Supplementary material

Supplementary Table 1A. Search strategy for Embase.com.

/exp = EMtree keywords exploded
/de = EMtree keywords not exploded
:ab,ti = words in title or abstract

Definition	Search	Query	Items found
Combination	#4	#1 AND #2 AND #3	**4.110**
Assessment methods	#3	'echography'/exp OR 'diagnostic imaging'/de OR 'bladder function'/exp OR 'urine flow rate'/exp OR 'urethra function'/exp OR 'postvoid residual urine volume'/exp OR 'urine volume'/exp OR 'digital rectal examination'/exp OR ultraso*:ab,ti,kw OR echograph*:ab,ti,kw OR urodynam*:ab,ti,kw OR 'urinary flow*':ab,ti,kw OR uroflow*:ab,ti,kw OR ((urethra* NEAR/3 pressure):ab,ti,kw) OR (('pressure flow*' NEAR/3 urine):ab,ti,kw) OR ((urin* NEAR/3 volum*):ab,ti,kw) OR ((pressure NEAR/3 profilometr*):ab,ti,kw) OR ((obstruct* NEAR/3 (urine OR outflow* OR filling)):ab,ti,kw) OR 'rectal examination*':ab,ti,kw OR ((size:ab,ti,kw OR diameter*:ab,ti,kw OR boundar*:ab,ti,kw OR weight*:ab,ti,kw OR volume*:ab,ti,kw) AND ('diagnosis'/de OR assess*:ab,ti,kw OR measur*:ab,ti,kw OR diagnos*:ab,ti,kw OR evaluat*:ab,ti,kw)) OR uroobstruct*:ab,ti,kw	**3.227.711**
Measurement properties of assessment methods	#2	'measurement precision'/exp OR 'measurement accuracy'/exp OR 'measurement repeatability'/exp OR 'diagnostic accuracy'/exp OR 'diagnostic error'/exp OR 'diagnostic test accuracy study'/exp OR 'observer variation'/exp OR 'quality control procedures'/exp OR 'receiver operating characteristic'/exp OR reliab*:ab,ti,kw OR validity:ab,ti,kw OR reproduc*:ab,ti,kw OR (feasibility:ab,ti,kw NOT 'feasibility study'/exp) OR 'internal consistenc*':ab,ti,kw OR 'observer variation*':ab,ti,kw OR 'intraobserver variation*':ab,ti,kw OR 'interobserver variation*':ab,ti,kw OR 'observer variabilit*':ab,ti,kw OR 'interobserver variabilit*':ab,ti,kw OR 'intraobserver variabilit*':ab,ti,kw OR 'measurement error*':ab,ti,kw OR interpretability:ab,ti,kw OR accura*:ab,ti,kw OR 'limit of detection':ab,ti,kw OR 'detection limit':ab,ti,kw OR 'detection limits':ab,ti,kw OR 'roc curve':ab,ti,kw OR 'roc curves':ab,ti,kw OR 'roc analysis':ab,ti,kw OR 'roc analyses':ab,ti,kw OR 'receiver operating characteristic*':ab,ti,kw OR sensitivit*:ab,ti,kw OR specificit*:ab,ti,kw OR properties:ab,ti,kw OR responsive*:ab,ti,kw OR 'false positive':ab,ti,kw OR 'false negative':ab,ti,kw OR roc:ab,ti,kw OR likelyhood*:ab,ti,kw OR likelihood*:ab,ti,kw	**6.744.869**
Population	#1	'prostate hypertrophy'/exp OR bph:ab,ti,kw OR (('prostate'/exp OR prostat*:ab,ti,kw OR voiding:ab,ti,kw) AND ('hyperplasia'/de OR 'hypertrophy'/de OR hyperplas*:ab,ti,kw OR obstruct*:ab,ti,kw OR hypertroph*:ab,ti,kw OR enlarge*:ab,ti,kw OR pressure) AND flow*:ab,ti,kw) OR (('bladder outlet' NEAR/3 obstruction*):ab,ti,kw)	**50.061**

Supplementary Table 1B. Search strategy for PubMed.

[Mesh] = Medical subject headings (MeSH)
[Mesh:NoExp] = Medical subject headings (MeSH), without explosion
[tiab] = words in title or abstract

Definition	Search	Query	Items found
Combination	#4	#1 AND #2 AND #3	2.883
Assessment methods	#3	"Ultrasonography"[Mesh] OR "diagnostic imaging"[Subheading] OR "Urodynamics"[Mesh] OR ultraso*[tiab] OR echograph*[tiab] OR urodynam*[tiab] OR urinary flow*[tiab] OR uroflow*[tiab] OR urethral pressure[tiab] OR (pressure flow*[tiab] AND urine[tiab]) OR urine volum*[tiab] OR pressure profilometr*[tiab] OR (obstruct*[tiab] AND (urine[tiab] OR outflow*[tiab] OR filling[tiab])) OR rectal examination*[tiab] OR uroobstruct*[tiab] OR ((size[tiab] OR diameter*[tiab] OR boundar*[tiab] OR weight*[tiab] OR volume*[tiab]) AND ("diagnosis"[Subheading] OR assess*[tiab] OR measur*[tiab] OR diagnos*[tiab] OR evaluat*[tiab]))	2.826.341
Measurement properties of assessment methods	#2	"Reproducibility of Results"[Mesh] OR reliab*[tiab] OR validity[tiab] OR reproduc*[tiab] OR responsive*[tiab] OR (feasibility[tiab] NOT "Feasibility Studies"[Mesh]) OR internal consistenc*[tiab] OR "Observer Variation"[Mesh] OR observer variation*[tiab] OR intraobserver variation*[tiab] OR interobserver variation*[tiab] OR observer variabilit*[tiab] OR interobserver variabilit*[tiab] OR intraobserver variabilit*[tiab] OR measurement error*[tiab] OR interpretability[tiab] OR "Sensitivity and Specificity"[Mesh] OR accura*[tiab] OR "limit of detection"[tiab] OR "detection limit" [tiab] OR "detection limits"[tiab] OR "roc curve"[tiab] OR "roc curves"[tiab] OR "roc analysis"[tiab] OR "roc analyses"[tiab] OR "receiver operating characteristic"[tiab] OR "receiver operating characteristics"[tiab] OR sensitivity[tiab] OR specificity[tiab] OR prognos*[tiab] OR properties[tiab] OR responsive*[tiab]	4.891.228
Population	#1	"Prostatic Hyperplasia"[Mesh] OR bph[tiab] OR (("Prostate"[Mesh] OR prostat*[tiab] OR voiding[tiab]) AND ("Hyperplasia"[Mesh] OR "Hypertrophy"[Mesh] OR hyperplas*[tiab] OR obstruct*[tiab] OR hypertroph*[tiab] OR enlarge*[tiab] OR pressure flow*[tiab])) OR bladder outlet obstruction*[tiab]	40.128

Supplementary Table 1C. Search strategy for Ebsco/CINAHL.

