduce morbidity and mortality, since the aim of a test is not merely to increase the number of diagnosed cases [29, 30].

There is consensus that a combination of DRE and PSA testing allows early detection of prostate disease [31]. Without clinical trials that support systematic screening for prostate cancer, routine early diagnosis may be justified by the advances in treatment of localised prostate cancer, reduction of negative effects, and increased quality of life. We should also not forget the great expenses incurred by patients and society during treatment for advanced prostate cancer [32], in addition to the condition's high mortality and decreased quality of life [33]. Our study had the objective of knowing the spontaneous habitual practice of the different doctors in different areas (rural and urban) on how they approach the investigation of prostate health in asymptomatic men. Our study was not an exhaustive screening of prostate diagnoses in all men, therefore DRE and PSA were not mandatory in all men.

The prevalence of prostate cancers refers to the prevalence in patients with pathological PSA, not in the entire group. It is a weakness of the study that we do not know the real situation of the prostate in asymptomatic individuals with normal PSA values or in those in whom PSA was not determined. The objective of the study is not to know the state of the prostate. The objective of the study is to know the behavior of general practitioners and medical doctor specialists on occupational risk regarding the state of the prostate in asymptomatic men.

Sexual function is a very important variable that may influence men's quality of life. However, this study focused only on the management of general practitioners and medical doctors specialists in occupational hazards regarding the investigation of prostate pathology in asymptomatic men. This is due to the fact that in totally asymptomatic men from the urological point of view, they are not usually investigated about sexual health, neither by general practitioners nor by medical doctors specialists in occupational risk.

Two other important prostate disorders are prostatitis and irritative and obstructive lower urinary tract symptoms. These disorders are not the object of our study as it was performed in asymptomatic men.

Studies on Primary Care do not justify a protocol for PSA testing in Occupational Health [33]. Our study is novel because it describes the medical examinations and results of prostate cancer screening in an Occupational Health Centre, in asymptomatic men from an urban environment.

There are studies about prostate diseases conducted by general practitioners or urologists. A strong point of our study has the great novelty of investigating how medical doctors specializing in occupational hazards study prostate status in asymptomatic men, and this had not been investi-

gated until now. The individuals in the urban area were all hospital workers. If a GA individual suffers from prostate cancer, they would lose days of work, quality of life, and could even lose their life. For this reason, our study wanted to know how medical doctors specializing in occupational risks studied the prostate status. This is the biggest contribution of our research.

5. Conclusions

PSA tests are routinely given to 70.27% of asymptomatic men who consult a doctor in urban environments and to 62.09% of men in rural environments.

In urban areas, the decision is affected by the preferences of the attending physician and by whether the patient is married. Occupational category, working hours and educational level have no impact.

In both rural and urban areas, the decision to undergo a prostate health exam is associated with healthy habits such as physical exercise. No relationship was found between prostate disorders in asymptomatic men and high BMI, dyslipidemia or diet.

Abbreviations

APFIEQ-CyL, Association for the Promotion of Training and Research in Surgical Specialties in Castilla y León; BMI, body mass index; BPH, benign prostatic hyperplasia; DM, diabetes mellitus; DRE, digital rectal examination; HBP, high blood pressure; PCa, prostate cancer; PSA, prostate specific antigen

Author contributions

Conceptualization, M.F.L.G and M.B.G.C.; Methodology, MFLG.; Software, M.J.G.P; Validation, J.A.M.C; Formal Analysis, M.M.S; Investigation, J.L.B.G, M.P.T and A.G.P; Resources, B.P.F; Data Curation, M.M.S and M.F.L.G; Writing – Original Draft Preparation, JFF; Writing – Review & Editing, J.F.F and M.C.F.F.; Visualization, J.F.F; Supervision, M.F.L.G; Project Administration, S.V.M.

Acknowledgements

The authors are grateful for the collaboration of the men participating in the study, the University of Salamanca, the Castilla y León Health System (Sacyl), and the Salamanca Biomedical Research Institute (IBSAL) for the possibility of developing this study.

Funding

The study was financed by the Association for the Promotion of Training and Research in Surgical Specialties in Castilla y León (APFIEQ-CyL), Salamanca 37007 Spain. Funding for the study was provided by the Urological Renal Multidisciplinary Research Group (GRUMUR, *Grupo de Investigación Multidisciplinar Urológico Renal*) of the Salamanca Biosanitary

Research Institute (IBSAL, *Instituto de Investigación Biosanitaria de Salamanca*).

Ethical considerations

The study protocol with code 2015/230/43 was approved by the Drug Research Ethics Committee of the Healthcare Area of Ávila, Spain. All patients who participated in the reviewed trials provided informed consent

Conflict of interest

The authors have no conflicts of interest to report.

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