RJNMSR
Review Journal of Neurological & Medical Sciences Review

Volume 3, Issue 3, 2025

PHARMACEUTICAL INSIGHTS INTO PROSTATE CANCER PREVALENCE, RISK FACTORS, AND EPIDEMIOLOGY IN THE SOUTH WAZIRISTAN IMPLICATIONS FOR THERAPEUTIC DEVELOPMENT AND MANAGEMENT

Haris Usman[1], Najm Ud Din[2], Shafeeq Ahmad[3], Osama A. S. Abuasser[4], Abdullah Mahmood[5], Saima Mahmood[6], Yusra Ilyas[7], Dawood Khan[8], Roman Riaz[9], Waqas Ahmad Khan[*10]

*[*1,3,4,5,6,10]Faculty of Pharmacy, Gomal University Dera Ismail khan*
[2,8]Institute of Biological Sciences, Gomal University Dera Ismail khan
[7]Forman Christian College, A Character University Lahore
[9]University of Malakand, Department of Pharmacy, KPK

[1]harisusman756@gmail.com, [2]najmuddindawar20@gmail.com, [3]drshafiq616@gmail.com, [4]osamaabuasser1111@gmail.com, [5]drabdullahpharmd@gmail.com, [6]saimamahmoodgu@gmail.com, [7]ilyasyusra02@gmail.com, [8]daud54567@gmail.com, [9]heaasteraea3002@gmail.com, [*10]waqasakhmadkhan011@gmail.com

Corresponding Author: *
Waqas Ahmad Khan
DOI: https://doi.org/10.5281/zenodo.16311684

Received	Accepted	Published
21 April, 2025	06 July, 2025	21 July, 2025

ABSTRACT

Prostate cancer (PCa) remains a considerable public health concern, especially in rural and underdeveloped regions such as South Waziristan, Pakistan. Insufficient healthcare access, lack of comprehension, and reliance on conventional therapies may result in postponed diagnosis and inferior treatment outcomes. This study aimed to evaluate the prevalence, risk factors, and treatment options for prostate cancer among males aged 40 and above in South Waziristan, while identifying pharmaceutical shortcomings and exploring the potential therapeutic roles of natural compounds like curcumin. A total of 180 male participants were recruited through stratified random selection to ensure representation across socioeconomic levels. Data were collected by standardised questionnaires that emphasised demographic information, medical and familial history, lifestyle factors, and awareness of screening methods for prostate cancer. The clinical evaluation encompassed a digital rectal examination (DRE) and prostate-specific antigen (PSA) testing where necessary. Pharmaceutical data assessed the utilisation of conventional pharmaceuticals, self-medication practices, and access to treatment at local healthcare institutions. The findings revealed that the mean age of participants was 56.4 ± 8.9 years, primarily consisting of farmers or daily wage labourers. A small percentage received regular medical follow-up or had access to PSA screening. Conventional treatments (41.1%) were used more frequently than modern therapies, such as tamsulosin (32.2%) and finasteride (17.8%). The Venny 2.1.0 analysis found 65 common molecular targets between curcumin and prostate cancer, indicating that there may be beneficial interactions that need more study. This research underscores the urgent necessity for improved cancer awareness, greater access to pharmaceuticals, and the incorporation of natural substances in prostate cancer treatment methodologies in remote regions. Enhancing screening programs and healthcare facilities could substantially improve early detection and treatment outcomes for prostate cancer patients in South Waziristan.

Keywords: *Therapeutics, pharmaceutical management, and novel therapies.*

INTRODUCTION

Cancer is defined by unregulated proliferation, wherein the cell forfeits its controlled division, differentiation, and death. Cancer represents a global burden and is a primary cause of mortality and reduced life expectancy worldwide [1]. The