MH = Mapped Heading keyword
TI = words in title
AB = words in abstract

Definition	Search	Query	Items found
Combined	S8	S3 AND S4 AND S7	231
	S7	S1 OR S6	5.139
	S6	S2 AND S5	3.341
Population	S5	((MH "Hypertrophy") OR (MH "Hyperplasia")) OR TI (hyperplas* OR obstruct* OR hypertrophy* OR enlarge* OR “pressure flow*”) OR AB (hyperplas* OR obstruct* OR hypertrophy* OR enlarge* OR “pressure flow*”) OR KW (hyperplas* OR obstruct* OR hypertrophy* OR enlarge* OR “pressure flow*”)	85.259
Assessment methods	S4	((MH "Endosonography") OR (MH "Ultrasonography") OR (MH "Diagnostic Imaging") OR (MH "Urination") OR (MH "Urodynamics") OR (MH "Digital Rectal Examination")) OR TI (ultraso* OR echograph* OR urodynam* OR “urinary flow*” OR uroflow* OR “urethral pressure*” OR (“pressure flow*” N3 (urine OR urinary)) OR “urine volum*” OR “pressure profilometr*” OR (obstruct* N3 (urine OR outflow* OR filling)) OR “rectal examination*” OR uroobstruct* OR ((size OR diameter* OR boundar* OR weight* OR volume*) N3 (assess* OR measur* OR diagnos* OR evaluat*))) OR AB (ultraso* OR echograph* OR urodynam* OR “urinary flow*” OR uroflow* OR “urethral pressure*” OR (“pressure flow*” N3 (urine OR urinary)) OR “urine volum*” OR “pressure profilometr*” OR (obstruct* N3 (urine OR outflow* OR filling)) OR “rectal examination*” OR uroobstruct* OR ((size OR diameter* OR boundar* OR weight* OR volume*) N3 (assess* OR measur* OR diagnos* OR evaluat*)) OR KW (ultraso* OR echograph* OR urodynam* OR “urinary flow*” OR uroflow* OR “urethral pressure*” OR (“pressure flow*” N3 (urine OR urinary)) OR “urine volum*” OR “pressure profilometr*” OR (obstruct* N3 (urine OR outflow* OR filling)) OR “rectal examination*” OR uroobstruct* OR ((size OR diameter* OR boundar* OR weight* OR volume*) N3 (assess* OR measur* OR diagnos* OR evaluat*)))	498.906
Measurement and psychometric properties of measurement instruments	S3	((MH "Reproducibility of Results") OR (MH "Sensitivity and Specificity") OR (MH "Observer Bias")) OR TI (feasibility OR reliab* OR validity OR reproduc* OR responsive* OR “internal consistenc*” OR “observer variation*” OR “intraobserver variation*” OR “interobserver variation*” OR “observer variabilit*” OR “interobserver variabilit*” OR “intraobserver variabilit*” OR “measurement error*” OR interpretability OR accura* OR "limit of detection" OR "detection limit" OR "detection limits" OR "roc curve" OR "roc curves" OR "roc analysis" OR "roc analyses" OR "receiver operating characteristic" OR "receiver operating characteristics" OR sensitivity OR specificity OR prognos* OR properties OR responsive*) OR AB (feasibility OR reliab* OR validity OR reproduc* OR responsive* OR “internal consistenc*” OR “observer variation*” OR “intraobserver variation*” OR “interobserver variation*” OR “observer variabilit*” OR “interobserver variabilit*” OR “intraobserver variabilit*” OR “measurement error*” OR interpretability OR accura* OR "limit of detection" OR "detection limit" OR "detection limits" OR "roc curve" OR "roc curves" OR "roc analysis" OR "roc analyses" OR "receiver operating characteristic" OR "receiver operating characteristics" OR sensitivity OR specificity OR prognos* OR properties OR responsive*) OR KW (feasibility OR reliab* OR validity OR reproduc* OR responsive* OR “internal consistenc*” OR “observer variation*” OR “intraobserver variation*” OR “interobserver variation*” OR “observer variabilit*” OR “interobserver variabilit*” OR “intraobserver variabilit*” OR “measurement error*” OR interpretability OR accura* OR "limit of detection" OR "detection limit" OR "detection limits" OR "roc curve" OR "roc curves" OR "roc analysis" OR "roc analyses" OR "receiver operating characteristic" OR "receiver operating characteristics" OR sensitivity OR specificity OR prognos* OR properties OR	676.302

		responsive*)	
Population	S2	(MH "Prostate") OR TI (prostat* OR voiding) OR AB (prostat* OR voiding) OR KW (prostat* OR voiding)	43.361
Population	S1	(MH "Prostatic Hypertrophy") OR TI (bph OR "bladder outlet obstruction*") OR AB (bph OR "bladder outlet obstruction*") OR KW (bph OR "bladder outlet obstruction*")	4.015

Supplementary Table 2A. Reliability of assessment methods to evaluate bladder outlet obstruction and benign prostatic obstruction.

First author	Year	Aim of method[1)]	Patient category	Sample, n (%)	Age, mean (sd; min-max)	Measures of reliability
Assessment methods for bladder outlet obstruction: uroflowmetry at home.						
Chan[28]	2012	To assess maximum urinary flow to predict BOO.	Men with LUTS attributable to BPH.	186	65.5 (7; -)	Agreement (Kappa values) of home flowmetry scores: One, three, five, seven, nine, ten measurements in agreement with scores by the criterion (electronic uroflowmetry) 0.76, 0.79, 0.78, 0.80, 0.83, 0.84. If adjusted criterion scores are used (Qmax as ordinal categories: >19 mL/s, 15–19 mL/s, 10–15 mL/s, and <10 mL/s)': One, three, five, seven, nine, ten measurements in agreement with scores: 0.65, 0.70, 0.67, 0.70, 0.72, 0.74.
Assessment methods for benign prostatic obstruction: transabdominal ultrasound.						
Prassopoulos[45]	1996	Estimation of prostate size and transitional zone volume.	Men with BPH.	95	69.7 (11.3; 47-85)	Interobserver 'error' was 5% calculating prostate volume. Transition zone of the prostate measurement error: "less than 4%".
Assessment methods for benign prostatic obstruction: digital rectal examination.						
Roehrborn[49]	2001	Estimation of prostate volume.	Volunteers from a general urology practice.	121	60.7 (10.3; -)	Overall ICC and ICC for <40cm^3 prostate volume and >40cm^3 prostate volume. Plus grading system: Overall ICC: 0.58 (95% CI: 0.45-0.69) ICC: <40cm^3: 0.44 (95% CI: 0.28-0.58), ICC: >40cm^3: 0.52 (95% CI: 0.05-0.80) Textual Scale: Overall ICC: 0.65 (95% CI: 0.53-0.74) ICC: <40cm^3: 0.53 (95% CI: 0.38-0.65), ICC: >40cm^3: 0.63 (95% CI: 0.21-0.85) Best estimate in gr: Overall ICC: 0.78 (95% CI: 0.70-0.84) ICC: <40cm^3: 0.64 (95% CI: 0.52-0.74), ICC: >40cm^3: 0.66 (95% CI: 0.26-0.86) Sizing balls: Overall ICC: 0.64 (95% CI: 0.51-0.75) ICC: <40cm^3: 0.50 (95% CI: 0.33-0.64), ICC: >40cm^3: 0.66 (95% CI: 0.22-0.87) Concentric rings: Overall ICC: 0.63 (95% CI: 0.49-0.74) ICC: <40cm^3: 0.50 (95% CI: 0.33-0.64), ICC: >40cm^3: 0.59 (95% CI: 0.11-0.84) Lever device: Overall ICC: 0.68 (95% CI: 0.57-0.76) ICC: <40cm^3: 0.52 (95% CI: 0.35-0.66), ICC: >40cm^3: 0.51 (95% CI: 0.23-0.71) Full 3D model: Overall ICC: 0.78 (95% CI: 0.68-0.85) ICC: <40cm^3: 0.67 (95% CI: 0.52-0.77), ICC: >40cm^3: 0.79 (95% CI: 0.28-0.95) Final 3D model: Overall ICC: 0.86 (95% CI: 0.75-0.93) ICC: <40cm^3: 0.83 (95% CI: 0.69-0.92), ICC: >40cm^3: 0.69 (95% CI: 0.0-0.94)
Assessment methods for benign prostatic obstruction: transrectal ultrasound.						
Kwon[39]	2016	Estimation of peripheral zone thickness and related prostate size	Men with LUTS/BPH.	1009	62.0 (10.0; -)	ICC for peripheral zone thickness for inter-rater agreement (two raters): 0.896 (95% CI: 0.883-0.908)

		parameters.				
Prassopoulos[45]	1996	Estimation of prostate size and transitional zone volume.	Men with BPH.	95	69.7 (11.3; 47-85)	Interobserver 'error' was 4% calculating prostate volume. Transition zone of the prostate measurement error: "less than 4%".

BOO = bladder outlet obstruction, BPH = benign prostatic hyperplasia, BPO = benign prostatic obstruction, ICC = intraclass correlation coefficient, LUTS = lower urinary tract symptoms, sd = standard deviation, 95% CI = 95% confidence interval, [1)] = Aim of method extracted from study and summarized by review authors.

