Middle-East Journal of
Non-Communicable Diseases
ISSN: 3115-929X

2026, Volume 1, Number 1

Research Paper

Population-based screening of prostate cancer among low-income men in north of Iran, Guilan

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Article info:
Received: 22 Nov 2025
Accepted: 23 Jan 2026

Keywords:
Prostatic neoplasms
Prostate-specific antigen
Digital rectal examination
Risk factors

ABSTRACT

Background: Prostate cancer (PC) is a leading cause of morbidity and mortality among men worldwide, with growing incidence in low- and middle-income countries. Data on population-based screening in economically disadvantaged groups in Iran remain scarce. This study evaluated the prevalence of abnormal prostate-specific antigen (PSA) levels, digital rectal examination (DRE) findings, and associated risk factors among low-income men in northern Iran.

Method: A cross-sectional study was conducted on 300 men enrolled through the patronage of a local relief foundation in Guilan Province, Iran. Eligibility was based on age and family history of PC. Data on sociodemographic characteristics, lifestyle factors, and urinary symptoms were collected via structured questionnaire. All participants underwent DRE performed by a urologist and serum PSA testing. Abnormal PSA was defined as >3 ng/mL. Statistical analyses were performed using chi-square test and one-way ANOVA.

Results: The mean age of participants was 63.7 ± 8.8 years, with 61.7% aged ≥60 years. Abnormal PSA was detected in 15.0% of men, while 54.0% presented with abnormal DRE findings. The most frequent urinary symptoms were nocturia and poor or interrupted urine flow (43.0% each). Older age and family history of PC in first-degree relatives were significantly associated with abnormal PSA and DRE abnormalities ($p<0.05$), whereas other sociodemographic and lifestyle factors showed no significant associations ($p>0.05$).

Conclusion: A substantial burden of prostate abnormalities was observed among low-income men in northern Iran. These findings highlight the importance of targeted, resource-sensitive screening strategies to reduce disparities in prostate cancer detection and outcomes.

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https://doi.org/10.61882/MEJNCD.1.1.7

1. Introduction

Prostate cancer (PC) is a major and growing public-health problem worldwide. In 2022 an estimated 1,467,854 new PC cases were diagnosed globally, representing 7.3% of all new cancer cases and making PC one of the most frequently diagnosed malignancies in men [1,2]. The worldwide burden of PC has been rising in part because of population ageing and improved detection, and it remains a leading cause of cancer morbidity and mortality in men [3,4]. Epidemiological patterns in Iran reflect this global trend but also show important regional variation. According to GLOBOCAN 2022, PC ranked among the top five cancers in Iran with 9,793 new cases in 2022, accounting for a substantial proportion of male cancers in the country [1,5].

National and subnational analyses have documented increasing incidence rates over recent decades and a non-negligible age-standardized incidence in Iran, with systematic reviews reporting age-standardized rates on the order of ~9 per 100,000 (depending on methodology and period), underscoring the growing public-health relevance [6,7].

Early detection of clinically significant PC remains complex and controversial. PSA-based screening can detect PC earlier but also leads to overdiagnosis and overtreatment; major guideline bodies consequently recommend individualized decision making and risk-stratified approaches rather than universal population screening [8]. The recent guidance emphasizes shared decision making for prostate-specific antigen (PSA) testing. Preventive Services Task Force recommends age-stratified, individualized approaches to PSA screening [9,10].

Socioeconomic factors profoundly affect PC detection, stage at diagnosis, and outcomes. Men with lower socioeconomic status are less likely to undergo PSA testing and diagnostic follow-up, present with more advanced disease, and experience higher PC-specific mortality in many settings. Organized, population-based screening programmes can reduce socioeconomic inequities in early detection where access and follow-up are reliably provided; however, evidence from lower-resource settings is limited [11,12].

Guilan Province in northern Iran includes substantial low-income and underserved populations for whom access to urological care and opportunistic PSA testing may be limited. Low income and limited health literacy contribute to lower screening uptake and delayed presentation, conditions underlined by regional studies showing socioeconomic gradients in cancer detection and outcome across Iran and comparable settings. Targeted, population-based screening initiatives among low-income men may therefore identify otherwise undiagnosed disease, enable timely referral, and provide data essential for designing equitable early-detection strategies adapted to the local health system [5,11].

