JOMH
Journal of Men's Health

Original Article
DOI: 10.31083/jomh.v16i3.296

IS DIGITAL RECTAL EXAMINATION STILL VALUABLE FOR MEASURING THE PROSTATE VOLUME IN CLINICAL PRACTICE?

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Submitted: 29 July 2020. Accepted: 09 September 2020. Published: 30 September 2020.

ABSTRACT

Background and objective

To investigate the usefulness of digital rectal examination (DRE), a cost-effective and simple way to measure prostate volume versus transrectal ultrasound (TRUS), and the gold standard method for measuring prostate volume.

Material and methods

From 2018 to 2019, a total of 580 patients who underwent DRE and TRUS for the initial evaluation of benign prostatic hyperplasia (BPH) were included in this study. DRE was performed twice at two appointments by a single urologist, and TRUS was performed once by a single radiologist. The patients were divided into seven groups according to TRUS-estimated prostate volume (A, <30 cc; B, 30–39 cc; C, 40–49 cc; D, 50–59 cc; E, 60–69 cc; F, 70–79 cc; G, >80 cc). We investigated the agreement between the TRUS and DRE measurements.

Results

There was a high percent agreement of DRE and TRUS in groups B–D (84.6, 84.1, and 79.1%, respectively). The highest over- and underestimations of prostate volume on DRE were 23.1 and 79.5% in groups A and G, respectively. In the Bland–Altman plot, the mean difference between TRUS and DRE in group A–D was closer to zero-line than that in groups E–G. The variability in differences between TRUS and DRE in groups A, B, and C was lower than that in groups D, E, F, and G.

Conclusion

DRE was accurate in measuring the prostate volume of 30~49 cc. We suggested that DRE remains a simple and cost-effective method for measuring prostate volume.

Keywords: *digital rectal examination; prostate volume; transrectal ultrasound*

J Mens Health Vol 16(3):e147–e155; 30 September 2020

INTRODUCTION

Benign prostatic hyperplasia (BPH) is the most common urologic disease in aging men.[1,2] As the incidence of BPH increases with age, it is important for urologists to decide the most appropriate treatment strategies (e.g., medication, surgical intervention) for patients with BPH. Accordingly, several recent studies have investigated the ability of several factors, especially prostate volume, to predict the treatment outcomes of men with BPH. They demonstrated a correlation between prostate volume and symptoms.[3,4] In addition, a cohort study showed that the risk of acute urinary retention (AUR) (>30 mL) in men with an enlarged prostate is three times more than in men without an enlarged prostate. These studies concluded that prostate volume is an important prognostic factor for the proper treatment of BPH.[5]

Transrectal ultrasound (TRUS) is the most commonly used method for estimating prostate volume in the evaluation of BPH in the clinical setting. Several studies have demonstrated that prostate volume measured by planimetry in TRUS is very close to the actual prostate volume, making it the gold standard method for measuring prostate volume.[6] However, digital rectal examination (DRE) is the simplest way to estimate prostate volume in clinical practice. DRE is still a commonly used examination technique for assessing a patient presenting with BPH/lower urinary tract symptoms (LUTS). Its use is also recommended by the latest guidelines from the American Urological Association and the European Association of Urology.[7] Although there can be a disparity between the prostate volume measured by DRE and the actual prostate volume, many urologists still use DRE as a simple and cost-effective way to assess the degree of prostatic enlargement and treatment response depending on prostate volume in real practice.

TRUS can now be used without any financial burden because it is now covered by the Korean medical insurance system. Therefore, one of the advantages of DRE, cost-effectiveness, has lost its sheen. Here, we investigated the usefulness of DRE versus TRUS for estimating prostate volume.

MATERIALS AND METHODS

Data Collection

After the study was approved by the Institutional Review Board of the Yeungnam University Medical Center, a total of 580 patients who underwent DRE and TRUS for the initial evaluation of BPH in the urologic outpatient department in 2018–2019 were enrolled in the study. In all patients, prostate-specific antigen (PSA), urinalysis, and International Prostate Symptom Score (IPSS) were assessed. Exclusion criteria were anal and/or rectal abnormalities, and history of prostate surgery.

