

Review Article

Effect of Kegel Exercises on the Management of Female Stress Urinary Incontinence: A Systematic Review of Randomized Controlled Trials

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Objective. The purpose of this study was to evaluate the effect of Kegel exercises on reducing urinary incontinence symptoms in women with stress urinary incontinence. **Methods.** Randomized controlled trials (RCTs) were conducted on females with stress urinary incontinence who had done Kegel exercises and met inclusion criteria in articles published between 1966 and 2012. The articles from periodicals indexed in KoreaMed, NDSL, Ovid Medline, Embase, Scopus, and other databases were selected, using key terms such as “Kegel” or “pelvic floor exercise.” Cochrane’s risk of bias was applied to assess the internal validity of the RCTs. Eleven selected studies were analyzed by meta-analysis using RevMan 5.1. **Results.** Eleven trials involving 510 women met the inclusion criteria. All trials contributed data to one or more of the main or secondary outcomes. They indicated that Kegel exercises significantly reduced the urinary incontinence symptoms of female stress urinary incontinence. There was no heterogeneity in the selected studies except the standardized bladder volumes of the pad test. **Conclusion.** There is some evidence that, for women with stress urinary incontinence, Kegel exercises may help manage urinary incontinence. However, while these results are helpful for understanding how to treat or cure stress urinary incontinence, further research is still required.

1. Introduction

Stress urinary incontinence (SUI), defined as “the complaint of involuntary leakage of urine on effort, exertion, sneezing, or coughing” by the International Continence Society [1], is the most common type of urinary incontinence in women. Although it is not a life-threatening condition [2], SUI affects the quality of women’s lives in many ways and may limit women’s social and personal relationships, as well as limiting physical activity [3]. Much has been written about the prevalence of stress urinary incontinence, which affects up to 40% of community-dwelling women living in the Western world. Furthermore, its prevalence is increasing due to an aging society [4], but only a quarter of all women with this problem seek medical support [3, 5].

Although surgical treatment is the more effective treatment for SUI, conservative treatment is now recommended

as first-line treatment in elderly women or those with mild symptoms [6]. Conservative treatments, a nonsurgical therapy, include improving the lifestyle, bladder training, pelvic floor muscle exercises, biofeedback, and the electrical stimulation of pelvic muscles [7]. Kegel exercises are the most popular method of reinforcing pelvic floor muscles and are noninvasive treatment such that they do not involve the placement of any vaginal weights/cones. They were first described in 1948 by the American gynecologist Anold Kegel. They are the most cost-effective treatment and differ from other therapies in that the patients can do them by themselves anytime, anywhere, while doing other work, and without regular hospital visits. The patients simply need to be trained in how to contract their pelvic floor muscles. Most studies show that Kegel exercises steadily reinforce the pelvic muscles [8]. However, in practice the results of patients vary depending on whether they exercise their pelvic floor muscles

after identifying them, how earnestly they exercise, and how much trust they place in the exercises themselves. Hence, these study results need to be critically evaluated with respect to actual practice [9]. Also, several studies have reported systematic reviews on pelvic floor muscles exercises but have covered the female urinary incontinence with stress, urge, and mixed UI or have dealt with all nonsurgical treatment including drugs [8, 10–12].

Therefore, the effects of Kegel exercises on urinary incontinence will be verified through a systematic review of the results of the randomized controlled trials (RCTs) in the literature, forming a basis for the suggestion that Kegel exercises are an economic intervention which can be understood and performed by both patients and nurses alike.

2. Methods

This study was conducted according to the Cochrane Handbook for Systematic Reviews of Interventions [13] and the statement by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMA) group [14].

2.1. Eligibility Criteria for Review

- (i) Participants: women with SUI.
- (ii) Interventions: Kegel exercises being defined as a program of repeated voluntary pelvic floor muscle contractions taught and supervised by a health care professional.
- (iii) Comparators: no treatment or routine care cases, such as advice and instruction being offered on the use of the continence guard.
- (iv) Outcomes: patient self-reported cure or improvement, urinary incontinence symptoms from recommended questionnaires, urinary incontinence episodes over 7 days, the pad test (1-hour pad test, standardized bladder volume on pad test), and pelvic floor muscle pressure.
- (v) Type of studies: only randomized controlled trials being included.

