Cochrane
Library

Cochrane Database of Systematic Reviews

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction (Review)

Silva V, Grande AJ, Peccin MS

Silva V, Grande AJ, Peccin MS.

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction.

Cochrane Database of Systematic Reviews 2019, Issue 4. Art. No.: CD012044.

DOI: [10.1002/14651858.CD012044.pub2](https://doi.org/10.1002/14651858.CD012044.pub2).

www.cochranelibrary.com

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction (Review)

Copyright © 2019 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

WILEY

TABLE OF CONTENTS

ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
SUMMARY OF FINDINGS	3
BACKGROUND	8
OBJECTIVES	9
METHODS	9
RESULTS	12
Figure 1.	13
Figure 2.	15
Figure 3.	16
Figure 4.	19
Figure 5.	19
Figure 6.	20
DISCUSSION	22
AUTHORS' CONCLUSIONS	23
ACKNOWLEDGEMENTS	24
REFERENCES	25
CHARACTERISTICS OF STUDIES	29
DATA AND ANALYSES	48
Analysis 1.1. Comparison 1 Physical activity versus watchful waiting, Outcome 1 Symptom score for LUTS.	49
Analysis 1.2. Comparison 1 Physical activity versus watchful waiting, Outcome 2 Response rate in symptom score.	49
Analysis 1.3. Comparison 1 Physical activity versus watchful waiting, Outcome 3 Withdrawal due to adverse events.	49
Analysis 2.1. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 1 Symptom score for LUTS.	50
Analysis 2.2. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 2 Response rate in symptom score.	51
Analysis 2.3. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 3 Withdrawal due to adverse events.	51
Analysis 2.4. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 4 Change of medication use.	52
Analysis 2.5. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 5 Need for an invasive procedure.	53
Analysis 3.1. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 1 Symptom score for LUTS.	54
Analysis 3.2. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 2 Response rate in symptom score.	54
Analysis 3.3. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 3 Withdrawal due to adverse events.	54
Analysis 3.4. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 4 Postvoid residual urine.	54
Analysis 4.1. Comparison 4 Physical activity compared to alpha-blockers, Outcome 1 Symptom score for LUTS.	55
Analysis 4.2. Comparison 4 Physical activity compared to alpha-blockers, Outcome 2 Response rate in symptom score.	55
Analysis 4.3. Comparison 4 Physical activity compared to alpha-blockers, Outcome 3 Withdrawal due to adverse events.	56
APPENDICES	56
CONTRIBUTIONS OF AUTHORS	64
DECLARATIONS OF INTEREST	64
SOURCES OF SUPPORT	64
DIFFERENCES BETWEEN PROTOCOL AND REVIEW	64
NOTES	65
INDEX TERMS	65

[Intervention Review]

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction

Valter Silva¹, Antonio Jose Grande², Maria S Peccin³

¹Postgraduate Program on Society, Technology and Public Policies (SOTEPP); Department of Medicine, Centro Universitário Tiradentes (UNIT/AL), Maceió, Brazil. ²Laboratory of Evidence-Based Practice, Universidade Estadual de Mato Grosso do Sul, Campo Grande, Brazil. ³Department of Human Movement Sciences, Universidade Federal de São Paulo, Santos, Brazil

Contact: Valter Silva, Postgraduate Program on Society, Technology and Public Policies (SOTEPP); Department of Medicine, Centro Universitário Tiradentes (UNIT/AL), Av. Comendador Gustavo Paiva, 5017, Cruz das Almas, Maceió, AL, 57038-000, Brazil. v.silva@ymail.com.

Editorial group: Cochrane Urology Group.

Publication status and date: New, published in Issue 4, 2019.

Citation: Silva V, Grande AJ, Peccin MS. Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database of Systematic Reviews* 2019, Issue 4. Art. No.: CD012044. DOI: [10.1002/14651858.CD012044.pub2](https://doi.org/10.1002/14651858.CD012044.pub2).

Copyright © 2019 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

Lower urinary tract symptoms caused by benign prostatic obstruction (LUTS/BPO) represents one of the most common clinical complaints in men. Physical activity might represent a viable first-line intervention for treating LUTS/BPO.

Objectives

To assess the effects of physical activity for lower urinary tract symptoms caused by benign prostatic obstruction (LUTS/BPO).

Search methods

We performed a comprehensive search of multiple databases (CENTRAL, MEDLINE, Embase, Web of Science, LILACS, ClinicalTrials.gov, and WHO ICTRP); checked the reference lists of retrieved articles; and handsearched abstract proceedings of conferences with no restrictions on the language of publication or publication status from database inception to 6 November 2018.

Selection criteria

We included published and unpublished randomised controlled and controlled clinical trials that included men diagnosed with LUTS/BPO. We excluded studies in which medical history suggested non-BPO causes of LUTS or prior invasive therapies to physical activity or that used electrical stimulation.

Data collection and analysis

Two review authors independently assessed study eligibility, extracted data, and assessed the risk of bias of included studies. We assessed primary outcomes (symptom score for LUTS; response rate, defined as 20% improvement in symptom score; withdrawal due to adverse events) and secondary outcomes (change of medication use; need for an invasive procedure; postvoid residual urine). We assessed the quality of the evidence using the GRADE approach.

Main results

We included six studies that randomised 652 men over 40 years old with moderate or severe LUTS. The four different comparisons were as follows:

Physical activity versus watchful waiting

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction (Review)

Copyright © 2019 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Two RCTs randomised 119 participants. The interventions included tai chi and pelvic floor exercise. The evidence was overall of very low quality, and we are uncertain about the effects of physical activity on symptom score for LUTS (mean difference (MD) -8.1, 95% confidence interval (CI) -13.2 to -3.1); response rate (risk ratio (RR) 1.80, 95% CI 0.81 to 4.02; 286 more men per 1000, 95% CI 68 fewer to 1079 more); and withdrawal due to adverse events (RR 1.00, 95% CI 0.59 to 1.69; 0 fewer men per 1000, 95% CI 205 fewer to 345 more).

Physical activity as part of self-management programme versus watchful waiting

Two RCTs randomised 362 participants. Pelvic floor exercise was one of multiple intervention components. The evidence was of very low quality, and we are uncertain about the effects of physical activity for symptom score for LUTS (MD -6.2, 95% CI -9.9 to -2.5); response rate (RR 2.36, 95% CI 1.32 to 4.21; 424 more men per 1000, 95% CI 100 more to 1000 more); and withdrawal due to adverse events (risk difference 0.00, 95% CI -0.05 to 0.06; 65 fewer men per 1000, 95% CI 65 fewer to 65 fewer).

Physical activity as part of weight reduction programme versus watchful waiting

One RCT randomised 130 participants. An unclear type of intense exercise was one of multiple intervention components. The evidence was of very low quality, and we are uncertain about the effects for symptom score for LUTS (MD -1.1, 95% CI -3.5 to 1.3); response rate (RR 1.20, 95% CI 0.74 to 1.94; 67 more men per 1000, 95% CI 87 fewer to 313 more); and withdrawal due to adverse events (RR 1.63, 95% CI 1.03 to 2.57; 184 more men per 1000, 95% CI 9 more to 459 more).

Physical activity versus alpha-blockers

One RCT randomised 41 participants to pelvic floor exercise or alpha-blockers. The evidence was of very low quality, and we are uncertain about the effects for symptom score for LUTS (MD 2.8, 95% CI -0.9 to 6.4) and response rate (RR 0.80, 95% CI 0.55 to 1.15; 167 fewer men per 1000, 95% CI 375 fewer to 125 more). The evidence was of low quality for withdrawal due to adverse events; the effects for this outcome may be similar between interventions (RR 0.86, 95% CI 0.06 to 12.89; 7 fewer men per 1000, 95% CI 49 fewer to 626 more).

Authors' conclusions

We rated the quality of the evidence for most of the effects of physical activity for LUTS/BPO as very low. We are therefore uncertain whether physical activity affects symptom scores for LUTS, response rate, and withdrawal due to adverse events. Our confidence in the estimates was lowered due to study limitations, inconsistency, indirectness, and imprecision. Additional high-quality research is necessary.

PLAIN LANGUAGE SUMMARY

Physical activity for lower urinary tract symptoms due to benign prostatic obstruction

Review question

What are the effects of physical activity on lower urinary tract symptoms in men with an enlarged prostate?

Background

As men grow older, many develop bothersome urinary problems, such as a weak stream and frequent urination during the day or nighttime. A common reason for these symptoms is enlargement of the prostate. Treatment for this problem includes lifestyle changes (like drinking less fluid), medications, and surgical procedures. Physical activity, defined as movement produced by muscles, may also improve these symptoms. We conducted this review to compare how physical activity compares to other methods, in treating such urinary tract symptoms.

Study characteristics

We included six studies, comprising 652 men altogether, that studied four different comparisons. The studies compared different forms of physical activity, alone or as part of a self-management programme, to watchful waiting (no specific intervention) or to alpha-blocker treatment.

Based on very low-quality evidence for the outcomes of symptom score for lower urinary tract symptoms, and stopping the treatment because of unwanted effects, we are uncertain whether physical activity interventions are helpful in men with lower urinary tract symptoms due to benign prostatic obstruction.

Quality of the evidence

The quality of the evidence was very low, which means that the true effect may be substantially different from the findings of the review. Further research is very likely to change the results.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Physical activity compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction

Patient or population: men with lower urinary tract symptoms secondary to benign prostatic obstruction

Intervention: physical activity (tai chi and pelvic floor exercise)

Comparison: watchful waiting

Outcomes	Nº of participants (studies)	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)	
				Risk with watchful waiting	Risk difference with physical activity
Symptom score for LUTS Assessed with: IPSS Follow-up: 3 months	91 (2 RCTs)	⊕⊕⊕⊕ VERY LOW ^{1 2 3}	-	The mean change in symptom score for LUTS was 17.1 (95% CI 11.9 to 22.3).	MD 8.1 lower (13.2 lower to 3.9 lower)
Response rate Assessed with: frequency Follow-up: 3 months	28 (1 RCT)	⊕⊕⊕⊕ VERY LOW ^{1 4 6}	RR 1.80 (0.81 to 4.02)	Study population 357 per 1000	 286 more per 1000 (68 fewer to 1000 more)
Withdrawal due to adverse events Assessed with: frequency Follow-up: 3 months	56 (1 RCT)	⊕⊕⊕⊕ VERY LOW ^{5 6 7}	RR 1.00 (0.59 to 1.69)	Study population 500 per 1000	 0 fewer per 1000 (205 fewer to 345 more)

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **MD:** mean difference; **RCT:** randomised controlled trial; **RR:** risk ratio.

GRADE Working Group grades of evidence

High quality: We are very confident that the true effect lies close to that of the estimate of the effect.

Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

- ¹Downgraded for study limitations (-1): high risk of bias: allocation concealment (Jung 2012); blinding of participants and personnel (Jung 2012; Weng 2010); incomplete outcome data (Jung 2012); selective reporting (Jung 2012); other bias (Jung 2012).
- ²Downgraded for indirectness (-1): outcome time frame insufficient (Jung 2012; Weng 2010).
- ³Downgraded for imprecision (-1): wide confidence interval; small sample size; low event rates—only one small study (Jung 2012; n = 28) contributed with data and analyses.
- ⁴Downgraded for imprecision (-1): wide confidence interval; small sample size; low event rates.
- ⁵Downgraded for study limitations (-1): high risk of bias: allocation concealment (Jung 2012); incomplete outcome data (Jung 2012); selective reporting (Jung 2012); other bias (Jung 2012).
- ⁶Downgraded for indirectness (-1): outcome time frame insufficient (Jung 2012).
- ⁷Downgraded for imprecision (-1): small sample size; low event rates.

Summary of findings 2. Physical activity as part of self-management programme compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction

Patient or population: men with lower urinary tract symptoms secondary to benign prostatic obstruction

Intervention: physical activity (pelvic floor exercise) as part of self-management programme

Comparison: watchful waiting

Outcomes	Nº of participants (studies)	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)	
				Risk with watchful waiting	Risk difference with physical activity as part of self-management programme
Symptom score for LUTS Assessed with: IPSS Follow-up: range 6 months to 12 months	362 (2 RCTs)	⊕⊕⊕⊕ VERY LOW 1 2 3 4	-	The mean change in symptom score for LUTS by IPSS was 17.8 (95% CI 16.7 to 18.8).	MD 6.2 lower (9.9 lower to 2.5 lower)
Response rate Assessed with: frequency Follow-up: range 6 months to 12 months	362 (2 RCTs)	⊕⊕⊕⊕ VERY LOW 1 3 4 5	RR 2.36 (1.32 to 4.21)	Study population 312 per 1000	 424 more per 1000 (100 more to 1000 more)
Withdrawal due to adverse events Assessed with: frequency Follow-up: range 6 months to 12 months	362 (2 RCTs)	⊕⊕⊕⊕ VERY LOW 3 6 7	Not estimable	Study population 65 per 1000	 65 fewer per 1000 (65 fewer to 65 fewer)

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **MD:** mean difference; **RCT:** randomised controlled trial; **RR:** risk ratio.

GRADE Working Group grades of evidence

High quality: We are very confident that the true effect lies close to that of the estimate of the effect.

Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

¹Downgraded for study limitations (-1): high risk of bias: allocation concealment (Brown 2007); blinding of participants and personnel (Brown 2007; Chen 2012); blinding of outcome assessment (Chen 2012); selective reporting (Brown 2007); other bias (Brown 2007).

²Downgraded for inconsistency (-1): variation in point estimates; confidence intervals do not overlap; heterogeneity ($I^2 = 87\%$; $P = 0.005$).

³Downgraded for indirectness (-1): pelvic floor exercise was one component of a complex intervention, thus we cannot attribute the effect to physical activity alone.

⁴Downgraded for imprecision (-1): wide confidence interval; low event rates.

⁵Downgraded for inconsistency (-1): variation in point estimates; heterogeneity ($I^2 = 83\%$; $P = 0.01$).

⁶Downgraded for study limitations (-1): high risk of bias: allocation concealment (Brown 2007); selective reporting (Brown 2007); other bias (Brown 2007).

⁷Downgraded for imprecision (-1): low event rates.

Summary of findings 3. Physical activity as part of weight reduction programme compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction

Patient or population: men with lower urinary tract symptoms secondary to benign prostatic obstruction

Intervention: physical activity (intense exercise) as part of weight reduction programme

Comparison: watchful waiting

Outcomes	N° of participants (studies)	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)	
				Risk with watchful waiting	Risk difference with physical activity as part of weight reduction programme
Symptom score for LUTS Assessed with: IPSS Follow-up: 48 weeks	117 (1 RCT)	⊕○○○ VERY LOW ^{1 2 3}	-	The mean change in symptom score for LUTS was -0.7 (95% CI -2.4 to 1.0).	MD 1.1 lower (3.5 lower to 1.3 higher)
Response rate Assessed with: frequency Follow-up: 48 weeks	117 (1 RCT)	⊕○○○ VERY LOW ^{1 2 3}	RR 1.20 (0.74 to 1.94)	Study population 333 per 1000	 67 more per 1000 (87 fewer to 313 more)

Withdrawal due to adverse events	130 (1 RCT)	⊕○○○ VERY LOW ^{2 3 4}	RR 1.63 (1.03 to 2.57)	Study population	
Assessed with: frequency				292 per 1000	184 more per 1000 (9 more to 459 more)
Follow-up: 48 weeks					

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **MD:** mean difference; **RCT:** randomised controlled trial; **RR:** risk ratio.

GRADE Working Group grades of evidence

High quality: We are very confident that the true effect lies close to that of the estimate of the effect.

Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

¹Downgraded for study limitations (-1): high risk of bias (Yee 2015): blinding of participants and personnel; incomplete outcome data; selective reporting; other bias.

²Downgraded for indirectness (-2): physical activity was one component of a complex intervention; thus we cannot attribute the effect to physical activity alone; the intervention was described as "intense exercise", but there was insufficient information regarding type, frequency, and duration of physical activity.

³Downgraded for imprecision (-1): low event rates.

⁴Downgraded for study limitations (-1): high risk of bias (Yee 2015): incomplete outcome data; selective reporting; other bias.

Summary of findings 4. Physical activity compared to alpha-blockers for lower urinary tract symptoms secondary to benign prostatic obstruction

Patient or population: men with lower urinary tract symptoms secondary to benign prostatic obstruction

Intervention: physical activity (pelvic floor exercise)

Comparison: alpha-blockers (tamsulosin 0.4 mg/day)

Outcomes	Nº of participants (studies)	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)	
				Risk with alpha-blockers	Risk difference with physical activity
Symptom score for LUTS Assessed with: IPSS Follow-up: 3 months	39 (1 RCT)	⊕○○○ VERY LOW ^{1 2 3}	-	The mean change in symptom score for LUTS was 8.8 (95% CI 5.9 to 11.7).	MD 2.8 higher (0.9 lower to 6.4 higher)

Response rate Assessed with: frequency Follow-up: 3 months	39 (1 RCT)	⊕⊕⊕⊕ VERY LOW ^{1 2 3}	RR 0.80 (0.55 to 1.15)	Study population	
				833 per 1000	167 fewer per 1000 (375 fewer to 125 more)
Withdrawal due to adverse events Assessed with: frequency Follow-up: 3 months	41 (1 RCT)	⊕⊕⊕⊕ LOW ^{2 3}	RR 0.86 (0.06 to 12.89)	Study population	
				53 per 1000	7 fewer per 1000 (49 fewer to 626 more)

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **MD:** mean difference; **RCT:** randomised controlled trial; **RR:** risk ratio.

GRADE Working Group grades of evidence

High quality: We are very confident that the true effect lies close to that of the estimate of the effect.

Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

¹Downgraded for study limitations (-1): high risk of bias ([Hut 2016](#)): blinding of participants and personnel; blinding of outcome assessment; selective reporting.

²Downgraded for indirectness (-1): outcome time frame insufficient ([Hut 2016](#)).

³Downgraded for imprecision (-1): small sample size; low event rates.

BACKGROUND

We conducted this systematic review following the protocol previously published in the Cochrane Database of Systematic Reviews (Silva 2016). For explanations of methodological terms, see the main glossary on the Cochrane website (community.cochrane.org/glossary).

Description of the condition

Lower urinary tract symptoms (LUTS) caused by benign prostatic obstruction (BPO) (LUTS/BPO) represents one of the most common clinical complaints in men (Gratzke 2015; McVary 2011). Lower urinary tract symptoms comprise storage, voiding, and postmicturition symptoms (Abrams 2003; Gratzke 2015; ICS 2017; McVary 2011). Storage symptoms include increased daytime frequency, nocturia, urgency, urinary incontinence (stress, urge, mixed, and continuous), overactive bladder, enuresis, and altered bladder sensation (ICS 2017). Voiding symptoms include slow stream, splitting or spraying, intermittent stream (intermittency), hesitancy, straining, and terminal dribble (ICS 2017). Postmicturition symptoms include a feeling of incomplete emptying and postmicturition dribble (ICS 2017). Symptom scores (e.g. International Prostate Symptom Score (IPSS) and Danish Prostate Symptom Score (DAN-PSS)) are the standard tool for assessing and monitoring male LUTS and identifying predominant symptom type (Gratzke 2015).

Although the aetiology of male LUTS is multifactorial, BPO is recognised as a major cause and is the preferred target of treatment. A physiologic increase in the number of cells in the prostate, reduced rate of cell death, or both, can cause a hyperplastic epithelial and stromal growth coalescing into microscopic and macroscopic nodules and defining a nonneoplastic histologic pattern called benign prostatic hyperplasia (BPH). Benign prostatic enlargement (BPE) secondary to BPH, together with increased prostatic smooth muscle tone, can compress the urethra, leading to bladder outlet obstruction (BOO) and secondary LUTS (Abrams 2003; Gratzke 2015; McVary 2011; Nicholson 2011; Roehrborn 2008; Tang 2009).

The prevalence of BPH by histologic approach is around 10% in men aged 30 to 39 years, 40% in men aged 40 to 59 years, 60% in men aged 60 to 69 years, 80% in men aged 70 to 79 years, and 90% in men aged 80 to 89 years old (Roehrborn 2008). Approximately 50% of all men aged 40 years or older who have a histologic diagnosis of BPH have moderate to severe LUTS (Roehrborn 2008). Benign prostatic obstruction occurs in 64% of men with LUTS (D'Silva 2014). As the worldwide population ages (men aged 60 years or over represented 7% of the global population in 1950 and 11% in 2015, a figure that could rise to 27% by 2100) (United Nations 2015), the probability of new cases of LUTS/BPO will increase. Among the 10 most prevalent diseases in men aged 50 years or older, LUTS/BPO ranks as the seventh most frequently diagnosed and most costly; moreover, with acute urinary retention or surgeries occurring in around 20% of cases, LUTS/BPO is the second most likely to trigger a significant clinical event within one year of initiating treatment (Fenter 2006). The direct cost of LUTS/BPO treatment in 2007 was estimated at USD 1.41 billion, including inpatient, hospital outpatient, ambulatory surgery, physician office, and emergency room visits (UDA 2012). Although LUTS/BPO is not often life threatening, it is associated with significant symptom burden and imposes high personal and societal costs (both direct and indirect)

that negatively affect quality of life in men and their partners; therefore, its impact should not be underestimated (McVary 2011; Speakman 2015).

Description of the intervention

Treatment options for men with LUTS/BPO include the following (Brown 2004a; Emberton 2006; Gratzke 2015; Gravas 2016; McVary 2011):

- Watchful waiting (also known as active surveillance, active monitoring, self-management, or self-care), a clinical management approach wherein usual treatment is delayed for a period of observation, during which disease progression is periodically monitored. Watchful waiting is generally employed for conditions that progress slowly or when the risks of treatment outweigh the potential benefits. Interventions can range from regular office visits to intensive, multidisciplinary, multimodal programmes that may include patient education, reassurance, counseling, lifestyle changes, and physical activity (e.g. pelvic floor exercise).
- Medical therapies, comprising single or combination drugs (e.g. alpha-blockers and 5-alpha reductase inhibitors (5-ARIs)).
- Complementary therapies or alternative medicines (e.g. *Serenoa repens*, *Pygeum africanum*, or tai chi).
- Surgical therapies.