Given the global burden of PC, the rising incidence in Iran, and the well-documented socioeconomic barriers to early detection, we conducted a population-based screening study focused on low-income men in Guilan. This study addresses a critical evidence gap by evaluating the frequency of abnormal PSA and abnormal rectal findings, describing clinical symptoms and local risk factor patterns, and exploring associations between demographic/socioeconomic factors and screening outcomes.

The results will inform locally appropriate policies for targeted early detection and follow-up pathways that aim to reduce PC morbidity and inequities in this underserved population.

2. Materials and Methods

2.1 Study Design and Setting

This descriptive cross-sectional study was conducted on 300 low-inome men covered by the patronage of a local relief foundation in Guilan Province, Iran. Data collection and clinical assessments were carried out at the Urology Department of Razi Hospital. The protocol was approved by the Ethics Committee of Guilan University of Medical Sciences (IR. GUMS. REC .1396.56), and written informed consent was obtained from all participants prior to enrollment.

Individuals suspected of having PC were referred for further diagnostic follow-up, with the center ensuring appropriate care. All study procedures adhered to the Declaration of Helsinki and relevant institutional guidelines.

2.2 Participants

Eligible participants were men over 50 years of age with no prior history of PC. Additionally, men aged ≥45 years with one first-degree relative diagnosed with PC before age 65, and men aged ≥40 years with more than one first-degree relative diagnosed before age 65, were also included. Exclusion criteria were cardiovascular or neurological disease and age over 85 years.

2.3 Data Collection

Participants completed a structured questionnaire covering demographic information, family history of PC, lifestyle factors including dietary habits such as intake of animal fat, fruits, and vegetables, daily tea consumption, smoking, and opium use, history of vasectomy or benign prostatic hyperplasia, and lower urinary tract symptoms including frequent urination particularly nocturia, difficulty initiating or controlling urination, weak or interrupted urine flow, incomplete bladder emptying, pain or burning during urination, erectile dysfunction, pain during orgasm, hematuria and hematospermia, and pain or cramping in the lower trunk, pelvis, or upper thighs.

For illiterate participants, questionnaires were completed through an interview by the researcher, while literate participants completed the forms themselves. Study objectives and procedures were explained in detail to minimize non-participation.

2.4 Clinical Examination

All participants underwent a Digital Rectal Examination (DRE) performed by a urologist using a gloved, lubricated finger to assess the prostate for asymmetry, nodules, induration, or other abnormalities. Subsequently, blood samples were collected for PSA testing.

Participants were instructed to abstain from sexual activity and strenuous exercise (particularly cycling) for 48 hours prior to sampling. PSA testing was performed at least 48 hours after the DRE and at least six weeks after any recent urinary tract infection, prostate biopsy, ultrasound, or cystoscopy.

PSA levels were measured using the PSA ELISA kit following the manufacturer's instructions. Based on previous studies, PSA levels above 3 ng/mL were considered abnormal for prostate screening [13].

2.5 Statistical Analysis

Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Statistical analyses were performed using the Chi-square and one-way ANOVA test, with p-values less than 0.05 considered statistically significant. All analyses were performed using SPSS version 20 (IBM Corp., Armonk, NY, USA).

3. Results

The mean age of participants was 63.7 ± 8.8 years. Most of the population were aged 60 years or older (61.7%). With respect to BMI, the majority were within the normal range of 19–25 kg/m² (57.7%), followed by overweight (25–30 kg/m²; 33.0%) and obese (>30 kg/m²; 9.3%). Nearly all participants were married (94.7. In terms of ethnicity, the dominant group was Gilak (63.3%), followed by Talesh (20.7%), Azeri (11.7%), Kurd (3.3%), and Fars (0.7%), with a small proportion categorized as other (0.3%).

Educationally, the highest frequency was observed among illiterate participants (68.3%), whereas only a small fraction had university-level education (0.3%). Regarding occupation, farming was the most common (39.0%), followed by workers (27.6%), other occupations (26.0%), unemployed (4.0%), livestock breeders (2.7%), and employees (0.7%) (Table1).