Prostate Volume Measurement

In eligible patients, DRE was performed twice by a single urologist at the first visit and at a re-visit approximately 3–4 days later, and the prostate volume measured by DRE was estimated in 5-cc increments. TRUS was performed once by a single radiologist using a Falcon 2101 ultrasound machine. The prostate volume assessed on TRUS was calculated using the height–width–length method (transverse × longitudinal × anteroposterior × pi/6).

Study Design

We assessed the concordance of the prostate volumes on the two DRE trials and then calculated the average prostate volume estimated twice by DRE (mean DRE) to increase the value's accuracy and precision. In addition, after dividing the patients into seven groups according to TRUS-estimated prostate volume (A, <30 cc; B, 30–39 cc; C, 40–49 cc; D, 50–59 cc; E, 60–69 cc; F, 70–79 cc; G, >80 cc), we investigated the agreement between TRUS and DRE values of each group, including under- and overestimations. Because the prostate volume on DRE was measured in 5-cc increments, the agreement between TRUS and DRE was defined as follows: absolute values of the difference between prostate volumes estimated using two different measurement methods of less than 2.5 cc.

Statistical Analysis

The statistical analysis was performed using SPSS v19.0 for Windows. Clinical variables, such as age, IPSS, PSA level, and prostate volumes using the two measurement methods are expressed as mean and standard deviation (SD). Intraclass correlation coefficients (ICC) were used to determine the concordance of prostate volumes on the two DRE trials. The agreement between TRUS and DRE values for each group was assessed using percent agreement, and the Bland–Altman plot. P values < 0.05 were considered statistically significant.

RESULTS

The patients' clinical characteristics, including age, PSA level, IPSS, and prostate volumes measured using different methods by group are shown in Table 1. As prostate volume increased, the mean values of the clinical variables, such as age, PSA level, IPSS, and quality of life (QoL) increased. The ICC between the two DRE trials (Table 2) was statistically significant in all groups ($p<0.05$), and the concordance between prostate volumes based on the two DRE trials was excellent in all groups except group A (slight, ICC≤0.2; fair, 0.2<ICC≤0.4; moderate, 0.4<ICC≤0.6; good, 0.6<ICC≤0.8; and excellent, ICC>0.8).

The percent agreement, overestimation, and underestimation of DRE versus TRUS are shown in Table 3 and Figure 1. There was a high percent agreement between DRE and TRUS in groups B, C, and D (84.6, 84.1, and 79.1%, respectively). The highest over- and underestimations of prostate volume on DRE were 23.1 and 79.5% in groups A and G, respectively.

The mean difference and limit of agreement (LoA) between TRUS and DRE by group are shown in the Bland–Altman plots (Figure 2, Table 4). In groups A, B, C, and D, the mean difference between TRUS and DRE was −0.22, −0.04, 0.89, and 1.49, respectively, indicating that the DRE values of groups A, B, C, and D were more accurate than those of groups E, F, and G because the mean difference is close to the equivalency line (zero difference line). The variability in the difference between TRUS and DRE of groups A, B, and C was lower than that of groups D, E, F, and G, with a lower gap between the upper LoA and the lower LoA (10.92, 10.46, and 10.19 in groups A, B, and C, respectively). Thus, the agreement between TRUS and DRE was better in groups B and C than in groups A, D, E, F, and G.

DISCUSSION

BPH is a progressive disease for which poor correlations were reported between symptoms and other parameters, such as prostate volume, flow rate, and presence of obstruction in the population-based studies of BPH.[8] In spite of this, prostate volume is an important parameter for the treatment of BPH, especially for choosing an appropriate surgical modality.[9,10] Men with larger baseline prostate volumes tend to experience greater growth.[11] Hence, it is important to accurately measure prostate volume to adequately manage BPH in clinical practice.