The usual approach to care involves pharmaceutical and invasive interventions. Adverse events and effects associated with available therapeutic modalities (Gratzke 2015; Gravas 2016; McVary 2011) include the following:

- Alpha-blockers: asthenia, dizziness, and (orthostatic) hypotension; falls and fractures (secondary to dizziness and hypotension); abnormal ejaculation (decreased or absent ejaculate volume); and intraoperative floppy-iris syndrome.
- 5-alpha reductase inhibitors: reduced libido; erectile dysfunction; ejaculation disorders (retrograde ejaculation, ejaculation failure, or decreased semen volume); and gynaecomastia.
- Antimuscarinic drugs: dry mouth, constipation, micturition difficulties, nasopharyngitis, and dizziness.
- Phosphodiesterase type 5 inhibitors: flushing, gastroesophageal reflux, headache, dyspepsia, back pain, and nasal congestion.
- Beta-3 agonists: hypertension, urinary tract infections, headache, and nasopharyngitis.
- Transurethral needle ablation of the prostate: mild haematuria, urinary tract infections, strictures, incontinence, erectile dysfunction, and ejaculation disorders.
- Laser treatments of the prostate: dysuria, urethral stricture, stress urinary incontinence, and reintervention.
- Prostatic stents: stent migration, exacerbation of LUTS, encrustation, perineal pain, and bladder storage symptoms.
- Prostatic urethral lift: haematuria, dysuria, pelvic pain, urgency, transient incontinence, and urinary tract infections.
- Minimally invasive simple prostatectomy: postoperative complication, haematuria requiring irrigation, urinary tract infections, ileus, and acute urinary retention.

The frequency of adverse events was significantly higher for combination drug therapy.

Physical activity appears to potentially be able to prevent and treat several health issues (Gillespie 2012; Howe 2011; Mishra 2012). In the case of LUTS/BPO, physical activity could be an attractive first-line and complementary option, since studies do not suggest that it is associated with adverse events (Barkin 2011; De Nunzio 2011; Donnell 2011; Dumoulin 2015; Russo 2015).

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure, including occupational activities, daily activities, exercise, and sports (Caspersen 1985). Intensity, frequency, and volume are important characteristics to take into consideration when implementing interventions of physical activities (Ainsworth 2011; Ainsworth 2012), particularly in the presence of a comorbidity such as LUTS/BPO (Parsons 2008; Sea 2009). Physical activity can be classified by metabolic equivalent of task (MET) as light intensity (1.6 to 2.9 METs), moderate intensity (3 to 5.9 METs), or vigorous intensity (6 or more METs). MET expresses the energy cost of physical activities, set by convention to 3.5 mL O₂/kg per minute (equivalent to 1 kilocalorie/kg per hour or 4.184 kJ/kg per hour) (Ainsworth 2011; Ainsworth 2012).

How the intervention might work

Physical activity is known to confer general health benefits (Warburton 2006) and holds promise as a potential first-line or complementary intervention for treating LUTS/BPO (Parsons 2008; Russo 2015; Sea 2009). Physical activity interventions for LUTS/BPO may work through multiple pathways in different physiologic dimensions (Barkin 2011; Barnard 2008; Chang 2008; De Nunzio 2011; Donnell 2011; Dumoulin 2015; Jung 2012; Parsons 2008; Sea 2009; Silva 2015): strengthening the pelvic floor; promoting activity of the parasympathetic nervous system and reducing excitement of the sympathetic nervous system (an effect similar to that of alpha-blocker drugs); decreasing resting sympathetic tone in the prostate; improving hormonal milieu through modulation of insulin and testosterone; reducing prostate inflammation through decreased oxidative damage; reducing the contractile response of smooth muscle; and reducing growth of prostate primary epithelial cells. In addition, immunologic function and antioxidant defence shows improvement with exercise, further protecting against comorbidities (Warburton 2006).

Physical activity might also have a clinically important placebo effect. Based on a network meta-analysis of monodrug therapy for LUTS/BPO (Yuan 2015), the placebo effect on the IPSS was around 20%: mean changes from baseline (17.85) of -3.39 (95% confidence interval -6.68 to -0.10; 89 trials, 48,854 men).

Why it is important to do this review

Because the prevalence of LUTS/BPO increases with age, the burden and number of men complaining of LUTS will rise as life expectancy increases and the elderly population grows. Consequently, there will be an increased demand for treatment services and a need to incorporate evidence-based medicine in treatments. Several Cochrane Reviews for LUTS/BPO focusing on drugs and supplements, health technology assessments, and surgery have been published in the Cochrane Library (Garimella 2009; Hoffman 2000; Hoffman 2012; Tacklind 2010; Tacklind 2012; Wilt 1998; Wilt 1999). Physical activity could prove to be a first-line and complementary intervention for treating LUTS/BPO (Parsons 2008; Russo 2015; Sea 2009). The American Urological Association

(AUA) considers lifestyle interventions, including physical activity, as a high-priority area for future research in LUTS/BPO (McVary 2011). Evidence at different levels, including clinical trials (e.g. Jung 2012) and reviews of nonrandomised trials not conducted by Cochrane, has shown that physical activity may improve LUTS/BPO (Parsons 2008; Sea 2009). However, no Cochrane Review to date has assessed the evidence for physical activity as a potential intervention for LUTS/BPO.

OBJECTIVES

To assess the effects of physical activity on lower urinary tract symptoms due to benign prostatic obstruction.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) and controlled clinical trials (CCTs), both published and unpublished, without restriction on language, date, or publication status.

Types of participants

We included only men diagnosed with LUTS by symptom scores (e.g. IPSS, DAN-PSS) presumably due to BPO. We excluded studies that included men with a history suggestive of non-BPO causes of LUTS (D'Silva 2014; Gratzke 2015). We used information from the study description regarding medical, neurologic, and urologic history to determine if the causes of LUTS were other than BPO, contacting study authors for additional details when necessary.

We excluded studies that included men who had previously received invasive therapies for LUTS/BPO, since the subsequent cause of LUTS could have been other than BPO.

We found studies involving a subset of relevant participants and contacted the study authors to request individual data but received no reply.

Types of interventions

Experimental interventions

We included any type of physical activity with or without concomitant interventions. We included interventions for which there were multiple interacting components.

We excluded studies that used electrical stimulation, since this type of intervention does not fulfil the conceptual definition of physical activity, and a previously published Cochrane Review (Berghmans 2013) covers a related topic. We excluded studies in which physical activity was applied after invasive therapies for LUTS/BPO, since the subsequent cause of LUTS could be other than BPO.

Comparator interventions

- Usual treatment (e.g. alpha-blockers, 5-ARIs, combination therapy, invasive therapies).
- Watchful waiting (e.g. active surveillance, nocturnal fluid restriction, caffeine and alcohol restriction, avoidance of over-the-counter decongestants).
- Complementary and alternative medicines (e.g. *Serenoa repens*, *Pygeum africanum*).

- Sham physical activity for which the probability of treatment effect may be attributed to a placebo effect (e.g. stretching).

Types of outcome measures

The outcomes listed were not used as criteria for including studies in the review:

Primary outcomes

- Symptom score for LUTS using a validated instrument (e.g. IPSS, BPH Impact Index (BII)).
- Response rate, defined as 20% improvement in symptom score (measured by authors' report or imputation).
- Withdrawal due to adverse events.

Secondary outcomes

- Change of medication use.
- Need for an invasive procedure (e.g. open prostatectomy, laser therapies, transurethral needle ablation, transurethral resection of the prostate, transurethral microwave therapy).
- Postvoid residual urine (PVR), measured by bladder scanner, transabdominal ultrasonography, or catheterisation.

Timing of outcome measurement

We used the outcome measure with the longest follow-up available for the included studies. We classified the outcome measurement as 'short term' (taken within three months or less); 'medium term' (more than three months to less than 12 months); and 'long term' (12 months or more). We used the data at the longest follow-up available as reported in the individual studies for the meta-analyses.

Main outcomes for 'Summary of findings' tables

We presented a 'Summary of findings' table reporting the following outcomes listed according to priority:

- Symptom score for LUTS;
- Response rate;
- Withdrawal due to adverse events.

Search methods for identification of studies

Electronic searches

We developed an electronic search strategy from inception of database to 6 November 2018 and identified all potential studies from:

- the Cochrane Central Register of Controlled Trials (CENTRAL) (via the Cochrane Library) ([Appendix 1](#));
- MEDLINE (via PubMed) ([Appendix 2](#));
- Embase (via Ovid) ([Appendix 3](#));
- Web of Science (via ISI Web of Knowledge, Core Collection: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI) ([Appendix 4](#));
- LILACS (Latin American and Caribbean Health Sciences database) (via BIREME) ([Appendix 5](#)).

We used the sensitivity-maximising version of the Cochrane Highly Sensitive Search Strategy to identify randomised trials in MEDLINE ([Lefebvre 2011](#)). We adapted the complete search strategy

for MEDLINE provided in [Appendix 2](#) for all databases under consideration.

We searched the following trial registers independently (from inception of database to 6 November 2018):

- ClinicalTrials.gov (US National Institutes of Health; clinicaltrials.gov/) ([Appendix 6](#));
- World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.who.int/trialsearch) ([Appendix 7](#)).

Searching other resources

We checked the reference lists of all included RCTs and review articles for additional references.

We contacted authors of the included RCTs to inquire about other published and unpublished RCTs.

We handsearched potentially relevant RCTs published as abstracts in the following conference proceedings (conference proceedings were considered from 2013 to 6 November 2018):

- American Urological Association Annual Meeting (AUA; www.jurology.com);
- Annual European Association of Urology (EAU; www.uroweb.org);
- Annual Meeting of the American College of Sports Medicine (ACSM; www.acsm.org).

Data collection and analysis

We performed data collection and analysis as recommended in the *Cochrane Handbook for Systematic Reviews of Interventions* ([Higgins 2011a](#)).

Selection of studies

Two review authors (VS, AJG) independently assessed whether studies identified by the search met the inclusion criteria of the review. Any disagreements were resolved by discussion or by consulting a third review author (MSP) if necessary.

Data extraction and management

Two review authors (VS, AJG) independently extracted the data using a previously tested, standardised extraction form. We translated studies reported in non-English-language journals before quality assessment. The data extraction form included PICO characteristics (participants, intervention, control, and outcome) and results from all included studies. We requested further information from study authors when necessary. We adapted the [Cochrane Data Extraction and Assessment Form](#) template to meet [MECIR standards](#) and the needs of this systematic review. This form contained information about the characteristics of each included study: study design, dates study was conducted, sample size, intervention and control groups, population demographics, inclusion and exclusion criteria, outcomes measured, methods and times of measurement, funding sources, and declarations of interest.

We extracted outcomes data relevant to this Cochrane Review as needed for calculation of summary statistics and measures of variance. For dichotomous outcomes, we attempted to obtain

numbers of events and totals for population of a 2×2 table, as well as summary statistics with corresponding measures of variance. For continuous outcomes, we attempted to obtain means and standard deviations or data necessary to calculate this information.

One review author (VS) entered all data into Review Manager 5 (RevMan 2014), and a second review author (AJG) double-checked the entries. Any disagreements were resolved by discussion or by consulting a third review author (MSP) if necessary.

We provided information, including trial identifiers, regarding potentially relevant ongoing studies in the Characteristics of ongoing studies table.

Dealing with duplicate and companion publications

When we found duplicate publications, companion documents, or multiple reports of a primary study, we maximised the yield of information by mapping all publications to unique studies and collating all available data. We used the most complete data set aggregated across all known publications. In case of doubt, we gave priority to the publication reporting the longest follow-up associated with our primary or secondary outcomes.

Assessment of risk of bias in included studies

Two review authors (VS, AJG) independently used the 'Risk of bias' tool described in the *Cochrane Handbook for Systematic Reviews of Interventions* to assess the risk of bias for all included studies (Higgins 2011b). A third review author (MSP) resolved any disagreements. We assessed risk of bias according to the following domains:

- Random sequence generation (selection bias);
- Allocation concealment (selection bias);
- Blinding of participants and personnel (performance bias);
- Blinding of outcome assessment (detection bias);
- Incomplete outcome data (attrition bias);
- Selective reporting (reporting bias);
- Other bias (other sources of bias related to a particular trial design (e.g. crossover or cluster-randomised) or specific circumstances, e.g. interventions mixed).

We classified risk of bias as low, high, or unclear in accordance with the Cochrane tool for assessment of risk of bias (Higgins 2011b).

For performance bias (blinding of participants and personnel) and detection bias (blinding of outcome assessment), we evaluated the risk of bias separately for each outcome according to the way of measuring (subjectively or objectively).

We also assessed attrition bias (incomplete outcome data) on an outcome-specific basis and grouped outcomes with similar judgements when reporting our findings in the 'Risk of bias' tables.

We further summarised the risk of bias across domains for each outcome in each included study, as well as across studies and domains for each outcome.

We defined the following endpoints as subjective outcomes:

- Symptom score for LUTS;
- Response rate.

We defined the following endpoints as objective outcomes:

- Withdrawals due to adverse events;
- Change of medication use;
- Invasive procedure;
- PVR.

Measures of treatment effect

For dichotomous data, we summarised the results as risk ratios (RRs). In addition, we converted a statistical parameter for effect size to the number needed to treat for an additional beneficial outcome (NNTB) or the number needed to treat for an additional harmful outcome (NNTH). For continuous outcomes, we used the mean difference (MD) for measures in the same unit or the standardised mean difference (SMD) for different scales used to evaluate the same outcome. All statistical parameters used 95% confidence intervals (CIs).

Unit of analysis issues

We considered the individual participant as the unit of analysis. In crossover RCTs, we used only the first period before the treatments were crossed over. When we identified trials with more than two intervention groups, we handled these in accordance with the guidance provided in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011c).

Dealing with missing data

For studies with missing data, we employed the strategies for dealing with missing data in accordance with those provided in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011b):

- We tried at first to contact the study authors by sending two emails to request additional information (e.g. incomplete reporting, lack of intention-to-treat analysis, summary data missing for an outcome, randomisation process not described, or any other necessary data). If we did not receive an answer, we reported and discussed this in the text, and highlighted it in tables.
- We described any methods used to deal with missing data.
- We performed sensitivity analyses to test the robustness of these assumptions.
- We discussed the impact of missing data on the results of the review.

If data were available, we performed intention-to-treat analyses; otherwise, we performed available-case analyses.

We used imputation of data to estimate the response rate (Furukawa 2005).

Where means and standard deviations (SDs) were not reported and we were unable to obtain the necessary information from the study authors, we imputed these values by estimating from the median, range, and the size of the sample, in accordance with the methods reported by Hozo 2005.

Assessment of heterogeneity

If we performed meta-analyses, we planned to assess heterogeneity by visual inspection of the forest plot and

considering the χ^2 test (with a significance level of $P < 0.10$). We planned to use the I^2 statistic when performing a fixed-effect meta-analysis, considering an I^2 greater than 50% as indicative of substantial heterogeneity; we planned to use τ^2 when performing a random-effects meta-analysis, considering a τ^2 greater than 1 as indicative of substantial heterogeneity.

Assessment of reporting biases

We attempted to obtain study protocols for the included studies to assess for selective outcome reporting.

As only six studies were included in the review, we did not assess the likelihood of publication bias using a funnel plot.

Data synthesis

We did not find good evidence for homogeneous effects across studies; thus we summarised data using a random-effects model. We interpreted random-effects meta-analyses with due consideration of the whole distribution of effects. In addition, we performed statistical analyses according to the statistical guidelines contained in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011a). We performed meta-analysis using an inverse-variance method for dichotomous and continuous outcomes. When data were sparse for dichotomous outcomes (e.g. low event rates or small study size), we used the Mantel-Haenszel method. We used Review Manager 5 software to perform analyses (RevMan 2014). When meta-analysis was not possible, we provided a narrative synthesis of the available evidence.

'Summary of findings' table

We presented the overall quality of the evidence for each outcome according to the GRADE approach, which takes into account five criteria related not only to internal validity (risk of bias, inconsistency, imprecision, publication bias), but also to external validity, such as directness of results (Guyatt 2008). For each comparison, two review authors (VS, AJG) independently rated the quality of evidence for each outcome as 'high', 'moderate', 'low', or 'very low' using GRADEpro GDT (GRADEpro GDT). Any discrepancies were resolved by consensus or by consulting a third review author when necessary. For each comparison, we presented a summary of the evidence for the main outcomes in a 'Summary of findings' table, which provided key information about the best estimate of the magnitude of the effect in relative terms and absolute differences for each relevant comparison of alternative management strategies; numbers of participants and studies addressing each important outcome; and the rating of the overall confidence in effect estimates for each outcome (Guyatt 2011; Schünemann 2011). When meta-analysis was not possible, we presented the results in a narrative 'Summary of findings' table.

Subgroup analysis and investigation of heterogeneity

We planned to investigate heterogeneity by performing subgroup analyses according to

- intensity of physical activity (e.g. light intensity (1.6 to 2.9 METs), moderate intensity (3 to 5.9 METs), and vigorous intensity (6 METs or greater)). To support intensity assessment, we used the authors' report and the 'Compendium of physical activities' (Ainsworth 2012);
- timing of outcome measurement (i.e. short term (within three months or less), medium term (more than three months to less than 12 months), and long term (12 months or more));
- severity of LUTS (e.g. mild (score of 0 to 7), moderate (score of 8 to 19), or severe (score of 20 to 35)).

We assessed statistical differences in subgroup analyses by CI overlap and by performing the test for subgroup differences available in Review Manager 5 (RevMan 2014).

Sensitivity analysis

We planned to perform sensitivity analyses in order to explore the influence of the following factors (when applicable) on effect sizes:

- restricting the analysis by taking into account risk of bias, by excluding studies at 'high risk' and 'unclear risk';
- using the alternative model (fixed-effect or random-effects) for analysis, to check the robustness of results.

RESULTS

Description of studies

Results of the search

Through database searching of the Cochrane Central Register of Controlled Trials (CENTRAL) via the Cochrane Library, MEDLINE (via PubMed), and Embase (Ovid), Web of Science (via ISI Web of Knowledge), LILACS (Latin American and Caribbean Health Sciences) via BIREME, we identified 734 records (see Figure 1). We identified an additional 13 records through other sources, including five records through handsearching reference lists, four records from the grey literature, three studies from trial register searches, and one through author contact. We screened the titles and abstracts of 747 records, excluding 713 records. We screened 34 full-text articles, and excluded 22 references from 13 studies for the following reasons: six studies (eight references) were not RCTs or CCTs; four studies (eight references) did not investigate the target population; two studies (four references) analysed other interventions; and one study (two references) was awaiting classification. We included a total of six studies (12 references) in the review. All included studies were published in English.

Figure 1. Study flow diagram.

Included studies

Details of the included studies are presented in the [Characteristics of included studies](#) tables. We included six trials that randomised 652 male participants, published between 2007 and 2016 in the English language (Brown 2007; Chen 2012; Hut 2016; Jung 2012; Weng 2010; Yee 2015). Hut 2016 was available as a brief report

(the most complete version) and, although the authors shared the thesis with us, it was based in pilot and only half of the sample was available. Weng 2010 was available only as an abstract.

We contacted the authors for further information on study methodology and results with little success. We sent study authors two emails requesting additional information but only received

a response from the authors of [Hut 2016](#), who confirmed the diagnosis of study participants.

Design

All six included studies were parallel RCTs ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)).

Sample sizes

The sample size of the included studies ranged from 41 participants, in [Hut 2016](#), to 222 participants, in [Chen 2012](#), for a total of 652 randomised men.

Setting

Five included trials were single-site studies ([Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)), and one was a two-site study ([Brown 2007](#)). Two studies were conducted in China ([Chen 2012](#); [Yee 2015](#)), one in the UK ([Brown 2007](#)), one in Korea ([Jung 2012](#)), one in the Netherlands ([Hut 2016](#)), and one in Taiwan ([Weng 2010](#)).

Participants

Participants were over the age of 40 years; [Weng 2010](#) included the youngest participants (mean 58.0, standard deviation (SD) 6.8) and [Jung 2012](#) the oldest (mean 70.7, SD 4.9). Race/ethnicity was described in [Brown 2007](#) (77% white and 23% non-white (black, Asian, other)) and [Chen 2012](#) (100% Chinese). The severity of LUTS by IPSS ranged from moderate to severe; [Jung 2012](#) included participants with lower severity (mean 14.7, SD 8.6), and [Chen 2012](#) included participants with greater severity (mean 20.1, SD 6.5). Postvoid residual urine (mL) was reported by [Hut 2016](#) (median 36.8) and [Yee 2015](#) (mean 47.3, SD 65.9). Only [Yee 2015](#) reported prostate volume (mL) (mean 54.4, SD 27.6). Prostate-specific antigen (PSA) (ng/mL) was reported in [Chen 2012](#) (mean 2.1, SD 0.5) and [Yee 2015](#) (mean 4.7, SD 4.9). Comorbidities were reported in [Brown 2007](#) (70% had one or more comorbidities) and [Chen 2012](#) (89% had one or more comorbidities), but specific comorbidities were not reported.

The included trials failed to report several baseline characteristics: Four studies did not report on race or ethnicity ([Hut 2016](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)). Five studies did not report on PVR and prostate volume ([Brown 2007](#); [Chen 2012](#); [Jung 2012](#); [Weng 2010](#)). Four studies did not report on PSA ([Brown 2007](#); [Hut 2016](#); [Jung 2012](#); [Weng 2010](#)). Four studies did not report on comorbidities ([Hut 2016](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)).

Interventions

Physical activity was used as experimental intervention and included tai chi, pelvic floor exercise, and intense exercise. The physical activity intervention used in four studies was pelvic floor exercise ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Weng 2010](#)); of these four studies, two used pelvic floor exercise as part of self-management programme ([Brown 2007](#); [Chen 2012](#)); one used only pelvic floor exercise ([Hut 2016](#)); and the fourth study applied the intervention concomitant to tamsulosin ([Weng 2010](#)). One study used tai chi as the physical activity intervention ([Jung 2012](#)). The newest study used some type of unreported intense exercise as part of a weight-reduction programme ([Yee 2015](#)).

The intensity of physical activity was light in four studies ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Weng 2010](#)); moderate in one study ([Jung 2012](#)); and in one study physical activity might be considered

vigorous ([Yee 2015](#) only reported "intense exercise"). [Hut 2016](#) described the frequency and volume of physical activity as "daily" (without further detail), 30 min/day. [Jung 2012](#) applied tai chi 3 times/week, 60 min/day. Four studies did not report the frequency and volume of physical activity ([Brown 2007](#); [Chen 2012](#); [Weng 2010](#); [Yee 2015](#)).

