CANADIAN JOURNAL OF UROLOGY

Tech Science Press

Doi:10.32604/cju.2026.075599
ARTICLE

Association of online health information exposure with disease awareness initial symptom severity in benign prostatic hyperplasia: a cross-sectional study

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GUO X, CHANG M, HAO G, ZHANG F, XIA H. Association of online health information exposure with disease awareness initial symptom severity in benign prostatic hyperplasia: a cross-sectional study. *Can J Urol* 2026;33(3):573–582.

Background: *Benign prostatic hyperplasia (BPH) is prevalent among aging men. Whether exposure to internet-derived health information is associated with disease awareness and symptom burden at initial diagnosis remains unclear.*
Methods: *We conducted a cross-sectional study of 400 newly diagnosed BPH outpatients. Participants were classified by prior exposure to internet-derived BPH content. BPH awareness and International Prostate Symptom Scores (IPSS) were compared using the Mann-Whitney U test and multivariate linear regression adjusted for age, education, and disposable income. Stratified analyses were performed according to educational attainment, disposable income, and content format.*
Results: *Exposure to internet-derived BPH content was independently associated with higher awareness and lower IPSS. Compared with unexposed participants, exposed participants had higher awareness (median 1.5 vs. 0) and lower IPSS (median 7.0 vs. 10.5) (both $p < 0.001$). In multivariable models, being unexposed was associated with a 1.39-point lower awareness score and a 2.20-point higher IPSS (both $p < 0.001$). In stratified analyses, the associations remained significant across education and income strata. Among exposed participants, those accessing text-based or mixed-format content had higher awareness and lower IPSS than those exposed to videos only (both $p < 0.001$).*
Conclusions: *This study shows that exposure to internet-derived health content is significantly associated with higher BPH awareness and a lower symptom burden at initial presentation. Text-based or mixed-format content may be more effective than video-only formats.*

Key Words: Benign prostatic hyperplasia, internet-derived health content, disease awareness, international prostate symptom score, cross-sectional survey

Introduction

Benign prostatic hyperplasia (BPH) is the most prevalent nonmalignant urological condition among aging men and a major contributor to lower urinary tract symptoms worldwide.[1] Delayed recognition and management frequently lead to greater prostate enlargement, more severe symptoms, and higher complication risks. Although effective medical

Received date 04 November 2025
Accepted for publication 27 January 2026
Published online 26 June 2026

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therapies—particularly α-blockers combined with 5α-reductase inhibitors—can alleviate symptoms and reduce the need for surgery,[2,3] suboptimal awareness and late presentation remain common.[4]

The widespread use of the internet and social media platforms has expanded public access to medical knowledge, with the stated goal of improving health awareness and promoting early detection and treatment of diseases.[5] However, the real-world effectiveness of such information remains uncertain. Understanding its actual impact and determinants is essential. Such evidence can help policymakers decide whether to promote digital health education and how to design efficient and equitable implementation strategies.

To address this gap, we conducted a cross-sectional study to examine whether exposure to online health information is associated with disease awareness and symptom severity at initial presentation among men with newly diagnosed BPH, and to identify the factors that may influence this association.

Methods

Study design and ethical approval

This cross-sectional observational study was conducted between August 2023 and February 2025 at the outpatient urology clinic of Beijing Friendship Hospital. Newly presenting male patients aged 50 to 80 years with lower urinary tract symptoms (LUTS) were screened sequentially during routine outpatient visits. Participants were enrolled into the exposed or non-exposed cohort using a quota-based approach, with recruitment continuing until 200 eligible participants per cohort were obtained, after which enrollment was stopped. All participants provided written informed consent before participation. Data were anonymized, and the study protocol was approved by the Ethics Committee of Beijing Friendship Hospital, Capital Medical University (Approval No. BFH20230711002; approval date: 15 August 2023).