In this study, 15.0% of participants (n = 45) had a PSA level greater than 3 ng/mL, and 54.0% (n = 162) presented with abnormal rectal masses. Among urinary and related symptoms (Table2), the most frequently reported were frequent urination and nocturia (43.0%) and poor or interrupted urine flow (43.0%). A considerable proportion of participants also experienced a feeling of incomplete bladder emptying (43.0%), difficulty in erection (35.3%), and pain or burning during urination (34.7%). In contrast, symptoms such as hematuria (6.7%), hematospermia (4.0%), and pain during orgasm (18.0%) were less commonly observed. Regarding risk factors (Table2), the majority of participants reported a diet high in animal fat (81.3%), while a smaller proportion adhered to a fruit- and vegetable-rich diet (27.7%). More than half of the participants were smokers (53.0%), and a notable percentage reported a history of opium use (28.0%). Only a few participants had undergone vasectomy (2.3%). In addition, benign prostatic enlargement (12.7%) was reported in a minority of the sample. Family history of prostate cancer was uncommon, with first-degree relatives reported in 7.7%, second-degree in 2.0%, and third-degree in 1.0% of participants.

The analysis revealed that age was significantly associated with several DRE findings. Participants aged ≥60 years had a higher frequency of DRE stiffness (49.2% vs. 32.2%, $p = 0.004$), DRE asymmetry (25.4% vs. 13.0%, $p = 0.030$), and precancerous lesions (17.8% vs. 10.4%, $p = 0.03$) compared to those aged <60 years. However, no significant difference was observed in the presence of DRE nodules between age groups ($p = 0.500$). Regarding BMI, only DRE asymmetry showed a significant association, with participants in the normal BMI range (19–25 kg/m²) demonstrating a higher frequency of asymmetry compared to overweight and obese groups (26.6%, $p = 0.040$). Other DRE findings were not significantly associated with BMI ($p > 0.05$). No statistically significant associations were observed between marital status, ethnicity, education, or occupation and the presence of DRE nodule, stiffness, or asymmetry ($p > 0.05$) (Table3).

A statistically significant association was identified between age and family history of prostate cancer in first-degree relatives with abnormal PSA levels ($p < 0.05$). In contrast, no significant associations were observed between abnormal PSA and the other investigated variables ($p > 0.05$). Analysis of risk factors (Table4), revealed that a family history of prostate cancer in first-degree relatives was significantly associated with precancerous lesions detected on DRE. None of the participants with a first-degree relative with prostate cancer exhibited precancerous lesions, whereas 16.2% of participants without such a history did ($p = 0.030$). Similarly, the presence of DRE nodules was significantly higher among participants without a first-degree family history compared to those with a history (16.2% vs. 0.0%, $p = 0.030$). Other risk factors, including high animal fat diet, high fiber diet, daily tea consumption, smoking, opium use, vasectomy history, benign prostatic enlargement, and family history of prostate cancer in second- or third-degree relatives, showed no statistically significant associations with DRE stiffness, asymmetry, nodules, or precancerous lesions ($p > 0.05$).

Table 1. Frequency of demographic characteristics of the study participants (N=300).

Demographic characteristic	Category	Frequency n (%)
Age	< 60 years	115 (38.3)
	≥ 60 years	185 (61.7)
BMI	19–25	173 (57.7)
	25–30	99 (33.0)
	> 30	28 (9.3)
Marital status	Single	16 (5.3)
	Married	284 (94.7)
Ethnicity	Fars	2 (0.7)
	Talesh	62 (20.7)
	Gilak	190 (63.3)
	Kurd	10 (3.3)
	Azeri	35 (11.7)
	Other	1 (0.3)
Education	Illiterate	205 (68.3)
	Below diploma	90 (30.0)
	Diploma	4 (1.4)
	University	1 (0.3)
Occupation	Farmer	117 (39.0)
	Livestock breeder	8 (2.7)
	Employee	2 (0.7)
	Worker	83 (27.6)
	Unemployed	12 (4.0)
	Other	78 (26.0)

N: number; %: percentage; BMI: Body Mass Index; Statistical significance was defined as $p < 0.05$.

Table 2. Frequency of symptoms and risk factors among the study participants (N = 300).