In [Brown 2007](#), [Hut 2016](#), and [Jung 2012](#), the sessions were designed to enable the participants to learn and perform the interventions individually. The remaining three studies did not report clearly how interventions were performed ([Chen 2012](#); [Weng 2010](#); [Yee 2015](#)). In [Brown 2007](#) and [Chen 2012](#), the self-management programme included six components: education and reassurance, fluid management, caffeine and alcohol, concurrent medication, toilet and bladder retraining, and miscellaneous. In [Hut 2016](#), participants were informed about micturition behaviour; taught breathing, relaxation, and proprioceptive exercises; and instructed to perform the pelvic floor exercises at home. [Jung 2012](#) instructed participants to perform tai chi at home, using warm-up exercise (15 min), 20 main movements (40 min), and a cool-down exercise (5 min). [Yee 2015](#) used a "comprehensive weight reduction program" (weight reduction protocol, medical nutrition therapy, and integrated assessment with counseling) without providing further detail. One study did not provide details ([Weng 2010](#)).

The main comparator intervention was watchful waiting, which was used in five studies ([Brown 2007](#); [Chen 2012](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)). [Hut 2016](#) used alpha-blockers (tamsulosin 0.4 mg or alfuzosin 10 mg daily) as the comparator.

Five studies used concomitant interventions. Three studies provided standard information on LUTS/BPO and its corresponding therapies for all participants ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#)). In two studies, all participants received an alpha-blocker (tamsulosin) ([Weng 2010](#); [Yee 2015](#)).

Duration of treatment ranged from eight weeks to 12 months. The follow-up was short term (within three months or less) in three studies ([Hut 2016](#); [Jung 2012](#); [Weng 2010](#)); medium term (more than three months to less than 12 months) in two studies ([Chen 2012](#); [Yee 2015](#)); and long term (12 months or more) in one study ([Brown 2007](#)).

Outcomes

A detailed description of the characteristics of included studies is presented in [Characteristics of included studies](#). The following is a brief overview:

All six included studies reported primary outcomes. Six studies reported 'symptom score for LUTS' by IPSS score ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)). The included studies did not report data for the outcome 'response rate', and the study authors did not respond to our emails; it was possible to impute data by Furukawa's method ([Furukawa 2005](#)), and we were able to impute this outcome based on IPSS score for four studies ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Yee 2015](#)). Five studies reported the outcome 'withdrawal due to adverse events' ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Yee 2015](#)).

Three studies reported secondary outcomes. One study reported 'change of medication use' and 'need for an invasive procedure' ([Brown 2007](#)). Two studies reported PVR ([Hut 2016](#); [Yee 2015](#)).

2015). Postvoid residual urine was reported incompletely in [Hut 2016](#), and it was not possible to extract or impute data.

Funding and conflicts

Five studies specified funding sources ([Brown 2007](#); [Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Yee 2015](#)); the remaining study did not report this information ([Weng 2010](#)).

One study declared a conflict of interest for one researcher who received fees from pharmaceutical companies, while all of the other authors reported no conflict of interest ([Brown 2007](#)). Four studies declared no conflict of interest ([Chen 2012](#); [Hut 2016](#); [Jung 2012](#); [Yee 2015](#)). [Weng 2010](#) did not declare any information regarding conflicts of interest.

Excluded studies

We assessed 34 full-text articles for eligibility. We excluded 13 studies (22 references). Of these, six (eight references) were not RCTs or CCTs ([Ausmees 2013](#); [Beyramijam 2013](#); [Brown 2004b](#); [NCT00628615](#); [NCT01576900](#); [Tibaek 2007](#)); four studies (eight references) did not meet our inclusion criteria of LUTS due to BPO ([Breyer 2014](#); [Burgio 2010](#); [Johnson 2016](#); [NCT00404638](#)); and two studies (four references) used physical activity in both study arms ([Roehrborn 2015](#)). For further details, see [Characteristics of excluded studies](#). [Liu 2016](#) is awaiting classification (see below).

Studies awaiting classification

We identified one completed study (two references) in accordance to study dates ([Liu 2016](#)), but the article or results were not posted. A multiple-arm trial was planned to assess the effects of yi jin jing versus tai chi versus watchful waiting. The study protocol is summarised in [Characteristics of studies awaiting classification](#). We contacted the authors but received no response. We will consider this study in future updates of this review.

Ongoing studies

We did not identify any ongoing studies.

Risk of bias in included studies

We assessed the risk of bias of the included studies according to the seven domains outlined in the Cochrane 'Risk of bias' tool ([Higgins 2011b](#)). Two studies ([Brown 2007](#); [Hut 2016](#)) had available protocols and published reports to extract the methodological details; the remaining studies ([Chen 2012](#); [Jung 2012](#); [Weng 2010](#); [Yee 2015](#)) data extraction was based only on the published reports. For an overview of review authors' judgements about each 'Risk of bias' item for individual studies and across all studies, see [Figure 2](#) and [Figure 3](#). For details on the risk of bias of the included studies, see [Characteristics of included studies](#).

Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

Figure 3. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias): Subjective outcomes	Blinding of participants and personnel (performance bias): Objective outcomes	Blinding of outcome assessment (detection bias): Subjective outcomes	Blinding of outcome assessment (detection bias): Objective outcomes	Incomplete outcome data (attrition bias): Subjective outcomes	Incomplete outcome data (attrition bias): Objective outcomes	Selective reporting (reporting bias)	Other bias
Brown 2007	+	-	-	+	?	+	+	+	-	-
Chen 2012	+	?	-	+	-	+	+	+	?	+
Hut 2016	?	?	-	+	-	+	+	+	-	?
Jung 2012	+	-	-	+	+	+	-	-	-	-
Weng 2010	?	?	-	?	?	?	?	?	?	?
Yee 2015	?	?	-	+	?	+	-	-	-	-

Allocation

Random sequence generation

Three studies reported adequate methods for sequence generation and were judged as at low risk of bias (Brown 2007; Chen 2012; Jung 2012). For the other three included studies (Hut 2016; Weng 2010; Yee 2015), information on sequence generation was not reported or was insufficient to permit a judgement (unclear risk of bias).

Allocation concealment

Four studies provided insufficient information to enable assessment (Chen 2012; Hut 2016; Weng 2010; Yee 2015). We classified the remaining two studies as at high risk of bias: Jung 2012 declared that they did not perform allocation concealment, and Brown 2007 changed the allocation concealment procedure, increasing the risk of selection bias.

Blinding

Blinding of participants and personnel

The nature of the study interventions (physical activity) implies that blinding of participants and personnel was not possible.

We considered the subjective outcomes (symptom score for LUTS and response rate) as at high risk of bias for blinding participants and personnel for all six included studies, since the study interventions meant that blinding of participants was not possible and that all outcomes were susceptible to bias (Brown 2007; Chen 2012; Hut 2016; Jung 2012; Weng 2010; Yee 2015).

We rated objective outcomes (withdrawals due to adverse events, change of medication use, need for invasive procedure, and PVR) as at low risk of bias, since participants attended the appointments at which objective outcomes were measured. One study did not report objective outcomes and was judged as at unclear risk of bias (Weng 2010).

Three studies were at high risk of performance bias due to co-interventions (Brown 2007; Chen 2012; Yee 2015).

Blinding of outcome assessment

Only one study blinded outcome assessment for subjective outcomes (symptom score for LUTS and response rate) and was judged as at low risk of bias (Jung 2012). We judged three open-label studies as at high risk of bias (Brown 2007; Chen 2012; Hut 2016). There was insufficient information to make a judgement for the remaining two studies (unclear risk of bias) (Weng 2010; Yee 2015).

We rated objective outcomes (withdrawals due to adverse events, change of medication use, need for invasive procedure, and PVR) as at low risk of bias, since participants attended the appointments at which objective outcomes were measured. One study did not report objective outcomes and was judged as at unclear risk of bias (Weng 2010).

Incomplete outcome data

We classified three studies as at low risk of bias: Chen 2012 included all randomised participants in the final analysis; Brown 2007 applied last observation carried forward to impute missing data of 25 randomised participants in the final analysis and performed sensitivity analysis demonstrating that the loss to follow-up did not

have a clinically relevant impact; and Hut 2016 lost one participant from each group, which we judged as not having a clinically relevant impact. We assessed two studies as at high risk of bias: Jung 2012 included only half of all randomised participants (28/56) in the final analysis; and Yee 2015 included only a part of the 50 missing randomised participants with an unclear explanation, resulting in a biased attempt to impute missing data. We judged Weng 2010 as at unclear risk of bias due to insufficient information to permit a judgement about exclusions and a lack of reporting of missing data (the study was available in abstract form only). Subjective and objective outcomes showed the same judgement and were grouped here.

Selective reporting

Only two studies registered their trials before conducting the study (Brown 2007; Hut 2016).

We judged four studies as at high risk of bias. We found differences between the protocols and the study reports in Brown 2007. Hut 2016 reported outcomes incompletely. Jung 2012 planned to include participants with an IPSS score of greater than 25, but there was evidence of protocol deviation and/or violation. Although Yee 2015 did not register the study protocol, we judged the study as at high risk of bias because not all timing of outcome measurements proposed in the methods section were reported.

We classified the remaining two studies as at unclear risk of bias because they provided insufficient information to enable an assessment of low or high risk (Chen 2012; Weng 2010).

Other potential sources of bias

We considered three studies to be at high risk of bias. In Brown 2007 there were changes in the advice that clinicians gave to the comparator group and direct communication between participants allocated to different groups. In Jung 2012, baseline characteristics were based on half of the randomised participants, and there was a risk to compromise baseline comparability of groups. In (Yee 2015), the description of intervention was nonreproducible, since it was reported with incompleteness.

We classified one study in which there were no differences in baseline characteristics and we did not identify sources of other bias as at low risk of bias (Chen 2012).

In two studies there was insufficient information to permit a judgement (unclear risk of bias): Hut 2016 was available only as a thesis (with a half of the participants included in final publication) and brief report, and Weng 2010 was available only as an abstract.

Effects of interventions

See: **Summary of findings for the main comparison** Physical activity compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction; **Summary of findings 2** Physical activity as part of self-management programme compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction; **Summary of findings 3** Physical activity as part of weight reduction programme compared to watchful waiting for lower urinary tract symptoms secondary to benign prostatic obstruction; **Summary of findings 4** Physical activity compared to alpha-blockers for lower urinary tract symptoms secondary to benign prostatic obstruction

Physical activity versus watchful waiting

See [Summary of findings for the main comparison](#).

We included two studies in this comparison ([Jung 2012](#); [Weng 2010](#)). [Weng 2010](#) used pelvic floor exercise for two months, and [Jung 2012](#) used tai chi for three months; both used a short-term follow-up for men with moderate LUTS. [Weng 2010](#) was only available as a conference abstract and did not report results in a form that could be extracted for meta-analysis.

Primary outcomes

Symptom score for LUTS

One study reported data for this outcome ([Jung 2012](#)). We are uncertain whether physical activity improves symptom score for LUTS by IPSS compared to watchful waiting (mean difference (MD) -8.1, 95% confidence interval (CI) -13.2 to -3.1; 1 study; 28 participants; [Analysis 1.1](#)). We assessed the quality of evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings for the main comparison](#)).

[Weng 2010](#) measured IPSS but did not report results in a form that could be extracted for data and analyses.

Response rate (20% improvement)

We are uncertain about the effect of physical activity compared to watchful waiting for response rate (risk ratio (RR) 1.80, 95% CI 0.81 to 4.02; 1 study; 28 participants; [Analysis 1.2](#)). Physical activity would result in 286 more men per 1000 (68 fewer to 1079 more) reporting a response rate. We assessed the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings for the main comparison](#)). We attempted contact with [Jung 2012](#) twice without response, after which we imputed data in accordance with [Furukawa 2005](#).

Withdrawal due to adverse events

One study reported data for this outcome ([Jung 2012](#)). We are uncertain about the effect of physical activity compared to watchful waiting on withdrawal due to adverse events (RR 1.00, 95% CI 0.59 to 1.69; 1 study; 56 participants; [Analysis 1.3](#)). Physical activity would result in 0 fewer men withdrawing due to adverse events per 1000 (205 fewer to 345 more). We assessed the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings for the main comparison](#)). There were 28 withdrawals overall in [Jung 2012](#):

- 14 in the physical activity group for the following reasons: did not attend after allocation (n = 3), fracture (n = 1), business trip (n = 1), attend to a spouse (n = 1), no desire (n = 5), and low attendance rate (n = 3); and

- 14 in the watchful waiting group for the following reasons: lost contact (n = 10), hospitalisation (n = 2), and taking medication (n = 2).

Secondary outcomes

Change of medication use

None of the studies reported data on change of medication use.

Need for an invasive procedure

None of the studies reported data on need for an invasive procedure.

Postvoid residual urine

None of the studies reported data on PVR.

Subgroup analyses

We did not perform subgroup analyses because there were not enough studies to estimate effects in various subgroups.

Sensitivity analyses

We did not perform sensitivity analyses because there were not enough studies included in the analysis to explore the data.

Assessment of reporting bias

We did not draw funnel plots due to the limited number of included studies.

Physical activity as part of self management programme versus watchful waiting

See [Summary of findings 2](#).

We included two studies in this comparison ([Brown 2007](#); [Chen 2012](#)), both of which used pelvic floor exercise as one of multiple interacting components of the experimental intervention. [Brown 2007](#) performed long-term follow-up, reporting outcomes at 12 months for men with moderate LUTS. [Chen 2012](#) used a medium-term follow-up, reporting outcomes at six months for men with predominantly severe LUTS.

Primary outcomes

Symptom score for LUTS

Two studies reported continuous data for symptom score for LUTS by IPSS ([Brown 2007](#); [Chen 2012](#)). We are uncertain about the effect of physical activity as part of a self-management programme compared to watchful waiting on symptom score for LUTS (MD -6.2, 95% CI -9.9 to -2.5; 2 studies; 362 participants; [Analysis 2.1](#); [Figure 4](#)). We identified substantial statistical heterogeneity ($I^2 = 87\%$). We judged the quality of the evidence for this outcome to be very low due to study limitations, inconsistency, indirectness, and imprecision ([Summary of findings 2](#)).

Figure 4. Forest plot of comparison: 2 Physical activity (pelvic floor exercise) as part of self management programme versus watchful waiting, outcome: 2.1 Symptom score for LUTS.

Response rate (20% improvement)

We are uncertain about the effect of physical activity as part of a self-management programme compared to watchful waiting on response rate (RR 2.36, 95% CI 1.32 to 4.21; number needed to treat for an additional beneficial outcome (NNTB) = 2, 95% CI 1 to 5; 2 studies; 362 participants; [Analysis 2.2](#); [Figure 5](#)). The intervention would result in 424 more men per 1000 (100 more

to 1001 more) reporting a response rate. We identified substantial statistical heterogeneity (I² = 83%). We judged the quality of the evidence for this outcome to be very low due to study limitations, inconsistency, indirectness, and imprecision ([Summary of findings 2](#)). The authors of [Brown 2007](#) and [Chen 2012](#) did not respond to our two contacts by email. We imputed the outcome data in accordance with [Furukawa 2005](#).

Figure 5. Forest plot of comparison: 2 Physical activity (pelvic floor exercise) as part of self management programme versus watchful waiting, outcome: 2.2 Response rate.

Withdrawal due to adverse events

Two studies reported data for withdrawal due to adverse events ([Brown 2007](#); [Chen 2012](#)). We are uncertain about the effects of

physical activity as part of a self-management programme versus watchful waiting on this outcome (risk difference (RD) 0.00, 95% CI -0.05 to 0.06; 2 studies; 362 participants; [Analysis 2.3](#); [Figure 6](#)).

We identified moderate statistical heterogeneity ($I^2 = 33\%$). Physical activity as part of a self-management programme would result in 65 fewer men withdrawing due to adverse events per 1000 (65 fewer to

65 fewer). We judged the quality of the evidence for this outcome to be very low due to study limitations, indirectness, and imprecision ([Summary of findings 2](#)).

Figure 6. Forest plot of comparison: 2 Physical activity (pelvic floor exercise) as part of self management programme versus watchful waiting, outcome: 2.3 Withdrawal due to adverse events.

There were 25 withdrawals (14 in the physical activity group and 11 in the watchful waiting group). We were unable to present numbers defined to reasons of withdrawals due to recoups, which cannot be separated for an inaccurate description. However, the reasons reported for the withdrawals in the study are attributed to changes in intervention and/or clinical condition (alpha-blocker, anticholinergic, surgery, catheterised for acute urinary retention, and rise in IPSS of ≥ 3 points).

Secondary outcomes

Change of medication use

One study reported data for change of medication use ([Brown 2007](#)). Long-term data were reported, and there might be an observed reduction in needed drug therapy favouring physical activity as part of self-management programme compared to watchful waiting (RR 0.48, 95% CI 0.25 to 0.92; NNTB = 6, 95% CI 3 to 50; 1 study; 140 participants; [Analysis 2.4](#)).

Need for an invasive procedure

One study reported data for need for an invasive procedure ([Brown 2007](#)). The study reported the data for long term. The need for an invasive procedure might not differ between the physical activity as part of self-management programme group and the watchful waiting group (RR 0.31, 95% CI 0.03 to 2.87; 1 study; 140 participants; [Analysis 2.5](#)).

Postvoid residual urine

None of the studies reported data on PVR.

Subgroup analyses

See [Analysis 2.1](#), [Analysis 2.2](#), and [Analysis 2.3](#).

We were able to perform subgroup analyses for timing of outcome measurement to primary outcomes. The data at the longest follow-up available were measured in [Chen 2012](#) at medium term at six months and in [Brown 2007](#) at long term at 12 months. The subgroup interaction test indicated a possible difference in effect for symptom score for LUTS ($\chi^2 = 7.96$, $P = 0.005$, $I^2 = 87.4\%$; [Figure 4](#)) and response rate ($\chi^2 = 5.78$, $P = 0.02$, $I^2 = 82.7\%$; [Figure 5](#)), but not for withdrawals due to adverse events ($\chi^2 = 0.18$, $P = 0.67$, $I^2 = 0\%$; [Figure 6](#)) based on timing of outcome measurement. Two reasons might explain the heterogeneity and the smaller effect size in [Brown 2007](#): 1) there is evidence of changes in the advice that the clinicians gave to the comparator group (watchful waiting), and (2) direct communication between men allocated to different groups. Although there were differences in the duration of the intervention (12 months in [Brown 2007](#) and six months in [Chen 2012](#)), this may not be the reason for the heterogeneity, since the effect size at six months is consistent at 12 months for [Brown 2007](#).

Sensitivity analyses

We did not perform sensitivity analyses because there were not enough studies included in the analysis to explore the data.

Assessment of reporting bias

We did not draw funnel plots due to the limited number of included studies.

Ongoing studies

We did not identify any ongoing studies for this comparison.

Physical activity as part of weight reduction programme versus watchful waiting

See [Summary of findings 3](#).

We included one study in this comparison. [Yee 2015](#) used some type of (unclear) vigorous exercise as one of multiple interacting components of the experimental intervention in men with moderate LUTS at medium-term follow-up (48 weeks).

Symptom score for LUTS

[Yee 2015](#) reported data for this outcome. We are uncertain about the effect of physical activity as part of a weight reduction programme for symptom score for LUTS compared to watchful waiting (MD -1.1, 95% CI -3.5 to 1.3; 1 study; 117 participants; [Analysis 3.1](#)). We rated the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings 3](#)).

Response rate (20% improvement)

We are uncertain of the effect of physical activity as part of a weight reduction programme compared to watchful waiting on response rate (RR 1.20, 95% CI 0.74 to 1.94; 1 study; 117 participants; [Analysis 3.2](#)). The intervention would result in 67 more men per 1000 (87 fewer to 313 more) reporting a response rate. We rated the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings 3](#)). We attempted two contacts with [Yee 2015](#) without receiving a response, after which we imputed data in accordance with [Furukawa 2005](#).

Withdrawal due to adverse events

[Yee 2015](#) reported data for this outcome. We are uncertain of the effect of the intervention on withdrawal due to adverse events (RR 1.63, 95% CI 1.03 to 2.57; number needed to treat for an additional harmful outcome (NNTH) = 6, 95% CI 3 to 50; 1 study; 130 participants; [Analysis 3.3](#)). Physical activity as part of weight reduction programme would result in 184 more men withdrawing due to adverse events per 1000 (9 more to 459 more). We rated the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings 3](#)).

Secondary outcomes

Change of medication use

The study did not report data on change of medication use.

Need for an invasive procedure

The study did not report data on need for an invasive procedure.

Postvoid residual urine

[Yee 2015](#) reported data on PVR. Physical activity as part of weight reduction programme did not improve PVR compared to watchful waiting (MD -25.0, 95% CI -54.7 to 4.7; 1 study; 117 participants; [Analysis 3.4](#)).

Subgroup analyses

We did not perform subgroup analyses because there were not enough studies to estimate effects in various subgroups.

Sensitivity analyses

We did not perform sensitivity analyses because there were not enough studies included in the analysis to explore the data.

Assessment of reporting bias

We did not draw funnel plots due to the limited number of included studies.

Ongoing studies

We did not identify any ongoing studies for this comparison.

Physical activity versus alpha-blockers

See [Summary of findings 4](#).

We included one study that was available as a brief report in this comparison. [Hut 2016](#) compared pelvic floor exercise versus alpha-blockers (tamsulosin 0.4 mg daily) applied in the short term for three months in men with moderate or severe LUTS. We attempted two contacts with the study authors without receiving a response, after which we imputed the data.

Primary outcomes

Symptom score for LUTS

[Hut 2016](#) measured symptom score for LUTS by IPSS. We are uncertain whether an improvement in the symptom score for LUTS with physical activity is comparable with alpha-blockers (MD 2.8, 95% CI -0.9 to 6.4; 1 study; 39 participants; [Analysis 4.1](#)). We rated the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings 4](#)). The authors reported median and range; we imputed mean and standard deviation according to [Hozo 2005](#).

Response rate (20% improvement)

[Hut 2016](#) contributed to this outcome. We are uncertain whether the number of men reporting response rate for LUTS is comparable between the physical activity and alpha-blockers groups (RR 0.80, 95% CI 0.55 to 1.15; 1 study; 39 participants; [Analysis 4.2](#)). Physical activity might result in 167 fewer men per 1000 (375 fewer to 125 more) reporting a response rate. We rated the quality of the evidence as very low due to study limitations, indirectness, and imprecision ([Summary of findings 4](#)). We imputed data in accordance with [Furukawa 2005](#).

