Received: 6 September 2024 | Accepted: 11 October 2024

DOI: 10.1002/uro2.93

UroPrecision Open Access

REVIEW ARTICLE

Sexual dysfunction after Rezum therapy for benign prostatic hyperplasia: A scoping review for the current insights and findings

Ibrahim A. Khalil[1] | **Kareim Khalafalla**[1,2] | **Ahmad R. Al-Qudimat**[3,4] | **Khalid Al Rumaihi**[1,2]

[1]Department of Urology, Hamad Medical Corporation, Doha, Qatar

[2]Department of Urology, College of Medicine, Qatar University, Doha, Qatar

[3]Surgical Research Section, Department of Surgery, Hamad Medical Corporation, Doha, Qatar

[4]Public Health Department, Public Health College, Health Science, Qatar University, Doha, Qatar

Correspondence

Kareim Khalafalla

Email: Dr.Kareim.moh2@gmail.com

Abstract

Benign prostatic hyperplasia (BPH) is a common condition among aging men, often leading to lower urinary tract symptoms (LUTS) of varying severity. Both medical and surgical treatments for BPH can negatively impact sexual function, affecting patients' overall quality of life. This has highlighted the need for minimally invasive interventions that minimize sexual side effects. Rezum, a water vapor therapy, has gained popularity in managing BPH and LUTS due to its proposed potential to preserve sexual function. This scoping review examines the impact of Rezum therapy on sexual function in patients treated for BPH. The review was conducted following the Joanna Briggs Institute (JBI) methodology for scoping reviews. A comprehensive search was performed using the PubMed and Scopus databases up to August 2024. Articles were included if they involved patients treated with Rezum for BPH and reported the effect of Rezum on sexual function using validated scoring tools. A total of 15 studies encompassing 2,425 patients, met the inclusion criteria. Erectile function was assessed in all studies using the International Index of Erectile Function (IIEF) scores. Of these, seven studies reported no significant changes in erectile function scores, six demonstrated improvements, and two reported a significant decline. Ejaculatory function was evaluated using the Male Sexual Health Questionnaire (MSHQ). The MSHQ-Bother score was reported in seven studies, with three indicating improvement and none reporting deterioration. The MSHQ-Function score was reported in eight studies, with only one study reporting a decline, while the remaining studies found no significant changes. In conclusion, Rezum therapy for managing BPH shows favorable outcomes for sexual function or, at the very least, does not negatively impact it. These findings can guide patient counseling, especially for those seeking to preserve ejaculation. Further research is needed to compare Rezum with other treatment options regarding sexual function.

KEYWORDS

benign prostate hyperplasia, orgasmic disorders, Rezum, sexual dysfunction

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2024 The Author(s). *UroPrecision* published by John Wiley & Sons Australia, Ltd on behalf of Higher Education Press.

1 | INTRODUCTION

Benign prostatic hyperplasia (BPH) is a prevalent condition among aging men, characterized by the proliferation of smooth muscle and epithelial cells within the prostate[1–3]. BPH affects approximately 210 million men globally, making it one of the most common conditions in older men[4]. The prevalence of BPH increases significantly with age, with studies showing a prevalence of 8%, 50%, and 80% in the fourth, sixth, and ninth decades of life, respectively[5,6]. In the United States, BPH is the most common benign tumor in men, affecting an estimated 50% of men between the ages of 51 and 60 years, and up to 90% of men over 80 years old[7]. Similarly, in Europe, BPH prevalence is reported to be around 60% in men aged 60–69 years. In Asia, studies have shown that BPH affects approximately 26% of men aged 40–79 years, with increasing prevalence in older age groups[8].

The progression of BPH often leads to the development of lower urinary tract symptoms (LUTS) of varying severity[5]. Clinical BPH is defined by the presence of at least three of the following criteria: (1) moderate to severe LUTS, (2) an enlarged prostate, and (3) decreased maximum urinary flow rate (Q_{max})[9]. Men typically seek medical attention for BPH when symptoms significantly disrupt their quality of life (QoL). The pathophysiology of LUTS shares similarities with erectile dysfunction (ED), and substantial evidence supports the relationship between LUTS and ED[10–13]. Most of the data linking LUTS and ED suggest that LUTS impairs the overall QoL and that low QoL contributes to or causes ED[14]. Additionally, studies demonstrate that the IPSS score is an independent risk factor for ED[15]. Furthermore, the biological interrelationships between ED and LUTS are supported by four leading theories: decreased or altered nitric oxide synthase/nitric oxide levels, autonomic hyperactivity affecting prostate growth and ED, increased Rho-kinase and endothelin activity, and prostate and penile ischemia. Each of these mechanisms has varying degrees of supporting evidence, suggesting a biologically plausible connection between the two conditions[16]. These biological connections not only underscore the interrelationship between ED and LUTS but also highlight how treatment strategies for BPH, whether medical or surgical, often impact sexual function. For instance, medical treatments using alpha-blockers or 5-alpha reductase inhibitors may cause sexual dysfunction, including ED, ejaculatory dysfunction (EjD), and decreased libido[17]. Similarly, surgical treatments for BPH are associated with sexual dysfunction, predominantly manifested as EjD, mainly retrograde ejaculation, and to a lesser extent, ED[18].