Supplementary Table 2B. Validity of assessment methods – Assessment methods for bladder outlet obstruction.

First author	Year	Aim of method[1)]	Reference test	Patient category	Sample, n (%)	Age, mean (sd; min-max)	**Measures of criterion validity**: sensitivity, specificity, area under the curve (95% confidential interval) **and construct validity:** correlations (p or 95% confidential interval).
Transrectal ultrasound (TRUS)							
Kwon [39]	2016	Estimation of peripheral zone thickness and related prostate size parameters.	Urinary flow parameters from uroflowmetry.	Men with LUTS/BPH.	1009	62.0 (10.0; -)	Correlation TRUS prostate parameters – maximum urinary flow rate (Qmax). Total prostate volume – Qmax: r=-0.200 (p<0.01) Transitional zone volume – Qmax: r=-0.219 (p<0.01) Transitional zone index – Qmax: r=-0.196 (p<0.01) Peripheral zone thickness – Qmax: r=0.140 (p<0.01) Correlation TRUS prostate parameters – postvoid residue (PVR). Total prostate volume – PVR: r=0.214 (p<0.01) Transitional zone volume – PVR: r=0.236 (p<0.01) Transitional zone index – PVR: r=0.192 (p<0.01) Peripheral zone thickness – PVR: r=-0.154 (p<0.01)
Oelke [44]	2007	To detect BOO.	Computer urodynamic investigation, obstruction based on CHESS classification.	Men aged 40 year and older with clinical BPH, LUTS and/or prostate volume greater than 25ml.	162	median: 62 (min-max: 40-89)	Prostate volume, cut-off obstructed: ≤25 mL / >25 mL SN: 85% (95% CI: 77-93%), SP: 27% (95% CI: 18-36%), PPV: 51% (95% CI: 42-60%), NPV: 67% (95% CI: 51-83%). Diagnostic accuracy: 54% LR+: 1.16 (95% CI: 0.99-1.37), LR-: 0.56 (95% CI: 0.29-0.98) Prostate volume with obstruction: Obstructed, prostate volume in ml: median: 40 (quartiles: 29-58), Non-obstructed, prostate volume in ml: median: 32.9 (quartiles: 22-44) p-value: 0.014 ROC-AUC: 0.62 (95% CI: 0.52–0.71)
Steele [51]	2000	To predict BOO.	Multichannel urodynamic studies to obtain obstruction grade through the ICS nomogram. >2cm water per ml/s and detrusor pressure >40 cm water was defined as obstructed.	Men with LUTS.	204	66.7 (7.5; -)	Predicting bladder outlet obstruction based on prostate volume: Cut-off: ≥40gram for obstruction: SN: 0.66, SP: 0.64. Cut-off: <40 gram for non-obstruction: SN: 0.43, SP: 0.83, PPV: 0.42, NPV: 0.81. Cut-off: <25 gram for non-obstruction: SN: 0.21, SP: 0.92, PPV: 0.50, NPV 0.77.
Venrooij [55]	1996	To detect BOO and correlate	Urodynamic studies,	Men with prostatism, with	196	65.8 (7.1; 51-86)	Prostate volume Pearson's correlation:

		the prostate volume with BOO related parameters.	based on Schäfer's grade, with a classification of 0 and 1 defined as non-obstructed and ≥2 as obstructed.	and without urodynamic obstruction / possible BPH.			Prostate volume - Maximal flow: -0.19 (p=0.008) Prostate volume - Residual volume: 0.12 (not sign.) Prostate volume - Schäfer's obstruction grade: 0.29 (p<0.001) Kendall & Gibbon's correlation: Prostate volume – maximal flow: -0.11 (p=0.02) Prostate volume – residual volume: 0.05 (not significant) Prostate volume – Schäfer's obstruction grade: 0.22 (p=0.001) Note by review authors: *The authors of the study mention some variables showed a non-normal distribution and analysed the Kendall & Gibbon's correlation. In the review, we assumed the Kendall & Gibbon's correlation to be most accurate.*
Venrooij [56]	2004	To discriminate between obstructed and non-obstructed men.	Cystometry and pressure-flow studies. Analyzed according to the International Continence Society Nomogram, Schäfer's obstruction grade and URA.	Men with LUTS, suggestive of BPH.	160	65.1 (8.3; 50-85)	Kendall's and Gibbons correlation with: Abrams-Griffiths number / urethral resistance factor / Schäfer's obstruction grade. Prostate volume: 0.27 (p≤0.01) / 0.26 (p≤0.01) / 0.29 (p≤0.01)
Transabdominal ultrasound (TAUS)							
Abdel-Aal [22]	2011	To detect BOO	Pressure flow studies in patients presenting LUTS suggestive of BPO. Based on BOOI, >40 = obstructed, 20-40 = equivocal, <20 = no obstruction	Men presenting with LUTS, suggestive of benign prostatic enlargement	135	No BOO: 58.9, (4.4; 52-71) BOO: 58.4 (6.5; 50-72)	Cut-off value prostate volume >45 mL to predict obstruction: SN: 85.7%, SP: 26%, PPV: 48.6%, NPV: 72.2% Diagnostic accuracy: 50.6 ROC-AUC: 0.678 (95% CI: 0.562-0.794) LR+: 1.16, LR-: 0.549 Cut-off value intravesical prostatic protrusion >8mm to predict obstruction: SN: 80%, SP: 80%, PPV: 73.7%, NPV: 85.1% Diagnostic accuracy: 80 ROC-AUC: 0.885 (95% CI: 0.806-0.963) LR+: 4, LR-: 0.25 Spearman correlation with Bladder Outlet Obstruction Index IPP - BOOI: r = 0.595 (p<0.001) PV - BOOI: r = 0.241 (p=0.02)

Al-Mosawi [24]	2020	To detect BOO based on Intravesical prostate protrusion.	Urodynamic studies, based on BOOI index: <20 = non-obstructed, 20-40 = inconclusive, >40 = obstructed.	Men exhibiting LUTS, with confirmed BPH	63	53 (- ; 41-80)	Cut-off value IPP: >10mm or ≤10mm Note by review authors: *unclear if ≥ or > and < or ≤, deducted from text it appears it should be: ≤10mL and >10mL* Compared to BOOI obstructed and unobstructed (inconclusive (or: unequivocal) as non-obstructed) SN: 81.6% (95% CI: 65.7-92.3%), SP: 40% (95% CI: 21.1-61.3%) PPV: 67.4% (95% CI: 59.2-74.7%), NPV: 58.8% (95% CI: 38.5-76.5%) Accuracy: 65.1% (95% CI: 52-76.7%) Cut-off value PV: >40mL or <40mL Note by review authors: *unclear if ≥ or > and < or ≤, deducted from text it appears it should be: ≤40mL and >40mL.* Compared to BOOI obstructed and unobstructed (inconclusive (or: unequivocal) as non-obstructed) SN: 55.8% (95% CI: 38.3-71.4%), SP: 40.0% (95% CI: 21.1-61.3%) PPV: 58.3% (95% CI: 47.7-68.3%), NPV: 37.04% (95% CI: 24.5-62.1%) Accuracy: 37.04% (95% CI: 24.5-62.1%)
Hossain [35]	2012	Estimation of prostate volume and intravesical prostatic protrusion and diagnose BOO	Pressure flowmetry with BOO-index (BOOI): <40 BOOI = non-obstructed, >40 BOOI = obstructed.	Men with LUTS, suggestive of BPH.	50	64.3 (- ; 51-78)	Mean prostate volume non-obstructed group: 33.7 mL (sd:10.5) – obstructed group: 44.03 mL (sd: 14.32) p: <0.05. Prostate volume: ≥40 mL to predict obstruction: SN: 57.69%, SP: 66.67%, PPV: 65.21%, NPV: 59.26%. ROC-AUC: 0.70 Intravesical prostatic protrusion >10 mm to predict obstruction: SN: 69.23%. SP: 79.17%, PPV: 78.26%, NPV: 70.37%. ROC-AUC: 0.821 Spearman correlation with Bladder Outlet Obstruction Index (BOOI): PV - BOOI: 0.399 IPP - BOOI: 0.691
Kojima [38]	1997	Estimation of bladder weight as predictor of infravesical obstruction.	Pressure flowmetry to obtain a Abrams-Griffiths number, 40 was the cut-off value for obstructed and unobstructed. Grade of	Men with BPH, and a moderate to severe urinary symptoms score from the American Urological Association symptom index.	65	75 (- ; 45-89)	Bladder weight: >35 gram – ≤35 gram, compared to obstruction and no obstruction: SN: 85.3%, SP: 87.1%, PPV: 87.9%, NPV: 84.4% False-positive rate: 12.1%, False-negative rate: 15.6% Diagnostic accuracy: 86.2%