Withdrawal due to adverse events

[Hut 2016](#) reported data for this outcome. The effects of physical activity and alpha-blockers on withdrawal due to adverse events might be similar (RR 0.56, 95% CI 0.06 to 12.89; 1 study; 41 participants; [Analysis 4.3](#)). The intervention would result in 7 fewer men withdrawing due to adverse events per 1000 (49 fewer to 626 more). We rated the quality of the evidence as low due to indirectness and imprecision ([Summary of findings 4](#)).

The reasons for withdrawals were not available in the main publication of [Hut 2016](#). We reported the reasons for withdrawals based on a subset of data from a pilot study provided by the authors through the sharing of a master's thesis, which counted 20 men (10 in the physical activity group and 10 in the alpha-blocker group). No withdrawals were reported for the physical activity group. Six out of 10 men in the alpha-blocker group reported adverse effects, which included dizziness (n = 3), ejaculatory dysfunction (n = 1),

itching ($n = 1$), and gastro-oesophageal reflux ($n = 1$), but only two withdrawals occurred (1 due to dizziness and 1 due to personal circumstances).

Secondary outcomes

Change of medication use

The study did not report data on change of medication use.

Need for an invasive procedure

The study did not report data on need for an invasive procedure.

Postvoid residual urine

Hut 2016 reported data on PVR, but the data available were median and P value for Mann–Whitney test, which limits the extraction for analysis. The change score was -18 mL in the physical therapy group and -11.5 mL in the alpha-blocker group.

Subgroup analyses

We did not perform subgroup analyses because there were not enough studies to estimate effects in various subgroups.

Sensitivity analyses

We did not perform sensitivity analyses because there were not enough studies included in the analysis to explore the data.

Assessment of reporting bias

We did not draw funnel plots due to the limited number of included studies.

Ongoing studies

We did not identify any ongoing studies for this comparison.

DISCUSSION

Summary of main results

We included six studies in this review randomising a total of 652 men in four comparisons. Men were over the age of 40 years with moderate or severe LUTS by IPSS score. These results should be interpreted with caution due to the overall very low quality of the evidence.

Physical activity versus watchful waiting: Two RCTs randomised 119 men. The interventions included tai chi and pelvic floor exercise. The evidence was overall very low quality, and we are uncertain about the effects of physical activity on symptom score for LUTS (MD -8.1, 95% CI -13.2 to -3.1), response rate (RR 1.80, 95% CI 0.81 to 4.02; 286 more men per 1000, 95% CI 68 fewer to 1000 more), and withdrawal due to adverse events (RR 1.00, 95% CI 0.59 to 1.69; 0 fewer men per 1000, 95% CI 205 fewer to 345 more).

Physical activity as part of self-management programme versus watchful waiting: Two RCTs randomised 362 men. Pelvic floor exercise was one of multiple intervention components. The quality of the evidence was very low, and we are uncertain about the effects of physical activity on symptom score for LUTS (MD -6.2, 95% CI -9.9 to -2.5), response rate (RR 2.36, 95% CI 1.32 to 4.21; 424 more men per 1000, 95% CI 100 more to 1001 more), and withdrawal due to adverse events (RD 0.00, 95% CI -0.05 to 0.06; 65 fewer men per 1000, 95% CI 65 fewer to 65 fewer).

Physical activity as part of weight reduction programme versus watchful waiting:

One RCT randomised 130 men. An unclear type of intense exercise was one of multiple intervention components. The quality of the evidence was very low, and we are uncertain about the effects of physical activity on symptom score for LUTS (MD -1.1, 95% CI -3.5 to 1.3), response rate (RR 1.20, 95% CI 0.74 to 1.94; 67 more men per 1000, 95% CI 87 fewer to 313 more), and withdrawal due to adverse events (RR 1.63, 95% CI 1.03 to 2.57; 184 more men per 1000, 95% CI 9 more to 459 more).

Physical activity versus alpha-blockers: One RCT randomised 41 men to pelvic floor exercise or alpha-blockers. The quality of the evidence was very low, and we are uncertain about the effects of physical activity on symptom score for LUTS (MD 2.8, 95% CI -0.9 to 6.4) and response rate (RR 0.80, 95% CI 0.55 to 1.15; 167 fewer men per 1000, 95% CI 375 fewer to 125 more). The quality of the evidence was low for withdrawal due to adverse events; the effects for this outcome may be similar between interventions (RR 0.86, 95% CI 0.06 to 12.89; 7 fewer men per 1000, 95% CI 49 fewer to 626 more).

Overall completeness and applicability of evidence

This review examined men with LUTS/BPO, one of the most common clinical complaints in men, who were treated with physical activity, an intervention well known to bring about general health benefits. Nevertheless, there were several limitations to this review that deserve consideration, as follows.

- Few studies have been conducted, and the existing studies have small sample sizes.
- In general, the studies incompletely described the baseline characteristics of the participants, such as race/ethnicity, weight, body mass index, duration of symptoms, maximal urinary flow rate (Qmax), PVR, prostate volume, PSA, and comorbidities.
- All six included studies reported primary outcomes, but the following points should be taken into consideration:
 - one trial provided only a narrative result for symptom score for LUTS;
 - we needed to impute response rate, as no trials reported this outcome;
 - not all studies reported withdrawal due to adverse events.
- The trials provided incomplete information on secondary outcomes:
 - only one study reported the outcomes of change of medication use and need for an invasive procedure; and
 - two studies reported data for PVR, but one study only provided information in narrative form.
- For most of the evidence there was an insufficient outcome time frame from studies with short- or medium-term follow-up.
- Few types of physical activity and intensities were used. Trials often failed to report the frequency and volume of physical activity.
- We have no evidence of the applicability of physical activity for LUTS/BPO versus several other prespecified comparison interventions, in particular for therapies already established (e.g. 5-ARIs, combination therapy, invasive therapies).

Quality of the evidence

We assessed the quality of the evidence using the GRADE approach. Overall, the quality of evidence was very low, and we are uncertain

of these findings of this review. The reasons for downgrading the evidence were study limitation (i.e. allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias); indirectness (i.e. outcome time frame insufficient, and physical activity as one component of a complex intervention); imprecision (i.e. wide confidence interval, small sample size, and low events); and inconsistency (i.e. variation in point estimates, confidence intervals not overlapping, and heterogeneity).

Potential biases in the review process

We followed the recommendations made for study selection, data collection, and data analysis provided in the *Cochrane Handbook for Systematic Reviews of Interventions* in this review in order to minimise bias (Higgins 2011a).

The strengths of the review process were numbers of databases searched and high-sensitivity search to detect all potentially relevant studies without language or publication status restrictions, and additionally searched trial registries for unpublished, planned, or ongoing studies. Two review authors independently assessed studies for inclusion, performed data extraction, and assessed risk of bias for all of the included studies. We previously published and followed the review protocol (Silva 2016) and reported [Differences between protocol and review](#).

The limitations of the review were that too few studies were included to assess for publication bias by constructing funnel plots; poor study reporting meant that we could not assess some 'Risk of bias' domains; and we found an absence of participant-centred outcome data in the included RCTs. Although the Cochrane RCT filter was adapted to Web of Science (see line #17, [Appendix 4](#)) (Lefebvre 2011), we could not find a study validation for this filter. This adaptation might introduce biases into the review process. In addition, correspondence with study investigators was incomplete.

Additional studies may have been conducted but not yet published or published but not yet identified. Should any such studies be identified, we will include them in future updates of this review.

Agreements and disagreements with other studies or reviews

Based on our broad search strategy, this is the first systematic review investigating the effectiveness and safety of physical activity interventions for treating LUTS/BPO. The previous reviews (Parsons 2008; Russo 2015; Sea 2009) only included observational studies and focused on risk factors of LUTS/BPO attributed to physical activity. Another difference was study design. We included only RCTs, while these other reviews used observational studies (e.g. cross-sectional, case-control, and retrospective or prospective cohort studies). There was minimal information in these other reviews regarding search strategy, assessment of risk of bias, and quality of the evidence, and no protocols were registered.

AUTHORS' CONCLUSIONS

Implications for practice

Patients, healthcare providers, and healthcare policymakers considering the use of physical activity for lower urinary tract symptoms due to benign prostatic obstruction (LUTS/BPO) should recognise that the evidence for the effectiveness and safety of

the intervention is considered to be of very low quality. We are uncertain of the effects of physical activity on symptom score for LUTS, response rate, and withdrawal due to adverse events. Our confidence in the estimates was lowered due to study limitations, inconsistency, indirectness, and imprecision.

Implications for research

The studies included in this review have important methodological limitations that compromise the quality of the evidence of the findings. Additional high-quality trials are needed to enable a more definitive conclusion. We encourage future research to produce evidence towards the following:

- Comparative effectiveness of physical activity for LUTS/BPO versus several other comparison interventions, in particular with therapies that are already well established (e.g. 5-alpha reductase inhibitors, combination therapy, invasive therapies) should be assessed.
- Different types of physical activities need to be compared, since efficacy and safety can be affected. Adherence may be influenced by the type of physical activity and how it is delivered, impacting on effects of intervention; e.g. walking, gym, aquatic activities, or group activities might have better adherence than running, cycling, or individual activities.
- Efficacy, safety, and adherence can also be changed due to different intensities (light, moderate, and vigorous), frequencies (day/week), and volumes (min/day) of physical activities. These comparisons can help answer the dose needed to produce benefits safely.
- Multimodal therapeutic trials, such as those applying the self-management programme, may use multiple intervention groups to compare more than two interventions (e.g. pelvic floor exercise versus education versus medication versus all interventions together).
- Multicentre pragmatic cluster-randomised controlled trials would be helpful. A pragmatic trial would assess real-world applicability of the intervention; e.g. in the experimental group, different types of physical activity can be used, while various intensities, frequencies, and volumes, and physical activity can be combined with other interventions. Multicentre cluster randomisation can reduce the potential for contamination between interventions being delivered within a single clinical site with the potential for subversion of the protocol.

Additionally, future studies should be better designed and reported as follows:

- Avoid biased allocation to interventions by using adequate methods (e.g. central allocation; sequentially numbered, opaque, sealed envelopes).
- Blind as many individuals as possible in the trial. Although participants cannot be blinded, it is possible to blind practitioners who will deliver the intervention, outcome assessors, and data analysts.
- Use intention-to-treat analysis and avoid per-protocol analysis. It is important that all randomised participants be included adequately in the final analysis.
- Register the study protocol, avoiding protocol deviations and violations and reporting all outcomes.

- Use a long-term duration intervention (12 months or more), continuing the follow-up after the intervention is stopped.
- Use an adequate sample size.
- Properly report baseline characteristics.
- Adequately report physical activity, i.e. intervention delivery, type of physical activity, intensity, frequency, and volume.
- Transparent reporting of results to allow independent confirmation of all analyses and also acknowledging study limitations.

ACKNOWLEDGEMENTS

We thank the following people for commenting on the draft review: Philipp Dahm, Alea Miller, Carrie Price, Ran Pang, Harris Foster, Eu Chang Hwang, Robert Lane, and Rourke Decker. Thanks to Jamie Blanck and Carrie Price, who updated the searches in Embase. Thanks to Lisa Winer, who served as Copy Editor. Thanks to Janny H Dekker, who shared the [Hut 2016](#) master's thesis.

We also thank the [Cochrane Urology Group](#) for its support in all processes throughout the review process.

REFERENCES

References to studies included in this review

Brown 2007 {published data only}

Brown CT, Emberton M. Self-management for men with lower urinary tract symptoms. *Current Urology Reports* 2009;**10**(4):261-6. [DOI: [10.1007/s11934-009-0043-6](https://doi.org/10.1007/s11934-009-0043-6)]

* Brown CT, Yap T, Cromwell DA, Rixon L, Steed L, Mulligan K, et al. Self management for men with lower urinary tract symptoms: randomised controlled trial. *BMJ* 2007;**334**(7583):25. [DOI: [10.1136/bmj.39010.551319.AE](https://doi.org/10.1136/bmj.39010.551319.AE); Erratum in: *BMJ* 2007;335(7617):0-f; For full information see html version in: www.bmj.com/content/334/7583/25]

NCT00270309. Self-management for men with uncomplicated lower urinary tract symptoms. clinicaltrials.gov/ct2/show/NCT00270309 (first received 26 December 2005).

Yap TL, Brown C, Cromwell DA, van der Meulen J, Emberton M. The impact of self-management of lower urinary tract symptoms on frequency-volume chart measures. *BJU International* 2009;**104**(8):1104-8. [DOI: [10.1111/j.1464-410X.2009.08497.x](https://doi.org/10.1111/j.1464-410X.2009.08497.x)]

Chen 2012 {published data only}

Chen Y, Zhang X, Hu X, Deng Y, Chen J, Li S, et al. The potential role of a self-management intervention for benign prostate hyperplasia. *Urology* 2012;**79**(6):1385-8. [DOI: [10.1016/j.urology.2011.11.091](https://doi.org/10.1016/j.urology.2011.11.091)]

Hut 2016 {published data only}

Dekker JH, Van der Heide W, Messelink B, Van der Heide CJ, Blanker M, Berger M. Pelvic floor muscle therapy compared to treatment with alpha-1 blocking agents for lower urinary tract symptoms in older men in primary care. ICS 2012; 2012 Oct 15-19; Beijing. International Continence Society, 2012. [Abstract 434; www.ics.org/2012/abstract/434]

Hut J. Pelvic Floor Exercises Compared to Medication in the Treatment of Older Men with Lower Urinary Tract Symptoms in General Practice. The FLOW Study. A Pilot [Master's thesis]. Groningen (NL): The University of Groningen, 2011. [File for downloading: scripties.umcg.eldoc.ub.rug.nl/FILES/root/geneeskunde/2011/HutJ/HutJ.docx; Full record and abstract: scripties.umcg.eldoc.ub.rug.nl/root/geneeskunde/2011/HutJ/?pFullItemRecord=ON]

* Hut J, van der Heide WK, Kollen BJ, Messelink EJ, Blanker MH, Dekker JH. Pelvic floor muscle therapy or alpha-blocking agents for treatment of men with lower urinary tract symptoms: an exploratory randomized controlled trial. *International Journal of Urology* 2017;**24**(6):473-4. [DOI: [10.1111/iju.13339](https://doi.org/10.1111/iju.13339)]

NTR2954. Lower urinary tract symptoms (LUTS) in older men. The FLOW study. www.trialregister.nl/trialreg/admin/rctview.asp?TC=2954 (first received 28 June 2011).

Jung 2012 {published data only}

Jung S, Lee E-N, Lee S-R, Kim M-S, Lee MS. Tai chi for lower urinary tract symptoms and quality of life in elderly patients with benign prostate hypertrophy: a randomised controlled

trial. *Evidence-Based Complementary and Alternative Medicine* 2012;**2012**:624692. [DOI: [10.1155/2012/624692](https://doi.org/10.1155/2012/624692)]

Weng 2010 {published data only}

Weng WC, Tseng HJ, Chang JC, Wang CY, Su CM. The effects of pelvic floor muscle exercise for irritable symptoms in older men with luts suggestive of bph. *International Journal of Urology* 2010;**17**(Suppl 1):A185.

Yee 2015 {published data only}

Yee CH, So WY, Yip SK, Wu E, Yau P, Ng CF. Effect of weight reduction on the severity of lower urinary tract symptoms in obese male patients with benign prostatic hyperplasia: a randomized controlled trial. *Korean Journal of Urology* 2015;**56**(3):240-6. [DOI: [10.4111/kju.2015.56.3.240](https://doi.org/10.4111/kju.2015.56.3.240)]

References to studies excluded from this review

Ausmees 2013 {published data only}

Ausmees K, Korrovits P, Timberg G, Punab M, Mändar R. Decline of seminal parameters in middle-aged males is associated with lower urinary tract symptoms, prostate enlargement and bladder outlet obstruction. *International Brazilian Journal of Urology* 2013;**39**(5):727-40. [DOI: [10.1590/S1677-5538.IBJU.2013.05.16](https://doi.org/10.1590/S1677-5538.IBJU.2013.05.16)]

Beyramijam 2013 {published data only}

Beyramijam M, Anoosheh M, Mohammadi E. Effect of designed self-care educational program on anxiety, stress, and depression in patients with benign prostatic hyperplasia undergoing prostate surgery. *Chronic Diseases Journal* 2013;**1**(2):55-62.

IRCT2012070610196N1. The effect of designed self care educational program on anxiety, stress, depression and complications after TURP surgery in patients with benign prostatic hyperplasia. apps.who.int/trialsearch/Trial2.aspx?TrialID=IRCT2012070610196N1 (first received 10 December 2012).

Breyer 2014 {published data only}

Breyer BN, Phelan S, Hogan PE, Rosen RC, Kitabchi AE, Wing RR, et al. Look AHEAD Research Group. Intensive lifestyle intervention reduces urinary incontinence in overweight/obese men with type 2 diabetes: results from the Look AHEAD trial. *Journal of Urology* 2014;**192**(1):144-9. [DOI: [10.1016/j.juro.2014.02.036](https://doi.org/10.1016/j.juro.2014.02.036)]

NCT00017953. Look AHEAD: Action for Health in Diabetes (Look AHEAD). clinicaltrials.gov/show/NCT00017953 (first received 21 June 2001).

Brown 2004b {published data only}

Brown CT, Coe J, Colpman D, Nuttall MC, Newman S, Van Der Meulen J, et al. The effect on voiding patterns of a self-management programme of lifestyle and behavioural interventions for men with uncomplicated lower urinary tract symptoms. *Journal of Urology* 2004;**171**(4 Suppl):359. [DOI: [10.1016/S0022-5347\(18\)38589-6](https://doi.org/10.1016/S0022-5347(18)38589-6)]

Burgio 2010 {published data only}

Burgio KL, Goode PS, Johnson TM, Hammontree L, Ouslander JG, Markland AD, et al. Behavioral versus drug treatment for overactive bladder in men: the Male Overactive Bladder Treatment in Veterans (MOTIVE) Trial. *Journal of the American Geriatrics Society* 2011;**59**(12):2209-16. [DOI: [10.1111/j.1532-5415.2011.03724.x](https://doi.org/10.1111/j.1532-5415.2011.03724.x)]

Burgio KL, Goode PS, Johnson TM, Hammontree LN, Ouslander JG, Markland AD, et al. Behavioral vs. drug treatment for overactive bladder in men: The MOTIVE trial. *Journal of Urology* 2010;**183**(4):e585. [DOI: [10.1016/j.juro.2010.02.2360](https://doi.org/10.1016/j.juro.2010.02.2360)]

Johnson TM, Markland AD, Goode PS, Vaughan CP, Colli JL, Ouslander JG, et al. Efficacy of adding behavioural treatment or antimuscarinic drug therapy to α -blocker therapy in men with nocturia. *BJU International* 2013;**112**(1):100-8. [DOI: [10.1111/j.1464-410X.2012.11736.x](https://doi.org/10.1111/j.1464-410X.2012.11736.x)]

NCT01187498. Behavioral Treatment of Overactive Bladder in Men (MOTIVE). clinicaltrials.gov/show/NCT01187498 (first received 24 August 2010).

Johnson 2016 {published data only}

Johnson TM 2nd, Vaughan CP, Goode PS, Bliwise DL, Markland AD, Huisingh C, et al. Pilot results from a randomized trial in men comparing alpha-adrenergic antagonist versus behavior and exercise for nocturia and sleep. *Clinical Therapeutics* 2016;**38**(11):2394-406.e3. [DOI: [10.1016/j.clinthera.2016.10.001](https://doi.org/10.1016/j.clinthera.2016.10.001)]

NCT00824200. Behavior and Exercise Versus Drug Treatment in Men With Nocturia (BEDTiMe). clinicaltrials.gov/show/NCT00824200 (first received 16 January 2009).

NCT00404638 {published data only}

NCT00404638. Treatment of enuresis nocturna by circular muscle exercise (Paula Method). clinicaltrials.gov/show/NCT00982098 (first received 22 September 2009).

NCT00628615 {published data only}

NCT00628615. Non-micturition bladder activity in relation to self-consciousness during filling phase and sensation measurement during the filling phase. clinicaltrials.gov/show/NCT00628615 (first received 5 March 2008).

NCT01576900 {published data only}

NCT01576900. The effect of combined Systematized Behavioural Modification Education Program (SyBeMeP) with DDAVP in patients with nocturia. clinicaltrials.gov/show/NCT01576900 (first received 13 April 2014).

Roehrborn 2015 {published data only}

NCT01294592. Comparative Efficacy of Dutasteride Plus Tamsulosin With Lifestyle Advice Versus Watchful Waiting Plus Lifestyle Advice in the Management of Treatment Naïve Men With Moderately Symptomatic Benign Prostatic Hyperplasia and Prostate Enlargement (CONDUCT). clinicaltrials.gov/show/NCT01294592 (first received 16 June 2014).

Roehrborn CG, Oyarzabal Perez I, Roos EP, Calomfirescu N, Brotherton B, Palacios JM, et al. Can we use baseline

characteristics to assess which men with moderately symptomatic benign prostatic hyperplasia at risk of progression will benefit from treatment? A post hoc analysis of data from the 2-year CONDUCT study. *World Journal of Urology* 2017;**35**(3):421-7. [DOI: [10.1007/s00345-016-1884-5](https://doi.org/10.1007/s00345-016-1884-5)]

Roehrborn CG, Oyarzabal Perez I, Roos EP, Calomfirescu N, Brotherton B, Wang F, et al. Efficacy and safety of a fixed-dose combination of dutasteride and tamsulosin treatment (Duodart®) compared with watchful waiting with initiation of tamsulosin therapy if symptoms do not improve, both provided with lifestyle advice, in the management of treatment-naïve men with moderately symptomatic benign prostatic hyperplasia: 2-year CONDUCT study results. *BJU International* 2015;**116**(3):450-9. [DOI: [10.1111/bju.13033](https://doi.org/10.1111/bju.13033)]

Tibaek 2007 {published data only}

Tibaek S, Klarskov P, Lund Hansen B, Thomsen H, Andresen H, Schmidt Jensen C, et al. Pelvic floor muscle training before transurethral resection of the prostate: a randomized, controlled, blinded study. *Scandinavian Journal of Urology and Nephrology* 2007;**41**(4):329-34. [DOI: [10.1080/00365590601183584](https://doi.org/10.1080/00365590601183584)]

Wolters 2004 {published data only}

Wolters R, Wensing M, Van Weel C, Grol R. The effect of a distance-learning programme on patient self-management of lower urinary tract symptoms (LUTS) in general practice: a randomised controlled trial. *European Urology* 2004;**46**(1):95-101.