The negative impact of BPH treatment on sexual function underscores the need for minimally invasive interventions that minimize sexual side effects while effectively alleviating LUTS and bladder outlet obstruction. The Rezum system, which uses convective heat transfer based on the thermodynamic properties of water, has shown promise in this regard[19]. Rezum was found to produce significant, rapid, and durable responses in the management of bladder outlet obstruction due to BPH and a wide range of ages, prostate volumes and morphologies, and severity of LUTS[20–22]. This efficacy was associated with evidence that Rezum treatment preserves sexual function[23,24]. Rezum preserves sexual function by reducing excess prostate tissue without damaging the nerves involved in ejaculation and erectile function. In contrast, surgeries like transurethral resection of the prostate (TURP) can lead to sexual dysfunction if the neurovascular bundles are damaged, potentially causing retrograde ejaculation and in fewer instances erectile issues[25].

Despite the growing use of Rezum for BPH treatment, particularly for reducing prostate volume and improving urinary symptoms[23], there is a notable need for comprehensive research on its long-term effects on sexual function. Most studies focus on procedural success and urinary outcomes, leaving a gap in understanding its impact on sexual health. This review aims to fill that gap by evaluating available evidence on sexual function post-Rezum, providing a more complete perspective on its benefits and potential drawbacks in BPH management.

2 | METHODOLOGY

2.1 | Scoping review search strategy

The scoping review was conducted following the Joanna Briggs Institute methodology for scoping reviews[26]. The comprehensive search was performed through the PubMed and Scopus databases from inception until August 2024, and the search strategy was developed in collaboration with the institute's librarian to optimize the search terms and ensure comprehensive coverage of the relevant literature. The search included keywords and advanced text search terms, such as Rezum OR water vapor therapy of prostate, OR water vaporization of the prostate. The search was limited to articles published in or translated into English.

Two authors independently screened and evaluated the articles according to the inclusion and exclusion criteria. Any disagreements were resolved through discussions with senior authors until a consensus was reached.

2.2 | Inclusion and exclusion criteria

Our study selection was guided by the following PICO question: “For patients with benign prostatic hyperplasia (Population), how does treatment with Rezum (Intervention) impact sexual function (Outcome) compared to no treatment or alternative BPH treatments (Comparison)?”

The inclusion criteria were: (a) studies of patients treated with Rezum for BPH, (b) studies reporting the

effect of Rezum on sexual function using validated scoring tools such as the International Index of Erectile Function (IIEF), either the 15-item questionnaire (IIEF-15) or the 5-item modified version (IIEF-5), as well as the Male Sexual Health Questionnaire (MSHQ), (c) no restrictions on age or prostate size, and (d) publications in English or translated into English.

The exclusion criteria included: (a) duplicate reports (including those containing the same patients' information), (b) studies with insufficient data, (c) studies reporting subjective descriptions or self-reported outcomes without the use of validated scales of sexual function, (d) case reports, reviews, comments, and editorials, and (e) animal studies.

2.3 | Data extraction

The authors extracted variables such as the number of patients, demographics, and sexual function were assessed using validated tools, specifically the International Index of Erectile Function (IIEF) for erectile function and the Male Sexual Health Questionnaire (MSHQ) for ejaculatory function. The IIEF-15 and IIEF-5 versions were used, depending on the study, with scores ranging from 0 to 30, where higher scores indicate better function. The ejaculatory function was assessed with the MSHQ-Bother and MSHQ-Function scores, which evaluate patient satisfaction and ejaculatory performance. Data were extracted on baseline and post-treatment scores, with attention to significant changes reported in the studies.

3 | RESULTS

3.1 | Literature search

Our initial search yielded a total of 462 articles. Title and abstract screening were performed on 100 articles after the removal of duplicates, non-English articles, non-human articles, editorials, case reports, comments, and reviews. A total of 41 studies were eligible for full-text