Variables		Category	Frequency N (%)
Symptoms	Frequent urination and frequent urinary drainage (esp. at night)	No	171 (57.0)
		Yes	129 (43.0)
	Difficulty starting urination or controlling flow	No	176 (58.7)
		Yes	124 (41.3)
	Inability to drain urine	No	233 (77.6)
		Yes	67 (22.4)
	Poor or interrupted urine flow	No	171 (57.0)
		Yes	129 (43.0)
	Pain or burning during urination	No	196 (65.3)
		Yes	104 (34.7)
	Feeling of incomplete bladder emptying	No	171 (57.0)
		Yes	129 (43.0)
	Difficulty in erection	No	194 (64.7)
		Yes	106 (35.3)
	Pain during orgasm	No	246 (82.0)
		Yes	54 (18.0)
	Hematuria	No	280 (93.3)
		Yes	20 (6.7)
	Hematospermia	No	288 (96.0)
		Yes	12 (4.0)
	Pain/cramping in lower trunk, pelvis, or upper thighs	No	270 (90.0)
		Yes	30 (10.0)
Risk Factors	Diet high in animal fat	No	244 (81.3)
		Yes	56 (18.7)
	Diet including fruits and vegetables	No	217 (72.3)
		Yes	83 (27.7)
	Daily tea consumption (cups/day)	<7	185 (61.7)
		>7	115 (38.3)
	Smoking	No	141 (47.0)
		Yes	159 (53.0)
	History of opium use	No	216 (72.0)
		Yes	84 (28.0)
	Vasectomy history	No	293 (97.7)
		Yes	7 (2.3)
	Benign Prostatic Hyperplasia	No	262 (87.3)
		Yes	38 (12.7)
	Family history of PC in first-degree relatives	No	277 (92.3)
		Yes	23 (7.7)
	Family history of PC in second-degree relatives	No	294 (98.0)
		Yes	6 (2.0)
	Family history of PC in third-degree relatives	No	297 (99.0)
		Yes	3 (1.0)

N: number; %: percentage; PC = Prostate Cancer; Statistical significance was set at $p < 0.05$.

Table 3. Comparison of the presence or absence of DRE nodule, stiffness, and asymmetry according to demographic characteristics (N = 300).