As mentioned earlier, TRUS is commonly considered the gold standard method for measuring prostate volume.[6] Alkan et al. reported strong correlations between the prostate volume measured by TRUS and the specimens of prostatectomy or transurethral resection of the prostate in 119 patients with BPH or prostate cancer.[12] Magnetic resonance imaging (MRI) has also been used to estimate the prostate volume. Jeong et al. reported that prostate volume estimated by MRI was strongly correlated with actual prostate volume measured after radical prostatectomy.[13] However, as these methods are time-consuming and costly for assessing the prostate volume, they are seldom available for initial patient evaluations.[7,14] The use of TRUS can be limited, especially in patients without an anus, in the treatment of rectal cancer. In such cases,

TABLE 1 Characteristics of Clinical Variables of Patients.

	Groups							Total (n=580)
	A (<30cc, n=78)	**B (30~39cc, n=123)**	**C (40~49cc, n=113)**	**D (50~59cc, n=91)**	**E (60~69cc, n=68)**	**F (70~79cc, n=63)**	**G (>80cc, n=44)**	
Age (years)	58.64 ± 6.60	62.94 ± 5.35	67.27 ± 4.62	68.97 ± 3.98	69.91 ± 4.25	70.94 ± 4.43	73.00 ± 3.42	66.60 ± 6.50
PSA levels (ng/mL)	2.03 ± 1.63	2.16 ± 1.32	3.17 ± 1.71	3.45 ± 1.97	4.10 ± 2.30	4.23 ± 1.49	4.56 ± 1.78	3.17 ± 1.94
IPSS	10.74 ± 2.56	10.41 ± 2.13	12.38 ± 2.03	13.70 ± 2.01	14.15 ± 2.55	15.62 ± 2.91	16.02 ± 2.78	12.78 ± 3.05
QoL	1.45 ± 0.86	1.69 ± 1.04	2.59 ± 0.84	3.20 ± 0.95	3.49 ± 1.15	3.89 ± 1.00	4.07 ± 1.00	2.70 ± 1.33
Prostate volumes (cc)								
TRUS	23.38 ± 3.08	33.51 ± 2.73	42.04 ± 2.34	53.26 ± 2.75	62.97 ± 2.69	72.89 ± 2.77	84.52 ± 5.50	48.51 ± 18.48
DRE								
1st	23.59 ± 4.02	33.17 ± 4.01	41.06 ± 3.63	51.70 ± 4.30	59.19 ± 5.01	67.22 ± 5.37	75.34 ± 5.64	46.28 ± 16.33
2nd	23.65 ± 3.39	33.94 ± 3.91	41.24 ± 3.57	51.81 ± 4.86	58.75 ± 5.49	66.90 ± 4.95	75.11 ± 5.76	46.40 ± 16.07
Mean	23.62 ± 3.21	33.56 ± 3.73	41.15 ± 3.49	51.76 ± 4.45	58.97 ± 5.12	67.06 ± 4.93	75.23 ± 5.47	46.37 ± 16.14

Values are presented as mean±SD.
PSA, prostate-specific antigen; IPSS, international prostate symptom score; QoL, quality of life; TRUS, transrectal ultrasound; DRE, digital rectal examination.

transabdominal ultrasound can be used, but it is not very accurate. In addition, the insertion of a probe to perform TRUS may be uncomfortable for patients with BPH.[7] Therefore, many investigators have studied the usefulness of DRE as the simplest way to measure the prostate volume.