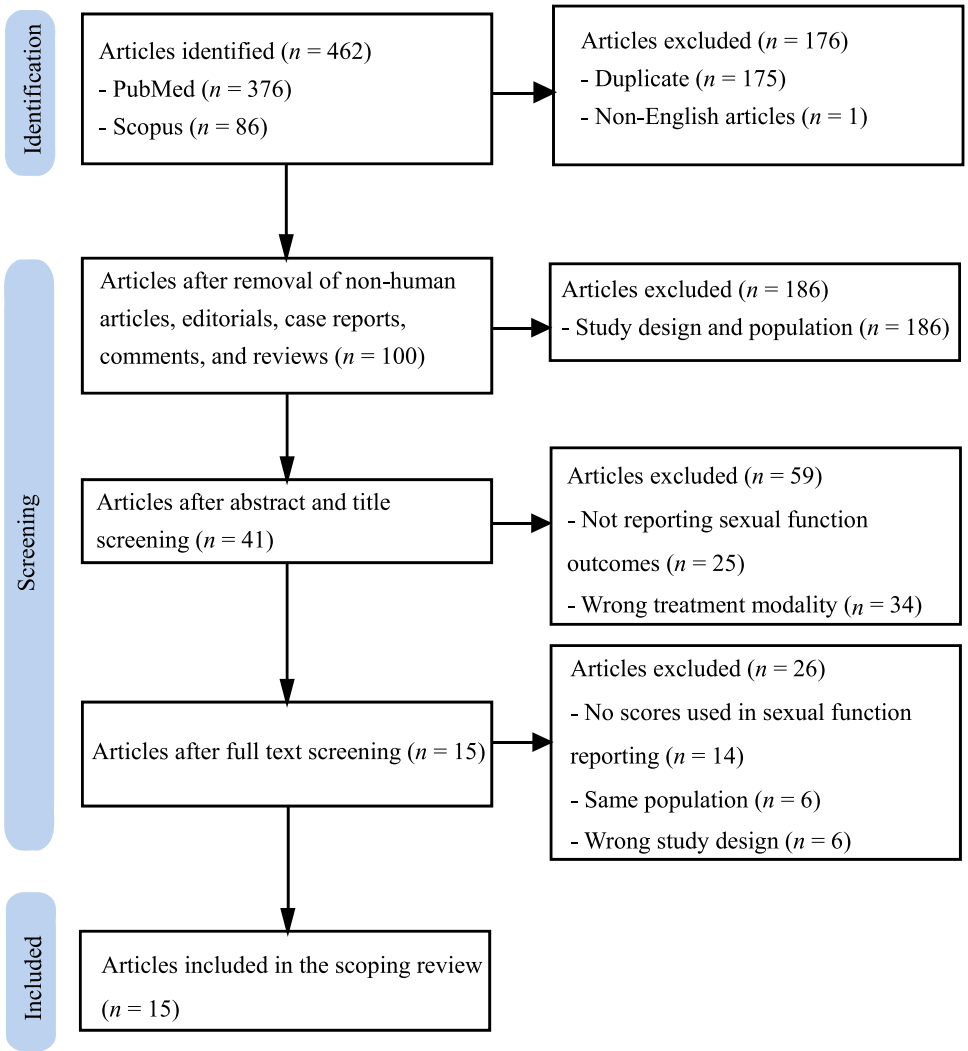

FIGURE 1 Flowchart for the articles' selection process for the scoping review.

screening, of which 15 articles were selected for this scoping review, as illustrated in the scoping review flowchart (Figure 1).

3.2 | Characteristics of the included studies

The studies included in this review were conducted between November 2016 and July 2024. A total of 15 articles were included, comprising nine prospective studies and six retrospective studies. The combined total of patients across these studies was 2425, with individual study populations ranging from 20 to 461 patients. The follow-up duration across the studies varied widely, ranging from 6 months to 60 months.

3.3 | Patient demographics

The patient demographics across the included studies show variability in age. Of the total studies, 11 reported mean ages, which ranged from 61.2 years to 67.5 years, with standard deviations between 6.0 years and 11.9 years, indicating some variability in the age distribution of the participants. Additionally, four studies provided median ages, with a notable report of a median age range between 63 years and 69.2 years and an interquartile range of 41–88, reflecting the age diversity within the study populations.

3.4 | Erectile function

Erectile function at baseline and after the Rezum procedure was assessed using the International Index of Erectile Function (IIEF)-15 or the modified IIEF-5 across the included studies. Seven studies reported no significant difference in erectile function scores post-procedure. However, six studies observed significant improvements in erectile function, while two studies noted a significant decrease. The follow-up duration across the studies varied widely, ranging from 6 months to 60 months. Table 1 provides a detailed summary of the baseline, and post-Rezum erectile function scores reported in the included studies.

TABLE 1 Baseline and follow-up erectile function evaluation by either IIEF-15 or IIEF-5 scores.

				Baseline		Follow up			
Author	**Year**	***n*[a]**	**Last follow up (month)**	***n***	**IIEF**	***n***	**IIEF**	***p* value[b]**	**Comments[e]**
Dixon et al.[27]	2016	65	24	31	11.8 ± 12.4	31	15.5 ± 11.5	0.006	Significant increase
Roehrborn et al.[28]	2017	136	24	71	22.9 ± 7.3	71	21.8 ± 8.7	0.2068	No significant change
Alegorides et al.[29]	2020	62	12	37	19 ± 6	37	19.4 ± 5.6	0.54	No significant change
Siena et al.[30]	2021	135	6	135	20 (16–22)[c]	135	23.5 (21–25.5)[c]	0.04	Significant increase
McVary et al.[31]	2021	136	60	65	23.8 ± 6.8	65	21.0 ± 10.2	0.0158	Significant decrease
Fernández-Guzmán et al.[32]	2021	137	12	67	15.07 ± 8.4	11	14.29 ± 8.2	0.783	No significant change
Whiting et al.[33]	2022	461	12	99	16.5 ± 8.4	99	18 ± 8.1	0.0222	Significant increase
Elterman et al.[34]	2022	299	12	37	51.3	37	52.9 ± 19.0	0.362	No significant change
Elterman et al.[35]	2022	83	12	64	40.7 ± 21.0	15	57.1 ± 17.6	0.18	No significant change
Campobasso et al.[36]	2022	262	12	262	17.4 ± 6.5	262	17.2 ± 7.4	0.964	No significant change
Ghahhari et al.[37]	2022	84	18	84	17.6 ± 7.1	84	22 ± 3.5	0.045	Significant increase
Schwartzmann et al.[38]	2023	102	24	69	23 (20–43)[c]	38	20.5 (18–22)[c]	<0.05	Significant decrease
Cindolo et al.[39]	2023	352	12	352	20 (16–22)[c]	352	21 (18–23)[c]	<0.001	Significant increase
Nguyen et al.[40]	2024	20	6	20	46 (7.4)[d]	20	48 (10.3)[d]	0.063	No significant change
Hawks-Ladds et al.[41]	2024	91	48	30	17 (11.8–29.3)[c]	30	28 (18.3–30)[c]	0.01	Significant increase

Abbreviations: IIEF, International Index of Erectile Function; IQR, interquartile range.