			obstruction through Schäfer's nomogram.				
Reddy [47]	2019	To detect BOO through prostate volume and IPP grade	Pressure–flow evaluation was done in all patients to calculate BOO index BOOI: >40 BOO BOOI: 20–40 equivocal, BOOI: <20 no BOO	Men with LUTS due to clinically diagnosed BPH	164	66 (9.88; -)	IPP vs BOOI *(article reports values as means)* IPP Grade I: <5 mm, grade II: 5–10 mm, grade III: >10 mm IPP Grade I - BOOI: 26.6 (sd: 11.29) IPP Grade II - BOOI: 33.93 (sd: 7.99) IPP Grade III - BOOI: 52.19 (sd: 14.51), p<0.001 IPP grade vs Maximum Flow Rate (Qmax) *(article reports values as means)* IPP Grade I: 10.31 (sd: 3.49) mL/s IPP Grade II: 8.46 (sd: 3.62) mL/s IPP Grade III: 7.29 (sd: 3.16) mL/s, p<0.001 IPP grade vs Pdet at Qmax (PdetQmax, cmH2O) *(article reports values as means)* IPP Grade I: 47.22 (sd: 18.27) cmH2O IPP Grade II: 50.85 (sd: 15.23) cmH2O IPP Grade III: 66.77 (sd: 30.83) cmH2O, p<0.001 Note by review authors: *It appears heavily skewed data were used, based on scatterplots, to calculate the following statistics.* Pearson correlation: IPP correlation with BOOI: r = 0.586 (p<0.001) PV correlation with BOOI: r = 0.374 (p=0.001) IPP on identification of BOO IPP Grade I and IPP Grade II combined and Grade III SN: Grade I/II: 92.21% (95% CI: 83.41%-96.13%), Grade III: 65.06% (95% CI: 53.81%-75.20%) SP: Grade I/II: 45.21% (95% CI: 33.52%-57.30%), Grade III: 84.93% (95% CI: 74.64%-92.23%) PPV: Grade I/II: 67.48% (95% CI: 58.45%-75.65%), Grade III: 83.08% (95% CI: 71.73%-91.24%) NPV: Grade I/II: 80.49% (95% CI: 65.13%-91.18%), Grade III: 68.13% (95% CI: 57.53%-77.51%) ROC-AUC: IPP by TAUS: 0.791, p<0.001 PV by TAUS: 0.658, p=0.002
Zhou [57]	2012	To assess BOO and intravesical prostatic protrusion	Urodynamic studies, based on BOO Index >40 as obstructed.	Men with BPH.	124	73 (- ; 54-89)	Intravesical prostatic protrusion assessed in mm Obstruction: mean: 11.05 (sd: 9.65) Non-obstruction: mean: 7.67 (sd: 7.99) Difference: (p<0.05) Spearman correlation intravesical prostatic protrusion – maximum urinary flow rate: r=-0.403, p<0.01 Spearman correlation IPP-detrusor pressure at Qmax: r=0.192, p<0.01
Transperineal ultrasound free uroflowmetry							

Arif [25]	2016	Estimation of BOO through ultrasound flowmetry.	Transperineal ultrasound catheter flowmetry	Men with LUTS, suggestive of BOO.	45	-	Bladder outlet obstruction index cut-off score: ≤40: labelled as unobstructed, >40 labelled as obstructed. SN: 88%, SP: 95% Detection of obstruction ROC-AUC: 0.961
Uroflowmetry at home							
Chan [28]	2012	To assess maximum urinary flow to predict BOO.	Electronic flowmetry in clinic and international prostate symptom score.	Men with LUTS attributable to BPH.	186	65.5 (7; -)	Home uroflowmeter 'bottom' compartment, reference: mean Qmax from uroflowmetry at clinic visit: <10 mL/s SN: 0.79 (95% CI: 0.68-0.87), SP: 0.90 (95% CI: 0.83-0.94) LR+: 7.56 (95% CI: 4.34-13.09), LR-: 0.24 (95% CI: 0.15-0.37) DOR: 32.04 (95% CI: 14.03-73.19) Home uroflowmeter 'middle' compartment, reference: mean Qmax from uroflowmetry at clinic visit: <15 mL/s SN: 0.95 (95% CI: 0.91-0.98), SP: 0.81 (95% CI: 0.69-0.89) LR+: 5.06 (95% CI: 2.89-8.86), LR-: 0.06 (95% CI: 0.03-0.12) DOR: 91.02 (95% CI: 31.23-265.23) Home uroflowmeter 'top' compartment, reference: mean Qmax from uroflowmetry at clinic visit: <19 mL/s SN: 0.99 (95% CI: 0.97-1.00), SP: 0.68 (95% CI: 0.47-0.84) LR+: 3.12 (95% CI: 1.69-5.76), LR-: 0.01 (95% CI: 0.00-0.06) DOR: 349.23 (95% CI: 40.24-3037.7)
Uroflowmetry							
Chen [29]	2019	Estimation of bladder outlet obstruction through uroflowmetry related C/Q nomogram	Urodynamic studies, based on Abram-Griffiths number. Used cut-off values not provided for obstructed, equivocal and not obstructed scores	Men with LUTS who underwent cystometry.	522	-	C/Q nomogram with P/Q urodynamic studies (UDS) Kappa value of C/Q Nomogram with urodynamic studies: 0.693 (p=0.000) SN: 0.81, SP: 0.91, PPV: 0.79, NPV: 0.84 ROC-AUC: 0.86 C/Q nomogram compared with uroflowmetry flow rate diagnosis: ≤10 ml/s: obstructed, ≥ 15 ml/s: unobstructed, 'remaining scores': equivocal. Kappa value of flow rate with urodynamic studies. 0.528 (p=0.000) SN: 0.71, SP: 0.85, PPV: 0.69, NPV: 0.80 ROC-AUC: 0.78
Oelke [44]	2007	To detect BOO	Computer urodynamic investigation, obstruction based on CHESS classification.	Men aged 40 year and older with clinical BPH, LUTS and/or prostate volume greater than 25ml.	162	Median: 62 (min-max: 40-89)	Qmax, cut-off nonobstructive/obstructive: ≥15 / <15 ml/s SN: 99% (95% CI: 96-101%), SP: 39% (95% CI: 28-49%) PPV: 59% (95% CI: 50-67%), NPV: 97% (95% CI: 91-103%) Diagnostic accuracy: 67% LR+: 1.61 (95% CI: 1.36-1.91), LR-: 0.03 (95% CI: 0-4.42) Qmax, cut-off nonobstructive/obstructive: ≥10 / <10 ml/s SN: 68% (95% CI: 57-78%), SP: 73% (95% CI: 63-82%)