2.2. Data Sources and Study Selection. KoreaMed, National Discovery for Science Leaders (NDSL), Ovid Medline, Embase, and Scopus were used as the main search databases, and the websites of the Korean Urological Association, Korean Continence Society, Korean Society of Obstetrics and Gynecology, Korean Society of Nursing Science, Korean Society of Women Health Nursing, and Korean Society of Adult Nursing were searched to include all Korean academic journals dealing with associated fields. The search date was April 2012.

Among the references searched, randomized control trials on female urinary incontinence patients undergoing Kegel exercises as the main intervention that report one or more major or secondary results were selected. Excluded were studies combining Kegel exercises with biofeedback or electrical stimulation therapy and those not published in either English or Korean.

After removing overlapping references from the primary search, papers were selected to match the inclusion and exclusion criteria. The first round of selection was based first on the title and abstract of each reference and the second on a more in-depth analysis. The reference selection process was first independently performed, and then a discussion was to be conducted in case of disagreement, and the third party intervention principle was applied if necessary. However, no disagreement occurred.

2.3. Risk of Bias in Included Studies. The methodological quality of selected studies was analyzed by two review authors independently using risk of bias (RoB) tool developed by Cochrane Collaboration. Disagreements were resolved by discussion and consensus.

2.4. Data Extraction and Analysis. Relevant data, such as the subject inclusion or exclusion criteria, baseline demographic and clinical characteristics of the study participants, treatment protocols, the follow-up period, and the outcome variables of each study, were consolidated using a standardized form. The magnitudes of the effects of Kegel exercises were calculated using the pooled relative risk (RR) for dichotomous outcome data and the mean difference (MD) and the standardized mean difference (SMD) for continuous outcome data with 95% confidence intervals (CIs) using the Mantel-Haenszel test. The selected eleven studies were analyzed using Review Manager (RevMan) version 5.1. For all statistical comparisons, differences with a $P < 0.05$ were considered significant. The I -squared (I^2) test was used to identify heterogeneity, and the chi-squared (χ^2) test was used to detect statistical heterogeneity. When heterogeneity was present ($P < 0.1$), the data were analyzed using the random effect model. In the absence of heterogeneity, a fixed effect model was applied. I^2 ranges from 0% to 100%. Here, values between 0% and 40% can be interpreted as unimportant heterogeneity, up to 60% as moderate heterogeneity, and over 60% as considerable heterogeneity [13].

3. Results

3.1. Characteristics of Included Studies. A total of 562 candidate papers were obtained through electronic reference searches, and 436 remained after excluding 126 overlapping ones. After exclusion of papers according to the inclusion and exclusion criteria by titles and abstracts, 41 papers remained and from those 11 were finally selected, leaving a total of 510 subjects. The detailed reference selection process is presented in the flow chart (Figure 1).

Kegel exercises have been regularly studied from 1989 to 2012 by 11 selected references. They were most actively studied in Europe in the 1990s and in Brazil since 2007, not to mention two Korean studies, indicating a worldwide interest in Kegel exercises as a nursing intervention. The general age of the subjects was 40s to 50s in seven papers and 60s and over in four papers. There were 510 subjects in total, all of whom were middle-aged women of 40 and over exhibiting SUI and the studies themselves were relatively small scale, involving between 20 and 82 subjects each. The Kegel exercises were

