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Original Article

Effects of Tanden Breathing on Constipation: A Randomized Controlled Trial

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Tanden breathing, an ancient health technique, involves expiratory abdominal pressure breathing is practiced in Japan. In this study we examined the ability of Tanden breathing to relieve constipation. The study was designed as a stratified-block randomized controlled trial enrolling 20 participants. Nineteen were female and one was male, none were elderly. During the 6-week intervention period, the participants performed video-guided Tanden breathing about 10 min once day. We evaluated constipation using the Constipation Assessment Scale (CAS). There were significant differences in the mean CAS score between time points (baseline, 3 weeks after baseline, 6 weeks after baseline), groups (intervention and control), and their interaction (time × group) using repeated-measures analysis of variance. The control group showed no change in the mean CAS score; the mean CAS scores of the intervention group changed from 7.2 at baseline to 3.9 at 3 weeks and 3.1 at 6 weeks after baseline. A regression analysis of the difference in the mean CAS between baseline and 6 weeks later showed that the CAS of the intervention group was 4.3 points lower than that of the control group (95% confidence interval, 2.5-6.1). The results suggested that Tanden breathing is effective in relieving constipation among young women.

Key words: Tanden breathing, Dantian, breathing exercises, constipation, mind–body therapy

Numerous traditional breathing techniques developed in Asia are thought to be beneficial for health. The Tanden breathing method has been handed down in various cultural arenas such as martial arts, meditation, healing, and the performing arts, and is practiced in Japan [1]. Along with relaxation and meditation, it involves expiratory abdominal pressure breathing, in which the upper abdomen is pulled in and the lower abdomen is pushed out during exhalation and abdominal pressure is applied [2]. The lower abdomen, which is called Tanden in Japanese and Dantian in Chinese, is traditionally regarded as the most important part of the body.

Previous studies on "breathing methods" in a broad sense have examined effects on health outcomes, such as heart rates, blood pressure, and post-traumatic stress disorder (PTSD) symptoms. They have also included randomized controlled trials (RCTs) [3-5] and a meta-analysis [6]. In contrast, scientific research on the Tanden method specifically is limited to a very few studies. One such report discussed the relationship between physiological status and clinical examinations during Tanden breathing [7]. Other case studies examined the use of the Tanden breathing method to improve constipation [8,9]. And at least two studies

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have considered the physiological effects of diaphragmatic breathing in general, including for the relief of constipation [10, 11].

In this RCT study, we focused on the impact of Tanden breathing on constipation symptoms as a specific health outcome that can be effectively evaluated across a limited intervention period [12] and can be expected to contribute to the quality of life (QOL) of patients.

According to the Ministry of Health, Labour and Welfare's "Comprehensive Survey of Living Conditions (FY2016)," the prevalence of people with constipation in Japan is reported to be approximately 2.5% for men and 4.6% for women. Applied to Japan as a whole, it can be estimated that approximately 4.5 million Japanese people experience subjective symptoms of constipation. According to the Japanese clinical practice guidelines, constipation is defined as "a condition in which a sufficient amount of feces that should be excreted from the body cannot be excreted comfortably" [13].

Constipation causes abdominal bloating and pain, and patients with chronic constipation have lower QOL than those without constipation/healthy individuals [14]. This decrease in QOL can lead to a decrease in social labor productivity [15], and with prolonged constipation, the stool becomes stiff, causing symptoms such as hemorrhoids and anal prolapse and other complications such as colon ulcers [16].

Constipation is a health factor that cannot be emphasized enough, especially in the elderly. As people age, constipation tends to occur more often because of various functional declines and lack of exercise associated with aging, as well as the increased use of medications such as iron supplementation and some blood pressure medications that have constipation as a side effect. Laxatives such as magnesium oxide are often prescribed as a treatment; however, hypermagnesemia can develop after long-term administration [17]. Thus, prevention and conservative treatment of constipation are especially important in Japan, where the population is aging. In this study, we examined the potential use of Tanden breathing to relieve constipation.