Characteristic		Precancerous Lesions n (%)			DRE Stiffness n (%)			DRE Asymmetry n (%)			DRE Nodule n (%)		
		Yes	No	*P*	Yes	No	*P*	Yes	No	*P*	Yes	No	*P*
Age	<60 years	12 (10.4)	103 (89.6)	0.03	37 (32.2)	78 (67.8)	0.004	15 (13.0)	100 (87.0)	0.030	15 (13.0)	100 (87.0)	0.500
	≥60 years	33 (17.8)	152 (82.2)		91 (49.2)	94 (50.8)		47 (25.4)	138 (74.6)		25 (13.5)	160 (86.5)	
BMI	19–25 kg/m^2	28 (16.2)	145 (83.8)	0.600	77 (44.5)	96 (55.5)	0.400	46 (26.6)	127 (73.4)	0.040	21 (12.1)	152 (87.9)	0.700
	25–30 kg/m^2	12 (12.1)	87 (87.9)		42 (42.4)	57 (57.6)		11 (11.1)	88 (88.9)		15 (15.2)	84 (84.8)	
	>30 kg/m^2	5 (17.9)	23 (82.1)		9 (32.1)	19 (67.9)		5 (17.9)	23 (82.1)		4 (14.3)	24 (85.7)	
Married	Yes	3 (18.8)	13 (81.2)	0.400	7 (43.8)	9 (56.2)	0.700	6 (37.5)	10 (62.5)	0.300	2 (12.5)	14 (87.5)	0.600
	No	42 (14.5)	242 (85.5)		121 (42.6)	163 (57.4)		56 (19.7)	228 (80.3)		38 (13.4)	246 (86.6)	
Race	Fars	0 (0.0)	2 (100.0)	0.800	0 (0.0)	2 (100.0)	0.600	0 (0.0)	2 (100.0)	0.300	0 (0.0)	2 (100.0)	0.200
	Talesh	10 (16.1)	52 (83.9)		29 (46.8)	33 (53.2)		11 (17.7)	51 (82.3)		13 (21.0)	49 (79.0)	
	Gilak	31 (16.3)	159 (83.7)		79 (41.6)	111 (58.4)		37 (19.5)	153 (80.5)		19 (10.0)	171 (90.0)	
	Kurd	1 (10.0)	9 (90.0)		4 (40.0)	6 (60.0)		2 (20.0)	8 (80.0)		2 (20.0)	8 (80.0)	
	Azari	3 (8.6)	32 (91.4)		15 (42.9)	20 (57.1)		12 (34.3)	23 (65.7)		6 (17.1)	29 (82.9)	
	Other	0 (0.0)	1 (100.0)		1 (100.0)	0 (0.0)		0 (0.0	1 (100.0)		0 (0.0)	1 (100.0)	
Education	Illiterate	35 (16.7)	170 (83.3)	0.200	91 (44.1)	114 (55.9)	0.600	44 (21.1)	161 (78.9)	0.900	32 (15.2)	173 (84.8)	0.500
	Under diploma	10 (12.2)	80 (87.8)		37 (41.1)	53 (58.9)		18 (20.0)	72 (80.0)		9 (10.0)	81 (90.0)	
	Diploma	0 (0.0)	4 (100.0)		1 (25.0)	3 (75.0)		1 (25.0)	3 (75.0)		0 (0.0)	4 (100.0)	
	University degree	0 (0.0)	1 (100.0)		0 (0.0)	1 (100.0)		0 (0.0)	1 (100.0)		0 (0.0)	1 (100.0)	
Occupation	Farmer	18 (15.4)	99 (84.6)	0.100	53 (45.3)	64 (54.7)	0.700	25 (21.4)	92 (78.6)	0.800	12 (10.3)	105 (89.7)	0.500
	Rancher	3 (37.5)	5 (62.5)		4 (50.0)	4 (50.0)		5 (62.5)	3 (37.5)		2 (25.0)	6 (75.0)	
	Employee	0 (0.0)	2 (100.0)		1 (50.0)	1 (50.0)		0 (0.0)	2 (100.0)		0 (0.0)	2 (100.0)	
	Worker	10 (12.0)	73 (88.0)		32 (38.6)	51 (61.4)		15 (18.1)	68 (81.9)		12 (14.0)	71 (85.5)	
	Unemployed	3 (25.0)	9 (75.0)		7 (58.3)	5 (41.7)		2 (16.7)	10 (83.3)		3 (25.0)	9 (75.0)	
	Other	11 (14.1)	67 (85.9)		31 (39.7)	47 (60.3)		15 (19.2)	63 (80.8)		11 (14.1)	67 (85.9)	

N: number; %: percentage; DRE: Digital Rectal Examination; BMI: Body Mass Index; P-values were calculated for variables with two categories based on chi-square and for variables with more than two categories based on one-way ANOVA test; statistical significance was set at $p < 0.05$.

Table 4. Association between DRE findings and lifestyle and familial risk factors among participants (N = 300).

Characteristic		Precancerous Lesions n (%)			DRE Stiffness n (%)			DRE Asymmetry n (%)			DRE Nodule n (%)		
		Yes	No	*P*	Yes	No	*P*	Yes	No	*P*	Yes	No	*P*
High animal fat diet	No	37 (15.2)	207 (84.8)	0.800	104 (42.6)	140 (57.4)	0.900	48 (19.7)	196 (80.3)	0.300	(13.9) 34	210(86.1)	0.500
	Yes	8 (14.3)	48 (85.7)		24 (42.9)	32 (57.1)		14 (25.0)	42 (75.0)		(10.7) 6	50 (89.3)	
High fiber diet	No	33 (15.2)	184 (84.8)	0.800	91 (41.9)	126 (58.1)	0.600	40 (18.4)	177 (81.6)	0.200	(13.8) 30	(86.2) 187	0.600
	Yes	12 (14.5)	71 (85.5)		37 (44.6)	46 (55.4)		22 (26.5)	61 (73.5)		(12.0) 10	73 (88.0)	
Daily tea drink	<7 cups/day	31 (16.8)	154 (83.2)	0.200	82 (44.3)	103 (55.7)	0.400	39 (21.1)	146 (78.9)	0.100	(13.5) 25	(86.5) 160	0.900
	≥7 cups/day	14 (12.2)	101 (87.8)		46 (40.0)	69 (60.0)		23 (20.0)	92 (80.0)		(13.0) 15	(8.07) 100	
Smoking	No	19 (13.5)	122 (86.5)	0.400	60 (42.6)	81 (57.4)	0.600	27 (19.1)	114 (80.9)	0.500	(13.5) 19	122 (86.5)	0.900
	Yes	26 (16.4)	133 (83.6)		68 (42.8)	91 (57.2)		35 (22.0)	124 (78.0)		(13.2) 21	138 (86.6)	