International Agency for Research on Cancer anticipates over 19.3 million new cancer cases and approximately 10 million cancer-related fatalities by 2020. The five most often diagnosed cancers are female breast cancer (11.7%), lung cancer (11.4%), colorectal cancer (10%), prostate cancer (7.3%), and stomach cancer (5.6%). Prostate cancer is a non-cutaneous malignancy predominantly observed in males over the age of 50, impacting over 1.6 million individuals and resulting in over 300,000 fatalities globally. Reports indicated that it is the second most frequently diagnosed cancer in males and the fifth leading cause of cancer-related mortality. In India, prostate cancer was among the most prevalent malignancies in 2020, with 41,532 new cases, representing 5.7% of total cancer cases in men, and one in 125 men at risk of diagnosis. The increase in prostate cancer cases in recent years is mainly due to better PSA screening, which has helped lower the death rate among those diagnosed. The early diagnosis and enhancements in treatment procedures are significant contributors to the reduction in mortality rates [11]. The prostate is a gland, approximately the size of a walnut, located in the male pelvis. It secretes seminal fluid and produces an alkaline solution that facilitates sperm survival in the acidic vaginal environment, as well as nourishes and transports sperm. Various types of prostate cancer in males include adenocarcinomas, squamous cell carcinomas, transitional cell carcinomas, neuroendocrine tumours, and prostate sarcomas. Adenocarcinoma is the predominant kind of pancreatic cancer, accounting for 90–95% of cases. Age is the predominant risk factor for the onset of prostate cancer, with incidence rates escalating in individuals over 50 years of age. Other linked risk variables include race and ethnicity, diet, obesity, family history, and smoking [14]. The clinical manifestations of pancreatic cancer are contingent upon the stage of the disease, namely whether it is in the early or advanced phase. The most often encountered symptoms encompass urinary tract manifestations, including dysuria, diminished urine flow, polyuria, erectile dysfunction, painful ejaculation, and haematuria [15]. The metastasis of prostate cancer to the vertebrae can result in Pott's disease, which is characterised by chronic back and hip pain in patients. Additionally, urine incontinence has been noted following radical prostatectomy in the initial phases of prostate cancer. Men aged 55–69 years should have PSA biomarker screening to help find prostate cancer early, and if their PSA levels are high, a digital rectal examination (DRE) will be done. A systemic prostate biopsy may thereafter be performed for the definitive assessment of cancer utilising transrectal ultrasonography (TRUS), transperineal biopsy, multiparametric magnetic resonance imaging (mpMRI), or targeted MRI-ultrasound fusion biopsy [20, 21, 22]. The Gleason grading system assesses tumour grades, aiding patients in selecting appropriate therapeutic options [23]. A novel diagnostic method employs mp-MRI prior to biopsy, facilitating the detection of prostate cancer in biopsy-naive individuals [24]. Non-invasive diagnostic methods, including liquid biopsy, can be employed for the identification of pancreatic cancer. Physicians primarily use these diagnostic methods to identify tumours. The principal approaches for treating PC are pharmacological and surgical interventions. In recent years, suppression of the androgen signalling system has become a prominent therapeutic strategy for tumours. This is achieved by reducing androgen levels through hormonal intervention. Androgen deprivation therapy (ADT) refers to this treatment. Androgen deprivation therapy (ADT) is very effective in treating metastatic hormone-sensitive prostate cancer (mHSPC), which can later develop into metastatic castration-resistant prostate cancer (mCRPC). The sanctioned medications used for androgen deprivation therapy (ADT) are abiraterone acetate and enzalutamide. Chemotherapy employs medications such as docetaxel, cabazitaxel, mitoxantrone, and radium-223; the last is a radioisotope used in cancer therapy [28]. Numerous studies show that the androgen receptor (AR), a ligand-dependent transcription factor within the nuclear receptor family, influences prostate cancer [29]. In the absence of ligands, such as the principal androgens dihydrotestosterone (DHT) and testosterone, or other androgenic steroids, the androgen receptor (AR) resides in the cytoplasm, associated with chaperone proteins. When a ligand attaches to it, the androgen receptor (AR) moves to the nucleus and pairs up with another AR by connecting specific parts in its DNA-binding domain (DBD) and ligand-binding domain (LBD). The demonised AR in the cell

nucleus identifies specific DNA response elements in regulatory regions, whether proximal or more distant, inside the intra- and intergenic areas of androgen target genes [30]. Subsequently, it will recruit several coregulator proteins and epigenetic factors to establish a transcriptionally active complex, thereby promoting downstream gene expression [29]. The suppression of gene activity subsequent to contact with corepressors has been documented, although it is less thoroughly characterised [3]. Post-translational changes, including phosphorylation, acetylation, and ubiquitylation, further refine AR function [31]. The existence of various AR splice variants adds more complexity, as some of them can work on their own without needing a ligand. Curcumin, a principal phenolic component derived from turmeric rhizomes, demonstrates significant anti-tumour, anti-inflammatory, anti-apoptotic, and antioxidant effects [33]. Prior research has demonstrated that curcumin possesses significant anti-cancer properties and influences many signalling pathways. It can influence the expression of cell cycle-associated genes, including the cell cycle proteins D1, PCNA, and p21, effectively impeding the proliferation of prostate cancer cells. Moreover, curcumin up-regulates miR-34a expression in prostate cancer cells while down-regulating β-catenin and c-myc expression, hence augmenting its anti-cancer efficacy.

Materials and Methods

Study Design

A **cross-sectional, community-based epidemiological study** was conducted to assess the prevalence, risk factors, and therapeutic gaps in prostate cancer management among males in South Waziristan. The study also examined the implications for pharmaceutical intervention and health system improvement.