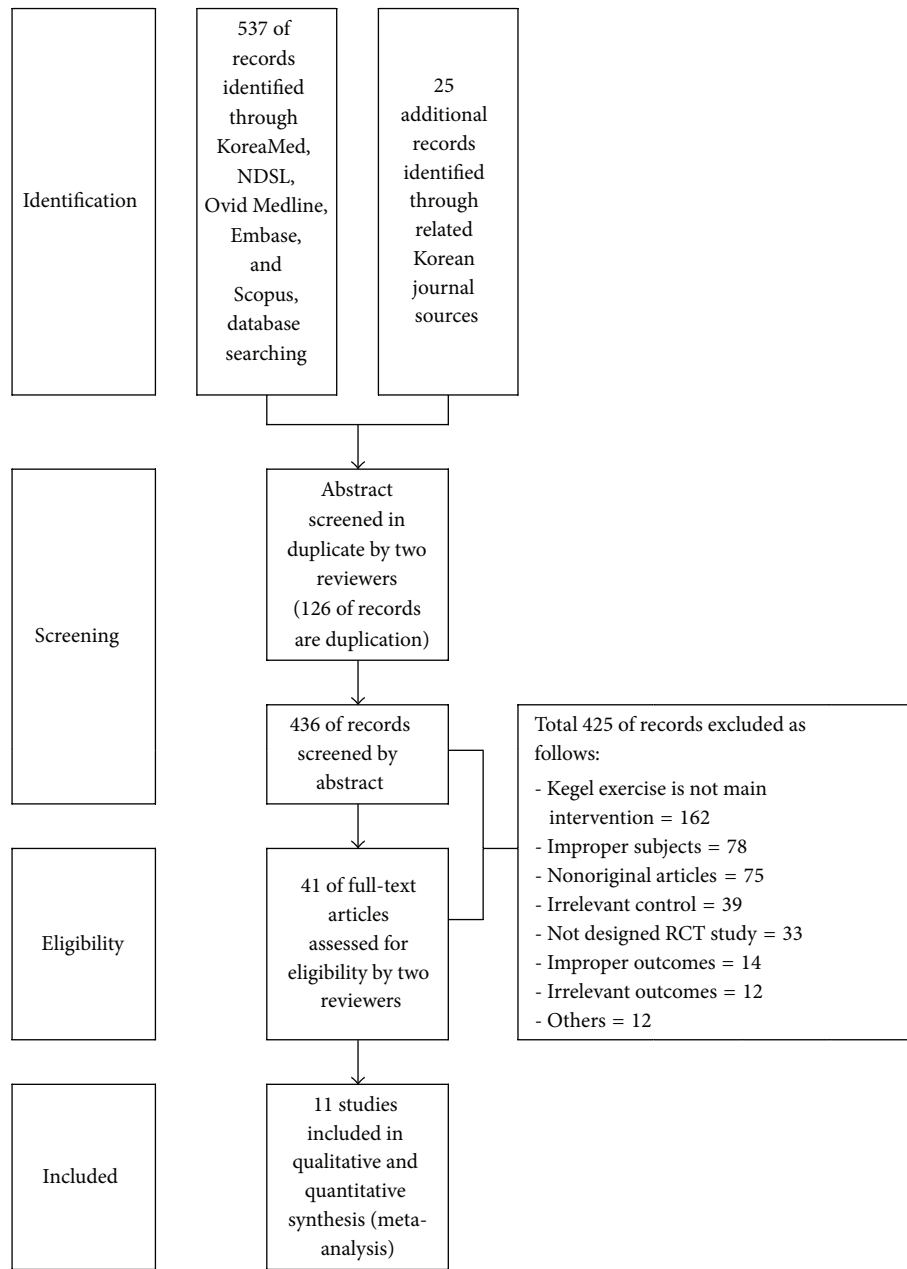


FIGURE 1: Flow diagram of studies selection.

mainly taught by professional physical therapists and varied by the number of contractions, five to six, and the number of times a day, 24 to 100. Other variations involved elevation of the intensity of the contraction. The followups were mostly done within three months, and only one study [15] showed a drop-out rate of less than 20% during the follow-up period (Table 1).

3.2. *Assessing Risk of Bias.* Eight of the eleven selected studies satisfied all assessment items (Figure 2) and three [16–18] were sufficient for appropriate random sequence generation but did not adequately describe allocation concealment.

The blinding of intervention and outcomes were unsatisfactory in five studies [15–19].

3.3. *Effects of Kegel Exercises*

3.3.1. *Subjective Assessment of Improvement in SUI.* Although various difference scales were used to measure patient responses to treatment in the selected studies, whatever the scale was, the data was included in the formal comparisons as long as the trials stated the number of women who perceived that they have been cured or improved, as defined by the trials. Subjective assessments of improvements in

TABLE 1: Characteristics of the selected studies.