Opium use	No	34 (15.7)	182 (84.3)	0.500	100 (46.3)	116 (53.7)	0.400	48 (22.2)	168 (77.8)	0.400	(14.8) 32	(85.2) 184	0.200
	Yes	11 (13.1)	73 (86.9)		28 (33.3)	56 (66.7)		14 (16.7)	70 (83.3)		(9.5) 8	76 (90.5)	
Vasectomy history	No	45 (15.4)	248 (84.6)	0.400	127 (43.3)	166 (56.7)	0.200	60 (20.5)	233 (79.5)	0.600	(13.7) 40	(86.3) 253	0.600
	Yes	0 (0.0)	7 (100.0)		1 (14.3)	6 (85.7)		2 (28.6)	5 (71.4)		(0.0) 0	7 (100.0)	
Benign prostatic enlargement	No	38 (14.5)	224 (85.5)	0.200	110 (42.0)	152 (58.0)	0.500	51 (19.5)	211 (80.5)	0.100	(13.0) 34	(87.0) 228	0.600
	Yes	7 (18.4)	31 (81.6)		18 (47.4)	20 (52.6)		11 (28.9)	27 (71.1)		(15.8) 6	32 (84.2)	
Prostate cancer in relatives (Grade 1)	No	45 (16.2)	232 (83.8)	0.030	120 (43.3)	157 (56.7)	0.400	58 (20.9)	219 (79.1)	0.800	(16.2) 45	(83.8) 232	0.030
	Yes	0 (0.0)	23 (100)		8 (34.8)	15 (65.2)		4 (17.4)	19 (82.6)		(0.0) 0	(100.0) 23	
Prostate cancer in relatives (Grade 2)	No	44 (15.0)	250 (85.0)	0.900	126 (42.9)	168 (57.1)	0.600	59 (20.1)	235 (79.9)	0.070	(13.6) 40	(86.4) 254	0.400
	Yes	1 (16.7)	5 (83.3)		2 (33.3)	4 (66.7)		3 (50.0)	3 (50.0)		(0.0) 0	6 (100.0)	
Prostate cancer in relatives (Grade 3)	No	45 (15.2)	252 (84.8)	0.600	127 (42.8)	170 (57.2)	0.400	62 (20.9)	235 (79.1)	0.300	(13.5) 40	(86.5) 257	0.400
	Yes	0 (0.0)	3 (100.0)		1 (33.3)	2 (66.7)		0 (0.0)	3 (100.0)		(0.0) 0	3 (100.0)	

N: number; %: percentage; PC: Prostate Cancer; BMI: Body Mass Index; P-values were calculated for variables with two categories based on chi-square and for variables with more than two categories based on one-way ANOVA test.; statistical significance was set at $p < 0.05$.

4. Discussion

The results of our population-based screening of 300 low-income men in Guilan reveal several findings of potential clinical and public-health importance. Fifteen percent of participants had a PSA above 3 ng/mL and more than half (54.0%) had an abnormality on DRE. Urinary storage and voiding symptoms were common, with nocturia/frequent urination, poor or interrupted stream, and a sensation of incomplete emptying each reported by roughly 43% of participants; erectile difficulty and dysuria were also frequent. Age was strongly associated with several abnormal DRE findings, and first-degree family history showed a statistically significant association with abnormal PSA. These observations must be interpreted against the international and regional evidence on PC epidemiology and the contested role of population screening. PC remains one of the most commonly diagnosed malignancies in men globally, and it ranked among the top five cancers in Iran. These global and national burdens frame the public-health rationale for early detection in settings where capacity and access allow timely diagnostic follow-up and treatment [1,14].