In fact, there can be a disparity between the prostate volume measured by DRE and the actual prostate volume. In a study analyzing four community-based data sources, DRE underestimated the enlarged prostate, especially those with volumes greater than 30 mL, compared with TRUS.[15] Bosch et al. also demonstrated that DRE is only good at discriminating whether a prostate volume is above or below 50 mL.[16] These studies analyzed the ability of DRE to discriminate whether prostate volume is above or below a specific value, such as 30, 40, or 50 cc.[15,16] Another study used various scales to express the prostate volume measured by DRE, but not as a unit of volume.[17] These results could help clinicians choose medical therapy, such as finasteride, but it is difficult to measure the prostate volume on DRE, which is similar to the actual size. Therefore, we hypothesized that it could be helpful to investigate the accuracy of DRE by dividing the results into several groups according to the prostate volume. This would allow clinicians to determine the accurate baseline prostate volume on DRE, as close to the actual prostate volume as possible, for the evaluation of BPH, especially in patients who refuse to undergo TRUS or MRI due to the high cost and the time requirements. Therefore, we divided the patients into seven groups per 10 cc according to the prostate volume measured by TRUS and investigated the accuracy and the precision of DRE compared with TRUS by group.

DRE tends to underestimate large prostates and overestimate small prostates. Roehrborn et al. demonstrated that the ratio of the posterior surface area (SA) of the prostate measured by DRE decreases, as the prostate enlarges and specific areas of the posterior SA are missed by DRE.[15] In the present study, we also found that DRE underestimates large prostate volumes, especially those above 60 cc. However, we found good agreement between DRE and TRUS in prostate volumes of 30–49 cc using the percent agreement and the

TABLE 2 Intra-rater Reliability of DRE Measures.

Groups	ICC between 1st DRE and 2nd DRE (95% CI)	p-value
A (<30cc, n=78)	0.662 (0.470~0.785)	<0.001
B (30~39cc, n=123)	0.875 (0.821~0.912)	<0.001
C (40~49cc, n=113)	0.936 (0.908~0.956)	<0.001
D (50~59cc, n=91)	0.937 (0.905~0.958)	<0.001
E (60~69cc, n=68)	0.945 (0.911~0.966)	<0.001
F (70~79cc, n=63)	0.902 (0.837~0.940)	<0.001
G (>80cc, n=44)	0.913 (0.840~0.952)	<0.001

ICC, intraclass correlation coefficient; DRE, digital rectal examination; CI, confidence interval.

TABLE 3 Percent Agreement, Underestimation, and Overestimation of DRE Compared with TRUS.

Groups	Percent agreement (%)	Underestimation (%)	Overestimation (%)
A (<30cc, n=78)	53/78 (67.9%)	7/78 (9.0%)	18/78 (23.1%)
B (30~39cc, n=123)	104/123 (84.6%)	9/123 (7.3%)	10/123 (8.1%)
C (40~49cc, n=113)	95/113 (84.1%)	14/113 (12.4%)	4/113 (3.5%)
D (50~59cc, n=91)	72/91 (79.1%)	16/91 (17.6%)	3/91 (3.3%)
E (60~69cc, n=68)	28/68 (41.2%)	36/68 (52.9%)	4/68 (5.9%)
F (70~79cc, n=63)	17/63 (27.0%)	45/63 (71.4%)	1/63 (1.6%)
G (>80cc, n=44)	9/44 (20.5%)	35/44 (79.5%)	0/44 (0.0%)

DRE, digital rectal examination; TRUS, transrectal ultrasound.