Eligibility criteria

Eligibility criteria required participants to have confirmed decision-making capacity and the ability to independently operate a personal computer or smartphone. Participants in the exposed group were required to provide verifiable records demonstrating exposure to BPH-related educational content, defined as at least five complete viewings/reads of content from five distinct sources (repeat viewing of the same item was not counted). "Verifiable records" referred to app-based viewing histories and/or browser histories that could confirm engagement with the content. For video-based resources, verification required evidence indicating that the video had been watched in full (e.g., completion status or full-duration playback in the app/client record). For text-based resources, verification relied on browser history documenting access to the specific page/article; the extent of reading could not be objectively quantified. All records were independently reviewed by a physician and an assistant physician, and eligibility was confirmed only when both reviewers agreed. Among 642 screened patients, 34 declined participation, 85 were excluded due to inability to independently use a smartphone or personal computer to search for BPH-related content, and 123 were excluded because self-reported exposure could not be verified or did not meet the ≥5-viewing criterion. Individuals with no prior exposure to BPH-related content were assigned to the non-exposed group. The recruitment process is shown in Figure 1.

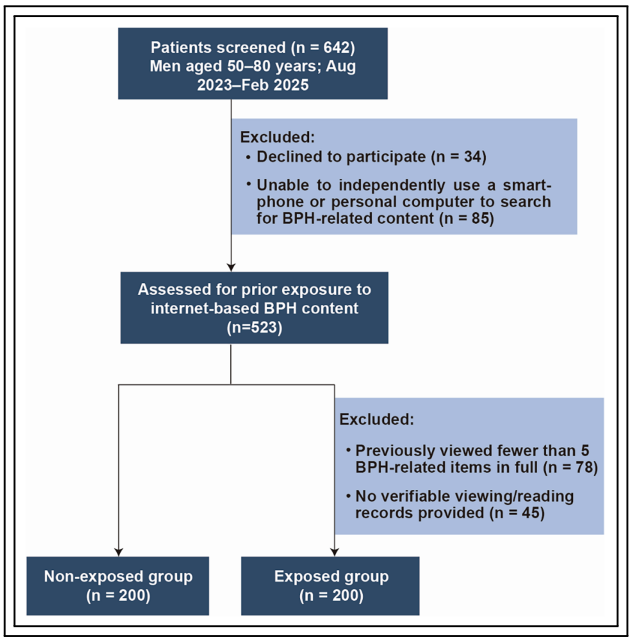

FIGURE 1. Participant recruitment and allocation were derived from exposure to internet-derived benign prostatic hyperplasia (BPH) content. Note. Exposure status was self-reported and verified during in-person interviews. Recruitment ceased once 200 participants were enrolled in each group.

Data collection and questionnaire

Data on age, education, and disposable income were collected via face-to-face interviews conducted by attending or senior urologists. The survey instrument consisted of two parts. The first was a self-developed five-item BPH awareness questionnaire designed to assess basic BPH awareness, including:

Q1: Can BPH cause nocturia?
Q2: Can BPH develop into prostate cancer?
Q3: Do all patients with BPH require surgery?
Q4: In which age group is BPH most prevalent?
Q5: What is the most common symptom of BPH?

Each correct response was scored as one point, yielding a total possible score of 0 to 5 (Supplement Material). The second part was the IPSS questionnaire, used to quantify symptom severity.[6]

Statistical analysis

Descriptive and inferential statistical analyses were performed using R software (version 4.2.2) with base R functions and package [car]. Continuous variables were summarized as medians and interquartile ranges (IQRs), and categorical variables as counts and percentages. Two-sided p-values < 0.05 were considered statistically significant. Between-group comparisons for continuous variables, including BPH awareness and IPSS scores, were conducted using the Mann-Whitney U test because these data were non-normally distributed. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Multivariate linear regression models, adjusted for age, education level, and income, were applied to assess the associations between media exposure and both BPH awareness and IPSS scores. Subgroup analyses were performed based on educational attainment, disposable income, and content format accessed. Internal consistency of the 5-item awareness score was assessed using Cronbach's alpha. Given the exploratory nature of the study, no adjustments were made for multiple comparisons. Given the very small number of participants who accessed text-only content (n = 4), this subgroup was not analyzed separately and was combined with the mixed-format group for statistical analyses.