[a]Total number of patients in the article.

[b]The *p* value for the change between baseline and follow-up.

[c]Median and IQR

[d]Median and standard error.

[e]Increase indicates improvement.

3.5 | Ejaculatory function

Ejaculatory function before and after the Rezum procedure was assessed using the Male Sexual Health Questionnaire (MSHQ)-Bother and MSHQ-Function scores across the included studies. Regarding MSHQ-Bother, it was reported in seven articles; three of these studies reported significant improvement, while the remaining four showed no significant change. In contrast, eight articles reported on MSHQ-Function, with seven showing no significant difference and only one study reporting a significant worsening in ejaculatory function post-Rezum. Table 2 provides a detailed summary of the baseline, and post-Rezum ejaculatory function scores reported in the included studies.

4 | DISCUSSION

Although TURP is still considered the gold standard for surgical treatment of LUTS/BPH, sexual dysfunction, including ejaculatory and ED are reported complications of this procedure[42,43]. The recent introduction and implementation of ultra minimally-invasive treatments (uMIST) aim to fill the current gap between patients' QoL—especially in terms of sexual function—and functional outcomes. These treatments may provide the opportunity to tailor the management of BPH by considering specific patient- and prostate-related factors, following the principles of personalized medicine[44]. uMIST mainly Rezum, UroLift, Aquablation, and Prostate Artery Embolization have minimal impact on patients' sexual function, particularly in preserving ejaculation, making them reasonable options for patients who prioritize maintaining ejaculatory function while seeking fast and effective relief from LUTS[44,45]. This article reviews the literature on the effects of Rezum on sexual function to aid in treatment decision-making. As Rezum gained popularity in the management of BPH and LUTS, it has shown proven efficacy in improving symptoms and urine flow, offering favorable outcomes compared to more invasive procedures and even medications[46].

Traditionally, surgical treatments for BPH, such as TURP and laser enucleation, have been associated with the risk of ejaculatory dysfunction[24,47,48]. Intraoperative damage or disruption to the anterograde ejaculation mechanism including the bladder neck, external sphincter, and the neurovascular bundles during these procedures can result in retrograde ejaculation, where semen enters the bladder instead of being expelled normally[25,49]. The rate of retrograde ejaculation after TURP, the gold standard treatment of BPH, is approximately 70%–90% and is associated with considerable bother[49–52]. On the other hand, studies have showed that antegrade ejaculation is preserved in 96.6% of the patients after the Rezum procedure[36]. In our review, we found that Rezum has no effect on ejaculatory function measured with MSHQ-Function[27-29,34-36,38,40] and MSHQ-Bother[31,34–36,38]. Nevertheless, three articles reported improved MSHQ-Bother score[27–29], and only one article reported worsening in MSHQ-Function[31]. The favorable outcomes of Rezum on ejaculatory function were maintained for a long duration of up to 5 years[31]. These results could be attributed to the mechanism of how Rezum treats an enlarged prostate while preserving the bladder neck and minimal or no risk of causing damage to the nerve responsible for maintaining antegrade ejaculation[53], which might be compromised in another prostate cavitary technique such as TURP or laser enucleation[25].

In terms of erectile function, which is a critical component of sexual outcomes post-BPH treatment, it can be affected by medications used to relieve LUTS[17] or as a complication of surgical interventions[25,51,52]. Although a low rate of ED is reported with procedures like TURP and laser enucleation[18], the impact on patients' QoL is significant. Our review found that Rezum therapy had no negative effect on erectile function in seven studies[28,29,32,34–36,40], with four studies even reporting significant improvement[27,30,33,37,39,41]. However, among these studies, only one article reported no significant changes in the use of ED medications from baseline post-Rezum[41], while the others did not comment on the use of ED medications[30,33,37,39]. The mechanism of Rezum, in which the collagenous pseudocapsule of the adenoma acts as a barrier to the convective vapor, allows for targeted treatment of obstructive nodules while minimizing nerve injury. This may account for its minimal impact on erectile function[53].

On the other hand, two studies did report a decline in IIEF scores post-Rezum[31,38]. McVary et al. found that while there was an overall decrease in IIEF scores, subjects with normal erectile function at baseline experienced minimal changes over 5 years, whereas those with pre-existing ED showed a slight, clinically insignificant decline[31]. The gradual decline in sexual function over time possibly reflects the para-aging process[54], as the significant decrease was evident with longer follow-up durations[31,38].