Year	Study	Location	Group		Interventions	Dropout <i>n</i> , (%)	Followup	Outcomes
			(<i>n</i> /mean age (yr)) Exp.	Con.				
2012	Pereira et al. [23]	Brazil	15 63.0 ± 10.7	15 62.9 ± 9.2	Kegel exercises: individual training; totally 12 sessions, twice-weekly session of 40 minutes each. Each session 100 contractions held for 3 seconds with 6 seconds of rest; carried out in the supine, sitting, and standing positions. Control: no treatment	No	6 weeks	(i) UI symptoms by KHO (ii) 1-hour pad test (iii) Pelvic floor muscle pressure
2011	Pereira et al. [22]	Brazil	15 60.2 ± 8.2	15 61.5 ± 10.1	Kegel exercises: group training; as above Control: no treatment	4 (14.2)	6 weeks	(i) UI symptoms by KHO (ii) 1-hour pad test (iii) Pelvic floor muscle pressure
2009	Lee et al. [16]	Korea	10 73.1 ± .1	10 71.8 ± 3.2	Kegel exercises: physiotherapist trained; twice a week for 50 minutes, 2 sets of 10–15 contractions a day. Control: usual care (education)	3 (12.0)	8 weeks	(i) UI symptoms by BFLUTS (ii) Pelvic floor muscle pressure
2008	Castro et al. [24]	Brazil	26 56.2 ± 12.5	24 52.6 ± 11.2	Kegel exercises: 10 repetitions of 5-second contractions with 5 seconds of recovery time; 20 repetitions of 1-second contractions and recovery; 5 repetitions of 10-second contractions and recovery; all the sessions were held in groups for 45 minutes. Control: no treatment	11 (18.0)	6 months	(i) UI episode for 7 days (ii) Standardized bladder volume on pad test
2007	Konstantinidou et al. [15]	Greece	10 47.8 ± 7.5	12 47.8 ± 7.5	Kegel exercises: 1-hour demonstration program; 3 sets of fast contractions and 3-4 sets of slow contractions daily lying, sitting, and standing positions. Control: usual care	8 (26.6)	12 weeks	(i) UI episode for 7 days

TABLE 1: Continued.

Year	Study	Location	Group (n/mean age (yr)) Exp. Con.	Interventions	Dropout n, (%)	Followup	Outcomes
2007	Zanetti et al. [25]	Brazil	23 56 (med)	21 54 (med)	No	3 months	(i) 1-hour pad test
				Kegel exercises: physiotherapist trained; twice a week, for 45 minutes; 10 repetitions of 5-second held contractions with 5 seconds of recovery; 20 repetitions of 1-second contractions and recovery; 5 repetitions of 10 seconds of contractions and recovery followed by 5 repetitions of strong contractions together with a cough, with one-minute intervals between each set. Control: usual care (unsupervised)			
2000	Sung et al. [17]	Korea	30	30	No	6 weeks	(i) UI episode for 7 days (ii) Pelvic floor muscle pressure
				Kegel exercises: exercise video tape; intensively programmed PFM exercise, which was developed by Bø et al. [20] Control: no treatment			
1999	Bø et al. [20]	Norway	25 49.5 ± 10.0	30 51.7 ± 8.8	6 (9.8)	6 months	(i) Subjective assessment of improvement in SUI (ii) UI episode for 7 days (iii) Standardized bladder volume on pad test (iv) Pelvic floor muscle pressure
				Kegel exercises: physical therapist group training; 3 times a day at home, 8–12 high intensity contractions, with holding periods of 6–8 seconds in lying, standing, kneeling, and sitting positions and also additional training in groups once a week for 45 minutes Control: no contact during intervention			
1993	Burns et al. [21]	USA	43 63.0 ± 6.0	39 63.0 ± 5.0	1 (1.2)	3–6 months	(i) Subjective assessment of improvement in SUI
				Kegel exercises: 12-minute video tape; 4 sets of 20 (10 quick and 10 sustained) and increased by 10 per set over 4 weeks until daily maximum 200 exercises Control: no treatment			
1991	Lagro-Janssen et al. [19]	Netherlands	33 46.1 ± 10.1	33 44.6 ± 8.2	No	3 months	(i) Subjective assessment of improvement in SUI (ii) UI episode for 7 days
				Kegel exercises: general practitioner researcher taught; squeeze pelvic muscle for 6 seconds, performed 5–10 sessions of 10 pelvic muscle contractions each day. Control: no treatment			
1989	Henalla et al. [18]	United Kingdom	26	25	No	3 months	(i) Subjective assessment of improvement in SUI
				Kegel exercises: physiotherapist trained; 5 seconds and repeat manoeuvre 5 times every hour. Control: no treatment			

Exp., experimental group; Con., control group; UI, urinary incontinence; KHO, King's health questionnaire; BFLUTS, Bristol female lower urinary tract symptoms questionnaire; SUI, stress urinary incontinence.