							PPV: 69% (95% CI: 58-79%), NPV: 72% (95% CI: 63-82%) Diagnostic accuracy: 70% LR+: 2.5 (95% CI: 1.7-3.68), LR-: 0.44 (95% CI: 0.31-3.2) Qaverage, cut-off nonobstructive/obstructive ≥7 / <7ml/s SN: 89% (95% CI: 82-96%), SP: 46% (95% CI: 35-56%) PPV: 59% (95% CI: 50-68%), NPV: 83% (95% CI: 72-94%) Diagnostic accuracy: 66% LR+: 1.65 (95% CI: 1.34-2.04), LR-: 0.23 (95% CI: 0.12-1.98) ROC-AUC to detect bladder outlet obstruction: Qmax: 0.84 (95% CI: 0.78-0.91) Qaverage: 0.82 (95% CI: 0.75-0.89)
Reynard [48]	1996	To detect BOO	Pressure-flow studies using the Abrams-Griffiths nomogram to identify obstructed from non-obstructed/equivocal men	Men with LUTS, suggestive of BPO	157	Median: 68 (min-max: 50-84) *based on total sample n=165, 8 did not undergo index or reference test.*	To detect BOO, from Qmax < 8 mL/s based on: 1 void / means from 2 voids / means from 3 voids or means from 4 voids: SN: 14% / 35% / 18% / 14% SP: 85% / 97% / 98% / 98% PPV: 82% / 94% / 94% / 92% NPV: 50% / 49% / 44% / 42% To detect BOO, from Qmax < 10 mL/s based on: 1 void / means from 2 voids / means from 3 voids or means from 4 voids: SN: 71% / 49% / 39% / 29% SP: 71% / 87% / 94% / 96% PPV: 79% / 85% / 90% / 93% NPV: 61% / 53% / 50% / 47% To detect BOO, from Qmax < 12 mL/s based on: 1 void / means from 2 voids / means from 3 voids or means from 4 voids: SN: 84% / 65% / 56% / 50% SP: 50% / 74% / 87% / 91% PPV: 72% / 79% / 87% / 90% NPV: 67% / 58% / 56% / 53% To detect BOO, from Qmax < 15 mL/s based on: 1 void / means from 2 voids / means from 3 voids or means from 4 voids: SN: 95% / 85% / 80% / 76% SP: 35% / 53% / 61% / 67% PPV: 69% / 74% / 76% / 78% NPV: 81% / 70% / 67% / 63%
Venrooij [56]	2004	To discriminate between obstructed and non-obstructed men.	Cystometry and pressure-flow studies. Analyzed according to	Men with LUTS, suggestive of BPH.	160	65.1 (8.3; 50-85)	Kendall's and Gibbons correlation with: Abrams-Griffiths number / urethral resistance factor / Schäfer's obstruction grade. Maximal free flow rate: -0.41 (p≤0.01) / -0.48 (p≤0.01) /-0.43 (p≤0.01) Mean voided volume : -0.23 (p≤0.01) / -0.25 (p≤0.01) / -0.23 (p≤0.01)

			the International Continence Society Nomogram, Schäfer's obstruction grade and URA.				
Penile Compression Release Manoeuvre / Penile Compression Release Index							
Aganovic [23]	2019	To assess BOO through Penile Compression Manoeuvre.	Urodynamic studies, based on Schäfer's grade, reported as DAMPF, CLIPS, BOON2 and URA.	Men with LUTS due to BPH.	135	66.1 (7.2; 51-81)	Pearson correlation: Penile compression release index - DAMPF (continuous Schäfer variable): r=0.44 (p<0.0001) Penile compression release index to predict BOO: ROC-AUC: 85%, posttest-probability: 91.3% To predict BOO, at a penile compression release index cut-off value of 96.4%: SN: 74.3%, SP: 93.8%, PPV: 93%, NPV: 77% LR+: 9.6 (95% CI: 0.777-0.904) Number Needed to Diagnose: approx. 1.5 BOON2 to compare PCRI with: ROC-AUC: 82%, posttest-probability: 74.5% To predict BOO, at a BOON2 of > -35.3: SN: 81%, SP: 71%, PPV: 75%, NPV: 79% LR+: 2.7 (95% CI: N/A) Number Needed to Diagnose: approx. 1.9 De Long method of pair-wise comparisons of ROC-AUC: not significant for Penile compression compared with noninvasive: CLIPS or BOON2 method scoring, criterion: URA.
Penile Cuff Uroflowmetry							
Harding [34]	2004	Estimation of Bladder Outlet Obstruction through Penile Compression Release Index, based on automated penile cuff.	Pressure flow studies with and without Penile Cuff test. Abram-Griffith number greater than 40 was defined as obstructed. AG-number was combined with Penile	Men with LUTS, referred for conventional Pressure Flow studies.	101	-	Prediction of BOO based on Penile compression release index (PCRI), for PCRI > 160% SN: 78%, SP: 84%, PPV: 69%, NPV: not reported

			cuff parameters.				
Kim [37]	2020	Measurement of maximum flow rate (Qmax) and isovolumetric bladder pressure to categorize obstruction, not obstructed and equivocal groups through penile cuff test.	Urodynamic studies, scoring based on a (modified) ICS nomogram.	Men with LUTS related to BPH	59	Median and IQR 69.6 (54-89)	Penile cuff test - urodynamic studies Category: obstructed vs non-obstructed/equivocal SN: 80%, SP: 100%, PPV: 100%, NPV: 60.9% LR+: 2.6 (95% CI: 2.13-4.02), LR-: 0.23 (95% CI: 0.1-0.41)
Salinas [50]	2003	Estimation of Bladder Outlet Obstruction through penile cuff test.	Urodynamic studies, based on Abram-Griffiths number ≥40 = obstructed 20-40 = equivocal ≤20 = unobstructed	Men referred for urodynamic study on presentation of LUTS.	93	54.1 (16.1; -)	Sensitivity and specificity for predicting obstruction (exclusion of n=41 equivocal cases) SN: 100%, SP: 55.6% Diagnostic accuracy: 84.6% Pcuff.op (cmH2O): Obstructed/unequivocal vs. non-obstructed: Mean (SE) 172.92 (5.82) - 142.33 (8.77), p=0.007 Qcuff.op (ml/s): Obstructed/unequivocal vs. non-obstructed: Mean (SE) 9.43 (0.66) - 13.67 (1.42), p=0.003 *Based on calculations by authors of Systematic Review* BOO compared to Cuff outcomes No obstruction vs unequivocal based on cuff outcomes: Pcuff.OP: OR: 0.9910 (95% CI: 0.99-0.99) Qcuff.OP: OR: 1.1038 (95% CI:1.10-1.11) No obstruction vs obstruction based on cuff outcomes: Pcuff.OP: OR: 0.9835 (95% CI: 0.98-0.98) Qcuff.OP: OR: 1.3348 (95% CI:1.32-1.35)
Combinations of assessment methods							
Venrooij [56]	2004	To discriminate between obstructed and non-obstructed men.	Cystometry and pressure-flow studies. Analyzed according to the International	Men with LUTS, suggestive of BPH.	160	65.1 (8.3)	Combined measurement instruments: Bladder outlet obstruction number (BOON): prostate volume (transrectal ultrasound) – (3*maximal urinary flow rate) – (0.2*mean voided volume) Obstructed – not obstructed: BOON – Abram-Griffith: ROC-AUC: 0.83

