



Feasibility and Preliminary Effects of Uddiyana Bandha on Glycaemic Control in Individuals with Type 2 Diabetes Mellitus: A Randomized Pilot Study

Subhalakshmi S^{1*}, Devi Nandhini² and Annamalai Dharuman²

¹Department of Yoga International Institute of Yoga and Naturopathy Medical Sciences

²Department of Yoga and Naturopathy, JSS Institute of Naturopathy and Yogic Sciences

* Corresponding author. E-mail: subhiiniyaval@gmail.com

<https://doi.org/10.48165/irjay.2026.9.05.06>

ARTICLE INFO

Article history

Received: 21.07.2026

Revised: 10.08.2026

Accepted: 08.09.2026

Keywords

Uddiyana Bandha

Blood glucose

Type 2 diabetes mellitus

Glycaemic control

Yoga

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major metabolic disorder requiring long-term pharmacological treatment and lifestyle modification. Uddiyana Bandha (UB), a traditional yogic abdominal practice, may influence autonomic and metabolic function; however, evidence regarding its effect on glycaemic parameters in T2DM remains limited. This pilot study aimed to evaluate the feasibility, safety, acceptability, and preliminary effects of UB as an adjunct to standard oral hypoglycaemic therapy in individuals with T2DM.

Methods: A randomized pilot study with a parallel-group design was conducted among 24 adults with T2DM aged 35–60 years. Participants were randomly allocated to the intervention group (n=12) or a control group receiving usual care alone (n=12). The intervention group continued prescribed oral hypoglycaemic medication and performed supervised UB practice for 30 consecutive days. Fasting blood glucose (FBG) and 2-hour post-load glucose (2-hr PG) were assessed at baseline and after the intervention using a 75-g oral glucose tolerance test. Feasibility outcomes included recruitment, consent, attendance, attrition, intervention and outcome-assessment completion, safety, and acceptability.

Results: In the UB group, FBG decreased from 195.26 ± 50.09 to 137.71 ± 32.68 mg/dL ($p=0.001$). The 2-hr PG decreased from 316.82 ± 91.64 to 236.11 ± 73.47 mg/dL ($p=0.001$). The control group also demonstrated reductions in FBG and 2-hr PG. However, the reduction in FBG was greater in the UB group than in the control group (57.55 ± 44.48 vs. 12.91 ± 16.61 mg/dL; $p=0.004$), as was the reduction in 2-hr PG (80.72 ± 63.03 vs. 38.73 ± 22.23 mg/dL; $p=0.041$). Recruitment was 70.6%, below the predefined 80% benchmark. Consent, intervention completion, and outcome-assessment completion were 100%; supervised attendance was 97.2%, with no attrition or adverse events. All participants in the UB group reported the intervention as acceptable.

Conclusion: A supervised UB intervention was feasible, acceptable, and well tolerated when provided as an adjunct to standard oral hypoglycaemic therapy. The preliminary findings indicate greater reductions in FBG and 2-hr PG compared with usual care alone. However, given the small sample size and short intervention period, these findings should be considered preliminary and require confirmation in a larger, adequately powered randomized controlled trial.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterised by persistently elevated blood glucose levels, mainly due to impaired insulin secretion by pancreatic β -cells and reduced sensitivity of peripheral tissues to insulin (1). Diabetes has become a major global health concern, affecting nearly one in eleven adults worldwide, with T2DM accounting for approximately 90% of all cases. Asia contributes substantially to the growing global burden of T2DM(2). The increasing prevalence of the disease is closely associated with rising levels of overweight and obesity, physical inactivity, and unhealthy dietary practices, including greater consumption of refined grains and sugar-sweetened beverages. Poor glycaemic control can progressively contribute to microvascular and macrovascular complications, adversely affecting quality of life and increasing healthcare requirements. Therefore, there is a continuing need for safe, affordable, and sustainable approaches that can complement conventional diabetes management (2,3).