Materials and Methods

Study design. We investigated the effects of Tanden breathing on constipation using a stratified-block RCT for patients with constipation symptoms in Japan. There were two groups, an intervention and non-intervention (control) group, with an allocation ratio of 1 : 1.

Participants. We recruited participants via the Internet between April 16 and July 31, 2019. We obtained written consent to participate either face-to-face or via an online meeting. Because it was difficult to estimate the difference of the between-group effects required for sample size calculation from the findings of previous studies, we decided the number of participants with a feasibility analysis. All participants gave their written consent, met the inclusion criteria, and did not meet the exclusion criteria.

Participants were required to meet all of the following inclusion criteria: men and women aged 20-80 years at the time of granting consent; constipation symptoms in the month before granting consent; and a score of ≥ 5 on the Japanese version of the Constipation Assessment Scale Version 2–Middle Term (CAS–MT) [18-21]. The age range of 20-80 years was considered suitable for participants to undergo training in Tanden breathing. The exclusion criteria were as follows: pregnancy or possible pregnancy; a habit of performing any type of breathing exercise; and deemed unsuitable as participants by the researcher for other reasons.

Intervention program and Tanden breathing. In this study, we defined Tanden breathing as "including the three elements of relaxation, meditation, and expiratory abdominal pressure breathing" based on the definitions in previous studies [1, 22]. Expiratory abdominal pressure breathing is the same as reverse abdominal breathing, in which the upper abdomen is pulled in and the lower abdomen is pushed out during exhalation and abdominal pressure is applied.

We developed a 10-min video program for participants to watch when performing Tanden breathing by themselves. We considered the following Tanden breathing components essential: three exhalations and one inhalation, waving respiration, and swinging respiration [8, 9] (see details in Table 1).

For the intervention group, we explained the implementation method and precautions using a 30-min video the day before the intervention began. During the 6-week intervention period, this group performed Tanden breathing once a day for approximately 10 min with the video program by themselves. After the intervention period ended, we provided the control group the opportunity to use the video for training in guided

Table 1 Contents of the Tanden Breathing Program

1. Relaxed respiration (beginning)
2. Calming
3. Relaxed respiration (also perform at the end of each breath in Steps 4-7)
4. 3 exhalations, 1 inhalation
5. Waving respiration (Short respiration)
6. Waving respiration (Long respiration)
7. Swinging respiration
8. Introspection
9. Relaxed respiration (ending)

Tanden breathing.

Measurements. To evaluate relief of constipation, we used the CAS–MT, for which validity and reliability have been previously confirmed [18-21]. The CAS is a self-administered questionnaire with a total of 16 points (range, 0-16 points) consisting of 8 items on the state of constipation symptoms during the past week using a 3-point Likert scale. A higher score means stronger symptoms; scores ≥ 5 are defined as indicative of problematic constipation. The questionnaire items concerned eight symptoms as follows: abdominal distension or bloating; amount of flatulence; number of defecations; rectal fullness or pressure; anal pain during defecation; volume of stool; stool excretion status; and diarrhea or liquid stool.

Both participant groups completed the questionnaires at baseline, 3 weeks after baseline, and 6 weeks after baseline. Demographic variables such as age, sex, height and weight, and previous experience using Tanden breathing were collected at baseline. We calculated body mass index (BMI) from height and weight. We collected the completed questionnaires either by hand or by e-mail attachment.

Randomization. We performed randomization using stratified-block allocation, stratifying by age (22-44 years, 45-64 years, and 65-79 years) and experience with Tanden breathing (experienced or not). We randomly selected block sizes from 2 and 4 to create an allocation table. The researcher in charge performed the allocation and managed the storage of the table; allocation was assigned to each group in the order of registration according to the table. The order of allocation and the block size were concealed from the researchers, except those with the responsibility for allocation. Blinding of the participants was not possible because of the nature of the intervention.