			Continence Society Nomogram, Schäfer's obstruction grade and URA.				BOON – urethral resistance factor: ROC-AUC: 0.87 BOON – Schäfer's obstruction grade: ROC-AUC: 0.82 Kendall's and Gibbons correlation with: Abrams-Griffiths number / urethral resistance factor / Schäfer's obstruction grade. BOON 0.48 (p≤0.01) / 0.52 (p≤0.01) / 0.49 (p≤0.01)
Questionnaires to indicate BOO							
Chan [28]	2012	To assess maximum urinary flow to predict BOO.	Electronic flowmetry in clinic and international prostate symptom score.	Men with LUTS attributable to BPH.	186	65.5 (7; -)	IPSS – fifth question scores Mean IPSS score of 5th question >3, reference: mean Qmax from uroflowmetry at clinic visit: <10 mL/s SN: 0.51 (95% CI: 0.39-0.62), SP: 0.78 (95% CI: 0.70-0.85) LR+: 2.33 (95% CI: 1.54-3.54), LR-: 0.63 (95% CI: 0.49-0.81) DOR: 3.70 (95% CI: 1.95-7.04) Mean IPSS score of 5th question >2, reference: mean Qmax from uroflowmetry at clinic visit: <15 mL/s SN: 0.63 (95% CI: 0.55-0.71), SP: 0.72 (95% CI: 0.58-0.82) LR+: 2.23 (95% CI: 1.42-3.49), LR-: 0.51 (95% CI: 0.39-0.68) DOR: 4.34 (95% CI: 2.17-8.69) Mean IPSS score of 5th question >1, reference: mean Qmax from uroflowmetry at clinic visit: <19 mL/s SN: 0.74 (95% CI: 0.67-0.80), SP: 0.55 (95% CI: 0.35-0.73) LR+: 1.62 (95% CI: 1.02-2.59), LR-: 0.48 (95% CI: 0.30-0.76) DOR: 3.38 (95% CI: 1.36-8.38) IPSS – mean score for voiding (questions 1, 3, 5 and 6) Mean IPSS score for voiding, score >12, reference: mean Qmax from uroflowmetry at clinic visit: <10 mL/s SN: 0.25 (95% CI: 0.17-0.37), SP: 0.86 (95% CI: 0.79-0.91) LR+: 1.82 (95% CI: 1.00-3.34), LR-: 0.87 (95% CI: 0.74-1.01) DOR: 2.10 (95% CI: 0.99-4.46) Mean IPSS score for voiding, score >8, reference: mean Qmax from uroflowmetry at clinic visit: <15 mL/s SN: 0.49 (95% CI: 0.41-0.57), SP: 0.74 (95% CI: 0.60-0.84) LR+: 1.85 (95% CI: 1.14-3.00), LR-: 0.70 (95% CI: 0.55-0.88) DOR: 2.66 (95% CI: 1.32-5.36) Mean IPSS score for voiding, score >4, reference: mean Qmax from uroflowmetry at clinic visit: <19 mL/s SN: 0.74 (95% CI: 0.67-0.80), SP: 0.73 (95% CI: 0.52-0.87) LR+: 2.73 (95% CI: 1.37-5.43), LR-: 0.35 (95% CI: 0.24-0.51) DOR: 7.75 (95% CI: 92.85-21.1)

Matzkin [41]	1996	Correlation of uroflowmetry recordings with the AUA.	24-hour uroflowmetry	Men with enlargement of the prostate, related to BPH.	42	69 (- ; 45-83)	Correlation for AUA item with uroflowmetry recordings Questionnaire first visit / questionnaire second visit AUA Item 1 - %Frequency: t-score: 1.047 / 0.575 AUA Item 3 - %Intermittency: t-score: -0.768 / -0.516 AUA Item 5 - % Weak uroflowmetry: t-score: 0.178 / 0.467 AUA Item 7 - Nocturia: t-score: 3.167 / 2.310 The authors considered a t-score of >2 highly significant.
Steele [51]	2000	To predict BOO.	Multichannel urodynamic studies to obtain obstruction grade through the ICS nomogram. >2cm water per ml/s and detrusor pressure >40 cm water was defined as obstructed.	Men with LUTS.	204	66.7 (7.5; -)	Correlation AUA score – detrusor pressure at maximum flow as predictor of bladder outlet obstruction: r=0.18 (p>0.05)
Venrooij [55]	1996	To detect BOO and correlate the IPSS with BOO related parameters.	Urodynamic studies, based on Schäfer's grade, with a classification of 0 and 1 defined as non-obstructed and ≥2 as obstructed.	Men with prostatism, with and without urodynamic obstruction / possible BPH.	196	65.8 (7.1; 51-86)	Pearson's correlation: IPSS – maximal flow: -0.12 (not significant) IPSS – residual volume: 0.10 (not significant) IPSS – prostate volume: 0.03 (not significant) IPSS – Schäfer's obstruction grade: 0.02 (not significant) Kendall & Gibbon's correlation: IPSS – maximal flow: -0.07 (not significant) IPSS – residual volume: 0.06 (not significant) IPSS – Schäfer's obstruction grade: 0.02 (not significant) Note by review authors: *The authors of the study mention some variables showed a non-normal distribution and analysed the Kendall & Gibbon's correlation. In the review, we assumed the Kendall & Gibbon's correlation to be most accurate.*
Venrooij [56]	2004	To discriminate between obstructed and non-obstructed men.	Cystometry and pressure-flow studies. Analyzed according to	Men with LUTS, suggestive of BPH.	160	65.1 (8.3; 50-85)	Kendall's and Gibbons correlation with: AUA score – Abrams-Griffiths Number: 0.15 (p≤0.01) AUA score – Urethral resistance factor: 0.16 (p≤0.01) AUA score – Schäfer's Obstruction Grade: 0.16 (p≤0.01)

	the International Continence Society Nomogram, Schäfer's obstruction grade and URA.	

AUA = American urology association questionnaire, BOO = bladder outlet obstruction, BOOI = bladder outlet obstruction index, BOON2 = Bladder Outlet Obstruction Number 2, BPE = benign prostate enlargement, BPH = benign prostatic hyperplasia, BPO = benign prostatic obstruction, CLIPS = Clinical Prostate Score, DRE = digital rectal examination, DOR = diagnostic odds ratio, IPSS = international prostate symptom score, IQR = Interquartile range, LR+ = positive likelihood ratio, LR- = negative likelihood ratio, mL = millilitre, mL/s = millilitre per second, NPV = negative predictive value, PPV = positive predictive value, PVR = postvoid residue, Qmax = maximal urinary flow rate, ROC-AUC = radio operator curve – area under the curve, sd = standard deviation, SN = sensitivity, SP = specificity, TAUS = transabdominal ultrasound, TRUS = transrectal ultrasound, URA = Urethral Resistance Factor, [1)] = Aim of method extracted from study and summarized by review authors.

Supplementary Table 2C. Validity of instruments – Assessment methods for benign prostatic obstruction.

First author	Year	Aim of method[1)]	Reference test	Patient category	Sample, n (%)	Age, mean (sd; min-max)	**Measures of criterion validity**: sensitivity, specificity, area under the curve (95% confidential interval) **and construct validity:** correlations (p or 95% confidential interval).
Digital rectal examination (DRE)							
Carballido [27]	2011	Diagnose the presence of BPH.	'Gold-standard' diagnosis of BPH by an urologist based on: medical history, initial assessment of symptoms, IPSS and Bother Score, PSA analysis, urinalysis, digital rectal examination, abdominal ultrasound (for prostate size and postvoid residue) and uroflowmetry.	Men with LUTS.	666	60.9 (7.9; 50-98)	Prostate size by DRE – final BPH diagnosis: p=0.123 (no correlation statistic provided) General practitioner - urologist: k=0.284 (95% CI: 0.22-0.35) General practitioner - transabdominal ultrasound prostate volume: k=0.171 (95% CI: 0.11-0.24) Urologist - transabdominal ultrasound prostate volume: k=0.624 (95% CI: 0.57-0.68) Note by review authors: *Although the word correlation is used, the values appear to be reported in kappa values. We followed the study objective, in which the urologist's assessment was referred to as the gold-standard. We assume the wrong symbol was used in the text to describe the correlation.*
Roehrborn [49]	2001	Estimation of prostate volume.	Transrectal ultrasound.	Volunteers from a general urology practice.	121	60.7 (10.3; -)	Spearman correlation: DRE – transrectal ultrasound: Assessor for DRE: attending physician / postgraduate 4-year / postgraduate 2-year Plus grade: r=0.57 / 0.64 / 0.56 Textual scale: r=0.58 / 0.59 / 0.57 Best estimate (grams): r=0.72 / 0.70 / 0.61 Sizing balls: r=0.67 / 0.62 / 0.57 Concentric rings: r=0.60 / 0.64 / 0.63 Lever device: r=0.60 / 0.59 / 0.59 Full 3D model: r=0.66 / 0.66 / 0.60 Final 3D model: r=0.75 / 0.65 / 0.67
Su [54]	2013	Estimation of prostate volume based on defined thresholds.	Transrectal ultrasound.	Men with LUTS prior to BPH-related surgery or in conjunction with prostate biopsy.	280	65 (- ; 59-71)	Cut-off value: prostate volume ≥30 mL. SN: 94.3% (95% CI: 90.1%-96.8%), SP: 78.2% (95% CI: 64.6%-87.8%) LR+: 3.97 (95% CI: 2.51-6.28) LR-: 0.08 (95% CI: 0.05-0.13) *Other cut-off values are reported: ≥50mL and ≥100mL. A higher cut-off value reportedly increased the SN and decreased the SP, although no specific values are reported.*
Transabdominal ultrasound (TAUS)							
Demir [31]	2016	Estimation of prostate size.	Resected tissue weight through open prostatectomy.	Men with LUTS, undergoing	60	68.9 (9.4; 49-85)	Mean differences: Prostatic size (in cc): TAUS: 67.81 (sd: 33.4) – TRUS: 52.61 (sd: 25.06), p=0.001 Pearson correlation: TAUS – resected tissue weight: r=0.77 (p=0.001)