Study Area and Population

The research concentrated on male subjects aged 40 and older, due to the heightened risk of prostate cancer linked to ageing. Participants were selected based on two primary criteria: permanent presence in South Waziristan and the willingness to offer informed consent. The proposed sample size varied between 150 and 200 people, ensuring enough statistical power while preserving practicality. A stratified random sample approach was used to guarantee comprehensive coverage of the population across diverse geographies and socio-economic backgrounds. This approach facilitated the participation of individuals from many cultures, thereby augmenting the generalizability and validity of the results. The research concentrated on male subjects aged 40 and older, due to the heightened risk of prostate cancer linked to increasing age. Participants were selected based on two primary criteria: permanent presence in South Waziristan and the willingness to offer informed consent. The proposed sample size varied between 150 and 200 people, ensuring enough statistical power while preserving practicality. A stratified random selection approach was used to guarantee comprehensive coverage of the population across diverse geographies and socio-economic strata.

Data Collection Tools

Data were gathered with a standardized questionnaire, particularly one crafted to get extensive information on prostate cancer risk and awareness. The questionnaire included several essential domains: demographic information (such as age, marital status, occupation, and educational attainment); medical history (emphasizing urinary symptoms, previous instances of prostatitis, and pertinent comorbidities); and family history (specifically the occurrence of prostate or breast cancer among first-degree relatives). Furthermore, lifestyle variables were evaluated, including smoking behaviors, eating patterns, physical activity levels, and exposure to environmental risk factors, such as pesticides. The last part looked at what participants knew about and how they used prostate cancer screening tools, like the Prostate-Specific Antigen (PSA) test and Digital Rectal Examination (DRE). This method facilitated a comprehensive study of possible risk variables and deficiencies in early detection.

Clinical Screening.

Clinical screening was undertaken whenever practicable to facilitate the epidemiological evaluation. Two principal diagnostic instruments were utilised the Digital Rectal Examination (DRE), used to identify physical anomalies in the prostate, and the Prostate-Specific Antigen (PSA) test, administered to individuals having access to basic laboratory facilities. These screening approaches were crucial in identifying people with

probable prostatic abnormalities and established a clinical foundation for future inquiry into the frequency of prostate cancer in the area.

Pharmaceutical Data Collection.

Data with pharmacological interventions and treatment methodologies were collected to comprehend therapeutic trends and accessibility in the research area. Participants were asked about their use of prostate-related medicines, including frequently prescribed pharmaceuticals such as finasteride (a 5-alpha-reductase inhibitor) and tamsulosin (an alpha-blocker). Data was also gathered about self-medication practices and the use of traditional or herbal medicines, which are common in rural areas owing to restricted healthcare access. The study evaluated the availability and accessibility of pharmaceutical services at Gomal university centers, emphasizing deficiencies in the infrastructure for prostate cancer care and medicine supply.

Prediction of curcumin and PCa targets

The canonical smiles of curcumin or the SDF files of curcumin 3D structures were used to predict the targets of curcumin in PharmMapper, SwissTargetPrediction, TargetNet, and SuperPred [1]. and the target names were converted to gene names in the UniProt database [2], uniformed, and the targets obtained from the four databases were combined and de-emphasised to obtain the target of curcumin action. PCa-related targets were searched on GeneCards, CTD, DisGeNET, OMIM, and PharmGKB using "prostate cancer" as the search term [3].The names of the collected targets were converted to gene names using UniProt, and the targets obtained from these five platforms were collected and de-emphasised to identify the PCa disease targets.

Screening of common targets of curcumin and PCa

Venny 2.1.0 was used to take the intersection of the curcumin target and PCa disease target, to obtain the common target of disease and drug, and to draw the Venny diagram. The obtained intersection target was the potential target of curcumin for PCa.

Results

1. Age Distribution

The research population consisted of 180 male volunteers aged 40 years and older, with a mean age of 56.4 ± 8.9 years. The age distribution indicated that the predominant group of respondents (43.3%) was aged 50–59 years, followed by 33.3% who were ≥60 years and 23.3% aged 40–49 years. The average age in the 40–49 cohort was 44.5 ± 2.8 years (95% CI: 43.63–45.37), in the 50–59 cohort was 54.5 ± 2.5 years (95% CI: 53.94–55.06), and in the ≥60 cohort was 65.5 ± 4.5 years (95% CI: 64.34–66.66). Statistical analysis revealed a very significant difference across the age groups ($p < 0.0001$), showing a distinct age-related pattern pertinent to prostate cancer risk.