The outcomes of Rezum on erectile function found in our review align with the broader body of published literature regarding the effect of surgical treatments for BPH on erectile function. The impact of these treatments is inconsistent, with some studies showing improvement, others reporting worsening, and the majority indicating no significant changes, as reported by Soans et al. in his systematic review[55]. This variability underscores the complex nature of the relationship between surgical interventions, the pathophysiology of BPH, and erectile function, influenced by factors such as patient characteristics and surgical technique.

TABLE 2 Baseline and follow-up ejaculatory function evaluation by MSHQ-B and MSHQ-F scores.

			MSHQ-Bother						MSHQ-Function					
			Baseline		Follow up				Baseline		Follow up			
Author, year	*n*[a]	Last follow up (months)	*n*	MSHQ-B score	*n*	MSHQ-B score	*p* value[b]	Comments[c]	*n*	MSHQ-F score	*n*	MSHQ-F score	*p* value[b]	Comments[d]
Dixon et al.[27]	65	24	8	2.6 ± 2.2	8	0.8 ± 0.5	0.035	Significant decrease	8	4.6 ± 5.2	8	7 ± 4.8	0.234	No significant change
Roehrborn et al.[28]	136	24	40	2.2 ± 1.6	40	1.7 ± 1.7	0.0118	Significant decrease	70	9.6 ± 3.0	70	9.1 ± 4.4	0.3601	No significant change
Alegorides et al.[29]	62	12	19	2.2 ± 1.7	19	0.9 ± 1.1	0.008	Significant decrease	19	7.9 ± 5.1	19	10 ± 3.5	0.056	No significant change
McVary et al.[31]	136	60	63	1.9 ± 1.6	63	1.6 ± 1.7	0.194	No significant change	63	10.2 ± 3.0	63	8.4 ± 4.5	0.0004	Significant decrease
Elterman et al.[34]	299	12	37	1.7	37	1.6 ± 1.4	0.972	No significant change	37	9.5	37	9.4 ± 4	0.961	No significant change
Elterman et al.[35]	83	12	50	1.8 ± 1.5	15	1.3 ± 1.3	1	No significant change	50	8.5 ± 3.5	15	10.1 ± 4.0	0.9	No significant change
Schwartzmann et al.[38]	102	24	36	2.5 (1–4)[e]	9	1 (0–1)[e]	>0.05	No significant change	36	9.5 (4–12)[e]	9	12 (7–13)[e]	>0.05	No significant change
Nguyen et al.[40]	20	6	-	-	-	-	-	-	20	11 (0.8)[f]	20	11 (1.1)[f]	0.461	No significant change

Abbreviations: IQR, interquartile range; MSHQ-B, Male Sexual Health Questionnaire-Bother; MSHQ-F, Male Sexual Health Questionnaire-Function.

[a]Total number of patients in the article.

[b]The *p* value for the change between baseline and follow-up.

[c]Decrease indicates improvement.

[d]Decrease indicates a decline in function.

[e]Median and IQR.

[f]Median and standard error.

With the availability of multiple treatment options for managing BPH, the decision-making process for patients has become increasingly complex. Choosing the most appropriate therapy requires careful consideration of each patient's specific needs, treatment goals, and potential side effects, particularly in preserving QoL, including sexual function. Some patients might accept a reduction in treatment efficacy to preserve ejaculation[44,45]. In our review, we found that Rezum is associated with favorable and durable effects on sexual function, which can significantly aid in patient care planning, especially given the variety of treatment options available for BPH.

4.1 | Limitations and strengths

There are several limitations to this scoping review. The studies included in this review varied significantly in patient demographics, treatment settings, and follow-up periods, ranging from 6 months to 60 months. This heterogeneity may impact the reliability and generalizability of the findings. Variations in patient age, prostate size, and comorbidities could influence treatment outcomes. Additionally, differences in the length of follow-up may lead to inconsistent reports of long-term effects, particularly in sexual function. Future studies should aim for more standardized patient populations and extended follow-up periods to provide a clearer understanding of Rezum's long-term impact on sexual function. Publication bias may also affect the evaluation, as studies with unfavorable results are less likely to be published. Additionally, there are no direct comparisons of Rezum's sexual outcomes with other treatments like TURP or uMIST options such as Urolift or needle ablation. Declining patient follow-up and inconsistent reporting on sexual outcomes further limit the reliability of the findings. Furthermore, there are potential influences of confounding factors, such as the concurrent use of medications like 5-alpha reductase inhibitors, which are known to affect sexual function. These medications may independently contribute to erectile dysfunction or ejaculatory dysfunction, complicating the interpretation of the effects attributed solely to Rezum therapy. Future studies should control for the use of such medications to provide a more accurate assessment of the direct impact of Rezum on sexual function. Lastly, reliance on published works may exclude ongoing or unpublished research, reducing the comprehensiveness of the review.

Despite these limitations, the scoping review offers an insightful summary of the state of the research on sexual dysfunction after BPH treatment with Rezum. It methodically lays out the available data, highlighting areas that still need research and any gaps in the body of knowledge. Because of the review's wide inclusion criteria, different study designs and populations are thoroughly analyzed, providing readers with a full overview of the subject. The review also emphasizes how crucial it is to treat sexual function as a primary endpoint for BPH patients since this can guide future research paths and clinical practice.