Results

Baseline characteristics of participants

A total of 400 men aged 50 to 80 years with newly diagnosed BPH were enrolled, including 200 individuals with prior exposure to internet-derived BPH content and 200 without such exposure. Participants in the non-exposed group were significantly older than those in the exposed group (median age 67.0 years vs. 63.0 years; $p < 0.001$). Educational attainment did not differ significantly between groups, with 9.5% of individuals in the exposed group and 7.0% in the non-exposed group holding a bachelor's degree or higher ($p = 0.467$). Notably, a higher proportion of participants in the exposed group reported a monthly disposable income exceeding RMB 5000 compared with the non-exposed group (44.0% vs. 29.5%; $p = 0.004$). At presentation, the median IPSS score was lower among exposed

TABLE 1. **Baseline characteristics of participants by exposure to internet-derived benign prostatic hyperplasia (BPH) content**

Characteristic	Exposed (n = 200)	Non-Exposed (n = 200)	*p*-value
Age (years), median (IQR)	63.0 (59.0, 70.0)	67.0 (61.0, 73.0)	<0.001
Education, n (%)			0.467
Bachelor or above	19 (9.5)	14 (7.0)	
Below bachelor	181 (90.5)	186 (93.0)	
Monthly disposable income, n (%)			0.004
Over 5000RMB	88 (44.0)	59 (29.5)	
Under 5000RMB	112 (56.0)	141 (70.5)	
IPSS score, median (IQR)	7.0 (5.0, 11.0)	10.5 (8.0, 14.0)	<0.001
Content format (within exposed group), n (%)			–
Video only	144 (72.0)	–	
Text only	4 (2.0)	–	
Both video and text	52 (26.0)	–	

Note. Abbreviations: IQR, interquartile range; IPSS, International Prostate Symptom Score.

individuals than among their non-exposed counterparts (7.0 vs. 10.5; $p < 0.001$). Among the exposed group, 72.0% had accessed content exclusively via video platforms, 2.0% exclusively through text-derived platforms, and 25.5% through both formats (Table 1).

Influence of internet-derived BPH content on disease awareness and IPSS scores

The 5-item awareness score showed acceptable internal consistency (Cronbach's $\alpha = 0.74$). As shown in Tables 2 and 3, multivariable linear regression demonstrated that internet-derived BPH content exposure was independently associated with higher awareness and lower IPSS. Specifically, compared with exposed participants, the non-exposed group had a 1.39-point lower awareness score ($\beta = -1.392$; 95% CI, −1.612 to −1.173; $p < 0.001$) and a 2.20-point higher IPSS ($\beta = 2.201$; 95% CI, 1.476 to 2.926; $p < 0.001$). No significant exposure-by-age, exposure-by-education, or exposure-by-income interaction terms were observed, and multicollinearity was low (all VIFs < 5). Consistently, exposed participants demonstrated greater disease awareness (median: 1.5 vs. 0; $p < 0.001$) and lower IPSS scores (median: 7 vs. 10; $p < 0.001$), as illustrated in Figure 2. In interaction models (Supplementary Tables S1 and S2), the exposure×education and exposure×income terms were not statistically significant for either awareness (Non-exposed×Below college: $\beta = 0.774$, $p = 0.076$; Non-exposed×Income <5000RMB: $\beta = 0.142$, $p = 0.569$) or IPSS (Non-exposed × Below college: $\beta = -1.766$, $p = 0.221$; Non-exposed × Income <5000RMB: $\beta = 0.856$, $p = 0.300$).

TABLE 2. **Multivariate linear regression analysis of factors associated with benign prostatic hyperplasia (BPH) awareness scores**

Predictor	Estimate	SE	*t*-value	*p*-value	VIF
Intercept[#]	4.878	0.546	8.934	<0.001	
Internet-derived BPH content					1.063
Non-exposed	−1.392	0.112	−12.427	<0.001	
Educational attainment					1.184
Below college level	−1.623	0.215	−7.555	<0.001	
Monthly disposable income					1.209
Less than 5000RMB	−0.613	0.124	−4.948	<0.001	
Age	−0.016	0.008	−1.954	0.051	1.042

Note. [#]Represents reference level. VIF (Variance Inflation Factor) is used to assess multicollinearity, with all values <2 indicating low risk. Abbreviations: SE, standard error.

TABLE 3. **Multivariate linear regression analysis of factors associated with International Prostate Symptom Scores (IPSS)**

Predictor	Estimate	SE	*t*-value	*p*-value	VIF
Intercept[#]	−3.003	1.805	−1.663	0.097	
Internet-derived BPH content					1.123
Non-exposed	2.201	0.370	5.940	<0.001	
Educational attainment					1.094
Below college level	0.122	0.026	4.594	<0.001	
Monthly disposable income					1.350
Less than 5000RMB	2.690	0.710	3.786	<0.001	
Age	1.431	0.410	3.4920	0.001	1.047

Note. [#]Represents reference level. VIF (Variance Inflation Factor) is used to assess multicollinearity, with all values <2 indicating low risk. Abbreviations: SE, standard error.