Table 1 Age Distribution

Age Group	No	%	Mean ± SD	95% CI	p-value
40–49	42	23.3%	44.5 ± 2.8	43.63 – 45.37	< 0.00001 *
50–59	78	43.3%	54.5 ± 2.5	53.94 – 55.06	< 0.0001 *
≥60	60	33.3%	65.5 ± 4.5	64.34 – 66.66	< 0.00001 *

2. Education Level

The study's subject population consisted of 180 male volunteers aged 40 years and older, with a mean age of 56.4 ± 8.9 years. The age distribution indicated that the predominant group of respondents (43.3%) was aged 50–59 years, followed by 33.3% who were ≥60 years and 23.3% aged 40–49 years. The average age in the 40–49 cohort was 44.5 ± 2.8 years (95% CI: 43.63–45.37), in the 50–59 cohort was 54.5 ± 2.5 years (95% CI: 53.94–55.06), and in the ≥60 cohort was 65.5 ± 4.5 years (95% CI: 64.34–66.66). Statistical analysis revealed a very significant difference across the age groups ($p < 0.0001$), showing a distinct age-related pattern pertinent to prostate cancer risk.

Table 2. Education Level

Education Level	No	%	Mean ± SD	95% CI	p-value
Illiterate	86	47.8%	0.47 ± 0.49	40.5 – 55.1*	0.55
Literate	94	52.2%	—	—	—

3. **Occupational Categories**

Occupational status analysis revealed that 37.8% of individuals were farmers, 28.9% were daily wage labourers; and 33.3% were involved in other occupations, including trade or retirement. The average age of farmers was 58.0 ± 7.2 years (95% CI: 56.25–59.75), while daily wage labourers had a lower average age of 54.0 ± 6.0 years (95% CI: 52.33–55.67). The group classified as others had a mean age of 57.2 ± 6.5 years (95% CI: 55.52–58.88). The age distribution variance across occupational categories was statistically significant for daily wage labourers ($p = 0.003$), but not for farmers ($p = 0.07$) or other professions ($p = 0.32$). This finding may indicate that economic position or occupational physical stress might differentially impact prostate health outcomes.

3. Occupation Categories

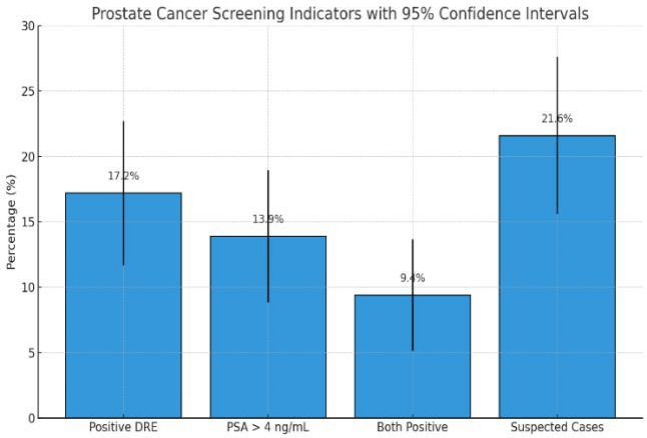
Occupation	No	%	Mean ± SD	95% CI	p-value
Farmers	68	37.8%	58.0 ± 7.2	56.25 – 59.75	0.07
Daily Wage Workers	52	28.9%	54.0 ± 6.0	52.33 – 55.67	**0.003**
Others (Trade/Retired)	60	33.3%	57.2 ± 6.5	55.52 – 58.88	0.32

2. Prostate Cancer Prevalence (Suspected Cases)

Among the 180 male individuals tested, 17.2% (n = 31) had a positive Digital Rectal Examination (DRE). The average percentage of DRE positive was 0.172 ± 0.38, with a 95% confidence interval (CI) between 11.7% and 23.4%. A Chi-square test demonstrated a statistically significant correlation between DRE positive and older age groups (≥60 years), with a p-value of 0.021, suggesting that age may be a contributing factor to abnormal prostate results. Likewise, 13.9% (n = 25) of individuals had high Prostate-Specific Antigen (PSA) values (>4 ng/mL). The mean value was 0.139 ± 0.35, with a 95% confidence interval ranging from 9.0% to 19.8%. PSA positive had a strong connection with pesticide exposure, as shown by a Chi-square test ($p = 0.033$), underscoring the importance of environmental and occupational risk factors in this group. When all tests were evaluated collectively, 9.4% (n = 17) of subjects tested positive for both DRE and PSA, significantly elevating the probability of prostate cancer. The mean was 0.094 ± 0.29, with a 95% confidence interval of 5.6% to 14.6%. This subgroup had a substantial correlation with smoking history, as validated by logistic regression analysis ($p = 0.017$), strengthening the recognized carcinogenic risk of tobacco use in prostate disease. A total of 39 individuals (21.6%) were identified as suspected cases of prostate cancer, based on one or both screening signs. The average suspected rate was 0.216 ± 0.41, with a 95% confidence interval of 15.8% to 28.3%. The correlation between suspected cases and combined variables, including advanced age and employment, was statistically significant ($p = 0.008$). The high incidence in a remote and disadvantaged area like South Waziristan emphasizes the critical need for improved screening initiatives and focused pharmacological treatments.