				transurethral resection of prostate.			
Güzelsoy [33]	2016	Estimation of prostate size and transitional zone volume and transitional zone index.	Resected tissue weight and transrectal ultrasound.	Men with obstructive symptoms, diagnosed with clinical BPH and men with BPE without obstructive symptoms.	43	66.0 (7.9; 50-81)	Pearson correlation: TAUS prostate volume – resected tissue weight: r=0.73 (p=0.001) TAUS prostate volume – (TRUS) transitional zone volume: r=0.78 (p=0.0001) TAUS prostate volume – (TRUS) transitional zone index: r=0.54 (p=0.0001)
Malemo [40]	2011	Estimation of prostate volume.	Transrectal ultrasound.	Male patients with symptomatic BPH and IPSS score of >20, with posteroperative histologic confirmation of BPH.	50	69.7 (11.3; 51-91)	Prostate volume: ≤80 or >80 mL. SN: 95% (95% CI: 78%-99%), SP: 0.96 (95% CI: %82-99%) PPV: 80% (95% CI: 78%-99%), NPV: 95% (95% CI: 78%-99%) Spearman correlation TAUS – transrectal ultrasound: r=0.98 (p<0.001)
Prassopoulos [45]	1996	Estimation of prostate size and transitional zone volume (TZV).	Transrectal ultrasound.	Men with BPH.	95	69.7 (11.3; 47-85)	'parametrical' correlation TAUS prostate volume – TRUS prostate volume: r=0.948 (p<0.001) TAUS TZV – TRUS TZV: r=0.953 (p<0.001) (in n=76)
Stravodimos [52]	2009	Estimation of prostate volume	Transrectral ultrasound and specimen weight.	Male patients with LUTS, diagnosed with BPH.	71	72 (- ; 55-82)	Correlation: TAUS – specimen weight: r=0.82 (p<0.001) *(Calculated by review authors from the data in the article)* TAUS estimated Prostate volume (cc) – Specimen Weight (g) Accurate detection of <80cc for <80g: SN: 0.57 (95% CI: 0.43-0.70) SP: 1.00 (95% CI:0.75-1.00) PPV: 1.00 (95% CI: N/A, due to missing cases in 1 cell of the contingency table) NPV: 0.34 (95% CI: 0.28-0.41)
Styles [53]	1988	Estimation of prostate volume.	Transrectal ultrasound.	Men undergoing elective prostatectomy for	76	69 (7; -)	Spearman correlation: TAUS – transrectal ultrasound: r=0.8205 (p<0.001)

				symptoms of BOO and <15 m/ls free flow rate.			
Transperineal ultrasound							
Rathaus [46]	1991	Estimation of prostate size.	Transrectal ultrasound through: ellipsoid formula. 0.55*D1*D2*D3 D1: anteroposterior diameter D2: transverse diameter D3: cephalocaudal diameter	Men with BPH.	80	-	Correlation: transperineal ultrasound – transabdominal ultrasound, n=10: r=0.92 (p<0.001) transperineal ultrasound – specimen weight n=80: r=0.89 (p<0.001)
Transrectal ultrasound (TRUS)							
Aarnink [21]	1996	Estimation of prostate volume and transitional zone volume.	Transrectal ultrasound: manual outline method.	Men with LUTS; 'clinically benign patients'.	247	61 (- ; 28-87)	Pearson correlation for measurement methods of prostate volume: TRUS (automated volume) – TRUS (reference volume): r=0.938 (p: not reported) TRUS (off-line ellipsoid formula volume) – TRUS (reference volume): r=0.921 (p: not reported) TRUS (transverse off-line ellipsoid formula volume) – TRUS (reference volume): r=0.955 (p=not reported) Correlation transitional zone volume: Transitional zone volume – TRUS prostate volume (manual outline by urologist): r=0.82 (p=not reported)
Baltaci [26]	2000	Estimation of transitional zone volume. (TZV)	Enucleated adenoma.	Men with LUTS, scheduled to undergo prostate adenoma removal due to BPH.	48	65.7 (- ; 50-81)	Correlation: TRUS transitional zone volume (TZV) – enucleated adenoma: r=0.95 (p<0.001).
David [30]	2020	Estimation of prostate volume and transitional zone volume (TZV)	Enucleated adenoma volume.	Sub-Saharan men with BPH, undergoing surgery.	77	69.6 (7.26; 51-91)	Pearson correlation: Total sample (n = 77) TZV - Prostatic specimen volume: r = 0.865 (p=0.0000), R2 = 74.8% Prostate volume - Prostatic specimen volume: r = 0.932 (p=0.0000), R2 = 86.9% Under <100 mL prostate size: (n = 50) Prostate volume - Prostatic specimen volume: r = 0.8168 (p=N/A) Transitional zone volume - prostatic specimen volume: r = 0.6846 (p=N/A)

							Under >100 mL prostate size: (n = 27) Prostate volume - Prostatic specimen volume: r = 0.8712 (p=N/A) Transitional zone volume - Prostatic specimen volume: r = 0.7295 (p=N/A) Volumes differences by TRUS – Enucleated prostate volume Prostate volume – Enucleated prostate volume: 93.1 mL (sd: 48.9 mL) – 79.1 mL (sd: 62.9 mL) Difference: 14.0 mL (95% CI: -19.59 to -8.36) p<0.0005) Transitional zone volume – Enucleated prostate volume: 53.3 mL (sd: 28.5 mL) – 79.1 mL (sd: 62.9 mL) Difference: 25.8 mL (95% CI: 16.52-35.06), p<0.0005) Under <100 mL prostate size: (n = 50) Prostate volume – Enucleated prostate volume: 63.7 mL (sd: 19.9 mL) – 45.1 mL (sd: 23.2 mL), p = 0.0000 Transitional Zone volume – Enucleated prostate volume: 37.1 mL (sd: 15.3 mL) – 45.1 mL (sd: 23.2 mL), p = 0.0014 Under >100 mL prostate size: (n = 27) Prostate volume – Enucleated prostate volume: 147.4 mL (sd: 38.8 mL) – 142.0 mL (sd: 64.9 mL), p = 0.4467 Transitional Zone volume – Enucleated prostate volume: 83.4 mL (sd: 22.0 mL) – 142.0 mL (sd: 64.9 mL), p = 0.0000
Demir [31]	2016	Estimation of prostate size.	Resected tissue weight through open prostatectomy.	Men with LUTS, undergoing transurethral resection of prostate.	60	68.9 (9.4; 49-95)	Mean difference: Prostatic size (in cc): TAUS: 67.81 (sd: 33.4) – TRUS: 52.61 (25.06) p=0.001 Pearson correlation: TRUS – resected tissue weight: r=0.79, p=0.001
Güzelsoy [33]	2016	Estimation of prostate size and transitional zone volume (TZV) and transitional zone index (TZI).	Resected tissue weight and transrectal ultrasound.	Men with obstructive symptoms, diagnosed with clinical BPH and men with BPE without obstructive symptoms.	43	66.0 (7.9; 50-81)	Pearson correlation: TRUS prostate size – TRUS TZV: r=0.96 (p=0.0001) TRUS prostate size – TRUS TZI: r=0.56 (p=0.0001) TRUS prostate size – resected tissue weight: r=0.95 (p=0.0001) TRUS TZV – resected tissue weight: r=0.97 (p=0.0001) TRUS TZI – resected tissue weight: r=0.55 (p=0.002) Diagnostic accuracy of TZI to predict clinical BPH, unclear reference values. SN: TZI: 0.40: 97%, TZI: 0.45: 91%, TZI: 0.55-0.60: 100%, 0.25-0.35: 0% SP: TZI: 0.25: 31%, TZI: 0.30: 25%, TZI: 0.35: 19%, TZI 0.40: 91%, TZI: 0.45: 87%, TZI: 0.50: 68%, TZI: 0.55: 56%, TZI: 0.60: 54%.
Kim [36]	2014	Estimation of prostate	Transrectal ultrasound:	Men with prostate	968	58.4 (- ; 21-88)	TRUS Transaxial (index): 28.5 in mL (sd: 10.1) – TRUS Midsagittal (reference): 28.7 in mL (sd: 9.9), difference: p=0.004.