Statistical analysis. We conducted a descriptive analysis of the background of participants and analyzed the mean difference in the CAS score at each time point for both groups. We used repeated-measures analysis of variance to test for significant differences in the mean CAS scores at each time point (time effect) and in each group (group effect). In addition, we tested the interaction effect (time × group). All p values were two-sided, and p values < 0.05 were considered statistically significant.

We compared the mean CAS scores of the intervention group with those of the control group between baseline and 6 weeks after baseline using regression analysis. Furthermore, we adjusted for experience with Tanden breathing and the combination of this experience and BMI.

We performed an intention-to-treat analysis, using EZR 1.41 (Saitama Medical Center, Jichi Medical University, Saitama, Japan) and a graphic user interface for R 3.6.1 (R Foundation for Statistical Computing, Vienna, Austria) [23].

Ethical considerations. This trial was reported according to the "CONSORT 2010 Statement" [24] and was conducted in compliance with the Declaration of Helsinki and the "Ethical Guidelines for Medical and Health Research Involving Human Subjects." In addition, this study was approved by the Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences and the Okayama University Hospital Ethics Committee (R1902-003) and was registered with the University Hospital Medical Information Network (000035662).

Results

Participant recruitment flow. The recruitment period was from April to July 2019. A total of 21 participants met the eligibility criteria, 10 in the intervention group and 11 in the control group. One participant in the intervention group later dropped out of the study after allocation because of personal reasons. We followed the remaining participants during the 6-week intervention period, performing the analysis with 20 participants (9 in the intervention group and 11 in the non-intervention control group), and no participants were excluded from the analysis (Fig. 1).

Participant demographics. Table 2 shows sex, experience with Tanden breathing, age, and BMI at

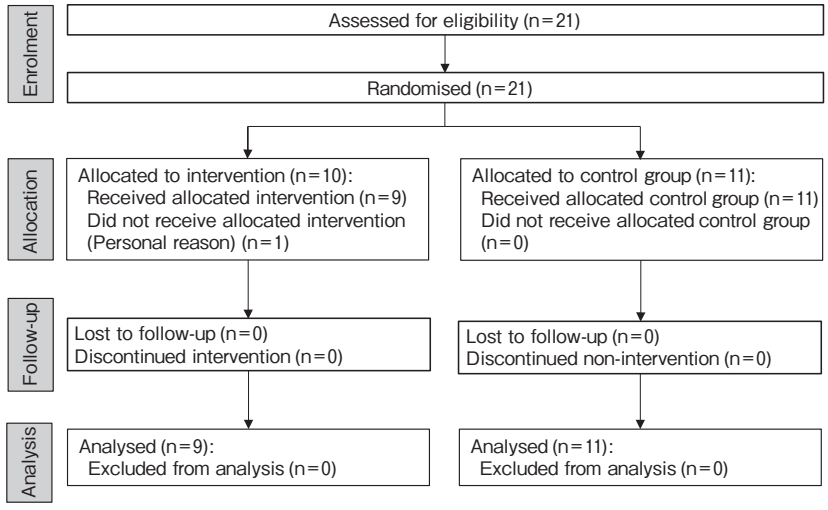

Fig. 1 Participant recruitment flow.

Table 2 Description of participant backgrounds

Characteristics	Intervention Group ($n=9$)	Control Group ($n=11$)
Sex, *n* (%)		
Female	9 (100)	10 (91)
Male	0 (0)	1 (9)
Experience, *n* (%)		
Yes	2 (22)	4 (36)
No	7 (78)	7 (64)
Age (years)		
Mean ± *SD*	34.8 ± 6.8	37.2 ± 3.9
20–44	8 (89)	10 (91)
45–64	1 (11)	1 (9)
BMI (kg/m^2)		
Mean ± *SD*	20.7 ± 2.0	22.8 ± 3.4
Number of sessions		
Mean ± *SD*	29.2 ± 8.1	N/A

SD, standard deviation.

baseline for both groups, as well as the number of days Tanden breathing was performed for the intervention group. All participants were younger than 65 years, and all but one participant was female. However, we observed no clear differences in patient characteristics between the two groups. Only one person in each group reported taking laxatives, so there was also no significant intergroup difference in laxative use.