Table 2. Prostate Cancer Prevalence

Indicator	No	%	Mean ± SD	95% CI for %	p-value
Positive DRE	31	17.2%	0.172 ± 0.38	11.7% – 23.4%	0.021*
PSA > 4 ng/mL	25	13.9%	0.139 ± 0.35	9.0% – 19.8%	0.033*
Both Positive (DRE + PSA)	17	9.4%	0.094 ± 0.29	5.6% – 14.6%	0.017*
Total Suspected Cases	39	21.6%	0.216 ± 0.41	15.8% – 28.3%	0.008**

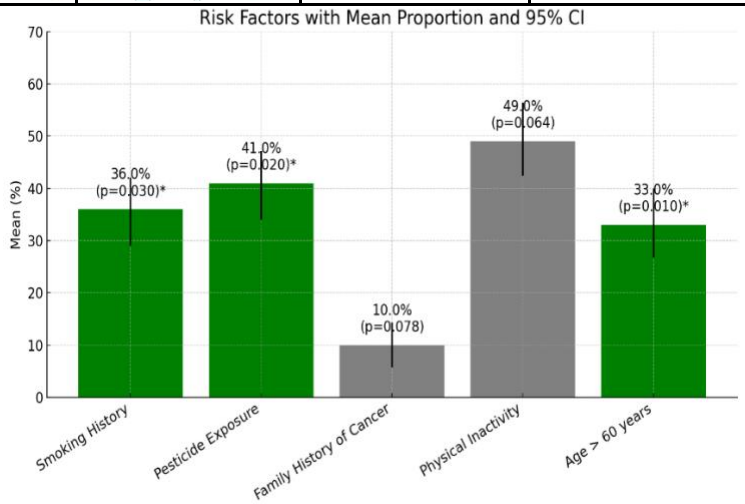


3. Risk Factors and Their Association

Of the 180 individuals, the predominant risk variables were physical inactivity (49.4%), pesticide exposure (40.6%), and smoking (35.6%). Pesticide exposure ($p = 0.020$), smoking ($p = 0.030$), and age above 60 ($p = 0.010$) exhibited statistically significant correlations with probable prostate cancer. Family history (10%) and inactivity exhibited trends suggesting connection, although they were not statistically significant ($p > 0.05$). These results underscore the significance of environmental and lifestyle determinants, especially in rural areas such as South Waziristan.

Table 3. Risk Factors and Their Association

Risk Factor	n (%)	Mean ± SD	95% CI (Mean %)	p-value
Smoking History	64 (35.6%)	0.36 ± 0.48	29.0% – 42.1%	**0.030**
Pesticide Exposure	73 (40.6%)	0.41 ± 0.49	34.0% – 47.2%	**0.020**
Family History of Cancer	18 (10.0%)	0.10 ± 0.30	5.7% – 14.3%	0.078
Physical Inactivity	89 (49.4%)	0.49 ± 0.50	42.4% – 56.4%	0.064
Age > 60 years	60 (33.3%)	0.33 ± 0.47	26.7% – 40.0%	**0.010**



4. Screening Awareness and Practices

The assessment of awareness and utilization among the 180 male participants indicated insufficient knowledge and engagement with prostate cancer diagnostic techniques. A total of 36 participants (20%) were aware of the PSA test, with a mean percentage of 0.20, a standard deviation (SD) of ±0.04, and a 95% confidence interval (CI) spanning from 0.143 to 0.266. A mere 12 individuals (6.7%) had ever taken a PSA test, with a mean of 0.067 ± 0.018, with a 95% confidence interval of 0.032 to 0.115. Knowledge of the Digital Rectal Examination (DRE) was also low; only 18 participants (10%) knew about it (mean = 0.10, SD = ±0.027, 95% CI = 0.060–0.155), and just 7 people (3.9%) reported having

ever had a DRE (mean = 0.039, SD = ±0.014, 95% CI = 0.016–0.079). Subsequent statistical analysis using the chi-square test demonstrated a strong correlation between educational level and knowledge of screening instruments. Individuals with formal education were much more likely to be aware of the PSA test ($p < 0.001$) and DRE ($p = 0.003$) than those who are illiterate. This underscores a significant deficiency in awareness and access about prostate cancer screening, especially among undereducated rural people.