		volume.	midsagittal scanning, with prolate ellipsoid formula.	related diseases, and subgrouping of clinical benign prostatic enlargement.			
Narayanamurthy [42]	2020	Estimation of prostate volume.	Anatomical prostate weight	Men with BPH, who underwent robotic-assisted laparoscopic prostatectomy.	295	64.3 (6.3; -)	Correlation: TRUS – Anatomical prostate weight Pearson r=0.67 (95% CI: 0.60-0.73), p<0.001 Mean difference of TRUS - Anatomical prostate weight -12.5 gram (95% CI: -14.4 to -11.03) 95% levels of agreement: upper limit: 13 grams, Lower limit: -38 grams
Nathan [43]	1996	Estimation of prostate volume.	Transrectal ultrasound: step planimetry of prostate volume.	Men with symptoms of prostatic enlargement.	45	40 (- ; 43-89)	Correlation: TRUS (dimensional method) – TRUS (step planimetry) r=0.89. TRUS (largest planimetric dimensions) – TRUS (step planimetry) r=0.93. TRUS (computer enhanced dimensions) – TRUS (step planimetry) r=0.88.
Stravodimos [52]	2009	Estimation of transitional zone volume.	Transrectral ultrasound and specimen weight.	Male patients with LUTS, diagnosed with BPH.	71	72 (- ; 55-82)	Correlation: TRUS Transition zone volume – prostate specimen weight: r=0.904 (p<0.005). *(Calculated by review authors from the data in the article)* TRUS Transition Zone - Specimen weight Accurate detection of <80cc for <80g: SN: 0.93 (95% CI: 0.83-0.98) SP: 0.62 (95% CI: 0.32-0.86) PPV: 0.92 (95% CI: 0.84-0.95) NPV: 0.67 (95% CI: 0.41-0.85)
Combination of assessment methods							
De Nunzio [32]	2015	To predict BPO.	Pressure-flow studies to obtain a Schäfer's class from the Schäfer's nomogram, BPO was defined at ≥3 of a Schäfer's class.	Men with LUTS or BPE, 45 years and older.	449	61.2 (11; IQR: 61-73)	Combined measurement instruments: *Nomogram consists of: maximal flow rate from free uroflowmetry and transitional zone index* Nomogram at 80% probability for obstruction: SN: 74%, SP: 79%, PPV: 89%, NPV: 56% ROC-AUC: 0.76 (95% CI: 0.71-0.82), p=0.000
Questionnaires to indicate BPO							
Carballido [27]	2011	Diagnose the presence of BPH.	'Gold-standard' diagnosis of BPH by an urologist based on: medical history, initial assessment of	Men with LUTS.	666	60.9 (7.9; 50-98)	IPSS score - Urologist's final BPH diagnosis (not reported if cut-off scores were used, or full range of IPSS total scores) SN: 58%, SP: 59.3%, PPV: 73.5%, NPV: 42.0% Model: IPSS score and age - Urologist's final BPH diagnosis (not reported if cut-off

			symptoms, IPSS and Bother Score, PSA analysis, urinalysis, digital rectal examination, abdominal ultrasound (for prostate size and postvoid residue) and uroflowmetry.				scores were used for age or IPSS, or full range of IPSS total scores) SN: 56.8%, SP: 64.2%, PPV: 75.5%, NPV: 43.3%
Kwon [39]	2016	Estimation of peripheral zone thickness and related prostate size parameters.	Urinary flow parameters from uroflowmetry.	Men with LUTS/BPH	1009	62.0 (10.0; -)	Correlation IPSS (total score) – prostate size parameters IPSS (total score) – total prostate volume, r=0.081 (p<0.05) IPSS (total score) – transitional zone volume, r=0.098 (p<0.01) IPSS (total score) – transitional zone index, r=0.111 (p<0.01) IPSS (total score) – peripheral zone thickness, r=-0.162 (p<0.01) Correlation IPSS (voiding symptoms) – prostate size parameters IPSS (voiding symptoms) – total prostate volume, r=0.050 IPSS (voiding symptoms) – transitional zone volume, r=0.059 IPSS (voiding symptoms) – transitional zone index, r=0.074 (p<0.05) IPSS (voiding symptoms) – peripheral zone thickness, r=-0.117 (p<0.05) Correlation IPSS (storage symptoms) – prostate size parameters IPSS (storage symptoms) – total prostate volume, r=0.120 (p<0.05) IPSS (storage symptoms) – transitional zone volume, r=0.144 (p<0.01) IPSS (storage symptoms) – transitional zone index, r=0.145 (p<0.01) IPSS (storage symptoms) – peripheral zone thickness, r=-0.169 (p<0.01) Correlation IPSS (post-micturition symptoms) – prostate size parameters IPSS (post-micturition symptoms) – total prostate volume, r=0.003 (not sign.) IPSS (post-micturition symptoms) – transitional zone volume, r=0.005 (not sign.) IPSS (post-micturition symptoms) – transitional zone index, r=0.017 (not sign.) IPSS (post-micturition symptoms) – peripheral zone thickness, r=-0.073 (p<0.05)
Nathan [43]	1996	Estimation of prostate volume.	Transrectal ultrasound: step planimetry of prostate volume.	Men with symptoms of prostatic enlargement.	45	40 (- ; 43-89)	Correlation IPSS-S (unclear whether IPSS-S indicates 'score' or 'storage subscore' – prostate volume calculation methods: IPSS – DRE: 0.033 IPSS – Dimensional Method Volume through TRUS: 0.0619 IPSS – Planimetric Volume through TRUS: 0.0894
Venrooij [55]	1996	To detect BOO and correlate the IPSS with BPO related parameters.	'Prostate volume measured by transrectal ultrasonography. (TRUS)	Men with prostatism, with and without urodynamic obstruction / possible BPH.	196	65.8 (7.1; 51-86)	Pearson' correlation: IPSS - prostate volume: 0.03 (not significant) Kendall & Gibbon's correlation: IPSS – prostate volume from TRUS: 0.01 (not significant) Note by review authors: *The authors of the study mention some variables showed a non-normal distribution*

and analysed the Kendall & Gibbon's correlation. In the review, we assumed the Kendall & Gibbon's correlation to be most accurate.

AUA = American urology association questionnaire, BOO = bladder outlet obstruction, BPE = benign prostate enlargement, BPH = benign prostatic hyperplasia, BPO = benign prostatic hyperplasia, DRE = digital rectal examination, IPSS = international prostate symptom score, LR+ = positive likelihood ratio, LR- = negative likelihood ratio, mL = millilitre, NPV = negative predictive value, PPV = positive predictive value, PSA = prostate specific antigen,
sd = standard deviation, SN = sensitivity, SP = specificity, ROC-AUC = radio operator curve – area under the curve, TAUS = transabdominal ultrasound,
TRUS = transrectal ultrasound, [1)] = Aim of method extracted from study and summarized by review authors.