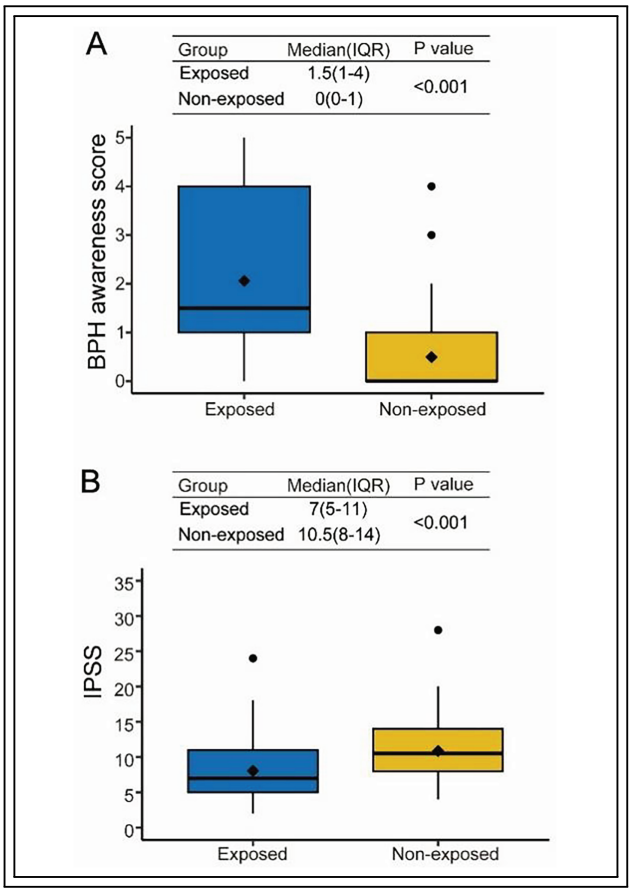

FIGURE 2. Effect of internet-derived BPH content on disease awareness and symptom burden. (**A**) Boxplot comparing BPH awareness scores between participants with and without prior exposure to internet-based BPH content; (**B**) Boxplot comparing IPSS between the two groups. Abbreviations: BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; IQR, interquartile range.

Stratified analysis by education

Among individuals with a bachelor's degree or higher, those exposed to internet-derived BPH content scored significantly higher in disease awareness (median: 4 vs. 2; $p < 0.001$) and reported lower symptom burden (median: 5 vs. 9; $p < 0.001$), as shown in Figure 3A,B. In participants with education below college level, the effect remained significant: disease awareness scores were higher (median: 1 vs. 0; $p < 0.001$), and IPSS scores were lower (median: 8 vs. 11; $p < 0.001$), consistent with the findings presented in Figure 3C,D.

Stratified analysis by monthly disposable income

In participants with a monthly disposable income >5000RMB, internet-derived BPH content was associated with improved disease awareness (median: 3 vs. 1; $p < 0.001$) and lower IPSS scores (median: 6 vs. 9; $p < 0.001$), as illustrated in Fig. 4A,B. In those with income <5000RMB, disease awareness scores remained higher in the exposed group (median: 1 vs. 0; $p < 0.001$), and IPSS scores were lower (median: 9 vs. 11; $p < 0.001$), as depicted in Figure 4C,D.

Effect of online content format

Among the exposed group, participants who accessed both videos and text-derived content showed superior awareness scores compared to those who accessed only videos (median: 4 vs. 1; $p < 0.001$). IPSS scores were also significantly lower in this group (median: 5 vs. 9; $p < 0.001$), as shown in Figure 5.