Problematic constipation and the mean CAS scores. In the control group, 2 participants' problematic constipation (both scoring 4 points on the CAS at baseline) showed improvement at 3 weeks after baseline. However, at 6 weeks, no participants showed improvement in problematic constipation. In contrast, in the intervention group, 5 participants reported that their problematic constipation improved at 3 weeks after baseline, and 8 reported an improvement at 6 weeks. Table 3 shows the significant differences in time effect (each time point), group effect (between groups), and

Table 3 Intergroup analysis of CAS scores

	Intervention Group ($n=9$)			Control Group ($n=11$)			Time Effect	Interaction Effect	Group Effect
	Baseline	3 weeks after baseline	6 weeks after baseline	Baseline	3 weeks after baseline	6 weeks after baseline	*p* value		
CAS score	7.2 ± 1.9	3.9 ± 1.8	3.1 ± 1.8	7.2 ± 2.1	7.5 ± 2.5	7.4 ± 2.1	$p<0.01$	$p<0.01$	$p<0.01$

Values expressed with a plus/minus sign are the mean ± standard deviation. All *p* values were estimated by repeated-measures analysis of variance. CAS, Constipation Assessment Scale.

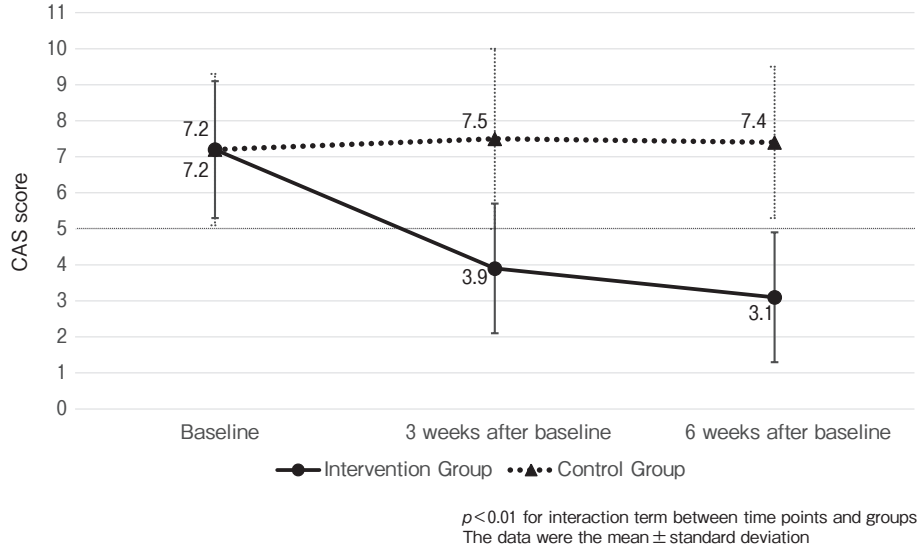

Fig. 2 Transition chart of the mean Constipation Assessment Scale (CAS) scores.

interaction effect (time × group).

Figure 2 shows the changes in the mean CAS scores. The mean CAS scores of the control group changed slightly from the baseline, but those of the intervention group changed from 7.2 at baseline to 3.9 at 3 weeks and 3.1 at 6 weeks, showing a remarkable intergroup difference.

Figure 3 shows the transition of the CAS score of each participant in the control group. Figure 4 shows the transition of the CAS score of each participant in the intervention group.