4.2 | Future directions

As we look to the future of BPH management, we need to move from the narrow focus on relieving obstruction and improving LUTS to a holistic approach that takes into consideration the patient's QoL, with sexual function as a major component in the management of BPH. The development of new uMISTs like Rezum, Urolift and Aquablation has challenged traditional treatments like TURP. Unfortunately, most of the published literature has focused on the efficacy of these treatments regarding relieving obstruction and LUTS, while evaluating the effects on sexual function as secondary outcomes. More precise research is needed to compare the available treatment modalities and sexual outcomes using objective scores to improve the understanding and generalizability of results.

Nevertheless, with the development of more minimally invasive therapies offering patients greater choices and better outcomes in managing BPH, there is a growing need for precise research to help urologists apply patient-centered medicine effectively in BPH management.

5 | CONCLUSION

In this review, Rezum therapy for managing BPH and resultant LUTS is found to have significant and durable favorable outcomes on sexual function, or at the very least, it does not negatively impact it. These findings can aid in counseling patients, especially those who wish to preserve ejaculation, on the most suitable treatment modality. Future research is necessary to compare the effects of Rezum on sexual function with other treatment modalities, to further validate its benefits and establish it as a preferred option in BPH management.

AUTHOR CONTRIBUTIONS

The study was conceptualized by Ibrahim A. Khalil and Kareim Khalafalla, with methodology developed jointly by Ibrahim A. Khaliland and Kareim Khalafalla. Both Ibrahim A. Khalil and Ahmad R. Al-Qudimat led the investigation. Ibrahim A. Khalil drafted the original manuscript, and all authors participated in the review and editing process. Visualization was supported by Ibrahim A. Khalil, Ahmad R. Al-Qudimat, and Kareim Khalafalla, while Kareim Khalafalla and Khalid Al Rumaihi provided supervision and handled project administration. All authors have reviewed and approved the final version of the manuscript for publication.

CONFLICT OF INTEREST STATEMENT

Kareim Khalafalla is one of the Editorial Board Members of *UroPrecision*. He was excluded from the peer-review process and all editorial decisions related to the acceptance and publication of this article. Peer review was handled independently by the other editors to minimize bias. The remaining authors declare no conflict of interest.

ETHICS STATEMENT

No ethical approval or patient consent was necessary.