Current management of T2DM primarily combines pharmacological treatment with lifestyle modification. Lifestyle measures such as regular physical activity and dietary modification are important components of diabetes care and can contribute to improved glycaemic control and prevention of complications. However, maintaining long-term adherence to lifestyle recommendations remains challenging for many individuals and is a recognised limitation of non-pharmacological approaches to diabetes management(4). Consequently, complementary approaches that are simple, accessible, and potentially feasible for regular practice have received increasing research attention. Yoga is one such mind-body approach, and previous research suggests that yoga-based practices may influence glycaemic regulation through effects on autonomic, metabolic, and endocrine function (5).

Uddiyana Bandha (UB) is a traditional yogic practice involving active drawing of the abdominal wall inward and upward in coordination with controlled breathing(6). Traditionally, the practice is described as influencing the movement of prana. From a physiological perspective, the abdominal muscle contraction and respiratory manoeuvre involved in UB may influence abdominal organ activity, circulatory dynamics, respiratory patterns, and autonomic function(7). These responses have been proposed as possible pathways through which the practice could influence metabolic

regulation and glucose homeostasis. However, despite its established place in traditional yoga practice, specific scientific evidence regarding the metabolic and glycaemic effects of UB remains limited.

Given this limited evidence, a preliminary investigation is warranted before undertaking a larger controlled trial. A pilot study can provide initial information regarding the feasibility, acceptability, safety, and potential changes in relevant metabolic outcomes associated with UB practice among individuals with T2DM. Such preliminary findings may also help refine the intervention protocol, outcome assessment, and methodology for future adequately powered clinical trials. Therefore, the present pilot study was undertaken to explore the feasibility and preliminary effects of UB as an adjunct to conventional care in individuals with T2DM.

METHODOLOGY

Study Design Setting

A randomized pilot study with a parallel-group design was conducted to evaluate the feasibility and preliminary effects of UB practice on glycaemic parameters among individuals with T2DM. Participants were randomly allocated to either an intervention group receiving UB in addition to usual care or a control group receiving usual care alone. The study was conducted in the outpatient department of the Yoga and Nature Cure Hospital. Ethical considerations, including informed consent and confidentiality, were maintained throughout the study.

Participants

A total of 24 participants were recruited for the study based on the eligibility criteria. Participants were aged between 35 and 60 years, had been diagnosed with T2DM, were receiving oral hypoglycaemic medication, and had a fasting blood glucose level above 120 mg/dL and a 2-hour oral glucose tolerance test (OGTT) value above 140 mg/dL.

Participants with T2DM and coexisting comorbidities such as hypertension, cardiovascular disease, or glaucoma were excluded. Individuals who had undergone surgery within the preceding six months were also excluded. A purposive sampling technique was used to recruit eligible participants. All participants were informed about the study procedures, potential benefits, and possible risks, and written informed consent was obtained before enrolment.

Randomization

After baseline assessment, participants were randomly assigned to the intervention or control group in a 1:1 ratio using a computer-generated randomization sequence. Allocation was performed using sequentially numbered, opaque, sealed envelopes to minimize the possibility of selection bias.(fig 1.)

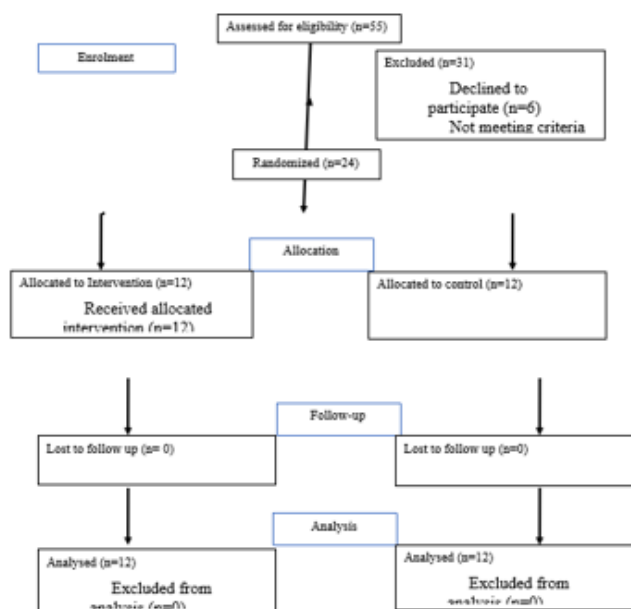


Figure 1: Consort flow diagram reporting the enrolled, treated and evaluated patients