Differences in the mean CAS scores. Table 4 shows the results of regression analysis of the differences in the mean CAS scores between baseline and 6 weeks after baseline. The intervention group scored 4.3 points lower than the waiting control group, and their symptoms improved significantly. In addition, the table shows the results after adjusting for experience with Tanden breathing and for both experience and BMI. We observed similar point estimates even after these adjustments.

In addition, when the difference in the CAS score between baseline and 6 weeks after baseline was calculated for each question, the item for number of defecations showed the greatest difference in the intervention group (Table 5).

Side-effects and adverse events. We observed no adverse events in the study participants in either group.

Discussion

The results of this study suggest that Tanden breathing is effective for relieving constipation among young women in the short term. We observed a remarkable difference between the intervention and control groups at 3 weeks after baseline, and a lesser but still significant difference at 6 weeks after baseline.

In addition, no deleterious effects of Tanden breathing were observed in any of the participants, and the intervention group experienced significant constipation relief. Thus, we consider this intervention to be beneficial. However, the number of participants was not large, and further verification of these results is required.

Tanden breathing is a type of diaphragmatic (abdominal) breathing. Previous studies have mentioned various physiological effects of diaphragmatic breathing, including constipation relief [10,11]. This breathing has been shown to affect the human body, including the gastrointestinal system, through regulation of the autonomic nervous system function [25,26]. Tanden breathing may also relieve constipation through its effects on the autonomic nervous system.

In addition, abdominal massage has been shown to relieve constipation [27,28]. Since Tanden breathing participants move their abdomens, it is possible that the movement of the colon helps relieve their constipation.

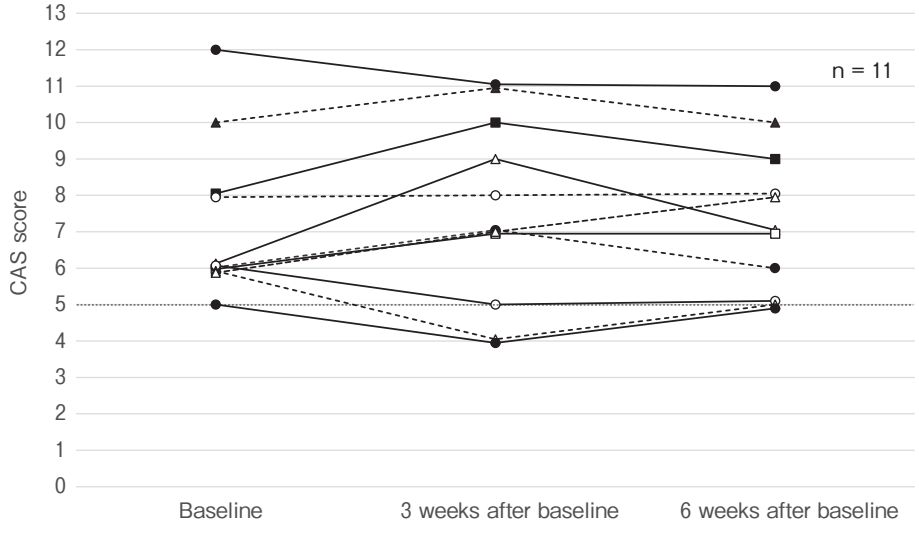

Fig. 3 Transition chart of the Constipation Assessment Scale (CAS) scores of each participant in the control group.