References

1. Langan RC. Benign prostatic hyperplasia. Primary Care Clin Office Pract. 2019;46:223–32.
2. Lee C, Kozlowski JM, Grayhack JT. Intrinsic and extrinsic factors controlling benign prostatic growth. Prostate. 1997;31:131–8.
3. Auffenberg GB, Helfand BT, McVary KT. Established medical therapy for benign prostatic hyperplasia. Urol Clin North Am. 2009;36:443–59.
4. Lokeshwar SD, Harper BT, Webb E, Jordan A, Dykes TA, Neal Jr., DE, et al. Epidemiology and treatment modalities for the management of benign prostatic hyperplasia. Transl Androl Urol. 2019;8(5):529–39.
5. Patel N, Parsons J. Epidemiology and etiology of benign prostatic hyperplasia and bladder outlet obstruction. Indian J Urol. 2014;30:170–6.
6. Berry SJ, Coffey DS, Walsh PC, Ewing LL. The development of human benign prostatic hyperplasia with age. J Urol. 1984;132:474–9.
7. Roehrborn CG. Benign prostatic hyperplasia: an overview. Rev Urol. 2005;7 Suppl 9(Suppl 9):S3–S14.
8. A.F. Awedew, H. Han, B. Abbasi, M. Abbasi-Kangevari, M.B. Ahmed, O. Almidani, et al. The global, regional, and national burden of benign prostatic hyperplasia in 204 countries and territories from 2000 to 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Healthy Longevity. 2022;3(11):e754–76.
9. McConnell JD, Roehrborn CG, Bautista OM, Andriole GL, Dixon CM, Kusek JW, et al. The long-term effect of doxazosin, finasteride, and combination therapy on the clinical progression of benign prostatic hyperplasia. N Engl J Med. 2003;349:2387–98.
10. Andersson KE, de Groat WC, McVary KT, Lue TF, Maggi M, Roehrborn CG, et al. Tadalafil for the treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia: pathophysiology and mechanism(s) of action. Neurourol Urodyn. 2011;30:292–301.
11. Lim KB. Epidemiology of clinical benign prostatic hyperplasia. Asian J Urol. 2017;4(3):148–51.
12. Kirby M, Chapple C, Jackson G, Eardley I, Edwards D, Hackett G, et al. Erectile dysfunction and lower urinary tract symptoms: a consensus on the importance of co-diagnosis. Int J Clin Pract. 2013;67:606–18.
13. Rosen RC, Link CL, O'Leary MP, Giuliano F, Aiyer LP, Mollon P. Lower urinary tract symptoms, and sexual health: the role of gender, lifestyle and medical comorbidities. BJU Int. 2009;103(Suppl 3):42–7.
14. Schiff JD, Mulhall JP. The link between LUTS and ED: clinical and basic science evidence. J Androl. 2004;25(4):470–8.
15. Blanker MH, Bohnen AM, Groeneveld FPMJ, Bernsen RMD, Prins A, Thomas S, et al. Correlates for erectile and ejaculatory dysfunction in older Dutch men: a community-based study. J Am Geriatr Soc. 2001;49(4):436–42.
16. McVary KT. Erectile dysfunction and lower urinary tract symptoms secondary to BPH. Eur Urol. 2005;47(6):838–45.
17. Giuliano F. Impact of medical treatments for benign prostatic hyperplasia on sexual function. BJU Int. 2006;97(Suppl 2):34–8.
18. Manfredi C, García-Gómez B, Arcaniolo D, García-Rojo E, Crocerossa F, Autorino R, et al. Impact of surgery for benign prostatic hyperplasia on sexual function: a systematic review and meta-analysis of erectile function and ejaculatory function. European Urology Focus. 2022;8(6):1711–32.
19. Magistro G, Chapple CR, Elhilali M, Gilling P, McVary KT, Roehrborn CG, et al. Emerging minimally invasive treatment options for male lower urinary tract symptoms. Eur Urol. 2017;72:986–97.
20. McVary KT, Miller LE, Bhattacharyya S, DeRouen K, Turner E, Zantek P, et al. Water vapor thermal therapy in men with prostate volume ≥80 cm^3: a systematic review and meta-analysis. Urology. 2024;184:244–50.
21. Khalil IA, Aldeeb M, Mohammed A, Awad K, Ibrahim T, Al-Zoubi RM, et al. The role of Rezum in the management of refractory urinary retention due to benign prostate hyperplasia: a literature review. Arab J Urol. 2023;21(3):185–9.
22. Abid A, Piperdi H, Babar M, Loloi J, Moutwakil A, Azhar U, et al. Minimally invasive surgical therapies for benign prostatic hyperplasia in the geriatric population: a systematic review. Prostate. 2024;84(10):895–908.
23. McVary KT, Gittelman MC, Goldberg KA, Patel K, Shore ND, Levin RM, et al. Final 5-year outcomes of the multicenter randomized sham-controlled trial of a water vapor thermal therapy for treatment of moderate to severe lower urinary tract symptoms secondary to benign prostatic hyperplasia. J Urol. 2021;206(3):715–24.
24. Busetto GM, Lombardo R, De Nunzio C, Santoro G, Tocci E, Schiavone N, et al. Ejaculation sparing of classic and minimally invasive surgical treatments of LUTS/BPH. Prostate Cancer Prostatic Dis. Published online April 13, 2014.
25. Leong JY, Patel AS, Ramasamy R. Minimizing sexual dysfunction in BPH surgery. Current Sexual Health Rep. 2019;11(3):190–200.
26. Peters MDJ, Godfrey C, McInerney P, et al. Chapter 11: scoping reviews (2020 version). In: Aromataris E, Munn Z, editors. JBI manual for evidence synthesis. JBI, Australia; 2020:407–13.
27. Dixon CM, Cedano ER, Pacik D, Vit V, Varga G, Wagrell L, et al. Two-year results after convective radiofrequency water vapor thermal therapy of symptomatic benign prostatic hyperplasia. Res Rep Urol. 2016;8:207–16.
28. Roehrborn CG, Gange SN, Gittelman MC, Goldberg KA, Patel K, Shore ND, et al. Convective thermal therapy: durable 2-year results of randomized controlled and prospective crossover studies for treatment of lower urinary tract symptoms due to benign prostatic hyperplasia. J Urol. 2017;197(6):1507–16.
29. Alegorides C, Fourmarier M, Eghazarian C, Lebdai S, Chevrot A, Droupy S. Treatment of benign prostate hyperplasia using the Rezum® water vapor therapy system: results at one year. Progrès en Urologie. 2020;30(12):624–31.
30. Siena G, Cindolo L, Ferrari G, Maruzzi D, Fasolis G, Condorelli SV, et al. Water vapor therapy (Rezūm) for lower urinary tract symptoms related to benign prostatic hyperplasia: early results from the first Italian multicentric study. World J Urol. 2021;39(10):3875–80.
31. McVary KT, El-Arabi A, Roehrborn C. Preservation of sexual function 5 years after water vapor thermal therapy for benign prostatic hyperplasia. Sex Med. 2021;9(6):100454.
32. Fernández-Guzmán E, Asensio Matas A, Capape Poves V, Rioja Zuazu J, Garrido Abad P, Martínez-Salamanca JI, et al. Resultados preliminares de un trabajo multicéntrico a nivel nacional para el tratamiento de STUI secundario a hiperplasia benigna de próstata mediante el sistema con vapor de agua Rezūm®. Actas Urológicas Españolas. 2022;46(5):310–6.
33. Whiting D, Noureldin M, Abdelmotagly Y, Johnston MJ, Brittain J, Rajkumar G, et al. Real-world early outcomes and retreatment