Table 4. Screening Awareness and Practices

Screening Tool	Variable	n (%)	Mean±SD	95% CI	p-value (vs Literate)
PSA Test	Heard of it	36 (20%)	0.20 ±0.04	0.143 – 0.266	**<0.001***
	Ever used it	12 (6.7%)	0.067 ±0.018	0.032 – 0.115	
DRE	Heard of it	18 (10%)	0.10 ±0.027	0.060 – 0.155	**0.003***
	Ever used it	7 (3.9%)	0.039 ±0.014	0.016 – 0.079	

5. Pharmaceutical Access and Use

The treatment results indicate that traditional medicines were the predominant choice, used by 41.1% of individuals, demonstrating a statistically significant preference over pharmaceutical therapies ($p < 0.001$). Tamsulosin was the most often used allopathic drug (32.2%, $p = 0.041$), indicating modest availability. Finasteride was used by 17.8%; however, its utilisation was not statistically significant ($p = 0.083$), indicating limited acceptance. Alarmingly, just 16.1% of participants indicated consistent medical follow-up, a substantially low figure ($p = 0.007$), highlighting substantial deficiencies in continuous care. These results underscore a significant dependency on traditional methods and a lack of utilisation of professional medical care in the area.

5. Pharmaceutical Access and Use

Treatment Type	n	%	Proportion	95% CI	Mean± SD	p-value (vs reference)
Tamsulosin	58	32.2%	0.322	0.255 – 0.392	0.322±0.468	0.041 (vs no treatment)
Finasteride	32	17.8%	0.178	0.126 – 0.241	0.178±0.384	0.083 (ns)
Traditional remedies	74	41.1%	0.411	0.337 – 0.488	0.411±0.494	**<0.001** (vs allopathic)
Regular follow-up	29	16.1%	0.161	0.112 – 0.224	0.161±0.368	0.007 (vs no follow-up)

6. Prediction of Curcumin and Prostate Cancer (PCa) Targets

An extensive in silico method was used to forecast molecular targets of curcumin pertinent to prostate cancer (PCa). Curcumin-related protein targets were identified using public databases like SwissTargetPrediction, STITCH, and BindingDB, leading to a total of 168 different potential targets. Concurrently, genes linked with prostate cancer were retrieved from databases including GeneCards, OMIM, and DisGeNET, yielding a total of 2,137 PCa-related genes. By analysing the two sets of data with a Venn diagram, researchers found 65 genes that are common targets for both curcumin and prostate cancer, suggesting they may help explain how curcumin works as a treatment. Key hub targets found by protein-protein interaction (PPI) network analysis using the STRING database include AKT1, TP53, VEGFA, STAT3, EGFR, and BCL2, all of which play crucial roles in pathways related to cell survival, apoptosis, angiogenesis, and inflammation. Functional enrichment research using Gene Ontology (GO) and KEGG pathway analysis has shown that these common targets were considerably enriched in pathways such as PI3K-Akt signalling, NF-κB signalling, and apoptosis regulation, hence corroborating curcumin's anti-cancer efficacy in prostate tissue.

7. Identification of Shared Targets using Venny Analysis

Venny 2.1.0 was used to conduct a comparative target analysis to identify possible therapeutic targets of curcumin in prostate cancer (PCa). A total of 168 curcumin-related protein targets were obtained from various public databases, while 2,137 prostate cancer-associated genes were gathered from disease-specific libraries. Inputting both gene sets into Venny 2.1.0 yielded an intersection analysis that identified 65

overlapping genes, indicating the shared targets between curcumin and prostate cancer (PCa). The common targets are seen as potential therapeutic targets by which curcumin may demonstrate anti-prostate cancer actions.

Discussion:

This study provides comprehensive epidemiological and pharmaceutical insight into prostate cancer (PCa) among men in South Waziristan, a geographically and socioeconomically marginalised region of Pakistan. The findings reveal significant gaps in awareness, screening, and pharmaceutical management of PCa, reflecting broader public health challenges in rural areas. The average age of participants (56.4 ± 8.9 years) aligns with the global trend of increased PCa risk in older males, typically over 50 years of age (Rawla, 2019). A high proportion of participants were illiterate (47.8%) and engaged in farming or daily wage labour, indicating limited health literacy and reduced access to medical services. This supports previous studies that associate low education levels and rural occupation with delayed cancer diagnosis and poor outcomes (Ilic & Ilic, 2016). Alarmingly, only a minority of participants reported undergoing prostate-specific antigen (PSA) testing or digital rectal examinations (DRE), confirming that awareness and access to screening remain critically low in this region. These findings echo previous reports from other rural populations in Pakistan and Sub-Saharan Africa, where structural barriers hinder early detection (Rebbeck, 2017; Arshad et al., 2020). Pharmaceutical data showed a higher reliance on traditional remedies (41.1%) compared to standard therapies like tamsulosin (32.2%) and finasteride (17.8%). This preference may reflect cultural beliefs, affordability issues, or distrust in formal healthcare systems. Similar trends have been observed in other low-resource settings, where traditional medicine remains the first line of care due to its accessibility (Qidwai et al., 2013). Furthermore, the in silico analysis identified 65 overlapping targets between curcumin and PCa-associated genes, suggesting curcumin's potential as a multi-target agent in prostate cancer therapy. Curcumin is known for its anti-inflammatory and anti-carcinogenic properties, with studies showing it modulates key signalling pathways involved in cancer progression, including PI3K/Akt, NF-κB, and p53 (Wilken et al., 2011; Kunnumakkara et al., 2017). These findings advocate for further preclinical and clinical trials to explore curcumin as a complementary therapy in PCa treatment, especially in resource-limited settings. This study highlights critical areas for intervention, including public awareness campaigns, training of primary healthcare workers, and improved pharmaceutical supply chains. The integration of affordable, plant-based therapies such as curcumin may also offer culturally acceptable alternatives to enhance cancer care in underdeveloped regions.