Intervention

Participants allocated to the intervention group continued their prescribed oral hypoglycaemic medications without any intentional change in dosage or regimen and additionally received supervised UB practice for 30 consecutive days. Before commencing the intervention, participants attended a one-day orientation programme in which the procedure, baseline assessment, practice schedule, precautions, and safety measures were explained and demonstrated by a qualified Yoga and Naturopathy physician.

The practice was performed daily under supervision and on an empty stomach. During the first three days, participants were introduced to preparatory practices to familiarize them with the required breathing pattern and abdominal movements before performing the complete technique. The practice was temporarily withheld during menstruation and resumed thereafter.

Participants were instructed to sit in a comfortable meditative posture, such as Padmasana or Bhadrasana,

with the spine erect and the knees comfortably positioned. When sitting was uncomfortable, the practice was performed in a standing position. Participants were instructed to inhale deeply through the nose, followed by a relatively rapid but gentle exhalation through slightly pursed lips. After complete exhalation, Jalandhara Bandha was performed by lowering the chin towards the chest while gently elevating the shoulders. The abdomen was then drawn inward and upward towards the spine without excessive straining. This position was maintained for a few seconds or for as long as it could be performed comfortably.

Before the next inhalation, the abdominal muscles were relaxed, Jalandhara Bandha was released by raising the head, and the participant returned to the starting position. Participants performed 8–10 rounds during each session, with approximately one minute of relaxed, natural breathing between rounds. In case of discomfort, participants were allowed to rest in Shavasana before resuming the practice when appropriate.

Throughout the practice, participants were encouraged to maintain awareness of the abdominal region and their natural breathing pattern. Traditional yogic awareness was directed towards the Manipura Chakra during the practice.

Safety was monitored throughout the intervention period, and any discomfort or adverse events experienced during the practice were documented. Participants continued their routine hypoglycaemic drugs, and any alteration in the type or dosage of oral hypoglycaemic medication during the study period was recorded.

Outcome Measures

Glycaemic Outcome Assessment

Glycaemic parameters were assessed at baseline and after completion of the 30-day intervention. Fasting blood glucose (FBG) and 2-hour post-load blood glucose were measured using a 75-g oral glucose tolerance test (OGTT).

Participants were instructed to maintain an overnight fast of 8–12 hours before the test. On the morning of the assessment, a fasting venous blood sample was collected. Following this, 75 g of glucose dissolved in 250 mL of water was administered orally, and participants were instructed to consume the glucose solution. A second venous blood sample was collected 2 hours after consumption of the glucose solution. The fasting and 2-hour post-load blood glucose (2 hr PG) concentrations were recorded for analysis.

Table 1: Feasibility assessment, a priori benchmark and observed result of the study.

Domain	A priori benchmark	Observed result	Benchmark met?
Recruitment	≥80% of eligible participants recruited	24/34 eligible recruited (70.6%)	No
Consent	≥80% of eligible participants consent	24/24 (100%)	Yes
Attendance	≥80% of scheduled supervised sessions attended	Study group: 350/360 sessions attended (97.2%); Control group: not applicable (no hospital visits required)	Yes (Study group)
Attrition	≤20% withdraw/lost to follow-up	0/24 (0%)	Yes
Intervention completion	≥80% complete 30-day intervention	12/12 Study group (100%)	Yes
Outcome assessment completion	≥80% complete baseline and post-intervention FBG/2-hr OGTT	24/24 (100%)	Yes
Safety	No intervention-related serious adverse events	0 adverse events reported	Yes
Acceptability/satisfaction	≥80% report intervention acceptable/satisfactory	12/12 Study group (100%)	Yes