rates following water vapour ablative therapy for symptomatic benign prostatic hyperplasia. European Urology Open Science. 2022;39:72–8.
34. Elterman D, Bhojani N, Vannabouathong C, Chughtai B, Zorn KC. Large, multi-center, prospective registry of rezūm water vapor therapy for benign prostatic hyperplasia. Urology. 2022;165:261–7.
35. Elterman D, Bhojani N, Vannabouathong C, Chughtai B, Zorn KC. Rezūm therapy for ≥80-mL benign prostatic enlargement: a large, multicentre cohort study. BJU Int. 2022;130(4): 522–7.
36. Campobasso D, Siena G, Chiodini P, Conti E, Franzoso F, Maruzzi D, et al. Composite urinary and sexual outcomes after Rezum: an analysis of predictive factors from an Italian multi-centric study. Prostate Cancer Prostatic Dis. 2023;26(2): 410–4.
37. Ghahhari J, Sountoulides P, Campobasso D, Faieta A, Sessa F, Viola L, et al. Mid-term results of water vapor thermal therapy in patients with lower urinary tract symptoms related to benign prostatic hyperplasia. Front Urol. 2022;2:990560.
38. Schwartzmann I, García Barreras S, D'Anna M, Parejo V, Torneo Ruiz I, Tagalos Muñoz AC, et al. Terapia termal con vapor de agua: variaciones técnicas entre hospitales universitarios españoles y eficacia a 2 años de seguimiento. Actas Urológicas Españolas. 2023;47(10):668–74.
39. Cindolo L, Morselli S, Campobasso D, Conti E, Sebastiani G, Franzoso F, et al. One-year outcomes after water vapor thermal therapy for symptomatic benign prostatic hyperplasia in an unselected Italian multicenter cohort. Minerva Urol Nephrol. 2023;75(2):203–9.
40. Nguyen V, Winograd J, Codelia-Anjum AJ, Zorn KC, Elterman D, Bhojani N, et al. Feasibility assessment of catheter-free water vapor thermal therapy for treatment of benign prostatic hyperplasia. World J Urol. 2024;42(1):383.
41. Hawks-Ladds N, Cook R, Babar M, Zhu M, Schulz A, Loloi J, et al. Four years of real-world sexual function outcomes after Rezum therapy in men with and without baseline erectile dysfunction. J Sex Med. 2024:qdae087.
42. Taher A. Erectile dysfunction after transurethral resection of the prostate: incidence and risk factors. World J Urol. 2004;22: 457–60.
43. Parsons JK, Dahm P, Köhler TS, Lerner LB, Wilt TJ. Surgical management of lower urinary tract symptoms attributed to benign prostatic hyperplasia: AUA Guideline Amendment 2020. J Urol. 2020;204:799–804.
44. Checcucci E, Veccia A, De Cillis S, Piramide F, Volpi G, Amparore D, et al. New ultra-minimally invasive surgical treatment for benign prostatic hyperplasia: a systematic review and analysis of comparative outcomes. Eur Urol Open Sci. 2021;33:28–41.
45. Lebdai S, Chevrot A, Doizi S, Pradere B, Delongchamps NB, Benchikh A, et al. Do patients have to choose between ejaculation and miction? A systematic review about ejaculation preservation technics for benign prostatic obstruction surgical treatment. World J Urol. 2019;37(2):299–308.
46. Yang J, Wu W, Amier Y, Li X, Wan W, Liu C, et al. Efficacy and safety of Water Vapor Thermal Therapy in the treatment of benign prostate hyperplasia: a systematic review and single-arm Meta-analysis. BMC Urol. 2023;23(1):72.
47. Gosso AA, Amparore D, Di Maida F, de Cillis S, Cocci A, Di Dio M, et al. Comparison of perioperative and short-terms outcomes of en-bloc Holmium laser enucleation of the prostate (HoLEP) and robot-assisted simple prostatectomy: a propensity-score matching analysis. Prostate Cancer Prostatic Dis. 2023;27: 478–84.
48. Porreca A, Schiavina R, Romagnoli D, Corsi P, Salvaggio A, D'Agostino D, et al. T-L technique for HoLEP: perioperative outcomes of a large single-centre series. Cent Eur J Urol. 2021;74: 366–71.
49. Gil-Vernet JM, Alvarez-Vijande R, Gil-Vernet A, Gil-Vernet JM. Ejaculation in men: a dynamic endorectal ultrasonographical study. Br J Urol. 1994;73(4):442–8.
50. Barazani Y, Stahl PJ, Nagler HM, Stember DS. Management of ejaculatory disorders in infertile men. Asian J Androl. 2012;14(4): 525–9.
51. Liao J, Zhang X, Chen M, Li D, Tan X, Gu J, et al. Transurethral resection of the prostate with preservation of the bladder neck decreases postoperative retrograde ejaculation. Wideochir Inne Tech Maloinwazyjne. 2019;14(1):96–101.
52. Muntener M, Aellig S, Kuettel R, Gehrlach C, Sulser T, Strebel RT. Sexual function after transurethral resection of the prostate (TURP): results of an independent prospective multicentre assessment of outcome. Eur Urol. 2007;52(2):510–6.
53. Doppalapudi S.K., Gupta N. What is new with rezūm water vapor thermal therapy for LUTS/BPH? Curr Urol Rep. 2021;22(1):4.
54. Wylie K, Kenney G. Sexual dysfunction and the ageing male. Maturitas. 2010;65(1):23–7.
55. Soans J, Vazirian-Zadeh M, Kum F, Dhariwal R, Breish MO, Singh S, et al. Can surgical treatment for benign prostatic hyperplasia improve sexual function? A systematic review. Aging Male. 2020;23(5):770–9.