References to studies awaiting assessment

Liu 2016 {published data only}

ChiCTR-IOR-16007698. Comparative effects of Yi Jin Jing versus Tai Chi exercise training on benign prostatic hyperplasia-related outcomes in older adults: study protocol for a randomized controlled trial. www.chictr.org.cn/showproj.aspx?proj=12814 (first received 4 January 2016).

* Liu X, Huang G, Chen P, Li Y, Xiang J, Chen T, et al. Comparative effects of Yi Jin Jing versus Tai Chi exercise training on benign prostatic hyperplasia-related outcomes in older adults: study protocol for a randomized controlled trial. *Trials* 2016;**17**(1):319. [DOI: [10.1186/s13063-016-1448-4](https://doi.org/10.1186/s13063-016-1448-4)]

Additional references

Abrams 2003

Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. *Urology* 2003;**61**(1):37-49. [DOI: [10.1016/S0090-4295\(02\)02243-4](https://doi.org/10.1016/S0090-4295(02)02243-4)]

Ainsworth 2011

Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr, Tudor-Locke C, et al. 2011 Compendium of physical activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise* 2011;**43**(8):1575-81. [DOI: [10.1249/MSS.0b013e31821e1212](https://doi.org/10.1249/MSS.0b013e31821e1212)]

Ainsworth 2012

Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr, Tudor-Locke C, et al. The compendium of physical activities tracking guide. Healthy Lifestyles Research Center, College of Nursing & Health Innovation, Arizona State University. sites.google.com/site/compendiumofphysicalactivities/home (accessed 7 May 2012).

Barkin 2011

Barkin J. Benign prostatic hyperplasia and lower urinary tract symptoms: evidence and approaches for best case management. *Canadian Journal of Urology* 2011;**18**(1):14-9. [PUBMED: 21501546]

Barnard 2008

Barnard RJ, Kobayashi N, Aronson WJ. Effect of diet and exercise intervention on the growth of prostate epithelial cells. *Prostate Cancer and Prostatic Diseases* 2008;**11**(4):362-6. [DOI: [10.1038/pcan.2008.6](https://doi.org/10.1038/pcan.2008.6)]

Berghmans 2013

Berghmans B, Hendriks E, Bernards A, de Bie R, Omar MI. Electrical stimulation with non-implanted electrodes for urinary incontinence in men. *Cochrane Database of Systematic Reviews* 2013, Issue 6. [DOI: [10.1002/14651858.CD001202.pub5](https://doi.org/10.1002/14651858.CD001202.pub5)]

Brown 2004a

Brown CT, van der Meulen J, Mundy AR, O'Flynn E, Emberton M. Defining the components of a self-management programme for men with uncomplicated lower urinary tract symptoms: a consensus approach. *European Urology* 2004;**46**(2):254-63. [DOI: [10.1016/j.eururo.2004.02.008](https://doi.org/10.1016/j.eururo.2004.02.008)]

Caspersen 1985

Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports (Washington, DC: 1974)* 1985;**100**(2):126-31. [PUBMED: 3920711]

Chang 2008

Chang RY, Koo M, Yu ZR, Kan CB, Chu IT, Hsu CT, et al. The effect of tai chi exercise on autonomic nervous function of patients with coronary artery disease. *Journal of Alternative and Complementary Medicine* 2008;**14**(9):1107-13. [DOI: [10.1089/acm.2008.0166](https://doi.org/10.1089/acm.2008.0166)]

D'Silva 2014

D'Silva KA, Dahm P, Wong CL. Does this man with lower urinary tract symptoms have bladder outlet obstruction? The Rational Clinical Examination: a systematic review. *JAMA* 2014;**312**(5):535-42. [DOI: [10.1001/jama.2014.5555](https://doi.org/10.1001/jama.2014.5555)]

De Nunzio 2011

De Nunzio C, Ahyai S, Autorino R, Bachmann A, Bialek W, Briganti A, et al. Benign prostatic hyperplasia and lower urinary tract symptoms: research priorities. *European Urology* 2011;**60**(6):1205-6. [DOI: [10.1016/j.eururo.2011.08.055](https://doi.org/10.1016/j.eururo.2011.08.055)]

Donnell 2011

Donnell RF. Benign prostate hyperplasia: a review of the year's progress from bench to clinic. *Current Opinion in Urology* 2011;**21**(1):22-6. [DOI: [10.1097/MOU.0b013e32834100dd](https://doi.org/10.1097/MOU.0b013e32834100dd)]

Dumoulin 2015

Dumoulin C, Hay-Smith J, Frawley H, McClurg D, Alewijnse D, Bo K, et al. 2014 consensus statement on improving pelvic floor muscle training adherence: International Continence Society 2011 State-of-the-Science Seminar. *Neurourology and Urodynamics* 2015;**34**(7):600-5. [DOI: [10.1002/nau.22796](https://doi.org/10.1002/nau.22796)]

Emberton 2006

Emberton M. Patient-led management of BPH: from watchful waiting to self-management of LUTS. *European Urology* 2006;**5**(12):704-9. [DOI: [10.1016/j.eursup.2006.06.008](https://doi.org/10.1016/j.eursup.2006.06.008)]

Fenter 2006

Fenter TC, Naslund MJ, Shah MB, Eaddy MT, Black L. The cost of treating the 10 most prevalent diseases in men 50 years of age or older. *American Journal of Managed Care* 2006;**12**(4 Suppl):S90-8. [PUBMED: 16551207]

Furukawa 2005

Furukawa TA, Cipriani A, Barbui C, Brambilla P, Watanabe N. Imputing response rates from means and standard deviations in meta-analyses. *International Clinical Psychopharmacology* 2005;**20**(1):49-52. [PUBMED: 15602117]

Garimella 2009

Garimella PS, Fink HA, MacDonald R, Wilt TJ. Naftopidil for the treatment of lower urinary tract symptoms compatible with benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 2009, Issue 4. [DOI: [10.1002/14651858.CD007360.pub2](https://doi.org/10.1002/14651858.CD007360.pub2)]

Gillespie 2012

Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2012, Issue 9. [DOI: [10.1002/14651858.CD007146.pub3](https://doi.org/10.1002/14651858.CD007146.pub3)]

GRADEpro GDT [Computer program]

McMaster University (developed by Evidence Prime). GRADEpro GDT. Version accessed 2 June 2018. Hamilton (ON): McMaster University (developed by Evidence Prime), 2015.

Gratzke 2015

Gratzke C, Bachmann A, Descaseaud A, Drake MJ, Madersbacher S, Mamoulakis C, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *European Urology* 2015;**67**(6):1099-109. [DOI: [10.1016/j.eururo.2014.12.038](https://doi.org/10.1016/j.eururo.2014.12.038)]

Gravas 2016

Gravas S, Bach T, Bachmann A, Drake M, Gacci M, Gratzke C, et al. EAU Guidelines 2016: Treatment of non neurogenic male LUTS. uroweb.org/guideline/treatment-of-non-neurogenic-male-luts/ (accessed 11 November 2016).

Guyatt 2008

Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Schünemann HJ, et al. GRADE: what is "quality of evidence" and why is it important to clinicians?. *BMJ (Clinical Research Ed.)* 2008;**336**(7651):995-8. [DOI: [10.1136/bmj.39490.551019.BE](https://doi.org/10.1136/bmj.39490.551019.BE)]

Guyatt 2011

Guyatt G, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, et al. GRADE guidelines: 1. Introduction - GRADE evidence profiles and summary of findings tables. *Journal of Clinical Epidemiology* 2011;**64**(4):383-94. [DOI: [10.1016/j.jclinepi.2010.04.026](https://doi.org/10.1016/j.jclinepi.2010.04.026)]

Higgins 2011a

Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from handbook.cochrane.org.

Higgins 2011b

Higgins JPT, Altman DG, Sterne JAC (editors). Chapter 8: Assessing risk of bias in included studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from handbook.cochrane.org.

Higgins 2011c

Higgins JPT, Deeks JJ, Altman DG (editors). Chapter 16: Special topics in statistics. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from handbook.cochrane.org.

Hoffman 2000

Hoffman RM, MacDonald R, Wilt T. Laser prostatectomy for benign prostatic obstruction. *Cochrane Database of Systematic Reviews* 2000, Issue 1. [DOI: [10.1002/14651858.CD001987.pub2](https://doi.org/10.1002/14651858.CD001987.pub2)]

Hoffman 2012

Hoffman RM, Monga M, Elliott SP, MacDonald R, Langsjoen J, Tacklind J, et al. Microwave thermotherapy for benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 2012, Issue 9. [DOI: [10.1002/14651858.CD004135.pub3](https://doi.org/10.1002/14651858.CD004135.pub3)]

Howe 2011

Howe TE, Shea B, Dawson LJ, Downie F, Murray A, Ross C, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database of Systematic Reviews* 2011, Issue 7. [DOI: [10.1002/14651858.CD000333.pub2](https://doi.org/10.1002/14651858.CD000333.pub2)]

Hozo 2005

Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Medical Research Methodology* 2005;**5**:13. [DOI: [10.1186/1471-2288-5-13](https://doi.org/10.1186/1471-2288-5-13)]

ICS 2017

International Continence Society. Terminology. www.ics.org/terminology (accessed 24 November 2017).

Lefebvre 2011

Lefebvre C, Manheimer E, Glanville J. Chapter 6: Searching for studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from handbook.cochrane.org.

McVary 2011

McVary KT, Roehrborn CG, Avins AL, Barry MJ, Bruskewitz RC, Donnell RF, et al. Update on AUA guideline on the management of benign prostatic hyperplasia. *Journal of Urology* 2011;**185**(5):1793-803. [DOI: [10.1016/j.juro.2011.01.074](https://doi.org/10.1016/j.juro.2011.01.074)]

Mishra 2012

Mishra SI, Scherer RW, Snyder C, Geigle PM, Berlanstein DR, Topaloglu O. Exercise interventions on health-related quality of life for people with cancer during active treatment. *Cochrane Database of Systematic Reviews* 2012, Issue 8. [DOI: [10.1002/14651858.CD008465.pub2](https://doi.org/10.1002/14651858.CD008465.pub2)]

Nicholson 2011

Nicholson TM, Ricke WA. Androgens and estrogens in benign prostatic hyperplasia: past, present and future. *Differentiation; Research in Biological Diversity* 2011;**82**(4-5):184-99. [DOI: [10.1016/j.diff.2011.04.006](https://doi.org/10.1016/j.diff.2011.04.006)]

Parsons 2008

Parsons JK, Kashefi C. Physical activity, benign prostatic hyperplasia, and lower urinary tract symptoms. *European Urology* 2008;**53**(6):1228-35. [DOI: [10.1016/j.eururo.2008.02.019](https://doi.org/10.1016/j.eururo.2008.02.019)]

RevMan 2014 [Computer program]

The Nordic Cochrane Centre, The Cochrane Collaboration. Review Manager (RevMan). Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.

Roehrborn 2008

Roehrborn CG. Pathology of benign prostatic hyperplasia. *International Journal of Impotence Research* 2008;**20**(3):S11-8. [DOI: [10.1038/ijir.2008.55](https://doi.org/10.1038/ijir.2008.55)]

Russo 2015

Russo GI, Castelli T, Urzì D, Privitera S, La Vignera S, Condorelli RA, et al. Emerging links between non-neurogenic lower urinary tract symptoms secondary to benign prostatic obstruction, metabolic syndrome and its components: a systematic review. *International Journal of Urology* 2015;**22**(11):982-90. [DOI: [10.1111/iju.12877](https://doi.org/10.1111/iju.12877)]

Schünemann 2011

Schünemann HJ, Oxman AD, Vist GE, Higgins JPT, Deeks JJ, Glasziou P, et al. Chapter 11: Interpreting results and drawing conclusions. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from handbook.cochrane.org.

Sea 2009

Sea J, Poon KS, McVary KT. Review of exercise and the risk of benign prostatic hyperplasia. *Physician and Sports Medicine* 2009;**37**(4):75-83. [DOI: [10.3810/psm.2009.12.1745](https://doi.org/10.3810/psm.2009.12.1745)]

Silva 2015

Silva TL, Mota MM, Fontes MT, Araújo JE, Carvalho VO, Bonjardim LR, et al. Effects of one resistance exercise session on vascular smooth muscle of hypertensive rats. *Arquivos Brasileiros de Cardiologia* 2015;**105**(2):160-7. [DOI: [10.5935/abc.20150070](https://doi.org/10.5935/abc.20150070)]

Speakman 2015

Speakman M, Kirby R, Doyle S, Ioannou C. Burden of male lower urinary tract symptoms (LUTS) suggestive of benign prostatic hyperplasia (BPH) - focus on the UK. *BJU International* 2015;**115**(4):508-19. [DOI: [10.1111/bju.12745](https://doi.org/10.1111/bju.12745)]

Tacklind 2010

Tacklind J, Fink HA, MacDonald R, Rutks I, Wilt TJ. Finasteride for benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 2010, Issue 10. [DOI: [10.1002/14651858.CD006015.pub3](https://doi.org/10.1002/14651858.CD006015.pub3)]

Tacklind 2012

Tacklind J, MacDonald R, Rutks I, Stanke JU, Wilt TJ. *Serenoa repens* for benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 2012, Issue 12. [DOI: [10.1002/14651858.CD001423.pub3](https://doi.org/10.1002/14651858.CD001423.pub3)]

Tang 2009

Tang J, Yang J. Etiopathogenesis of benign prostatic hyperplasia. *Indian Journal of Urology* 2009;**25**(3):312-7. [DOI: [10.4103/0970-1591.56179](https://doi.org/10.4103/0970-1591.56179)]

UDA 2012

Urologic Diseases in America. Table 14-10. Economic impact of urologic disease. In: Litwin MS, Saigal CS (editors). *Urologic Diseases in America*. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Washington, DC: US Government Printing Office, 2012; NIH Publication No. 12-7865, pp. 463-496. urology.ucla.edu/workfiles/Research/UDA_2012_Compendium.pdf (accessed 7 January 2015).

United Nations 2015

United Nations, Department of Economic and Social Affairs, Population Division. *World population prospects: the 2015 revision, key findings and advance tables*. 2015. Working Paper No. ESA/P/WP.241. esa.un.org/unpd/wpp/ (accessed 18 August 2015).

Warburton 2006

Warburton DER, Nicol CR, Bredin SSD. Health benefits of physical activity: the evidence. *Canadian Medical Association Journal* 2006;**174**(6):801-9. [DOI: [10.1503/cmaj.051351](https://doi.org/10.1503/cmaj.051351)]

Wilt 1998

Wilt TJ, Ishani A. Pygeum africanum for benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 1998, Issue 1. [DOI: [10.1002/14651858.CD001044](https://doi.org/10.1002/14651858.CD001044)]

Wilt 1999

Wilt TJ, Ishani A, MacDonald R, Stark G, Mulrow CD, Lau J. Beta-sitosterols for benign prostatic hyperplasia. *Cochrane Database of Systematic Reviews* 1999, Issue 3. [DOI: [10.1002/14651858.CD001043](https://doi.org/10.1002/14651858.CD001043)]

Yuan 2015

Yuan JQ, Mao C, Wong SY, Yang ZY, Fu XH, Dai XY, et al. Comparative effectiveness and safety of monodrug therapies for lower urinary tract symptoms associated with benign prostatic hyperplasia: a network meta-analysis. *Medicine* 2015;**94**(27):e974. [DOI: [10.1097/MD.0000000000000974](https://doi.org/10.1097/MD.0000000000000974)]

References to other published versions of this review

Silva 2016

Silva V, Grande AJ, Stanton KR, Peccin MS. Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database of Systematic Reviews* 2016, Issue 1. [DOI: [10.1002/14651858.CD012044](https://doi.org/10.1002/14651858.CD012044)]

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Brown 2007

Methods	Study design: 2-site, parallel randomised controlled trial, open-label Study dates: January 2003 to April 2004 Setting: Teaching hospital and a district general hospital in London Country: UK
Participants	Inclusion criteria: New patients with uncomplicated LUTS due to BPO, over the age of 40 years Exclusion criteria: Age under 40 years; lower urinary tract symptoms due to any urological malignancy or whilst investigating any urological malignancy, e.g. prostate cancer; previous prostatic surgery within the last 10 years or pelvic radiotherapy; complications of urinary obstruction (acute or chronic urinary retention: postmicturition volumes over 300 mL, bladder stones, renal failure, recurrent urinary

Brown 2007 (Continued)

tract infection, or haematuria); uncontrolled diabetes, dementia, and end-stage cardiac or respiratory failure; inability to speak or understand the English language; severe symptoms where drug therapy or surgical management is indicated or requested by the patient; any man who is or has been in the previous 3 months on medical therapy for LUTS, including alpha-blockers, 5-alpha reductase inhibitors (finasteride), or anticholinergics

Sample size: 140 men were randomised

Age (years): 63.4 ± 10.8 (mean ± SD)

Race/ethnicity: 77% white and 23% non-white (black, Asian, other)

Weight (kg): Not reported

BMI (kg/m²): Not reported

IPSS (score): 16.4 ± 5.8 (mean ± SD); moderate

Duration of symptoms (years): 4.1 ± 5.5 (mean ± SD)

Qmax (mL/s): Not reported

PVR (mL): Not reported

Prostate volume (mL): Not reported

PSA (ng/mL): Not reported

Comorbidities: 70% had 1 or more comorbidities, but which comorbidities was not reported

Interventions

Experimental interventions group (n = 73): Physical activity (pelvic floor exercise) as part of self-management programme. In addition to standard care, the intervention group took part in small-group sessions (5 to 8 men), each lasting between 1.5 and 2 hours, which were scheduled 1, 2, and 6 weeks after randomisation. Two urology nurse specialists facilitated the standardised sessions; they were trained in group facilitation skills and in techniques to enhance self-management skills. The aim of these sessions was to bring about modification of lifestyle (e.g. fluid management, avoidance of caffeine, use of alcohol, and pelvic floor exercises) and specific changes in behaviour (such as bladder retraining, double voiding, and urethral milking). The sessions were designed to enable the participants to learn techniques of problem solving and goal setting and to receive support from each other by using techniques of brainstorming in the context of group discussions. At 3, 6, and 12 months, clinicians who were not involved in the conduct of the trial saw participants in the urology outpatient departments. The participants were asked not to reveal to the clinicians which treatment group they had been randomised to.

Type of physical activity: conditioning exercise, therapeutic exercise.

Intensity of physical activity: 2.8 METs (light intensity).

Frequency of physical activity (day/week): not reported.

Volume of physical activity (min/day): not reported.

Comparator interventions group (n = 67): Watchful waiting: standard care in the 2 participating centres began with watchful waiting. Escalation to medical treatment and surgery was left entirely to the discretion of the clinician and participant.

Concomitant interventions: All participants, irrespective of treatment allocation, received standard written information about lower urinary tract symptoms.

Run-in: None

Follow-up: 12 months (long term)

Outcomes

Primary outcomes

Symptom score for LUTS*:

Brown 2007 (Continued)

How measured: IPSS score

Time points measured: baseline, 3 months, 6 months, and 12 months

Response rate*:

How measured: Frequency (by imputation of response rate from mean and SD in accordance with [Furukawa 2005](#))

Time points measured: 3 months, 6 months, and 12 months

Withdrawal due to adverse events:**

How measured: Frequency

Time points measured: 12 months

Secondary outcomes

Change of medication use:**

How measured: Frequency

Time points measured: 3 months, 6 months, and 12 months

Need for an invasive procedure:**

How measured: Frequency

Time points measured: 3 months, 6 months, and 12 months

PVR:**

Not assessed

*Subjective outcome

**Objective outcome

Funding sources	<p>BUFA Foundation Project Grant. CTB received a research fellowship from the Royal College of Surgeons of England, funded by Cazenove & Co. JvdM is funded by a national public health career scientist award from the Department of Health and NHS R&D Programme.</p>
Declarations of interest	<p>Mark Emberton has received fees from GlaxoSmithKline and Sanofi-Synthelabo for acting as a consultant, giving lectures, and working as an investigator. All other authors declared no interest.</p>
Notes	<p>Contact information: We sent emails to study authors (Christian T Brown: drchristianbrown@hotmail.com; Jan van der Meulen: Jan.vanderMeulen@LSHTM.ac.uk; Tet L Yap: tetyap@gmail.com; Mark Emberton: nisma.akhtar1@nhs.net). The study authors did not reply.</p> <p>There is information in an HTML version of the paper that is additional to the PDF version; see www.bmj.com/content/334/7583/25.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer randomisation was used to generate list of numbers.
Allocation concealment (selection bias)	High risk	The authors changed the procedure, and there is a risk of selection bias. Firstly, they performed the randomisation by calling a third party who held a randomisation list. Owing to difficulties in contacting the third party out of hours, randomisation from the 41st participant included onwards was done by calling

Brown 2007 (Continued)

		the secretariats of the urological outpatient departments of the 2 participating hospitals.
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Low risk	Participants attended the appointments at which objective outcomes were measured.
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Although the authors asked participants not to reveal their allocation to the clinicians performing the consultations after randomisation, there was no guarantee that the blinding was maintained. We judged this domain as at unclear risk of bias.
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Clinicians conducted the assessments of participants at which objectives outcomes were measured.
Incomplete outcome data (attrition bias) Subjective outcomes	Low risk	Of 140 randomised participants, 14 of 73 in the experimental group and 11 of 67 in the comparator group did not complete the study. The authors applied last observation carried forward to impute missing data in the final analysis and performed sensitivity analysis. The loss to follow-up did not have a clinically relevant impact.
Incomplete outcome data (attrition bias) Objective outcomes	Low risk	As above
Selective reporting (reporting bias)	High risk	Not all of the study's prespecified outcomes in the protocol were reported in the study, e.g. death, infection, SF-36, illness perception questionnaire (see ClinicalTrials.gov NCT00270309).
Other bias	High risk	1 author received fees from the pharmaceutical industry. There was no evidence of an imbalance in baseline characteristics.