Discussion

BPH is the most prevalent urological condition among older men and contributes substantially to the global burden of lower urinary tract symptoms.[7,8] A population-derived study conducted in East Asia found that 34.0% of respondents reported moderate to severe symptoms, with prevalence rates of 39.8% and 43.2% in the 55–60 and >60 age groups, respectively.[9,10] Given that delayed management is associated with worse outcomes, early recognition and intervention are clinically important. Current guidelines emphasize proactive monitoring and timely treatment to alleviate symptoms, preserve bladder function, and prevent complications. In addition, early recognition of LUTS and simple behavioral modifications, such as limiting fluid intake before bedtime and adopting timed voiding, can improve quality of life and reduce healthcare burdens.[11]

In this cross-sectional study, we observed that exposure to internet-derived BPH content was significantly associated with greater disease awareness and lower IPSS scores, suggesting that online health information may facilitate earlier recognition and care-seeking for BPH. Although few studies have directly examined the impact of social media-based information exposure on disease awareness, several have explored the potential of digital platforms in enhancing health literacy.[5] For instance, in cardiovascular disease management, WeChat-based mobile health interventions have been shown to improve medication adherence and patient understanding of secondary prevention in coronary heart disease,[12,13]

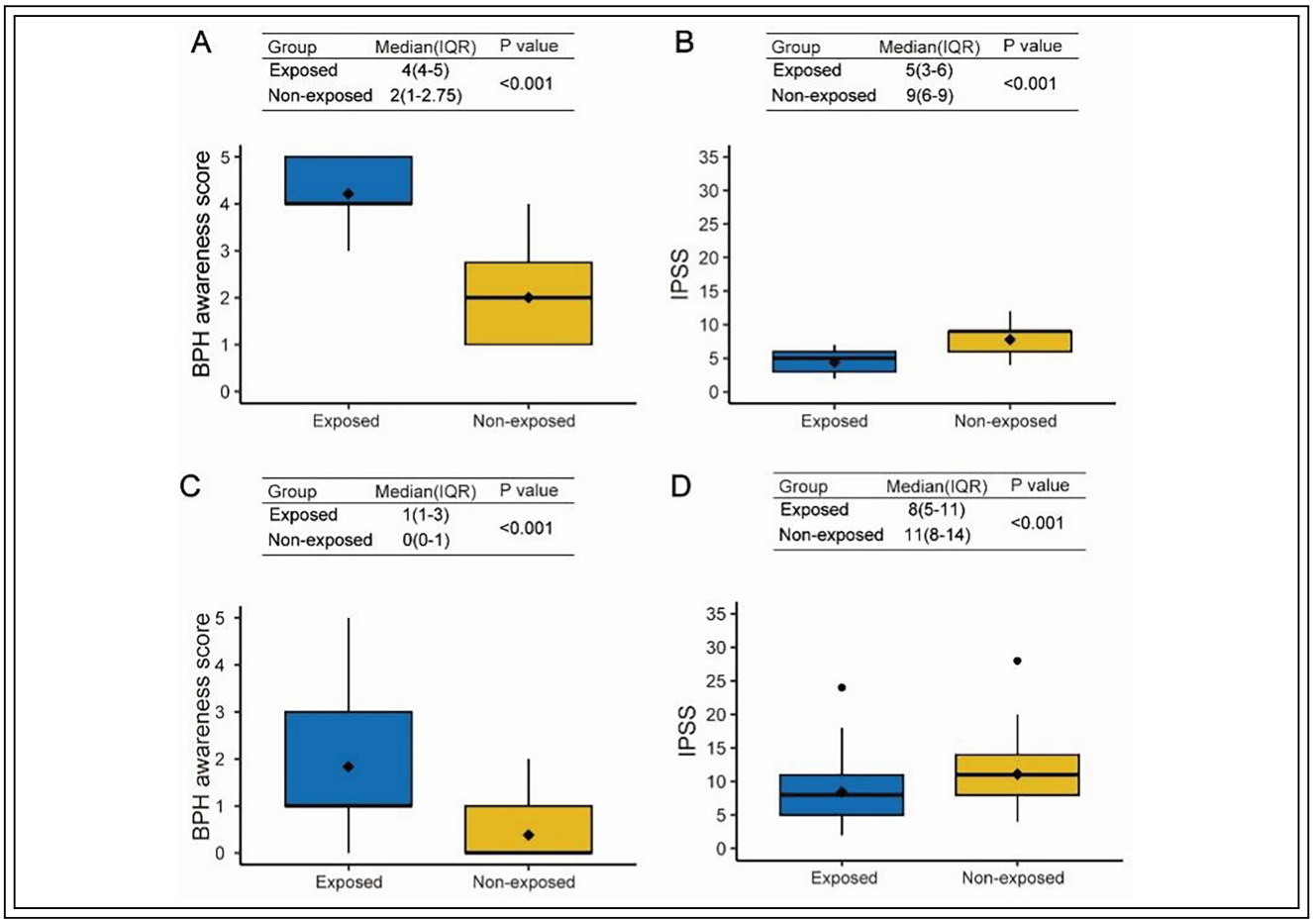

FIGURE 3. Stratified analyses of the impact of internet-derived BPH content by educational attainment. (**A**) BPH awareness and (**B**) IPSS scores among participants with a bachelor's degree or above, comparing those exposed versus unexposed to internet-based BPH content. (**C**) BPH awareness and (**D**) IPSS scores among participants with educational attainment below bachelor level. Abbreviations: BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; IQR, interquartile range.

and a smartphone- and social media-based cardiac rehabilitation program further enhanced patient education and long-term behavioral change.[14] Likewise, in diabetes management, Yang et al. reported that a structured education model delivered via mobile platforms significantly improved glycemic control and disease-related knowledge,[15] while Zhang et al. demonstrated that both patients and endocrinologists widely recognized the value of mobile applications in facilitating patient education and long-term management.[16] Together with our findings, these results suggest that internet- and social media–based health education may positively influence patients even before a formal diagnosis is made.

The interaction analyses did not provide statistical evidence that the association between exposure to internet-derived health content and outcomes differed by educational attainment or disposable income. Nevertheless, in stratified descriptive comparisons, the absolute differences between exposed and non-exposed participants appeared numerically larger among individuals with higher education and higher income. Prior study suggested that each additional year of education has been associated with a significant increase in digital health literacy scores.[17,18] Conversely, individuals with lower educational attainment are more susceptible to misinformation and may lack the skills to discern credible online health resources. One systematic review reported that individuals with low health literacy had a 20% lower accuracy rate in evaluating online information quality ($p < 0.001$), potentially limiting their capacity to benefit from online health content.[19]