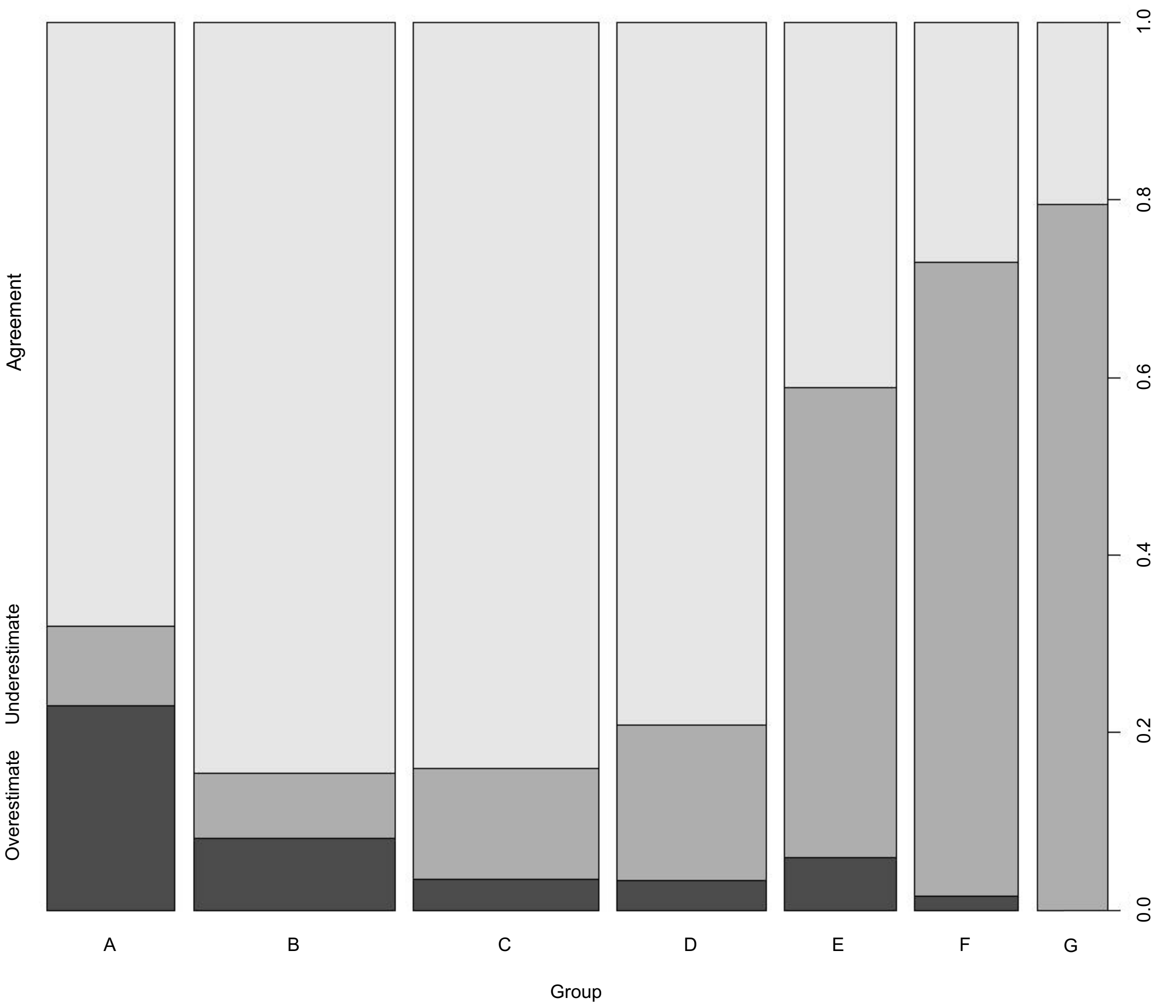

FIGURE 1 The histogram of percent agreement, overestimation, and underestimation of DRE compared with TRUS. TRUS, transrectal ultrasound; DRE, digital rectal examination.

Bland–Altman plot. Several cross-sectional studies reported that the total prostate volume of healthy men aged 40–79 years is approximately 25–45 cc.[18] The mean prostate volume of patients with BPH was reportedly about 30–40 cc in population-based studies.[19,20] Given that the mean prostate volume for Koreans is smaller than that for the Caucasians, our results showed that DRE is more useful as a method of prostate volume measurement in Korea.[21] Furthermore, the accuracy of DRE depends on examiner experience.[22] Therefore, a more accurate DRE can be achieved only by urologists, unlike TRUS. In this study, DRE was performed by a single, experienced urologist to increase its accuracy, and we assessed DRE reliability and accuracy using ICC to assess intraobserver reliability.[17]

Also, DRE is commonly performed to screen for prostate cancer, as well as to measure the prostate volume. There are several studies that indicate that the prostate cancer detection rate on both PSA and DRE abnormality is higher than that on the abnormality of DRE or PSA alone.[23,24] Although we did not investigate as to whether DRE finding is abnormal or not in our study, we think that DRE can be a simple and useful method for screening prostate cancer as well as for measuring the prostate volume.