Chen 2012

Methods	<p>Study design: Single-site, parallel randomised clinical trial</p> <p>Study dates: March 2008 to September 2009</p> <p>Setting: Urology outpatient clinic, tertiary teaching hospital in Beijing</p> <p>Country: China</p>
Participants	<p>Inclusion criteria: LUTS due to BPO, older than 40 years of age, had been administered beta-blockers for 3 months or longer, and had no other factors influencing their urination, such as prostate cancer</p> <p>Exclusion criteria: Severe cardiovascular disease, severe symptoms necessitating immediate medical or surgical treatment, complications potentially related to their symptoms (PSA > 4 ng/mL, residual volumes > 50 mL, creatinine > 130 mol/L, bladder stones, haematuria, urinary retention, or recurrent urinary tract infections), psychic disease or unable to speak or understand Chinese, needed to be administered 5-alpha-reductase inhibitor, or uncontrolled diabetes, dementia, or endstage cardiac disease or respiratory failure</p>

Chen 2012 (Continued)

Sample size: 222 men were randomised

Age (years): 70.7 ± 7.8 (mean ± SD)

Race/ethnicity: 100% Chinese

Weight (kg): Not reported

BMI (kg/m²): Not reported

IPSS (score): 20.1 ± 6.5 (mean ± SD); severe

Duration of symptoms (years): 5.4 ± 3.4 (mean ± SD)

Qmax (mL/s): Not reported

PVR (mL): Not reported

Prostate volume (mL): Not reported

PSA (ng/mL): 2.1 ± 0.5 (mean ± SD)

Comorbidities: 89% had 1 or more comorbidities, but which comorbidities was not reported

Interventions

Experimental interventions group (n = 119): Physical activity (pelvic floor exercise) as part of self management programme. Intervention group participants received the standard BPH education programme as well as a self management intervention, which included a 2-hour face-to-face demonstration and follow-up by telephone. The intervention included:

- explain the link among LUTS, the bladder, and the prostate;
- use patient education groups;
- restrict fluid if intake is excessive;
- avoid caffeine;
- avoid alcohol;
- retrain the bladder;
- retrain “bad” voiding habits to good;
- reschedule diuretics if appropriate;
- milk the urethral for postmicturition dribbling;
- avoid constipation;
- practice pelvic floor exercises; and
- drink cranberry juice.

Type of physical activity: Conditioning exercise, therapeutic exercise

Intensity of physical activity: 2.8 METs (light intensity)

Frequency of physical activity (day/week): Not reported

Volume of physical activity (min/day): Not reported

Comparator interventions group (n = 103): Watchful waiting: BPH education programme in the out-patient clinic, which mainly provides basic information on BPH and its corresponding therapies

Concomitant interventions: Both groups received standard BPH education programme in the out-patient clinic, which mainly provides basic information on BPH and its corresponding therapies

Run-in: None

Follow-up: 6 months (medium term)

Outcomes

Primary outcomes
Symptom score for LUTS*:

Chen 2012 (Continued)

How measured: IPSS score

Time points measured: baseline, 3 months, 6 months

Response rate*:

How measured: Frequency (by imputation of response rate from mean and SD in accordance with [Furukawa 2005](#))

Time points measured: 6 months

Withdrawal due to adverse events**:

How measured: Frequency

Time points measured: 6 months

Change of medication use**:

Not assessed

Need for an invasive procedure**:

Not assessed

PVR**:

Not assessed

*Subjective outcome

**Objective outcome

Funding sources	This study was funded by Peking University People's Hospital Research and Development Funds.
Declarations of interest	None known.
Notes	Contact information: We contacted the corresponding author (Tao Xu: xutao@medmail.com.cn) but received no reply.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A random number table was used for assigning participants into either the intervention or control group.
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Low risk	Participants attended the appointments at which objective outcomes were measured.
Blinding of outcome assessment (detection bias)	High risk	There was no blinding of outcome assessor.

Chen 2012 (Continued)

Subjective outcomes

Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	There was no blinding of outcome assessor. However, researchers conducted the assessments of participants at which objectives outcomes were measured.
Incomplete outcome data (attrition bias) Subjective outcomes	Low risk	All randomised participants were included in the study analysis.
Incomplete outcome data (attrition bias) Objective outcomes	Low risk	As above
Selective reporting (reporting bias)	Unclear risk	The study protocol is not available, and there was insufficient information to make a judgement of low or high risk of bias.
Other bias	Low risk	There was no evidence of an imbalance in baseline characteristics; no other sources of bias were identified.

Hut 2016

Methods	<p>Study design: Single-site, parallel randomised clinical trial</p> <p>Study dates: June 2011 to March 2012</p> <p>Setting: Pelvic Floor Center Groningen and home</p> <p>Country: the Netherlands</p>
Participants	<p>Inclusion criteria: Age 50 years or older; LUTS symptoms by an IPSS score of 8 or higher for more than 6 months; interpretable flow (minimal production of 100 mL of urine); no treatment for LUTS in the preceding 6 months; no urinary tract infection or neurological bladder disorders; no urological malignancy or surgery of prostate, bladder, anus, pelvic floor; no indwelling catheter or intermittent catheterisation. Able to visit a pelvic floor physiotherapist or to fill in questionnaires in Dutch</p> <p>Exclusion criteria: Terminal stage of disease (according to the general practitioner); psychiatric or cognitive disorders (according to the general practitioner); contraindication for prescribing alpha-blocking agents (according to the general practitioner and checked by the investigator); abnormal prostate gland as found by digital rectal examination</p> <p>Sample size: 41 men were randomised</p> <p>Age (years): 51 to 82</p> <p>Race/ethnicity: Not reported</p> <p>Weight (kg): Not reported</p> <p>BMI (kg/m²): Not reported</p> <p>IPSS (score): 17.19 ± 5.07 (mean ± SD); moderate to severe</p> <p>Duration of symptoms (years): Not reported</p> <p>Qmax (mL/s): Experimental group (median): 11.8; comparator group (median): 10.3</p> <p>PVR (mL): Experimental group (median): 34.0; comparator group (median): 40.0</p> <p>Prostate volume (mL): Not reported</p>

Hut 2016 (Continued)

PSA (ng/mL): Not reported

Comorbidities: Not reported

Interventions

Experimental interventions group (n = 22): Pelvic floor exercise: participants were referred to a specialised physiotherapist. During 3 months, the participants visited the physiotherapist 6 times. The first 3 visits took 1 hour each. The last 3 visits took half an hour each. During the first visit, participants received education on the anatomy of the lower urinary tract in men and on pelvic floor function and dysfunction. They were informed about micturition behaviour and learned exercises on breathing and relaxation and also proprioceptive exercises. The physiotherapist also examined the pelvic floor to evaluate contraction and relaxation of the pelvic floor muscles. Electromyography was used to quantify the function of the pelvic floor muscles and to provide feedback to the participant on the effect of the exercises (myofeedback training). The participant was instructed to perform the pelvic floor exercises at home on a daily basis. The cornerstone of the home exercises consisted of variations of contractions and relaxations of the pelvic floor muscles, twice a day during 15 minutes, but this could be adjusted as the therapy progressed according to the needs of the individual participant. Myofeedback training was offered, if necessary. During the last 3 sessions the physiotherapist had a more motivational role: progress and adherence to the exercise programme was discussed and stimulated. Special attention was given to the situations in daily life in which the participant is most bothered by his symptoms (e.g. during the night or during social activities).

Type of physical activity: Conditioning exercise, therapeutic exercise

Intensity of physical activity: 2.8 METs (light intensity)

Frequency of physical activity (day/week): Participant was instructed to perform daily. Information was insufficient.

Volume of physical activity (min/day): 30 min

Comparator interventions group (n = 19): Usual care based on alpha-blockers (tamsulosin 0.4 mg or alfuzosin 10 mg daily). The research physician asked the participant's own general practitioner to prescribe 1 of the 2 alpha-blockers: tamsulosin sustained-release capsule 0.4 mg once daily or alfuzosin 10 mg sustained-release tablet once daily. The choice of the alpha-blocker was according to the preference of the general practitioner.

Concomitant interventions: All participants were educated on pelvic floor function and dysfunction and on the relation of this dysfunction to their symptoms

Run-in: None

Follow-up: 3 months (short term)

Outcomes

Primary outcomes
Symptom score for LUTS*:

How measured: IPSS score (by imputation of mean and SD from median and range in accordance with Hozo 2005)

Time points measured: baseline and 3 months

Response rate*:

How measured: Frequency (by imputation of response rate from mean and SD in accordance with Furukawa 2005)

Time points measured: 3 months

Withdrawal due to adverse events:**

How measured: Frequency

Time points measured: 3 months

Hut 2016 (Continued)

Secondary outcomes
Change of medication use:**

Not assessed

Need for an invasive procedure:**

Not assessed

PVR:**
How measured: Means of an abdominal ultrasound examination (Bladderscan 6400)

Time points measured: Baseline, 3 months

*Subjective outcome

**Objective outcome

Funding sources	Doelmatigheidsfonds University Medical Center Groningen
Declarations of interest	None known.
Notes	Contact information: We contacted study authors (Janny Dekker: j.h.dekker@umcg.nl ; Jan Hut: jhut85@hotmail.com , j.hut@umcg.nl). Dr Dekker confirmed the diagnosis of LUTS/BPO and agreed to share Dr Hut's thesis.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Low risk	"None" as stated in the protocol. However, participants attended the appointments at which objective outcomes were measured.
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	"None" as stated in the protocol.
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	"None" as stated in the protocol. However, researchers conducted the assessments of participants at which objective outcomes were measured.
Incomplete outcome data (attrition bias) Subjective outcomes	Low risk	Of 41 randomised participants, 1 of 22 in the experimental group and 1 of 19 in the comparator group did not complete the study. The authors applied last observation carried forward to impute missing data in the final analysis, but only per-protocol analysis was reported. We judged that the loss to follow-up did not have a clinically relevant impact.

Hut 2016 (Continued)

Incomplete outcome data (attrition bias) Objective outcomes	Low risk	As above
Selective reporting (reporting bias)	High risk	The outcomes were reported incompletely requiring imputation for primary outcomes (e.g. symptom score for LUTS and response rate). There was insufficient information for secondary outcomes to impute data (e.g. PVR).
Other bias	Unclear risk	Limited information to make a clear judgement

Jung 2012

Methods	<p>Study design: Single-site, parallel randomised controlled trial</p> <p>Study dates: Study dates not available</p> <p>Setting: Dong-A University Medical Center</p> <p>Country: Korea</p>
Participants	<p>Inclusion criteria: Males aged over 60 years with BPH, able to understand the content of questionnaires and experimental schedules, had not participated in regular exercise in the previous 6 months, IPSS > 25 points, had not received transurethral resection, and was not participating in any other form of CAM</p> <p>Exclusion criteria: Not reported</p> <p>Sample size: 56 men were randomised</p> <p>Age (years): 70.7 ± 4.9 (mean ± SD)</p> <p>Race/ethnicity: Not reported</p> <p>Weight (kg): Not reported</p> <p>BMI (kg/m²): Not reported</p> <p>IPSS (score): 14.7 ± 8.6 (mean ± SD); moderate</p> <p>Duration of symptoms (years): 4.1 ± 5.46 (mean ± SD)</p> <p>Qmax (mL/s): Not reported</p> <p>PVR (mL): Not reported</p> <p>Prostate volume (mL): Not reported</p> <p>PSA (ng/mL): Not reported</p> <p>Comorbidities: Impaired glucose tolerance or diabetics. It is unclear how many and if it is the only comorbidity.</p>
Interventions	<p>Experimental interventions group (n = 28): Tai chi: the programme consisted of a warm-up exercise (15 min), 20 main movements (40 min), and a cool-down exercise (5 min). The intervention program used 11 basic and 9 combined movements (20 total). The study's warm-up and cool-down exercises involved stretching and relaxing the head, neck, upper body, lower body, and entire body. The 11 basic tai chi movements involved the commencement form, opening and closing hands, waving hands in the cloud (left), opening and closing hands, the fair lady working at the shuttle, opening and closing hands, toe kicks left and right, opening and closing hands, waving hands in the cloud (right), opening and closing hands, and the closing form. The 9 combined forms included waving hands in the cloud (left), open-</p>

Jung 2012 (Continued)

ing and closing hands, stroking the bird's tail (left), opening and closing hands, stroking the bird's tail (right), opening and closing hands, waving hands in the cloud (right), opening and closing hands, and the closing form. When the participants performed the opening and closing hands, they also performed breathing exercises. The participants in the tai chi group attended classes 3 times weekly for 12 weeks; the classes were led by 2 tai chi instructors. Participants were individually instructed in the appropriate movements. The participants learned and practiced the motions during the first 5 weeks. The participants were performing the routine competently during the last 7 weeks. A special guidebook for home practice, containing pictures and written descriptions of the exercises in the tai chi programme, was produced. The participants were asked to practice their exercises at home using the guidebook 2 times daily (in the morning and evening). The participants recorded the frequency and duration of their home tai chi in their exercise logs, which the instructors assessed during every weekly session. A videotape was available if the participants desired.

Type of physical activity: Sports, tai chi

Intensity of physical activity: 3.0 METs (moderate intensity)

Frequency of physical activity (day/week): 3 times

Volume of physical activity (min/day): 60 min

Comparator interventions group (n = 28): Watchful waiting: the control participants received no other treatment and did not participate in any structured exercise programmes during the study period

Concomitant interventions: None

Run-in: None

Follow-up: 3 months (short term)

Outcomes

Primary outcomes

Symptom score for LUTS*:

How measured: IPSS score

Time points measured: baseline, 12 weeks

Response rate*:

How measured: Frequency (by imputation of response rate from mean and SD in accordance with [Furukawa 2005](#))

Time points measured: 12 weeks

Withdrawal due to adverse events:**

How measured: Frequency

Time points measured: 12 weeks

Change of medication use:**

Not assessed

Need for an invasive procedure:**

Not assessed

PVR:**

Not assessed

*Subjective outcome

Jung 2012 (Continued)

**Objective outcome

Funding sources	The research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF), funded by the Ministry of Education, Science and Technology (KRF-2008-531-E00100).
Declarations of interest	None known.
Notes	Contact information: We contacted the author (Eun-NamLee: enlee@donga.ac.kr) but received no reply.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised by tossing a coin.
Allocation concealment (selection bias)	High risk	There was no allocation concealment.
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Low risk	Participants attended the appointments at which objective outcomes were measured.
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Nursing assistants who did not participate in the trial and who were blinded to the allocation performed the outcome assessments.
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	As above
Incomplete outcome data (attrition bias) Subjective outcomes	High risk	Of 56 randomised participants, 14 of 28 in the experimental group and 14 of 28 in the comparator group did not complete the study and were not included in the final analysis.
Incomplete outcome data (attrition bias) Objective outcomes	High risk	As above
Selective reporting (reporting bias)	High risk	The study protocol is not available, but there is evidence of protocol deviation/violation. The authors planned to include participants with IPSS > 25 score; the baseline characteristics show a moderate IPSS (mean 14.72, 95% confidence interval 11.54 to 17.90).
Other bias	High risk	Baseline characteristics were based on half of all randomised participants, limiting the comparability of groups.

Weng 2010

Methods	<p>Study design: Single site, parallel randomised controlled trial</p> <p>Study dates: Study dates not available</p> <p>Setting: Unreported</p> <p>Country: Taiwan</p>
Participants	<p>Inclusion criteria: Men with irritable symptoms suggestive of BPH</p> <p>Exclusion criteria: Not reported.</p> <p>Sample size: 63 men were randomised</p> <p>Age (years): 58.0 ± 6.8 (mean $\pm$ SD)</p> <p>Race/ethnicity: Not reported</p> <p>Weight (kg): Not reported</p> <p>BMI (kg/m²): Not reported</p> <p>IPSS (score): 14.6 ± 4.5 (mean $\pm$ SD); moderate</p> <p>Duration of symptoms (years): 4.1 ± 5.46 (mean $\pm$ SD)</p> <p>Qmax (mL/s): $13.2 \pm 4.$ (mean $\pm$ SD)</p> <p>PVR (mL): Not reported</p> <p>Prostate volume (mL): Not reported</p> <p>PSA (ng/mL): Not reported</p> <p>Comorbidities: Not reported</p>
Interventions	<p>Experimental interventions group (n = not reported): pelvic floor exercise, 30 min weekly</p> <p><u>Type of physical activity:</u> Conditioning exercise, therapeutic exercise</p> <p><u>Intensity of physical activity:</u> 2.8 METs (light intensity)</p> <p><u>Frequency of physical activity (day/week):</u> Not reported</p> <p><u>Volume of physical activity (min/day):</u> Not reported</p> <p>Comparator interventions group (n = not reported): Watchful waiting</p> <p>Concomitant interventions: All participants received tamsulosin</p> <p>Run-in: None</p> <p>Follow-up: 8 weeks (short term)</p>
Outcomes	<p>Primary outcomes</p> <p>Symptom score for LUTS*:</p> <p><u>How measured:</u> IPSS score</p> <p><u>Time points measured:</u> Baseline, 8 weeks</p> <p>Response rate*:</p> <p>Not assessed</p>

Weng 2010 (Continued)

Withdrawal due to adverse events:**

Not assessed

Change of medication use:**

Not assessed

Need for an invasive procedure:**

Not assessed

PVR:**

Not assessed

*Subjective outcome

**Objective outcome

Funding sources	Unknown
Declarations of interest	Unknown
Notes	Contact information: We were unable to establish contact with the authors due to the absence of an email address. Data extraction was based on a meeting abstract.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Unclear risk	Not applicable (objective outcomes not reported)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Insufficient information to make a judgement
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Not applicable (objective outcomes not reported)
Incomplete outcome data (attrition bias) Subjective outcomes	Unclear risk	Insufficient information to make a judgement

Weng 2010 (Continued)

Incomplete outcome data (attrition bias) Objective outcomes	Unclear risk	Not applicable (objective outcomes not reported)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to make a judgement
Other bias	Unclear risk	Limited information. Limited reporting of baseline characteristics to determine comparability of groups

Yee 2015

Methods	<p>Study design: Single-site, parallel randomised controlled trial</p> <p>Study dates: Study dates not available</p> <p>Setting: Men who attended our urology clinic for LUTS</p> <p>Country: China</p>
Participants	<p>Inclusion criteria: Men with LUTS due to BPH, aged ≥ 50 years old, BMI between 25 and 35 kg/m², moderate to severe lower urinary tract symptoms (IPSS > 7), Qmax between 5 and 15 mL/s, PVR < 150 mL, prostate volume > 30 mL</p> <p>Exclusion criteria: Patients with urethral stricture, neurogenic bladder, or structural abnormality. Patients on long-term catheterisation or intermittent self catheterisation. Patients with prostate cancer or bladder cancer. Patients on 5-alpha-reductase inhibitors, phytotherapy, or hormonal therapy. Patients who cannot tolerate tamsulosin OCAS. Patients with poor cardiac status (NYHA class III or above) or other medical conditions that are not suitable for intense exercise or weight reduction programme.</p> <p>Sample size: 130 men were randomised</p> <p>Age (years): 64.9 ± 7.6 (mean $\pm$ SD)</p> <p>Race/ethnicity: Not reported</p> <p>Weight (kg): 74.7 ± 7.6 (mean $\pm$ SD)</p> <p>BMI (kg/m²): 27.4 ± 2.0 (mean $\pm$ SD)</p> <p>IPSS (score): 17.5 ± 6.6 (mean $\pm$ SD); moderate</p> <p>Duration of symptoms (years): Not reported</p> <p>Qmax (mL/s): 27.4 ± 4.1 (mean $\pm$ SD)</p> <p>PVR (mL): 47.3 ± 65.9 (mean $\pm$ SD)</p> <p>Prostate volume (mL): 54.4 ± 27.6 (mean $\pm$ SD)</p> <p>PSA (ng/mL): 4.7 ± 4.9 (mean $\pm$ SD)</p> <p>Comorbidities: Not reported</p>
Interventions	<p>Experimental interventions group (n = 65): Physical activity as part of a weight reduction programme. The comprehensive weight reduction programme included 3 aspects; namely, an integrated assessment, a weight reduction protocol, and medical nutrition therapy. The integrated assessment included assessment of dietary and activity (any type of unreported intense exercise) patterns together with appropriate counselling.</p> <p>Type of physical activity: Insufficient information</p>

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction (Review)

Yee 2015 (Continued)

Intensity of physical activity: Intense exercise (insufficient information)

Frequency of physical activity (day/week): Not reported

Volume of physical activity (min/day): Not reported

Comparator interventions group (n = 65): Watchful waiting: participants received a standardised pre-recorded video programme on the general principle of weight reduction

Concomitant interventions: None

Run-in: 4 weeks before randomisation and intervention, a standardised alpha-adrenergic blocker therapy (tamsulosin 0.4 mg) was used

Follow-up: 48 weeks (medium term)

Outcomes	<p>Primary outcomes</p> <p><i>Symptom score for LUTS*</i></p> <p><u>How measured:</u> IPSS score</p> <p><u>Time points measured:</u> Baseline, 6, 12, 24, 36, 48 weeks</p> <p><i>Response rate*</i></p> <p><u>How measured:</u> Frequency (by imputation of response rate from mean and SD in accordance with Furukawa 2005)</p> <p><u>Time points measured:</u> Baseline, 6, 12, 24, 36, 48 weeks</p> <p><i>Withdrawal due to adverse events**</i></p> <p><u>How measured:</u> Frequency</p> <p><u>Time points measured:</u> 48 weeks</p> <p>Secondary outcomes</p> <p><i>Change of medication use**</i></p> <p>Not assessed</p> <p><i>Need for an invasive procedure**</i></p> <p>Not assessed</p> <p><i>PVR**</i></p> <p><u>How measured:</u> Unreported</p> <p><u>Time points measured:</u> Baseline, 24, 48 weeks</p> <p>*Subjective outcome</p> <p>**Objective outcome</p>
Funding sources	Health and Medical Research Fund, Hong Kong Special Administrative Region Government (project number: 091 00391)
Declarations of interest	None known.
Notes	Contact information: We contacted Chi-Fai Ng (ngcf@surgery.cuhk.edu.hk) but received no reply.