Table 2: Baseline (Pre-treatment) Characteristics of Study and Control Groups

Parameter	Study Group (n=12) Mean ± SD	Control Group (n=12) Mean ± SD	p-value
Age (years)	44.92 ± 5.07	47.33 ± 3.63	0.193
FBG Pre (mg/dL)	195.26 ± 50.09	191.38 ± 77.43	0.885
2-hr PG Pre (mg/dL)	316.82 ± 91.64	334.36 ± 110.33	0.676

Feasibility

The feasibility of the intervention was evaluated across several domains, including participant recruitment, consent, attendance, attrition, completion of the intervention and outcome assessments, safety, accessibility, and participant acceptability and satisfaction. Before initiating the study, predefined benchmark criteria were established for each feasibility and acceptability domain.

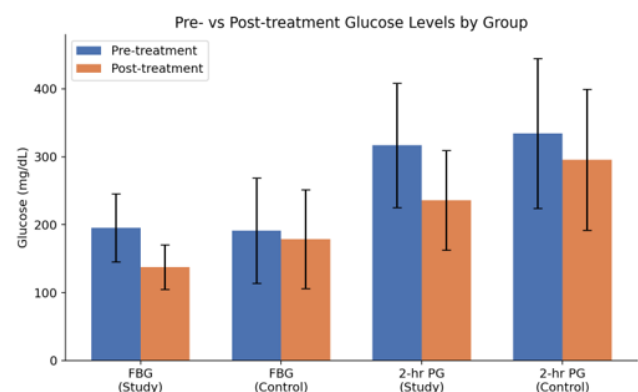
RESULTS

Twenty-four patients were included in this study, divided equally into a Study group (n = 12; 6 male, 6 female) and a Control group (n = 12; 6 male, 6 female). Table 2 summarizes baseline demographic and glycaemic characteristics of the two groups. The mean age was 44.9 ± 5.1 years in the Study group and 47.3 ± 3.6 years in the Control group, with no significant difference between groups (independent t-test, $t = -1.34$, $p = 0.193$).

*FBG – Fasting Blood Glucose, 2-hr PG – 2-hour post-loaded glucose

Within-Group Changes (Pre vs. Post): In the Study group, FBG decreased significantly from 195.3 ± 50.1 mg/dL to 137.7 ± 32.7 mg/dL, a mean reduction of 57.6

± 44.5 mg/dL (27.6% reduction; paired $t = 4.48$, $p < 0.001$). Similarly, 2-hr PG fell significantly from 316.8 ± 91.6 mg/dL to 236.1 ± 73.5 mg/dL, a mean reduction of 80.7 ± 63.0 mg/dL (24.1% reduction; paired $t = 4.44$, $p = 0.001$). (fig 2.)

**Figure 2:** Mean (± SD) FBG and 2-hr PG levels before and after treatment in the Study and Control groups.

In the Control group, FBG also decreased significantly, from 191.4 ± 77.4 mg/dL to 178.5 ± 72.7 mg/dL, a smaller mean reduction of 12.9 ± 16.6 mg/dL (6.4% reduction; paired $t = 2.69$, $p = 0.021$). 2-hr PG decreased from 334.4 ± 110.3 mg/dL to 295.6 ± 103.9 mg/dL, a mean reduction

Table 3: Pre- vs Post-treatment Glucose Levels (Paired t-test)