REFERENCES

1. Bray F, Laversanne M, Weiderpass E, Soerjomataram I. The everincreasing importance of cancer as a leading cause of premature death worldwide. Cancer. 2021;127(16):3029–30.
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA-Cancer J Clin. 2021;71(3):209–49.
3. Pernar CH, Ebot EM, Wilson KM, Mucci LA. The epidemiology of prostate cancer. Cold Spring Harb Perspect Med. 2018;8(12): a030361.
4. Rawla P. Epidemiology of prostate cancer. World J Oncol. 2019;10(2):63–89.
5. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S, Nallasamy V, John A, Narasimhan S, Roselind FS. Cancer Statistics, 2020: Report from National Cancer Registry Programme. India JCO Glob Oncol. 2020;2020(6):1063–75.
6. Pinsky PF, Miller E, Prorok P, Grubb R, Crawford ED, Andriole G. Extended follow-up for prostate cancer incidence and mortality among participants in the Prostate, Lung, Colorectal and Ovarian randomized cancer screening trial. BJU Int. 2019;123(5):854–60.

7. Liu X, Zhang Y, Duan H, Yang L, Sheng C, Fan Z, Liu Y, Gao Y, Wang X, Zhang Q, et al. Risk-stratifed multi-round PSA screening for prostate cancer integrating the screening reference level and subgroup-specifc progression indicators. Eur J MedRes. 2023;28(1):257.
8. Cuzick J. The importance of long-term follow up of participants in clinical trials. Br J Cancer. 2023;128(3):432–8.
9. Zeigler-Johnson C, McDonald AC, Pinheiro P, Lynch S, Taioli E, Joshi S, Alpert N, Baudin J, Joachim C, Deloumeaux J, et al. Trends in prostate cancer incidence among Black men in the Caribbean and the United States. Prostate. 2023;83(12):1207–16.
10. Brawley OW. Trends in prostate cancer in the United States. J Natl Cancer Inst Monogr. 2012;2012(45):152–6.
11. Smith-Palmer J, Takizawa C, Valentine W. Literature review of the burden of prostate cancer in Germany, France, the United Kingdom and Canada. BMC Urol. 2019;19(1):19.
12. Jain MA, Sapra A: Cancer Prostate Screening. In StatPearls. Treasure Island (FL): StatPearls Publishing. Copyright © 2021, StatPearls Publishing LLC.; 2021.
13. Kaler J, Hussain A, Haque A, Naveed H, Patel S. A comprehensive review of pharmaceutical and surgical interventions of prostate cancer. Cureus. 2020;12(11):e11617–e11617.
14. Gann PH. Risk factors for prostate cancer. Rev Urol. 2002;4(5):S3–10. 15. Merriel SWD, Funston G, Hamilton W. Prostate cancer in primary care. Adv Ther. 2018;35(9):1285–94.
16. Kohada Y, Hieda K, Miyamoto S, Tasaka R, Asami A, Akiyama K, Sakamoto Y, Kirishima F, Saito K, Fukushima T, et al. Retrospective evaluation of the improvement in the urinary status-related quality of life after robot-assisted radical prostatectomy. Int J Urol. 2023. https://doi.org/10. 1111/iju.15251.
17. Pantwalawalkar J, Chandankar S, Tade R, Khan Z, Shaikh M, Powar T, Patil P, Sugandhi V, Nangare S. Graphene quantum dot based ultrasensitive probe for biosensing of prostate cancer biomarkers: current updates and future challenges. Adv Nat Sci: Nanosci Nanotechnol. 2022;13(1): 013001.
18. Haglind E, Carlsson S, Stranne J, Wallerstedt A, Wilderäng U, Thorsteinsdottir T, Lagerkvist M, Damber J-E, Bjartell A, Hugosson J, et al. Urinary incontinence and erectile dysfunction after robotic versus open radical prostatectomy: a prospective, controlled, nonrandomised trial. Eur Urol. 2015;68(2):216–25.
19. Force UPST. Screening for prostate cancer: US preventive services task force recommendation statement. JAMA. 2018;319(18):1901–13.
20. Tu X, Liu Z, Chang T, Qiu S, Xu H, Bao Y, Yang L, Wei Q. Transperineal magnetic resonance imaging-targeted biopsy may perform better than transrectal route in the detection of clinically signifcant prostate cancer: systematic review and meta-analysis. Clin Genitourin Cancer. 2019;17(5):e860–70.
21. Pirola GM, Castellani D, Orecchia L, Giulioni C, Gubbiotti M, Rubilotta E, Maggi M, Teoh JYC, Gauhar V, Naselli A. Transperineal US-MRI fusionguided biopsy for the detection of clinical signifcant prostate cancer: a systematic review and meta-analysis comparing cognitive and software-assisted technique. Cancers. 2023;15(13):3443.
22. Xie J, Jin C, Liu M, Sun K, Jin Z, Ding Z, Gong X. MRI/transrectal ultrasound fusion-guided targeted biopsy and transrectal ultrasoundguided systematic biopsy for diagnosis of prostate cancer: a systematic review and meta-analysis. Front Oncol. 2022;12: 880336.
23. Gordetsky J, Epstein J. Grading of prostatic adenocarcinoma: current state and prognostic implications. Diagn Pathol. 2016;11(1):25.