Risk of bias

Yee 2015 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) Subjective outcomes	High risk	This is an open-label study. We judged this domain as at high risk of bias.
Blinding of participants and personnel (performance bias) Objective outcomes	Low risk	Participants attended the appointments at which objective outcomes were measured.
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Insufficient information to make a judgement
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Objective outcomes are not likely to have been affected by lack of blinding.
Incomplete outcome data (attrition bias) Subjective outcomes	High risk	Of 130 randomised participants, 31 of 65 in the experimental group and 19 of 65 in the comparator group did not complete the study. The authors tried to impute only a part of the missing data in the final analysis (117/130). There was high risk of bias in imputation.
Incomplete outcome data (attrition bias) Objective outcomes	High risk	As above
Selective reporting (reporting bias)	High risk	No study protocol is available, and not all timing of outcome measurement proposed was reported.
Other bias	High risk	Poor description of intervention, compromising reproducibility of the study. There was no evidence of an imbalance in baseline characteristics.

BMI: body mass index; **BPH:** benign prostatic hyperplasia; **BPO:** benign prostatic obstruction; **CAM:** complementary and alternative medicine; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **METs:** metabolic equivalents of task; **NYHA:** New York Heart Association; **OCAS:** oral controlled absorption system; **PSA:** prostate-specific antigen; **PVR:** postvoid residual urine; **Qmax:** maximal urinary flow rate; **SD:** standard deviation; **SF-36:** 36-Item Short Form Health Survey.

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Ausmees 2013	Wrong study design: cohort study
Beyramijam 2013	Wrong study design: the authors measured outcomes only at baseline and after TURP
Breyer 2014	Wrong patient population: the authors do not confirm if LUTS was due to BPO

Study	Reason for exclusion
Brown 2004b	Wrong study design: before-and-after study
Burgio 2010	Wrong patient population: we did not receive confirmation from the authors if LUTS was due to BPO
Johnson 2016	Wrong patient population: the authors accepted healthy volunteers
NCT00404638	Wrong patient population: study with children and adolescents (7 to 15 years old)
NCT00628615	Wrong study design: observational study
NCT01576900	Wrong study design: case-control study
Roehrborn 2015	Wrong intervention: physical activity for all study arms
Tibaek 2007	Wrong study design: the authors measured outcomes only at baseline and after TURP
Wolters 2004	Wrong intervention: did not use physical activity

BPO: benign prostatic obstruction; **LUTS:** lower urinary tract symptoms; **TURP:** transurethral resection of the prostate.

Characteristics of studies awaiting assessment *[ordered by study ID]*

[Liu 2016](#)

Methods	<p>Study design: Single-site, multi-arm randomised controlled trial</p> <p>Study dates: February 2016 to December 2016</p> <p>Setting: Participants from the community of Shanghai</p> <p>Country: China</p>
Participants	<p>Inclusion criteria: Men were required to meet all of the following criteria: aged between 60 and 70 years; a relatively stable body weight over the past 6 months with a weight change of less than 2%; a sedentary lifestyle, not having exercised for the past 3 months, or exercising occasionally less than once a week for 20 min each time; no yi jin jing and/or tai chi training experience for the past 3 months; apparently healthy, free of cardiovascular disease, and not being treated with BPH drugs or other therapies during the last 6 months; voluntary participation in this research for at least 6 months and provision of written informed consent</p> <p>Exclusion criteria: Men were excluded for any of the following: signs and symptoms of or having the following diseases (but not limited to these diseases): Crohn's disease, sarcoidosis, chronic diarrhoea, heart disease, rheumatoid arthritis, systemic lupus erythematosus, and cancer; having taken any relevant drugs in the last 6 months, such as for insulin-dependent diabetes mellitus or antibiotics; any conflict with the objectives of this study</p> <p>Sample size: 150 participants with 50 in each group</p> <p>Age (years): Waiting</p> <p>Race/ethnicity: Waiting</p> <p>Weight (kg): Waiting</p> <p>BMI (kg/m²): Waiting</p> <p>IPSS (score): Waiting</p>

Liu 2016 (Continued)

Duration of symptoms (years): Waiting

Qmax (mL/s): Waiting

PVR (mL): Waiting

Prostate volume (mL): Waiting

PSA (ng/mL): Waiting

Comorbidities: Waiting

Interventions

Experimental interventions group 1 (n = 50): Yi jin jing training: participants will undergo 30-minute sessions 5 times a week for 6 months. After completing the 6 months of treatment sessions, participants will be asked to continue with their exercises. The research team will monitor these participants twice a month with home calls until the 3-month follow-up evaluations. All exercise participants are asked to record their exercise behaviour for the 3 months.

Type of physical activity: Sports, yi jin jing (qi gong)

Intensity of physical activity: 3.0 METs (moderate intensity)

Frequency of physical activity (day/week): 5 times

Volume of physical activity (min/day): 30 min

Experimental interventions group 2 (n = 50): Tai chi exercise training: participants will undergo 30-minute sessions 5 times a week for 6 months. After completing the 6 months of treatment sessions, participants will be asked to continue with their exercises. The research team will monitor these participants twice a month with home calls until the 3-month follow-up evaluations. All exercise participants are asked to record their exercise behaviour for the 3 months.

Type of physical activity: Sports, tai chi

Intensity of physical activity: 3.0 METs (moderate intensity)

Frequency of physical activity (day/week): 5 times

Volume of physical activity (min/day): 30 min

Comparator interventions group (n = 50): Watchful waiting: control group participants will keep their regular daily life in normal living conditions without any intervention or exercise training, or both. After completing the 6 months of treatment sessions, participants will be encouraged to maintain their usual activities and life.

Concomitant interventions: None

Run-in: None

Follow-up: 6 months (medium term)

Outcomes

Symptom score for LUTS:

How measured: IPSS score and urination-related quality of life

Time points measured: Baseline, 3 months, 6 months

Response rate*:

How measured: Waiting

Time points measured: Waiting

Withdrawal due to adverse events:**

How measured: Count

Liu 2016 (Continued)

Time points measured: 6 months

Change of medication use:**

Not assessed

Need for an invasive procedure:**

Not assessed

PVR:**

Not assessed

*Subjective outcome

**Objective outcome

Notes

Funding sources: The study received financial support from the Doctoral Program of Higher Education of China (grant STCSM 13490503500 to RW), a Shanghai Sports Bureau of Science and Technology integrated project plan (Z022), and the Chinese National Natural Science Foundation (81472148)

Declarations of interest: None known

Contact information: The randomised controlled trial was completed in accordance with study dates. We attempted two contacts by email with authors without success (Xiang Yun Liu, h6yf@163.com; Guoyuan Huang, ghuang@usi.edu; Peijie Chen, chenpeijie@sus.edu.cn; Yong Li, 15201816267@163.com; Jiu Lin Xiang, 15201755936@163.com; Ting Chen, 1121458712@qq.com; Ru Wang, wangru0612@163.com). We are awaiting replies or publication of study.

BMI: body mass index; **BPH:** benign prostatic hyperplasia; **IPSS:** International Prostate Symptom Score; **LUTS:** lower urinary tract symptoms; **METS:** metabolic equivalents of task; **PSA:** prostate-specific antigen; **PVR:** postvoid residual urine; **Qmax:** maximal urinary flow rate.

DATA AND ANALYSES

Comparison 1. Physical activity versus watchful waiting

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Symptom score for LUTS	1	28	Mean Difference (IV, Random, 95% CI)	-8.14 [-13.20, -3.08]
2 Response rate in symptom score	1	28	Risk Ratio (M-H, Random, 95% CI)	1.8 [0.81, 4.02]
3 Withdrawal due to adverse events	1	56	Risk Ratio (M-H, Random, 95% CI)	1.0 [0.59, 1.69]

Analysis 1.1. Comparison 1 Physical activity versus watchful waiting, Outcome 1 Symptom score for LUTS.

Analysis 1.2. Comparison 1 Physical activity versus watchful waiting, Outcome 2 Response rate in symptom score.

Analysis 1.3. Comparison 1 Physical activity versus watchful waiting, Outcome 3 Withdrawal due to adverse events.

Comparison 2. Physical activity as part of self-management programme versus watchful waiting

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Symptom score for LUTS	2	362	Mean Difference (IV, Random, 95% CI)	-6.16 [-9.85, -2.46]
1.1 Medium term	1	222	Mean Difference (IV, Random, 95% CI)	-7.97 [-9.52, -6.42]
1.2 Long term	1	140	Mean Difference (IV, Random, 95% CI)	-4.20 [-6.31, -2.09]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2 Response rate in symptom score	2	362	Risk Ratio (M-H, Random, 95% CI)	2.36 [1.32, 4.21]
2.1 Medium term	1	222	Risk Ratio (M-H, Random, 95% CI)	3.16 [2.24, 4.46]
2.2 Long term	1	140	Risk Ratio (M-H, Random, 95% CI)	1.77 [1.28, 2.45]
3 Withdrawal due to adverse events	2	362	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.05, 0.06]
3.1 Medium term	1	222	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.02, 0.02]
3.2 Long term	1	140	Risk Difference (M-H, Random, 95% CI)	0.03 [-0.10, 0.15]
4 Change of medication use	1		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Short term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.28 [0.10, 0.82]
4.2 Medium term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.34 [0.15, 0.75]
4.3 Long term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.48 [0.25, 0.92]
5 Need for an invasive procedure	1		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Short term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.31 [0.03, 2.87]
5.2 Medium term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.31 [0.03, 2.87]
5.3 Long term	1	140	Risk Ratio (M-H, Random, 95% CI)	0.31 [0.03, 2.87]

Analysis 2.1. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 1 Symptom score for LUTS.

Analysis 2.2. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 2 Response rate in symptom score.

Analysis 2.3. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 3 Withdrawal due to adverse events.

Analysis 2.4. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 4 Change of medication use.

Analysis 2.5. Comparison 2 Physical activity as part of self-management programme versus watchful waiting, Outcome 5 Need for an invasive procedure.

Comparison 3. Physical activity as part of weight reduction programme versus watchful waiting

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Symptom score for LUTS	1	117	Mean Difference (IV, Random, 95% CI)	-1.1 [-3.46, 1.26]
2 Response rate in symptom score	1	117	Risk Ratio (M-H, Random, 95% CI)	1.2 [0.74, 1.94]
3 Withdrawal due to adverse events	1	130	Risk Ratio (M-H, Random, 95% CI)	1.63 [1.03, 2.57]
4 Postvoid residual urine	1	117	Mean Difference (IV, Random, 95% CI)	-25.0 [-54.73, 4.73]

Analysis 3.1. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 1 Symptom score for LUTS.

Analysis 3.2. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 2 Response rate in symptom score.

Analysis 3.3. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 3 Withdrawal due to adverse events.

Analysis 3.4. Comparison 3 Physical activity as part of weight reduction programme versus watchful waiting, Outcome 4 Postvoid residual urine.

Comparison 4. Physical activity compared to alpha-blockers

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Symptom score for LUTS	1	39	Mean Difference (IV, Random, 95% CI)	2.75 [-0.93, 6.43]
2 Response rate in symptom score	1	39	Risk Ratio (M-H, Random, 95% CI)	0.8 [0.55, 1.15]
3 Withdrawal due to adverse events	1	41	Risk Ratio (M-H, Random, 95% CI)	0.86 [0.06, 12.89]

Analysis 4.1. Comparison 4 Physical activity compared to alpha-blockers, Outcome 1 Symptom score for LUTS.

Analysis 4.2. Comparison 4 Physical activity compared to alpha-blockers, Outcome 2 Response rate in symptom score.

Analysis 4.3. Comparison 4 Physical activity compared to alpha-blockers, Outcome 3 Withdrawal due to adverse events.

APPENDICES

Appendix 1. CENTRAL search strategy

#1	MeSH descriptor: [Motor Activity] explode all trees
#2	"Motor Activity":ti,ab,kw OR "Motor Activities":ti,ab,kw OR "Physical Activity" :ti,ab,kw OR "Physical Activities" :ti,ab,kw OR "Locomotor Activity" :ti,ab,kw OR "Locomotor Activities":ti,ab,kw
#3	MeSH descriptor: [Exercise] explode all trees
#4	"Exercise":ti,ab,kw OR "Exercises":ti,ab,kw
#5	MeSH descriptor: [Resistance Training] explode all trees
#6	"Resistance Training":ti,ab,kw OR "Strength Training":ti,ab,kw OR "Weight Lifting":ti,ab,kw OR "Weight Bearing":ti,ab,kw
#7	MeSH descriptor: [Physical Fitness] explode all trees
#8	"Physical Fitness":ti,ab,kw OR "Physical Conditioning":ti,ab,kw OR "Physical Conditionings":ti,ab,kw
#9	MeSH descriptor: [Sports] explode all trees
#10	"Sports":ti,ab,kw OR "Sport":ti,ab,kw OR "Athletics":ti,ab,kw OR "Athletic":ti,ab,kw
#11	MeSH descriptor: [Tai Ji] explode all trees
#12	"Tai Ji":ti,ab,kw OR "Tai Chi":ti,ab,kw OR "Tai Ji Quan":ti,ab,kw OR "Taiji":ti,ab,kw OR "Taiji-quan":ti,ab,kw OR "Tai Chi":ti,ab,kw OR "Tai Chi Chuan":ti,ab,kw
#13	MeSH descriptor: [Physical Therapy Modalities] explode all trees
#14	"Physical Therapy Modality":ti,ab,kw OR "Physical Therapy Modalities":ti,ab,kw OR "Physiotherapy":ti,ab,kw OR "Physiotherapies":ti,ab,kw
#15	MeSH descriptor: [Physical Therapy Specialty] explode all trees

(Continued)

#16	"Physical Therapy":ti,ab,kw OR "Physical Therapies":ti,ab,kw
#17	MeSH descriptor: [Physical Therapy Department, Hospital] explode all trees
#18	"Physical Therapy Department":ti,ab,kw OR "Physical Therapy Departments":ti,ab,kw
#19	MeSH descriptor: [Rehabilitation] explode all trees
#20	"Rehabilitation":ti,ab,kw OR "Rehab":ti,ab,kw
#21	MeSH descriptor: [Sedentary Lifestyle] explode all trees
#22	"Sedentary Lifestyle":ti,ab,kw OR "Sedentary Lifestyles":ti,ab,kw OR "Sedentary Life Style":ti,ab,kw OR "Sedentary Life Styles":ti,ab,kw
#23	"Kegel exercise":ti,ab,kw OR "Kegel exercises":ti,ab,kw OR "Pelvic floor exercise":ti,ab,kw OR "Pelvic floor exercises":ti,ab,kw OR "Pelvic floor muscle training":ti,ab,kw OR "Pelvic floor muscle exercise":ti,ab,kw OR "Pelvic floor muscle exercises":ti,ab,kw
#24	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23
#25	MeSH descriptor: [Prostatic Hyperplasia] explode all trees
#26	"Adenofibromyomatosis":ti,ab,kw OR "BPH":ti,ab,kw OR "Prostate Benign Hyperplasia":ti,ab,kw OR "Prostate Benign Hyperplasias":ti,ab,kw OR "Prostate Benign Hypertrophies":ti,ab,kw OR "Prostate Benign Hypertrophy":ti,ab,kw OR "Prostate Enlargement":ti,ab,kw OR "Prostate Enlargements":ti,ab,kw OR "Prostate Gland Hypertrophies":ti,ab,kw OR "Prostate Gland Hypertrophy":ti,ab,kw OR "Prostate Hyperplasia":ti,ab,kw OR "Prostate Hyperplasias":ti,ab,kw OR "Prostate Hyperthrophies":ti,ab,kw OR "Prostate Hyperthrophy":ti,ab,kw OR "Prostate Hypertrophy":ti,ab,kw OR "Prostate Hypertrophies":ti,ab,kw OR "Prostate Hypertrophias":ti,ab,kw OR "Prostate Hypertrophia":ti,ab,kw OR "Prostate Hypertrophies":ti,ab,kw OR "Prostatic Adenoma":ti,ab,kw OR "Prostate Adenomas":ti,ab,kw OR "Prostatic Benign Hyperplasia":ti,ab,kw OR "Prostatic Benign Hyperplasias":ti,ab,kw OR "Prostatic Benign Hypertrophies":ti,ab,kw OR "Prostatic Benign Hypertrophy":ti,ab,kw OR "Prostatic Hyperplasia":ti,ab,kw OR "Prostatic Hyperplasias":ti,ab,kw OR "Prostatic Hypertrophies":ti,ab,kw OR "Prostatic Hypertrophy":ti,ab,kw OR "Prostatic Hypertrophias":ti,ab,kw OR "Prostatic Hypertrophies":ti,ab,kw OR "Enlarged prostate":ti,ab,kw OR "Enlarged prostates":ti,ab,kw
#27	MeSH descriptor: [Urinary Bladder Neck Obstruction] explode all trees
#28	"Bladder Neck Obstruction":ti,ab,kw OR "Bladder outlet obstruction":ti,ab,kw OR "BOO":ti,ab,kw OR "Bladder neck strangulation":ti,ab,kw OR "Bladder stenosis":ti,ab,kw OR "Vesicourethral fistula":ti,ab,kw OR "Obstructio vesicae urinariae":ti,ab,kw OR "Urinary bladder neck obstruction":ti,ab,kw OR "Urinary bladder neck stenosis":ti,ab,kw OR "Urinary bladder obstruction":ti,ab,kw OR "Bladder neck strangulations":ti,ab,kw OR "Bladder stenoses":ti,ab,kw OR "Vesicourethral fistulas":ti,ab,kw OR "Bladder obstruction":ti,ab,kw OR "Bladder obstructions":ti,ab,kw
#29	"Benign prostatic obstruction":ti,ab,kw OR "Benign prostatic obstructions":ti,ab,kw OR "BPO":ti,ab,kw OR "Benign prostatic enlargement":ti,ab,kw OR "Benign prostatic enlargements":ti,ab,kw OR "BPE":ti,ab,kw
#30	#25 OR #26 OR #27 OR #28 OR #29
#31	MeSH descriptor: [Lower Urinary Tract Symptoms] explode all trees
#32	"LUTS":ti,ab,kw OR "Lower Urinary Tract Symptoms":ti,ab,kw OR "Lower Urinary Tract Symptom":ti,ab,kw OR "lower urinary tract disease":ti,ab,kw OR "lower urinary tract diseases":ti,ab,kw

(Continued)

OR "lower urinary tract disorder":ti,ab,kw OR "lower urinary tract disorders":ti,ab,kw OR "lower urinary tract dysfunction":ti,ab,kw OR "lower urinary tract dysfunctions":ti,ab,kw OR "LUT-D":ti,ab,kw OR "dysuria":ti,ab,kw OR "nocturia":ti,ab,kw OR "prostatism":ti,ab,kw OR "overactive urinary bladder":ti,ab,kw OR "urinary incontinence":ti,ab,kw

#33	#31 OR #32
#34	#24 AND #30 AND #33

Appendix 2. MEDLINE (via PubMed) search strategy

#1	"Motor Activity"[MeSH] OR "Motor Activity"[All Fields] OR "Motor Activities"[All Fields] OR "Physical Activity" [All Fields] OR "Physical Activities" [All Fields] OR "Locomotor Activity" [All Fields] OR "Locomotor Activities"[All Fields]
#2	"Exercise"[MeSH] OR "Exercise"[All Fields] OR "Exercises"[All Fields]
#3	"Resistance Training"[MeSH] OR "Resistance Training"[All Fields] OR "Strength Training"[All Fields] OR "Weight Lifting"[All Fields] OR "Weight Bearing"[All Fields]
#4	"Physical Fitness"[MeSH] OR "Physical Fitness"[All Fields] OR "Physical Conditioning"[All Fields] OR "Physical Conditionings"[All Fields]
#5	"Sports"[MeSH] OR "Sports"[All Fields] OR "Sport"[All Fields] OR "Athletics"[All Fields] OR "Athletic"[All Fields]
#6	"Tai Ji"[MeSH] OR "Tai Ji"[All Fields] OR "Tai Chi"[All Fields] OR "Tai Ji Quan"[All Fields] OR "Taiji"[All Fields] OR "Taijiquan"[All Fields] OR "Tai Chi"[All Fields] OR "Tai Chi Chuan"[All Fields]
#7	"Physical Therapy Modalities"[MeSH] OR "Physical Therapy Modality"[All Fields] OR "Physical Therapy Modalities"[All Fields] OR "Physiotherapy"[All Fields] OR "Physiotherapies"[All Fields]
#8	"Physical Therapy Specialty"[MeSH] OR "Physical Therapy"[All Fields] OR "Physical Therapies"[All Fields]
#9	"Physical Therapy Department, Hospital"[MeSH] OR "Physical Therapy Department"[All Fields] OR "Physical Therapy Departments"[All Fields]
#10	"Rehabilitation"[MeSH] OR "Rehabilitation"[All Fields] OR "Rehab"[All Fields]
#11	"Sedentary Lifestyle"[MeSH] OR "Sedentary Lifestyle"[All Fields] OR "Sedentary Lifestyles"[All Fields] OR "Sedentary Life Style"[All Fields] OR "Sedentary Life Styles"[All Fields]
#12	"Kegel exercise"[All Fields] OR "Kegel exercises"[All Fields] OR "Pelvic floor exercise"[All Fields] OR "Pelvic floor exercises"[All Fields] OR "Pelvic floor muscle training"[All Fields] OR "Pelvic floor muscle exercise"[All Fields] OR "Pelvic floor muscle exercises"[All Fields]
#13	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12
#14	"Prostatic Hyperplasia"[MeSH] OR "Adenofibromyomatosis"[All Fields] OR "BPH"[All Fields] OR "Prostate Benign Hyperplasia"[All Fields] OR "Prostate Benign Hyperplasias"[All Fields] OR "Prostate Benign Hypertrophies"[All Fields] OR "Prostate Benign Hypertrophy"[All Fields] OR "Prostate Enlargement"[All Fields] OR "Prostate Enlargements"[All Fields] OR "Prostate Gland Hypertrophies"[All Fields] OR "Prostate Gland Hypertrophy"[All Fields] OR "Prostate Hyperplasia"[All Fields] OR "Prostate Hyperplasias"[All Fields] OR "Prostate Hyperthrophies"[All Fields] OR

(Continued)