At the same time, randomized trials and pooled syntheses have demonstrated that PSA-based screening, when offered universally, produces a mix of modest reductions in metastatic disease and prostate-cancer mortality but also substantial overdiagnosis and overtreatment; the balance of benefit and harm is sensitive to the screening protocol used and to downstream diagnostic pathways [15]. This global uncertainty helps explain why contemporary guidance increasingly favors individualized, risk-stratified screening rather than blanket population screening [15,16]. Two aspects of our findings are especially salient in that wider context. First, the relatively high proportion of men with PSA > 3 ng/mL (15%) and the very high proportion with abnormal DRE (54%) suggest that men in this low-income, under-served community may be less likely to have had prior opportunistic PSA testing and therefore present with a higher baseline burden of detectable abnormalities than populations with routine screening access. Multi-country analyses of screening coverage in low- and middle-income countries show generally low screening uptake, with coverage frequently below 50% and pronounced pro-urban and pro-wealth gradients; organized outreach programs have been shown to reduce those gaps when they include active offers and culturally appropriate engagement [11,12]. Our data therefore add weight to the proposition that targeted, organized screening initiatives if linked to reliable diagnostic follow-up could reduce detection inequities in settings similar to Guilan.

Second, the discordance between the high rate of abnormal DREs in our cohort and recent evidence questioning the sensitivity and reproducibility of DRE as a screening tool deserves emphasis. Large screening initiatives and critical reviews have increasingly reported that DRE has low sensitivity for early, clinically significant prostate cancer and may contribute limited incremental value beyond PSA measurement alone. The analyses from contemporary trials and reviews have argued that DRE detects few cancers that PSA would not, and that its subjective nature leads to poor reproducibility [17,18]. The very high rate of DRE abnormalities observed in this study is therefore likely to reflect a combination of true underlying conditions such as benign prostatic hyperplasia and chronic prostatic inflammation together with normal inter-examiner variability, rather than representing a clear indication of previously undiagnosed aggressive malignancy. This finding highlights the importance of

ensuring that any screening program is directly connected to appropriate diagnostic confirmation through biopsy or MRI when available before any conclusions about cancer prevalence are made.

Comparing our numeric findings to other published screening cohorts clarifies these points. Sensitivity estimates for PSA depend on age and the chosen cutoff: population screening modelling studies report that a PSA threshold of 3 ng/mL yields higher sensitivity than a 4 ng/mL threshold but also increases false positives, with sensitivity typically peaking in older age groups [19]. Screening trials that adopted lower PSA thresholds therefore report more screen-positives and more diagnostic procedures; our selection of 3 ng/mL aligns with risk-adapted approaches used in several European organized screening protocols, yet it inevitably identifies more men who will require follow-up. The German PROBASE randomized trial of risk-adapted screening which is evaluating a protocol beginning at age 45 with risk stratification to reduce overdiagnosis highlights how refined, age-specific strategies can lower unnecessary interventions while preserving detection of clinically important cancers; the PROBASE investigators and other groups have argued for risk-adapted algorithms rather than crude population screening [20,21]. In short, our 15% prevalence of PSA > 3 ng/mL is not necessarily anomalous, but it highlights the practical consequences of selecting a lower diagnostic threshold in a previously unscreened population.

Our study also examined demographic and behavioural correlates of prostate findings. Age showed a strong association with both DRE abnormalities and elevated PSA, which aligns with extensive epidemiologic evidence indicating that prostate pathology, both benign and malignant, increases with advancing age and that age is the primary risk factor for prostate cancer [22,23]. The correlation of abnormal PSA with family history in first-degree relatives in our sample is biologically plausible and reflects established hereditary risk patterns, although the low prevalence of reported family history limits interpretability [24,25]. By contrast, we did not find significant associations between DRE or PSA status and lifestyle factors including high animal-fat intake, fruit and vegetable consumption, tea drinking, smoking, opium use, or vasectomy history, a pattern that is compatible with large reviews and cohort studies reporting generally modest, inconsistent, or null associations for many dietary and behavioural exposures and prostate cancer risk [26,27]. These null findings should be interpreted cautiously because many lifestyle–cancer effects are small, require large samples and detailed exposure assessment to detect, and are vulnerable to misclassification and temporal ambiguity in cross-sectional designs.