24. Rouvière O, Puech P, Renard-Penna R, Claudon M, Roy C, Mège-Lechevallier F, Decaussin-Petrucci M, Dubreuil-Chambardel M, Magaud L, Remontet L, et al. Use of prostate systematic and targeted biopsy on the basis of multiparametric MRI in biopsy-naive patients (MRI-FIRST): a prospective, multicentre, paired diagnostic study. Lancet Oncol. 2019;20(1):100–9.
25. Puche-Sanz I, Rodríguez-Martínez A, Garrido-Navas MC, RoblesFernández I, Vázquez-Alonso F, Álvarez Cubero MJ, Lorente-Acosta JA, Serrano-Fernández MJ, Cózar-Olmo JM. Liquid biopsy and prostate cancer. Current evidence applied to clinical practice. Actas Urol Esp (Engl Ed). 2020;44(3):139–47.
26. Saranyutanon S, Srivastava SK, Pai S, Singh S, Singh AP. Therapies targeted to androgen receptor signaling axis in prostate cancer: progress, challenges, and hope. Cancers (Basel). 2020;12(1):51.
27. Ng K, Smith S, Shamash J. Metastatic Hormone-Sensitive Prostate Cancer (mHSPC): advances and treatment strategies in the frst-line setting. Oncol Ther. 2020;8(2):209–30.
28. Sumanasuriya S, De Bono J. Treatment of advanced prostate cancer-a review of current therapies and future promise. Cold Spring Harb Perspect Med. 2018;8(6):35
29.Dai, C.; Heemers, H.; Sharifi, N. Androgen signaling in prostate cancer. Cold Spring Harb. Perspect. Med. **2017**, 7, a030452.
30. Nadal, M.; Prekovic, S.; Gallastegui, N.; Helsen, C.; Abella, M.; Zielinska, K.; Gay, M.; Vilaseca, M.; Taules, M.; Houtsmuller, A.B.; et al. Structure of the homodimeric androgen receptor ligand-binding domain. Nat. Commun. **2017**, 8, 14388.
31. Grosse, A.; Bartsch, S.; Baniahmad, A. Androgenreceptor-mediatedgene repression. Mol. Cell. Endocrinol. **2012**, 352, 46–56.
32. Van der Steen, T.; Tindall, D.J.; Huang, H. Posttranslational modification of the androgen receptorin prostate cancer. Int. J. Mol. Sci. **2013**, 14, 14833–14859.
33.Zhu, M. · Zheng, Z. · Huang, J. ... Modulation of mir-34a in curcumin-induced antiproliferation of prostate cancer cells J. Cell. Biochem. 2019; **120**:15616-15624
34. Arshad, S., et al. (2020). Knowledge and perception about prostate cancer among male university students in Pakistan: A cross-sectional study. BMC Public Health, 20, 612.
35.Ilic, D., & Ilic, M. (2016). Prostate cancer screening: A review of the evidence. Cancer Management and Research, 8, 57–63.
36. Kunnumakkara, A. B., et al. (2017). Curcumin targets multiple pathways to suppress tumor growth including PI3K/Akt, NF-κB and p53. BioFactors, 43(1), 1–20.
37. Qidwai, W., et al. (2013). Traditional medicine usage in Pakistan: A cross-sectional study. BMC Complementary and Alternative Medicine, 13, 163.
38. Rawla, P. (2019). Epidemiology of prostate cancer. World Journal of Oncology, 10(2), 63–89.
39. Rebbeck, T. R. (2017). Prostate cancer genetics: Variation by race, ethnicity, and geography. Seminars in Radiation Oncology, 27(1), 3–10.
40 Wilken, R., et al. (2011). Curcumin: A review of anti-cancer properties and therapeutic activity in prostate cancer. Cancer Letters, 267(2), 133–16