	“Prostate Hyperthrophy”[All Fields] OR “Prostate Hypertrophy”[All Fields] OR “Prostate Hypertrophies”[All Fields] OR “Prostate Hypertrophia”[All Fields] OR “Prostate Hypertrophias”[All Fields] OR “Prostatic Adenoma”[All Fields] OR “Prostate Adenomas”[All Fields] OR “Prostatic Benign Hyperplasia”[All Fields] OR “Prostatic Benign Hyperplasias”[All Fields] OR “Prostatic Benign Hypertrophies”[All Fields] OR “Prostatic Benign Hypertrophy”[All Fields] OR “Prostatic Hyperplasia”[All Fields] OR “Prostatic Hyperplasias”[All Fields] OR “Prostatic Hypertrophies”[All Fields] OR “Prostatic Hypertrophy”[All Fields] OR “Prostatic Hypertrophia”[All Fields] OR “Prostatic Hypertrophias”[All Fields] OR “Enlarged prostate”[All Fields] OR “Enlarged prostates”[All Fields]
#15	“Urinary Bladder Neck Obstruction”[MeSH] OR “Bladder Neck Obstruction”[All Fields] OR “Bladder outlet obstruction”[All Fields] OR “BOO”[All Fields] OR “Bladder neck strangulation”[All Fields] OR “Bladder stenosis”[All Fields] OR “Vesicourethral fistula”[All Fields] OR “Obstructio vesicae urinae”[All Fields] OR “Urinary bladder neck obstruction”[All Fields] OR “Urinary bladder neck stenosis”[All Fields] OR “Urinary bladder obstruction”[All Fields] OR “Bladder neck strangulations”[All Fields] OR “Bladder stenoses”[All Fields] OR “Vesicourethral fistulas”[All Fields] OR “Bladder obstruction”[All Fields] OR “Bladder obstructions”[All Fields]
#16	“Benign prostatic obstruction”[All Fields] OR “Benign prostatic obstructions”[All Fields] OR “BPO”[All Fields] OR “Benign prostatic enlargement”[All Fields] OR “Benign prostatic enlargements”[All Fields] OR “BPE”[All Fields]
#17	#14 OR #15 OR #16
#18	"Lower Urinary Tract Symptoms"[MeSH] OR "LUTS"[All Fields] OR "Lower Urinary Tract Symptoms"[All Fields] OR "Lower Urinary Tract Symptom"[All Fields] OR "lower urinary tract disease"[all fields] OR "lower urinary tract diseases"[all fields] OR "lower urinary tract disorder"[all fields] OR "lower urinary tract disorders"[all fields] OR "lower urinary tract dysfunction"[all fields] OR "lower urinary tract dysfunctions"[all fields] OR "LUTD"[all fields] OR "dysuria"[all fields] OR "nocturia"[all fields] OR "prostatism"[all fields] OR "overactive urinary bladder"[all fields] OR "urinary incontinence"[all fields]
#19	#13 AND #17 AND #18
#20	randomized controlled trial [pt]
#21	controlled clinical trial [pt]
#22	randomized [tiab]
#23	placebo [tiab]
#24	drug therapy [sh]
#25	randomly [tiab]
#26	trial [tiab]
#27	groups [tiab]
#28	#20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27
#29	animals [mh] NOT humans [mh]
#30	#19 AND #28
#31	#30 NOT #29

Appendix 3. Embase (via Ovid) search strategy

#1	(motor activity).sh.
#2	(Motor Activity OR Motor Activities OR Physical Activity OR Physical Activities OR Locomotor Activity OR Locomotor Activities).tw.
#3	(exercise).sh.
#4	(Exercise OR Exercises).tw.
#5	(resistance training).sh.
#6	(Resistance Training OR Strength Training OR Weight Lifting OR Weight Bearing).tw.
#7	(fitness).sh.
#8	(Physical Fitness OR Physical Conditioning OR Physical Conditionings).tw.
#9	(sport).sh.
#10	(Sports OR Sport OR Athletics OR Athletic).tw.
#11	(tai chi).tw.
#12	(Tai Ji OR Tai Chi OR Tai Ji Quan OR Taiji OR Taijiquan OR Tai Chi OR Tai Chi Chuan).tw.
#13	(physiotherapy).sh.
#14	(Physical Therapy Modality OR Physical Therapy Modalities OR Physiotherapy OR Physiotherapies).tw.
#15	(Physical Therapy OR Physical Therapies).tw.
#16	(Physical Therapy Department OR Physical Therapy Departments).tw.
#17	(rehabilitation).sh.
#18	(Rehabilitation OR Rehab).tw.
#19	(sedentary lifestyle).sh.
#20	(Sedentary Lifestyle OR Sedentary Lifestyles OR Sedentary Life Style OR Sedentary Life Styles).tw.
#21	(Kegel exercise OR Kegel exercises OR Pelvic floor exercise OR Pelvic floor exercises OR Pelvic floor muscle training OR Pelvic floor muscle exercise OR Pelvic floor muscle exercises).tw.
#22	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21
#23	(prostate hypertrophy).sh.
#24	(Adenofibromyomatosis OR BPH OR Prostate Benign Hyperplasia OR Prostate Benign Hyperplasias OR Prostate Benign Hypertrophies OR Prostate Benign Hypertrophy OR Prostate Enlargement OR Prostate Enlargements OR Prostate Gland Hypertrophies OR Prostate Gland Hypertrophy OR Prostate Hyperplasia OR Prostate Hyperplasias OR Prostate Hyperthrophies OR Prostate Hyperthrophy OR Prostate Hypertrophy OR Prostate Hypertrophies OR Prostate Hypertrophia OR Prostate

(Continued)

	Hypertrophias OR Prostatic Adenoma OR Prostate Adenomas OR Prostatic Benign Hyperplasia OR Prostatic Benign Hyperplasias OR Prostatic Benign Hypertrophies OR Prostatic Benign Hypertrophy OR Prostatic Hyperplasia OR Prostatic Hyperplasias OR Prostatic Hypertrophies OR Prostatic Hypertrophy OR Prostatic Hypertrophia OR Prostatic Hypertrophias OR Enlarged prostate OR Enlarged prostates).tw.
#25	(bladder obstruction).sh.
#26	(Bladder Neck Obstruction OR Bladder outlet obstruction OR BOO OR Bladder neck strangulation OR Bladder stenosis OR Vesicourethral fistula OR Obstructio vesicae urinariae OR Urinary bladder neck obstruction OR Urinary bladder neck stenosis OR Urinary bladder obstruction OR Bladder neck strangulations OR Bladder stenoses OR Vesicourethral fistulas OR Bladder obstruction OR Bladder obstructions).tw.
#27	(Benign prostatic obstruction OR Benign prostatic obstructions OR BPO OR Benign prostatic enlargement OR Benign prostatic enlargements OR BPE).tw.
#28	#23 OR #24 OR #25 OR #26 OR #27
#29	(lower urinary tract symptom).tw.
#30	(LUTS OR Lower Urinary Tract Symptoms OR Lower Urinary Tract Symptom OR lower urinary tract disease OR lower urinary tract diseases OR lower urinary tract disorder OR lower urinary tract disorders OR lower urinary tract dysfunction OR lower urinary tract dysfunctions OR LUTD OR dysuria OR nocturia OR prostatism OR overactive urinary bladder OR urinary incontinence).tw.
#31	#29 OR #30
#32	#22 AND #28 AND #31

Appendix 4. Web of Science (via ISI Web of Knowledge) search strategy

#1	TS=("Motor Activit*" OR "Physical Activit*" OR "Locomotor Activit*")
#2	TS=(Exercis*)
#3	TS=("Resistance Training" OR "Strength Training" OR "Weight Lifting" OR "Weight Bearing")
#4	TS=("Physical Fitness" OR "Physical Conditioning*")
#5	TS=(Sport* OR Athletic*)
#6	TS=("Tai Ji" OR "Tai Chi" OR "Tai Ji Quan" OR Taiji OR Taijiquan OR "Tai Chi" OR "Tai Chi Chuan")
#7	TS=("Physical Therap*" OR Physiotherap*)
#8	TS=(Rehab*)
#9	TS=("Sedentary Lifestyle*" OR "Sedentary Life Style*" OR Lifestyle* OR "Life style*")
#10	TS=("Kegel exercise*" OR "Pelvic floor exercise*" OR "Pelvic floor muscle training" OR "Pelvic floor muscle exercise*")
#11	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10

(Continued)

#12	TS=(Adenofibromyomatosis OR BPH OR "Prostate Benign Hyper*" OR "Prostate Enlargement*" OR "Prostate Gland Hypertroph*" OR "Prostate Hyper*" OR "Prostatic Adenoma*" OR "Prostate Adenoma*" OR "Prostatic Benign Hyper*" OR "Prostatic Hyper*" OR "Enlarged prostate*")
#13	TS=("Bladder outlet obstruction*" OR BOO OR "Bladder neck strangulation*" OR "Vesicourethral fistula*" OR "Obstructio vesicae urinariae" OR "Urinary bladder neck obstruction*" OR "Urinary bladder neck stenosis*" OR "Urinary bladder obstruction*" OR "Bladder stenosis*" OR "Bladder obstruction*")
#14	TS=("Benign prostatic obstruction*" OR BPO OR "Benign prostatic enlargement*" OR BPE)
#15	#14 OR #13 OR #12
#16	TS=(LUTS OR "Lower Urinary Tract*" OR LUTD OR Dysuria OR Nocturia OR Prostatism OR "Overactive urinary bladder" OR "Urinary incontinence")
#17	TS= clinical trial* OR TS=research design OR TS=comparative stud* OR TS=evaluation stud* OR TS=controlled trial* OR TS=follow-up stud* OR TS=prospective stud* OR TS=random* OR TS=placebo* OR TS=(single blind*) OR TS=(double blind*)
#18	#11 AND #15 AND #16 AND #17

Appendix 5. LILACS (via BIREME; interface iAHx) search strategy

#1	(MH:F01.145.632\$ OR G11.427.590.530.698\$ OR MH:"Motor Activity" OR TW:"Motor Activity" OR TW:"Motor Activities" OR TW:"Physical Activity" OR TW:"Physical Activities" OR TW:"Locomotor Activity" OR TW:"Locomotor Activities" OR TW:"Atividade Motora" OR TW:"Atividade Locomotora" OR TW:"Atividade Física" OR TW:"Actividad Motora" OR TW:"Actividad Locomotora" OR TW:"Actividad Física") OR (MH:G11.427.590.530.698.277\$ OR MH:I03.350\$ OR MH:Exercise OR TW:"Exercise" OR TW:"Exercises" OR TW:"Exercício" OR TW:"Exercício Aeróbico" OR TW:"Exercício Isométrico" OR TW:"Exercício Físico" OR TW:"Atividade Física para Idoso" OR TW:"Ejercicio" OR TW:"Ejercicio Aeróbico" OR TW:"Ejercicio Isométrico" OR TW:"Ejercicio Físico") OR (MH:E02.779.483.875\$ OR MH:E02.831.387.875\$ OR MH:G11.427.590.530.698.277.500\$ OR MH:I03.350.500\$ OR MH:"Resistance Training" OR TW:"Resistance Training" OR TW:"Strength Training" OR TW:"Weight Lifting" OR TW:"Weight Bearing" OR TW:"Treinamento de Resistência" OR TW:"Musculação" OR TW:"Programa de Fortalecimento por Levantamento de Peso" OR TW:"Programa de Musculação por Levantamento de Peso" OR TW:"Entrenamiento de Resistencia" OR TW:"Musculación" OR TW:"Programa de Fortalecimiento Soportando Peso" OR TW:"Programa de Fortalecimiento Levantando Peso") OR (MH:G11.427.685\$ OR MH:I03.450.642.845.054.800\$ OR MH:N01.400.545\$ OR MH:"Physical Fitness" OR TW:"Physical Fitness" OR TW:"Physical Conditioning" OR TW:"Physical Conditionings" OR TW:"Aptidão Física" OR TW:"Forma Física" OR TW:"Habilidade Física" OR TW:"Aptitud Física") OR (MH:I03.450.642.845\$ OR MH:Sports OR TW:"Sports" OR TW:"Sport" OR TW:"Athletics" OR TW:"Athletic" OR TW:"Esportes" OR TW:"Atividades Esportivas" OR TW:"Desportes" OR TW:"Deportes" OR TW:"Actividades Deportivas") OR (MH:E02.190.525.890\$ OR MH:E02.779.474.913\$ OR MH:I03.450.642.845.560.500\$ OR MH:"Tai Ji" OR TW:"Tai Ji" OR TW:"Tai Chi" OR TW:"Tai Ji Quan" OR TW:"Taiji" OR TW:"Taijiquan" OR TW:"Tai Chi" OR TW:"Tai Chi Chuan") OR (MH:E02.779\$ OR MH:"Physical Therapy Modalities" OR TW:"Physical Therapy Modality" OR TW:"Physical Therapy Modalities" OR TW:"Physiotherapy" OR TW:"Physiotherapies" OR TW:"Modalidades de Fisioterapia" OR TW:"Fisioterapia" OR TW:"Técnicas Fisioterápicas" OR TW:"Modalidades de Terapia Física" OR TW:"Técnicas de Fisioterapia") OR (MH:H02.010.625\$ OR MH:"Physical Therapy Specialty" OR TW:"Physical Therapy" OR TW:"Physical Therapies" OR TW:"Especialidade Fisioterapia" OR TW:"Curso de Fisioterapia" OR TW:"Terapia Física" OR TW:"Especialidad de Terapia Física") OR (MH:N02.278.354.422.615\$ OR MH:N04.452.442.422.615\$ OR MH:VS3.002.001.001.010.004.002\$ OR MH:"Physical Therapy Department, Hospital" OR TW:"Physical Therapy Department" OR TW:"Physical Therapy Departments" OR TW:"Serviço Hospitalar de Fisioterapia" OR TW:"Servicio de Ter-
-----------	--

(Continued)

	apia Física en Hospital") OR (MH:E02.831\$ OR MH:H02.403.680.600\$ OR MH:N02.421.784\$ OR MH:SP4.046.442.633.869.155\$ OR MH:SP8.946.117.208\$ OR MH:VS4.002.001.002.003\$ OR MH:"Rehabilitation" OR TW:"Rehabilitation" OR TW:"Rehab" OR TW:"Reabilitação" OR TW:"Habilitação" OR TW:"Rehabilitación" OR TW:"Habilitacion") OR (MH:F01.829.458.705\$ OR MH:"Sedentary Lifestyle" OR TW:"Sedentary Lifestyle" OR TW:"Sedentary Lifestyles" OR TW:"Sedentary Life Style" OR TW:"Sedentary Life Styles" OR TW:"Estilo de Vida Sedentário" OR TW:"Sedentarismo") OR (TW:"Kegel exercise" OR TW:"Kegel exercises" OR TW:"Pelvic floor exercise" OR TW:"Pelvic floor exercises" OR TW:"Pelvic floor muscle training" OR TW:"Pelvic floor muscle exercise" OR TW:"Pelvic floor muscle exercises")
#2	(MH:C12.294.565.500\$ OR MH:"Prostatic Hyperplasia" OR TW:"Adenofibromyomatosis" OR TW:"BPH" OR TW:"Prostate Benign Hyperplasia" OR TW:"Prostate Benign Hyperplasias" OR TW:"Prostate Benign Hypertrophies" OR TW:"Prostate Benign Hypertrophy" OR TW:"Prostate Enlargement" OR TW:"Prostate Enlargements" OR TW:"Prostate Gland Hypertrophies" OR TW:"Prostate Gland Hypertrophy" OR TW:"Prostate Hyperplasia" OR TW:"Prostate Hyperplasias" OR TW:"Prostate Hyperthrophies" OR TW:"Prostate Hyperthrophy" OR TW:"Prostate Hypertrophy" OR TW:"Prostate Hypertrophies" OR TW:"Prostate Hypertrophia" OR TW:"Prostate Hypertrophias" OR TW:"Prostatic Adenoma" OR TW:"Prostate Adenomas" OR TW:"Prostatic Benign Hyperplasia" OR TW:"Prostatic Benign Hyperplasias" OR TW:"Prostatic Benign Hypertrophies" OR TW:"Prostatic Benign Hypertrophy" OR TW:"Prostatic Hyperplasia" OR TW:"Prostatic Hyperplasias" OR TW:"Prostatic Hypertrophies" OR TW:"Prostatic Hypertrophy" OR TW:"Prostatic Hypertrophia" OR TW:"Prostatic Hypertrophias" OR TW:"Enlarged prostate" OR TW:"Enlarged prostates") OR (MH:C12.777.767.700.962\$ OR MH:C12.777.829.760\$ OR MH:C13.351.968.767.700.850\$ OR MH:C13.351.968.829.601\$ OR MH:"Urinary Bladder Neck Obstruction" OR TW:"Bladder Neck Obstruction" OR TW:"Bladder outlet obstruction" OR TW:"BOO" OR TW:"Bladder neck strangulation" OR TW:"Bladder stenosis" OR TW:"Vesicourethral fistula" OR TW:"Obstructio vesicae urinariae" OR TW:"Urinary bladder neck obstruction" OR TW:"Urinary bladder neck stenosis" OR TW:"Urinary bladder obstruction" OR TW:"Bladder neck strangulations" OR TW:"Bladder stenoses" OR TW:"Vesicourethral fistulas" OR TW:"Bladder obstruction" OR TW:"Bladder obstructions" OR TW:"Obstrução do Colo da Bexiga Urinária" OR TW:"Obstrução do Colo da Bexiga" OR TW:"Obstrucción del Cuello de la Vejiga Urinaria" OR TW:"Obstrucción del Cuello Vesical") OR (TW:"Benign prostatic obstruction" OR TW:"Benign prostatic obstructions" OR TW:"BPO" OR TW:"Benign prostatic enlargement" OR TW:"Benign prostatic enlargements" OR TW:"BPE")
#3	(MH:C23.888.942.343\$ OR MH:"Lower Urinary Tract Symptoms" OR TW:"LUTS" OR TW:"Lower Urinary Tract Symptoms" OR TW:"Lower Urinary Tract Symptom" OR TW:"lower urinary tract disease" OR TW:"lower urinary tract diseases" OR TW:"lower urinary tract disorder" OR TW:"lower urinary tract disorders" OR TW:"lower urinary tract dysfunction" OR TW:"lower urinary tract dysfunctions" OR TW:"LUTD" OR TW:"dysuria" OR TW:"nocturia" OR TW:"prostatism" OR TW:"overactive urinary bladder" OR TW:"urinary incontinence")
#4	db:"LILACS"

Appendix 6. ClinicalTrials.gov (via expert search syntax) search strategy

INFLECT EXACT NOT "Female" [GENDER] AND ("Lower Urinary Tract Symptoms" OR "LUTS" OR "dysuria" OR "nocturia" OR "prostatism" OR "overactive urinary bladder" OR "urinary incontinence" OR "BPH" OR "Prostate Benign Hyperplasia" OR "Prostate Enlargement" OR "Bladder Neck Obstruction" OR "BOO" OR "Benign prostatic obstruction" OR "BPO" OR "Benign prostatic enlargement" OR "BPE") [DISEASE] AND ("Physical activity" OR "Exercise" OR "Resistance Training" OR "Strength Training" OR "Weight Lifting" OR "Weight Bearing" OR "Tai Ji" OR "Tai Chi" OR "Physical Therapy" OR "Physiotherapy") [TREATMENT]

Appendix 7. WHO ICTRP (via Advanced Search) search strategy

Physical activity for lower urinary tract symptoms secondary to benign prostatic obstruction (Review)

Copyright © 2019 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

In the Condition	Lower Urinary Tract Symptom OR LUTS OR dysuria OR nocturia OR overactive urinary bladder OR urinary incontinence OR BPH OR Prostate Benign Hyperplasia OR Bladder Neck Obstruction OR BOO OR Benign prostatic obstruction OR BPO OR BPE
In the Intervention	Physical activity OR Exercise OR Resistance Training OR Strength Training OR Weight Lifting OR Weight Bearing OR Tai Ji OR Tai Chi OR Physical Therapy OR Physiotherapy
Recruitment status	ALL

CONTRIBUTIONS OF AUTHORS

VS: co-ordination of the protocol and review, searching studies to contextualise background, planning the methods section, drafting the protocol and review, developing search strategies, searching for trials, study selection, extracting data, assessing risk of bias, performing data analysis, interpretation of data, drafting the review, and approving the final version of the review.

AJG: searching studies to contextualise background, planning the methods section, drafting the protocol, searching for trials, study selection, extracting data, assessing risk of bias, double-checking data analysis, interpretation of data, drafting the review, and approving the final version of the review.

KRS: planning the methods section, drafting the protocol, providing critical content review, and approving the final version of the review.

MSP: planning the methods section, drafting the protocol, providing critical content review, and approving the final version of the review.

Valter Silva is the guarantor of the review.

DECLARATIONS OF INTEREST

VS: none known.

AJG: none known.

KRS: none known.

MSP: none known.

SOURCES OF SUPPORT

Internal sources

- Centro Universitário Tiradentes (UNIT/AL), Brazil.

Employer

- Universidade Estadual de Mato Grosso do Sul, Brazil.

Employer

- Coppin State University, USA.

Employer

- Universidade Federal de São Paulo, Other.

External sources

- No sources of support supplied, Other.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

This review is based on a published protocol ([Silva 2016](#)), with the differences described below:

We stated in the protocol: “Concomitant interventions will have to be the same in the intervention and comparator groups to establish fair comparisons.” This was changed to “Multiple interacting components interventions were included.” The reason for this was that the term ‘watchful waiting’ (active surveillance) is used in conditions such as LUTS/BPO, and some multiple interacting components can be used as part of complex interventions, such as those identified in this review.

We changed the descriptions of outcomes to improve readability, as follows:

- “change in symptom score for LUTS” to “symptom score for LUTS”;
- “number of men reporting a response rate for LUTS from baseline” to “response rate”;
- “number of men withdrawing due to adverse events ” to “withdrawal due to adverse events”;
- “number of men with a reduction of medication use ” to “change of medication use” (additionally the term ‘reduction’ was replaced with ‘change’);
- “number of men with a need for an invasive procedure” to “need for an invasive procedure”.

All these changes were made after discussion with and with the formal agreement of the [Cochrane Urology Group](#).

NOTES

We based parts of the [Methods](#) section of the protocol on a standard template developed by the [Cochrane Metabolic and Endocrine Disorders Group](#), which has been modified and adapted for use by the [Cochrane Urology Group](#).

INDEX TERMS

Medical Subject Headings (MeSH)

Exercise [*physiology]; Lower Urinary Tract Symptoms [*etiology] [*therapy]; Prostatic Hyperplasia [*complications] [therapy]; Randomized Controlled Trials as Topic; Treatment Outcome

MeSH check words

Adult; Humans; Male