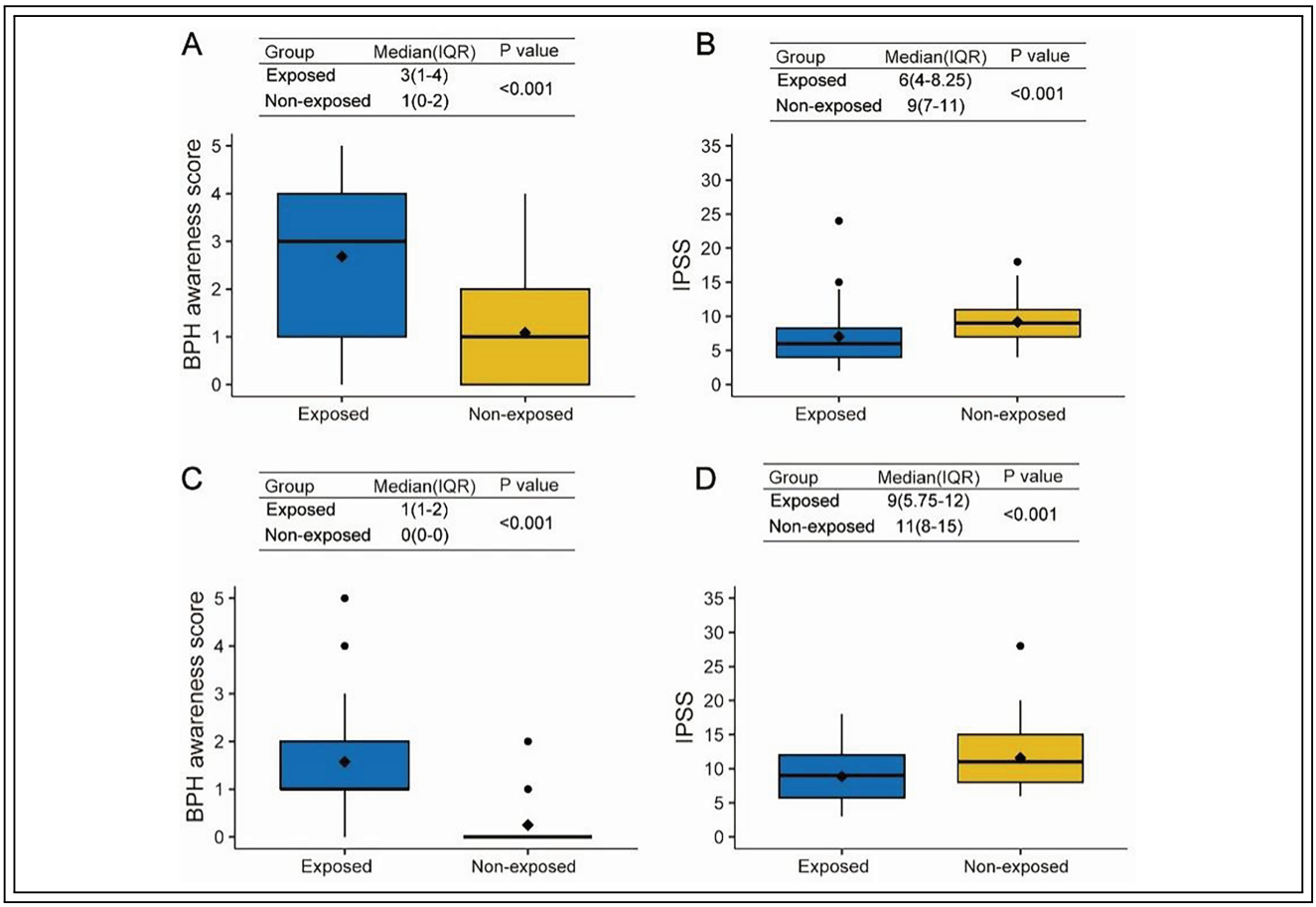

FIGURE 4. Stratified analyses of the impact of internet-derived BPH content by monthly disposable income. (**A**) BPH awareness and (**B**) IPSS scores among participants with a monthly disposable income greater than RMB 5000, comparing exposed and non-exposed groups. (**C**) BPH awareness and (**D**) IPSS scores among participants with income less than RMB 5000. Abbreviations: BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; IQR, interquartile range.

We also observed similar patterns when stratifying by disposable income. This may partly reflect the overlap between education and income levels. Moreover, affluent individuals are more likely to engage in health-promoting behaviors. For instance, a population-derived study in the Netherlands found that digital health technology usage was significantly higher among individuals with higher income or education, both before and during the COVID-19 pandemic.[20] European data also indicate that individuals with lower socioeconomic position—including lower income—had significantly higher odds of inadequate health literacy, which in turn was associated with poorer health outcomes.[21] In addition, a nationally representative CHARLS study found that higher-income older adults were more likely to undergo annual physical examinations.[22] Collectively, these findings suggest that socioeconomic factors may shape how effectively individuals access and utilize internet-derived health content, even when formal tests do not show significant effect modification in our sample.

Notably, participants who accessed text-based content (alone or combined with video) had higher knowledge scores than those who accessed video-only content ($p < 0.001$). This suggests that content modality matters. Text platforms offer structured, in-depth educational materials conducive to comprehension and long-term retention.[5,23] Moreover, health content on text-derived media is more frequently produced by medical institutions and certified professionals, thereby enhancing its perceived credibility and trustworthiness.[24] From the perspective of the