Group	Parameter	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	Mean Reduction $\pm$ SD	p-value
Study	FBG (mg/dL)	195.26 $\pm$ 50.09	137.71 $\pm$ 32.68	57.55 $\pm$ 44.48	0.001*
Study	2-hr PG (mg/dL)	316.82 $\pm$ 91.64	236.11 $\pm$ 73.47	80.72 $\pm$ 63.03	0.001*
Control	FBG (mg/dL)	191.38 $\pm$ 77.43	178.47 $\pm$ 72.74	12.91 $\pm$ 16.61	0.021*
Control	2-hr PG (mg/dL)	334.36 $\pm$ 110.33	295.63 $\pm$ 103.94	38.73 $\pm$ 22.23	<0.001*

Table 4: Comparison of Glucose Reduction Between Study and Control Groups

Parameter	Study Group Reduction (Mean $\pm$ SD)	Control Group Reduction (Mean $\pm$ SD)	p-value
FBG reduction (mg/dL)	57.55 $\pm$ 44.48	12.91 $\pm$ 16.61	0.004
2-hr PG reduction (mg/dL)	80.72 $\pm$ 63.03	38.73 $\pm$ 22.23	0.041

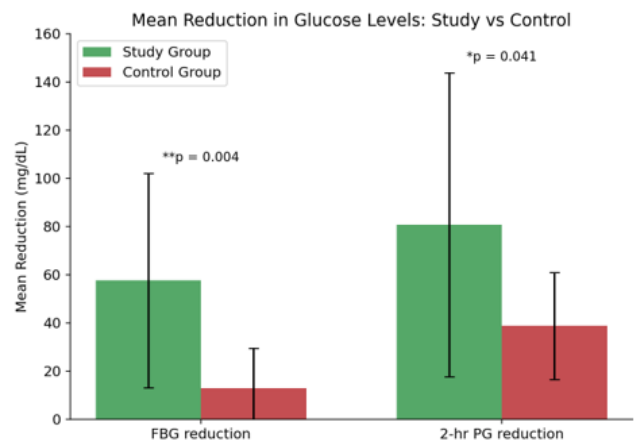
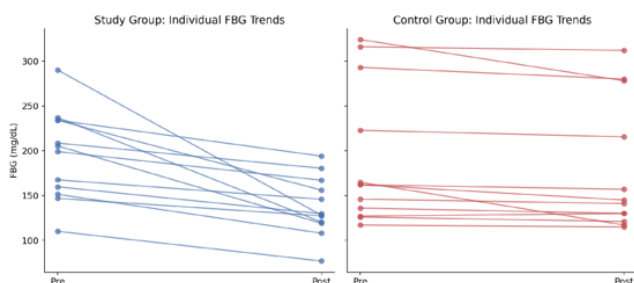
of 38.7 $\pm$ 22.2 mg/dL (11.9% reduction; paired t = 6.03, p < 0.001).

*Statistically significant at p < 0.05 (paired-samples t -test). FBG – Fasting Blood Glucose, 2-hr PG – 2-hour post-loaded glucose

Although both groups showed statistically significant improvement, the magnitude of reduction was substantially greater in the Study group. The reduction in FBG was significantly larger in the Study group than in the Control group (57.6 $\pm$ 44.5 vs. 12.9 $\pm$ 16.6 mg/dL; independent t = 3.26, p = 0.004). Likewise, the reduction in 2-hr PG was significantly greater in the Study group (80.7 $\pm$ 63.0 vs. 38.7 $\pm$ 22.2 mg/dL; independent t = 2.18, p = 0.041).

Post-intervention absolute values trended lower in the Study group for both FBG (137.7 $\pm$ 32.7 vs. 178.5 $\pm$ 72.7 mg/dL, p = 0.090) and 2-hr PG (236.1 $\pm$ 73.5 vs. 295.6 $\pm$ 103.9 mg/dL, p = 0.119), though these between-group differences in final values did not reach statistical significance.