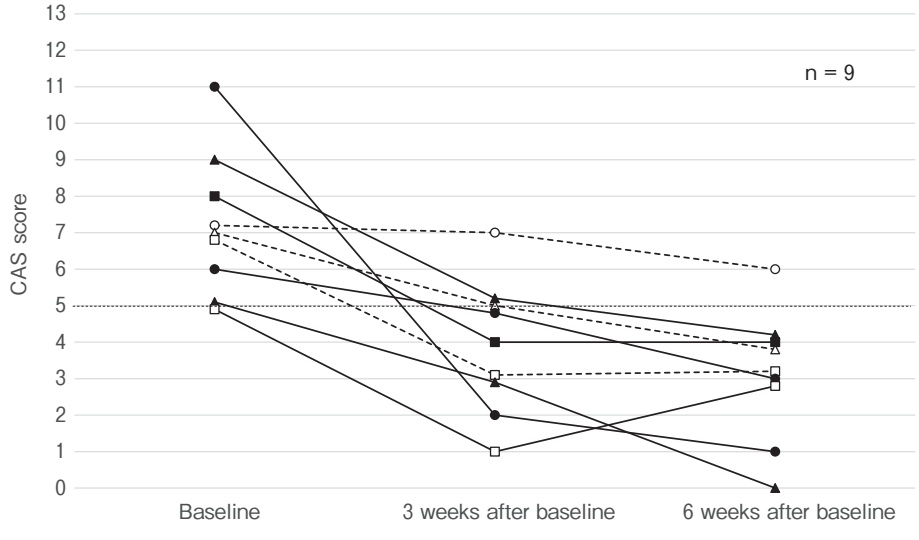

Fig. 4 Transition chart of the Constipation Assessment Scale (CAS) scores of each participant in the intervention group.

Table 4 Intergroup differences in the mean CAS scores between baseline and 6 weeks after baseline

	Mean difference (95%CI)
Crude	−4.3 (−6.1 to −2.5)
Adjusted for experience	−4.4 (−6.2 to −2.7)
Adjusted for experience and BMI	−4.6 (−6.7 to −2.5)

Mean differences were estimated by regression analysis. CAS, Constipation Assessment Scale; CI, confidence interval; BMI, body mass index.

Strengths of this study included its RCT design, which allowed us to deal with unmeasured confounders, such as laxative use, and obtain high internal validity. Our study thus provides an important foundation for future assessments of the health effects of Tanden breathing. In addition, we developed a practical, 10- min video that serves to clarify the definition of Tanden breathing, which had not been well established previously.

This study has several limitations. First, external

Table 5 The sum of differences in the CAS score between baseline and 6 weeks after baseline for each questionnaire item

Question items	Sum of differences[a]	
	Intervention Group ($n=9$)	Control Group ($n=11$)
1. Abdominal distension or bloating	−6	1
2. Amount of flatulence	−1	−2
3. Number of defecations	−9	0
4. Rectal fullness or pressure	−5	1
5. Anal pain during defecation	−3	−2
6. Volume of stool	−4	1
7. Stool excretion status	−7	1
8. Diarrhea or Liquid stool	−2	2

[a]Sum of differences in each group was calculated using the following formula:

$$\sum_{i=1}^{n} [(\textit{The CAS score at 6 weeks after baseline})_i - (\textit{The CAS score at baseline})_i]$$

validity is limited because all but one participant was female, and none were elderly. Therefore, it is necessary to conduct additional studies including men and older participants. Second, blinding was not conducted because of the nature of the intervention, so the improvement effect may have been overestimated. In future studies, as a countermeasure, using a breathing method similar to Tanden breathing for the control group would allow for blinding. For example, yoga breathing is similar to Tanden breathing and has been evaluated scientifically in previous studies such as that by Cramer *et al.* [29]. To show that Tanden breathing has health benefits, it is necessary to evaluate the similarities and differences between health methods. Third, we could not measure the degree of the sustained intervention effect; future studies must extend our findings into the long term. Because we observed constipation relief 3-6 weeks after the intervention, it is necessary to extend the intervention period to >6 weeks. Fourth, there are some concerns about possible bias because participants self-reported their effects and they were not blinded.

In conclusion, we evaluated the effect of Tanden breathing on constipation. It was suggested that Tanden breathing, a simple method of self-care, is effective in relieving constipation among young women in the short term. However, caution is required because our results do not guarantee the effectiveness of intervention for broader health outcomes. In the future, other potential health outcomes of Tanden breathing should be similarly evaluated in randomized controlled trials.

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