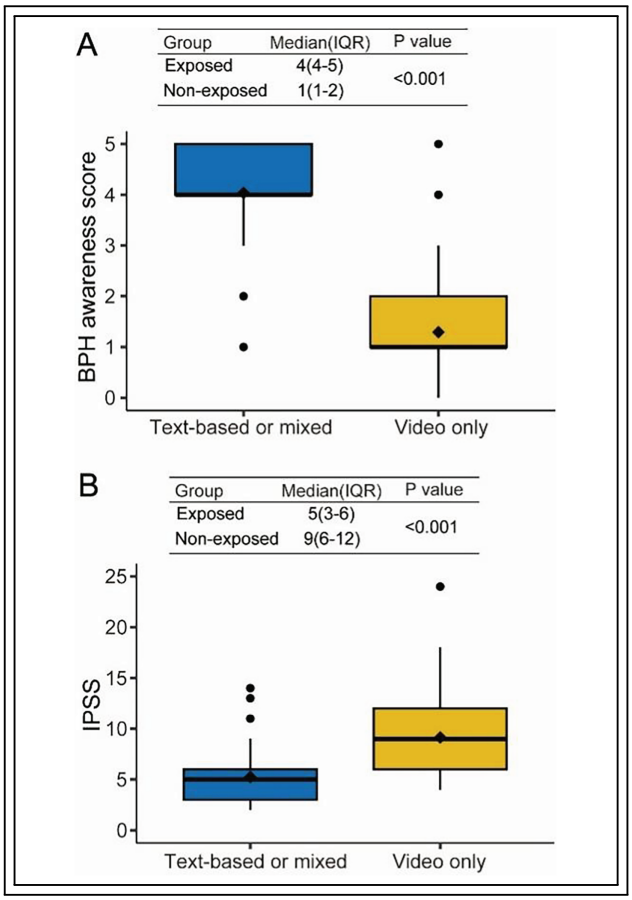

FIGURE 5. Comparison of content format on BPH awareness and IPSS scores. (**A**) BPH awareness scores among participants exposed to text-based or mixed-format content versus video-only exposure. (**B**) IPSS scores for participants by content format. Abbreviations: BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; IQR, interquartile range.

elaboration likelihood model, text-derived materials encourage central processing, whereas videos may rely on peripheral cues and result in more transient learning outcomes.[23] Quality concerns also persist for health videos on video platforms. For example, existing studies have noted substantial variability and potential misinformation in health content related to chronic obstructive pulmonary disease and cardiovascular diseases,[25,26] with similar issues also observed in information concerning the diagnosis and treatment of prostate cancer.[27–30]

This study has several limitations. First, it was conducted at a single tertiary center, potentially limiting the generalizability of the findings to other geographic regions or healthcare settings, particularly those with different levels of digital access and health literacy. Second, selection bias may have been introduced, as individuals who were more inclined to participate in a health-related survey may also have had greater baseline health awareness or digital engagement. Third, exposure misclassification cannot be ruled out, as the source and credibility of the accessed health content—whether from official channels or unverified creators—were not systematically assessed, which may have led to heterogeneous exposure effects. Fourth, given the cross-sectional design of the study, causal inferences regarding the impact of internet-derived health content on disease knowledge or symptom burden cannot be established. Longitudinal or interventional studies are warranted to confirm these associations and assess temporal dynamics. Finally, although multivariable models were used, residual confounding by unmeasured factors such as health-seeking behavior or comorbid conditions may still exist.

Conclusions

This study shows that exposure to internet-derived health content is significantly associated with higher BPH awareness and a lower symptom burden at initial presentation, and these associations were observed across education and income strata. Furthermore, participants who accessed text-based or mixed-format content showed more favorable awareness and symptom scores than those who relied solely on video content. These findings support incorporating digital health education into patient-centered health promotion strategies and suggest that text-based or mixed-format content may be more effective.

Acknowledgement

None.

Funding Statement

Funding for this work was provided by grant KM202410025014 from Beijing Municipal Education Commission, grant L251006 from Beijing Natural Science Foundation, and by grant No. YYZZ202318 from Beijing Friendship Hospital, Capital Medical University.

Author Contributions

Xiaoxiao Guo and Haoran Xia had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Concept and design: Xiaoxiao Guo, Haoran Xia. Acquisition, analysis, or interpretation of data: Xiaoxiao Guo, Mingyu Chang, Fengbo Zhang. Drafting of the manuscript: Xiaoxiao Guo. Critical review of the manuscript for important intellectual content: All authors. Statistical analysis: Xiaoxiao Guo, Gangyue Hao. Obtained funding: Xiaoxiao Guo, Haoran Xia. Supervision: Fengbo Zhang, Gangyue Hao. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request, subject to institutional ethical approval and data-sharing regulations.

Ethics Approval and Informed Consent

The study protocol was approved by the Ethics Committee of Beijing Friendship Hospital, Capital Medical University (Approval No. BFH20230711002; approval date: August 15, 2023). All participants provided written informed consent prior to participation. All data were anonymized before analysis.

Conflicts of Interest

The authors declare no conflicts of interest.

Supplementary Materials

The supplementary material is available online at https://www.techscience.com/doi/10.32604/cju.2026.075599/s1.

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