Our findings have important implications for both practice and research. The high prevalence of PSA elevations and abnormal DRE findings among low-income men in Guilan underscores the need for targeted, risk-stratified screening rather than neglecting early detection in underserved populations. Screening programs should include clear protocols for confirmatory diagnostics and shared decision-making that communicate both potential benefits earlier detection of clinically significant cancer, and potential harms, including false positives, biopsy complications, overdiagnosis, and overtreatment. Prior to large-scale implementation, feasibility and resource assessments including urologic referral pathways, imaging, biopsy capacity, treatment availability, and long-term follow-up are essential. Scientifically, this cohort offers a unique opportunity for prospective longitudinal study to track diagnostic confirmation, cancer staging, management, and outcomes, directly addressing limitations inherent to cross-sectional designs.

Several limitations merit consideration. The cross-sectional design precludes inference regarding whether elevated PSA or abnormal DRE truly represent prostate cancer or affect survival or quality of life. Diagnostic confirmation via biopsy was not reported, leaving the proportion of malignant disease undetermined. Recruitment through a relief foundation may introduce selection bias, and although DRE was performed by a urologist, inter-examiner variability limits generalizability. The sample size, while sufficient for prevalence estimates and moderate associations, limits statistical power for detecting small effects or for detailed subgroup analysis. Nevertheless, the study has notable strengths. It examines a medically underserved population with scarce data, integrates clinical examination and biomarker measurement with structured sociodemographic and lifestyle assessment, follows rigorous pre-analytical PSA precautions, and ensures ethical oversight with linkage to care for abnormal findings. Future priorities include risk-stratified screening pathways, prospective follow-up to quantify local benefits and harms, and implementation research addressing barriers such as health literacy, transportation, clinic capacity, and culturally tailored education. Such strategies are essential to maximize population benefit while minimizing inequities in early prostate cancer detection.

Our study provides robust evidence that low-income men in northern Iran exhibit high frequencies of PSA and DRE abnormalities, particularly among older individuals. Family history emerges as a double-edged factor encouraging earlier testing but associated with fewer palpable lesions. These findings underscore the necessity of strategically targeted, culturally appropriate prostate cancer screening programs in underserved Iranian populations to improve early detection and reduce health inequities.

Ethical declarations

This study was approved by the Ethics Committee of Guilan University of Medical Sciences, Rasht, Iran

under protocol number [IR. GUMS. REC .1396.56], and all participants were fully informed about the aim of the research study and the voluntary nature of participation. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Conflict of interest

No potential conflict of interest was reported by the authors.

Financial support

This study was supported by a grant from Guilan University of Medical Sciences with tracking code 3279.

Authors' contributions

Conceptualization: FMGH, SF, FJ, and AR, Data curation: FMGH, SF, FJ, AR, RMGH, and SY, Formal analysis: FJ, MM, and RMGH, Funding acquisition: No funding, Investigation: FMGH, SF, FJ, AR, SY, and RMGH, Methodology: FMGH, SF, FJ, and AR, Project administration: FMGH, SF, FJ, and AR, Resources: FMGH, FJ, and SF, Software: FJ, MM, SY ,and RMGH, Supervision: FMGH, SF, and AR, Validation: FMGH, SF, FJ, and RMGH, and AR, Visualization: FMGH, SF, FJ, AR, and RMGH, Writing – original draft: FMGH, SF, FJ, AR, SY, RMGH, and MM, Writing – review and editing: FMGH, SF, FJ, AR, SY, RMGH, and MM. All authors reviewed and confirmed the final manuscript.

Acknowledgments

We thank the subjects who participated in this research and the Guilan University of Medical Science, Rasht, Iran for cooperation in data acquisition. This study was derived from a residency thesis in internal medicine at Guilan University of Medical Sciences, Rasht, Iran.

Declaration of using generative AI and AI-assisted technologies

During the preparation of this manuscript, generative artificial intelligence tools were used solely to enhance language clarity and grammatical accuracy. All content was subsequently reviewed, revised where necessary, and approved by the authors, who assume full responsibility for the integrity and final content of the published work.

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