Feasibility: We approached 55 individuals; 21 were ineligible, 6 declined, and 4 were excluded for other reasons, leaving 24 participants enrolled and randomised (12 Study, 12 Control), a recruitment rate of 70.6% (24/34 eligible), below the 80% benchmark. All 24 participants (100%) consented. In the Study group, attendance was 97.2% (350/360 scheduled sessions; 4 participants attended all sessions, 6 missed 1 day, 2 missed 2 days); the Control group had no hospital visit requirement. There was no attrition (0/24), 100% intervention completion, and 100% outcome assessment completion – all exceeding benchmarks. No adverse events occurred, and all 12 Study group participants (100%) found the practice acceptable.(fig 3.)(fig 4.)

**Figure 3:** Mean reduction in FBG and 2-hr PG: Study vs Control group (error bars = SD; independent t -test).**Figure 4:** Individual patient FBG trajectories from pre- to post-treatment in the Study and Control groups, illustrating a steeper and more consistent decline in the Study group.

DISCUSSION

In this pilot randomized study, 30 days of supervised Uddiyana Bandha as an adjunct to standard oral hypoglycaemic therapy were associated with improvement in glycemic parameters among participants with T2DM. Both the Study and Control groups showed significant reductions in fasting blood glucose (FBG) and 2-hour post-load glucose (2-h PG). However, the reduction was greater in the Study group, with a 27.6% reduction in

FBG and a 24.1% reduction in 2-h PG. These findings suggest that UB may provide an additional short-term benefit when combined with routine pharmacological treatment. Because this was a small pilot study, the findings should be considered preliminary.

The observed improvement is generally consistent with previous studies reporting beneficial effects of yoga-based interventions on glycemic control in people with T2DM. Previous trials and reviews have reported reductions in fasting glucose and HbA1c following yoga interventions(8,9). However, most previous studies evaluated multicomponent yoga programs rather than a single practice. Therefore, the present findings provide preliminary evidence regarding Uddiyana Bandha specifically, but direct comparison with previous yoga studies should be interpreted cautiously.

The mechanism responsible for the observed improvement is not clear. Uddiyana Bandha involves abdominal retraction following expiration, breath retention, forceful exhalation, and abdominal contraction; it may trigger a reflex increase in vagal tone, leading to enhanced parasympathetic activity and improved cardiovascular regulation(7,10). A case series in patients with T2DM reported acute changes in fasting blood glucose and blood pressure following a 45-minute Uddiyana Bandha session. The authors proposed that abdominal contraction and changes in intra-abdominal pressure and visceral circulation may contribute to these responses(11). In the present study, repeated supervised practice for 30 days was associated with greater reductions in FBG and 2-h PG in the Study group compared with the Control group. However, the underlying mechanisms were not assessed and require further investigation.

The feasibility findings were favourable. The intervention showed high attendance, complete follow-up, high acceptability, and no adverse events during the study period. These findings suggest that a supervised 30-day Uddiyana Bandha program can be implemented in a clinical setting. However, recruitment did not reach the predefined target of 80%. This indicates that recruitment procedures and eligibility screening may need to be refined before conducting a larger trial. The high retention and acceptability observed in this study support the feasibility of continuing to evaluate the intervention in a larger sample.

This study has several strengths. It included a concurrent Control group, assessed both fasting and post-load glucose, used supervised intervention delivery, and prospectively assessed feasibility outcomes. However, several limitations should be considered. The sample size was small, with 12 participants in each

group, and the intervention lasted only 30 days. HbA1c was not assessed, so the longer-term effect on glycemic control could not be determined. Participants continued their usual oral hypoglycaemic medication; therefore, the findings relate to Uddiyana Bandha as an adjunctive intervention rather than a replacement for pharmacological treatment. In addition, the Study group received greater participant–researcher contact than the Control group, which may have influenced adherence or behavioural responses. Blinding was also not possible because of the nature of the intervention.

CONCLUSION

This pilot study demonstrates that Uddiyana Bandha is feasible, safe, and acceptable as an adjunct to standard oral hypoglycaemic therapy, and preliminary data suggest it may produce a significantly greater reduction in fasting and post-load glucose than medication alone. These findings support proceeding to a larger, adequately powered randomized controlled trial, with particular attention to strengthening recruitment strategy, given that all other pre-specified feasibility benchmarks were met or exceeded.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Grammarly for assistance with language and grammatical improvement. We thank the International Institute of Yoga and Naturopathy Medical Sciences for providing the support and facilities required to conduct this research. We also sincerely thank the AMO for their assistance with participant recruitment and coordination during the study.