TABLE 4 Mean Difference between TRUS and DRE, and the Limit of Agreement in Bland–Altman Plot, as Shown in Figure 2.

Groups	Mean difference between TRUS and DRE±SD	The limit of agreement
A (<30cc, n=78)	−0.22 ± 2.79	−5.68 to 5.24
B (30~39cc, n=123)	−0.04 ± 2.67	−5.27 to 5.19
C (40~49cc, n=113)	0.89 ± 2.60	−4.20 to 5.99
D (50~59cc, n=91)	1.50 ± 3.31	−4.99 to 7.98
E (60~69cc, n=68)	4.00 ± 4.91	−5.63 to 13.63
F (70~79cc, n=63)	5.83 ± 4.47	−2.94 to 14.59
G (>80cc, n=44)	9.36 ± 6.12	−2.64 to 21.36

TRUS, transrectal ultrasound; DRE, digital rectal examination; SD, standard deviation.

Meanwhile, DRE is still the most cost-effective method for estimating the prostate volume, compared with TRUS and MRI in Korea, although the price of TRUS is less than in the past due to the recent change of medical insurance in Korea (DRE, 6201 KRW; TRUS, 57,291 KRW; MRI, 727,690 KRW). As previously mentioned, MRI is the most accurate method for measuring the prostate volume, compared with DRE and TRUS.[13] However, given its price, we thought that performing MRI to estimate the prostate volume for patients with BPH only is not viable in Korea. Thus, in comparison with TRUS, DRE can be a worthy option for assessing the prostate volume in patients with BPH who refuse to undergo TRUS because they find it time-consuming and uncomfortable.

This study has some limitations. The sample size was not distributed equally between groups, although the overall sample sizes were sufficient. In addition, we did not investigate the agreements between DRE and TRUS in normal prostate volume

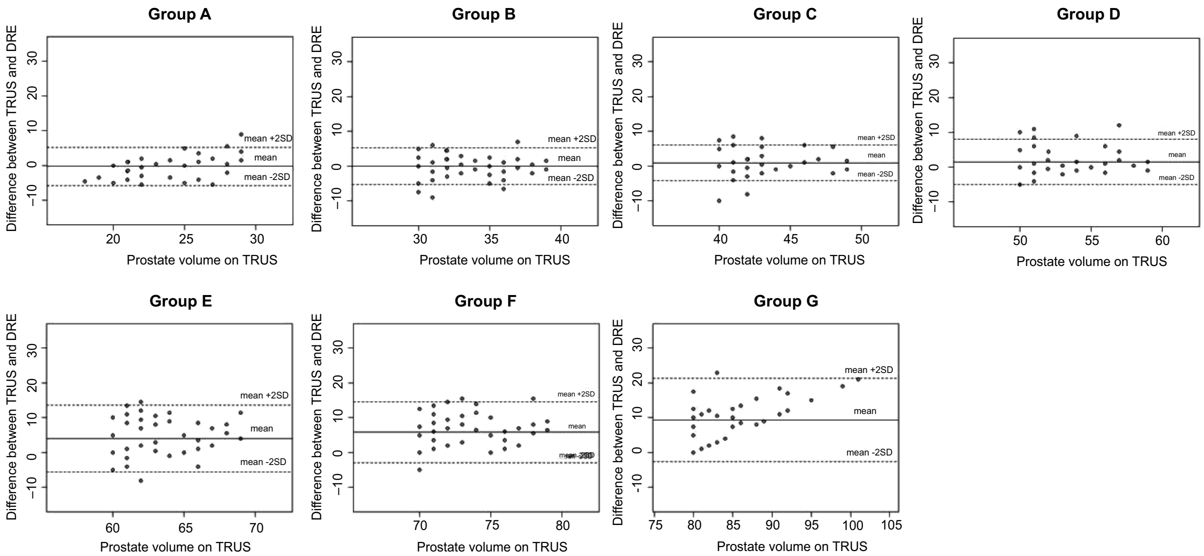

FIGURE 2 Bland–Altman plots of agreement between TRUS and DRE for each group. The prostate volume estimated by TRUS (gold standard) is presented on the X-axis, and the differences between the prostate volume on TRUS and DRE are presented on the Y-axis. TRUS, transrectal ultrasound; DRE, digital rectal examination.