REFERENCES

1. T. P., Subhashini, T., S. T. K., Sing, P., & D. A. (2025). Impact of multimodal lifestyle and pharmacological interventions on glycaemic control: A case report of type 2 diabetes mellitus. *International Journal of Yogic, Human Movement and Sports Sciences*, 10(2), 624–627. <https://doi.org/10.22271/yogic.2025.v10.i2i.1842>
2. Zheng, Y., Ley, S. H., & Hu, F. B. (2018). Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nature Reviews Endocrinology*, 14(2), 88–98. <https://doi.org/10.1038/nrendo.2017.151>
3. Galicia-Garcia, U., Benito-Vicente, A., Jebari, S., Larrea-Sebal, A., Siddiqi, H., Uribe, K. B., et al. (2020). Pathophysiology of type 2 diabetes mellitus. *International Journal of Molecular Sciences*, 21(17), 6275. <https://doi.org/10.3390/ijms21176275>
4. Raveendran, A. V., Deshpandae, A., & Joshi, S. R. (2018). Therapeutic role of yoga in type 2 diabetes. *Endocrinology and*

- Metabolism*, 33(3), 307. <https://doi.org/10.3803/EnM.2018.33.3.307>
5. Jyotsna, V. (2014). Prediabetes and type 2 diabetes mellitus: Evidence for effect of yoga. *Indian Journal of Endocrinology and Metabolism*, 18(6), 745. <https://doi.org/10.4103/2230-8210.141318>
 6. Nataesh, S. R., Akshayamini, T., Ragasudha, A., Mangaiarkarasi, N., & Mooventhan, A. (2025). Immediate effects of Uddiyana bandha on blood pressure and heart rate variability in healthy individuals: A randomized crossover study. *Journal of Bodywork and Movement Therapies*, 45, 262–268. <https://doi.org/10.1016/j.jbmt.2025.08.022>
 7. Naragatti, S., & H. S. V. (2024). Exploring the efficacy and mechanisms of Uddiyana Bandha in yoga practice: A scientific evidence-based comprehensive study. *International Journal of Science and Research*, 13(9), 975–979. <https://doi.org/10.21275/SR24916105420>
 8. Li, Y., Nie, L., & Li, M. A. (2026). Effect of yoga on glycemic control in adults with type 2 diabetes mellitus: A Bayesian three-level meta-analysis of randomized controlled trials. *Frontiers in Endocrinology*, 17. <https://doi.org/10.3389/fendo.2026.1889124>
 9. Hirosaki, M., Ohira, T., Wu, Y., Eguchi, E., Shirai, K., Imano, H., et al. (2023). Laughter yoga as an enjoyable therapeutic approach for glycemic control in individuals with type 2 diabetes: A randomized controlled trial. *Frontiers in Endocrinology*, 14. <https://doi.org/10.3389/fendo.2023.1148468>
 10. Govindasamy, K., Kaur, D., Elayaraja, M., Sethi, D., Kalidas, S., Karmakar, D., et al. (2026). Immediate effect of Uddiyana Bandha on heart rate variability in patients with hypertension: A randomised controlled study. *Annals of Neurosciences*, 33(3), 322–328. <https://doi.org/10.1177/09727531241299258>
 11. Abirami, M., Prasath, M. N., Poornima, R., Lakshmi, K. S., Kanimozhi, K. K., & Maheshkumar, K. (2024). Effect of Uddiyana Bandha in patients with type 2 diabetes mellitus: A case series. *International Research Journal of Ayurveda & Yoga*, 7(8), 43–46. <https://doi.org/10.48165/IRJAY.2024.70808>