below 20 cc because very few patients had a normal prostate volume. Finally, it was unknown as to whether patients in this study had prostate cancer. We suspect that there might be a difference in the prostate volumes measured by DRE in patients with prostate cancer versus those with BPH, even if the actual prostate volumes were the same. Nonetheless, this is one of the few studies that investigated the usefulness of DRE versus TRUS for measuring the prostate volume. Although one of the advantages of DRE, cost-effectiveness, has lost its sheen due to the recent changes in medical insurance in Korea, its use could be helpful for clinicians for assessing the prostate volume in patients with BPH.

CONCLUSIONS

In our study, DRE underestimated enlarged prostates larger than 60 cc compared with TRUS, but it accurately measured prostate volumes of 30–49 cc. Although TRUS can now be used without much of a financial burden in Korea, DRE is still considered as the simplest and the most cost-effective method of measuring the prostate volume in patients with BPH in clinical practice.

FUNDING

This work was supported by the 2018 Yeungnam University Research Grant.

REFERENCES

1. Lee YJ, Lee JW, Park J, et al. Nationwide incidence and treatment pattern of benign prostatic hyperplasia in Korea. Investig Clin Urol 2016;57:424–30. https://doi.org/10.4111/icu.2016.57.6.424
2. Putra IB, Hamid AR, Mochtar CA, Umbas R. Relationship of age, prostate-specific antigen, and prostate volume in Indonesian men with benign prostatic hyperplasia. Prostate Int 2016;4:43–8. https://doi.org/10.1016/j.prnil.2016.03.002
3. Girman CJ, Jacobsen SJ, Rhodes T. Prostate size related to urinary symptoms and health-related quality of life in randomly selected men. J Urol 1997;157:193.
4. Jacobsen SJ, Girman CJ, Guess HA, et al. Do prostate size and urinary flow rate predict health care-seeking behavior for urinary symptoms in men? Urology 1995;45:64–9. https://doi.org/10.1016/S0090-4295(95)96766-4
5. Jacobsen SJ, Jacobsen DJ, Girman CJ, et al. Natural history of prostatism: Risk factors for acute urinary retention. J Urol 1997;158:481–7. https://doi.org/10.1016/S0022-5347(01)64508-7
6. Eri LM, Thomassen H, Brennhovd B, Håheim LL. Accuracy and repeatability of prostate volume measurements by transrectal ultrasound. Prostate Cancer Prostatic Dis. 2002;5:273–8. https://doi.org/10.1038/sj.pcan.4500568
7. Su MZ, Lenaghan D, Woo HH. Dichotomous estimation of prostate volume: A diagnostic study of the accuracy of the digital rectal examination. World J Mens Helath 2013;31:220–5. https://doi.org/10.5534/wjmh.2013.31.3.220
8. Emberton M, Andriole GL, de la Rosette J, et al. Benign prostatic hyperplasia: A progressive disease of aging men. Urology 2003;61:267–73. https://doi.org/10.1016/S0090-4295(02)02371-3
9. Boyle P, Gould AL, Roehrborn CG. Prostate volume predicts outcome of treatment of benign prostatic hyperplasia with finasteride: Meta-analysis of randomized clinical trials. Urology 1996;48:398–405. https://doi.org/10.1016/S0090-4295(96)00353-6
10. Oelke M, Bachmann A, Descazeaud A, et al. EAU guidelines on the treatment and follow-up of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. Eur Urol 2013;64:118–40. https://doi.org/10.1016/j.eururo.2013.03.004
11. Rhodes T, Girman CJ, Jacobsen SJ, Roberts RO, Guess HA, Lieber MM. Longitudinal prostate growth rates during 5 years in randomly selected community men 40 to 79 years old. J Urol 1999;161:1174–9. https://doi.org/10.1016/S0022-5347(01)61621-5
12. Alkan I, Turkeri L, Biren T, Çevik I, Akdaş A. Volume determinations by transrectal ultrasonography in patients with benign prostatic hyperplasia:

Correlation with removed prostate weight. Int Urol Nephrol 1996;28:517–23. https://doi.org/10.1007/BF02550959
13. Jeong CW, Park HK, Hong SK, Byun S-S, Lee HJ, Lee SE. Comparison of prostate volume measured by transrectal ultrasonography and MRI with the actual prostate volume measured after radical prostatectomy. Urol Int 2008;81:179–85. https://doi.org/10.1159/000144057
14. Yamamoto T, Fukuta F, Masumori N. Does digital rectal examination predict prostate volume greater than 30mL? Int J Urol 2017;24:373–6. https://doi.org/10.1111/iju.13328
15. Roehrborn CG, Girman CJ, Rhodes T, et al. Correlation between prostate size estimated by digital rectal examination and measured by transrectal ultrasound. Urology 1997;49:548–57. https://doi.org/10.1016/S0090-4295(97)00031-9
16. Bosch JL, Bohnen AM, Groeneveld FP, Bernsen R. Validity of three caliper-based transrectal ultrasound methods and digital rectal examination in the estimation of prostate volume and its changes with age: The Krimpen Study. The Prostate 2005;62:353–63. https://doi.org/10.1002/pros.20144
17. Roehrborn CG, Sech S, Montoya J, Rhodes T, Girman CJ. Interexaminer reliability and validity of a three-dimensional model to assess prostate volume by digital rectal examination. Urology 2001;57:1087–92. https://doi.org/10.1016/S0090-4295(01)00965-7
18. Roehrborn CG. Benign prostatic hyperplasia: Etiology, pathophysiology, epidemiology, and natural history. In: Wein AJ, Kavoussi LR, Partin AW, Peters CA, editors. Campbell-Walsh urology. 11th ed. Philadelphia, PA: Elsevier; 2016. p. 2425–62.
19. Jacobsen SJ, Girman CJ, Lieber MM. Natural history of benign prostatic hyperplasia. Urology 2001;58:5–16. https://doi.org/10.1016/S0090-4295(01)01298-5
20. Lee SH, Chung BH, Kim CS, et al. Survey on benign prostatic hyperplasia distribution and treatment patterns for men with lower urinary tract symptoms visiting urologists at general hospitals in korea: A prospective, noncontrolled, observational cohort study. Urology 2012;79:1379–84. https://doi.org/10.1016/j.urology.2012.02.010
21. Lee SE, Kim DY, Kwak C. Interrelationship among age, prostate specific antigen and prostate volume in Korean men living at the metropolitan area. Korean J Urol 1999;40:1311–17.
22. Varenhorst E, Berglund K, Lofman O, Pedersen K. Inter-observer variation in assessment of the prostate by digital rectal examination. Br J Urol 1993;72:173–6. https://doi.org/10.1111/j.1464-410X.1993.tb00682.x
23. Seo HK, Chung MK, Ryu BS, Lee KH, Korean Urological Oncologic Society Prostate Cancer Study Group. Detection rate of prostate cancer according to prostate-specific antigen and digital rectal examination in Korean men: A nationwide multicenter study. Urology 2007;70:1109–12. https://doi.org/10.1016/j.urology.2007.07.052
24. Jia Y, Zhu LY, Xian YX, et al. Detection rate of prostate cancer following biopsy among the northern Han Chinese population: A single-center retrospective study of 1022 cases. World J Surg Oncol 2017;15:165. https://doi.org/10.1186/s12957-017-1238-9