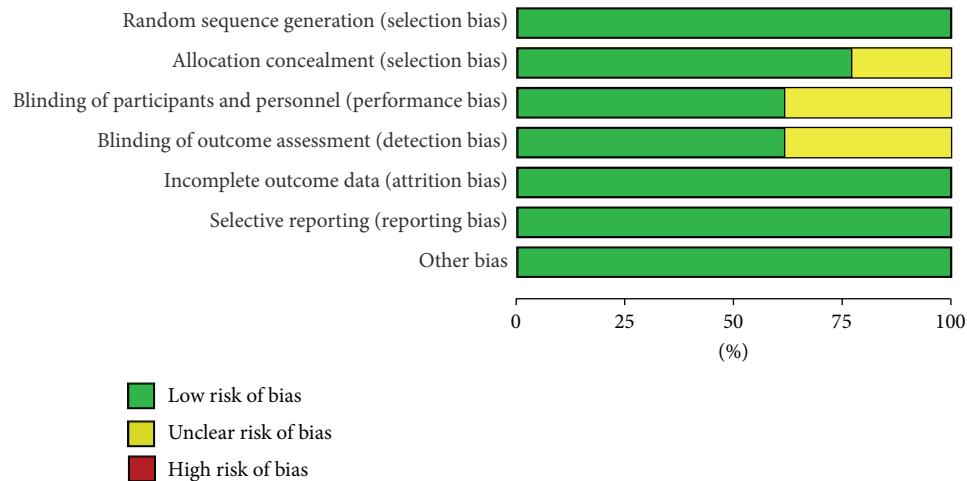


FIGURE 2: Risk of bias graph.

SUI were measured in four studies [18–21]. As the relative risk was 26.09 (95% confidence interval, 8.50 to 80.11), each Kegel exercise group showed more perceived symptoms of urinary incontinence than their respective control group. Thus, there was a statistically significant difference between the Kegel exercise group and the control group and there was insubstantial heterogeneity ($I^2 = 0.0\%$, $P = 0.540$) in the measured studies (Figure 3(a)).

3.3.2. Incontinence Impact by Recommended Questionnaire. Urinary incontinence symptoms were measured by a questionnaire in three studies [16, 22, 23]. In these studies, the symptoms were significantly lower in the Kegel exercise groups than in the control group (SMD -1.35 , 95% confidence interval, -1.84 to -0.85 ; $Z = 5.33$, $P < 0.001$) and there was no heterogeneity ($I^2 = 0.0\%$, $P = 0.710$) (Figure 3(b)).

3.3.3. Urinary Incontinence Episode for 7 Days. Three studies measured urinary incontinence episodes for 7 days [15, 19, 24] through patient self-reported urinary diaries. Kegel exercises reduced urinary incontinence episodes with a standardized mean difference (SMD) of 1.52 (95% confidence interval, -1.90 to -1.13) for 7 days. The effect size of the two groups was statistically significant ($Z = 7.74$, $P < 0.001$), and there was no heterogeneity ($I^2 = 0.0\%$, $P = 0.370$) (Figure 3(c)).

3.3.4. Pad Test. Pad tests were conducted in five studies by two different methods. One used a 1-hour pad test, presenting results as mean urine loss volumes (g), and another used a standardized bladder volume and the third used mean pad weight.

Three studies measured mean urine loss volumes [22, 23, 25]. Kegel exercise groups had an MD of 3.27 g (95% confidence interval, -5.04 to -1.50) less urine loss than controls statistically ($Z = 3.62$, $P = 0.0003$) and exhibited no heterogeneity ($I^2 = 0.0\%$, $P = 0.920$) (Figure 3(d)). One study [20] reported only the mean but found that women doing Kegel exercises reported a mean pad weight increase of 3.2 g less than controls (15.0 g) with a statistical significance

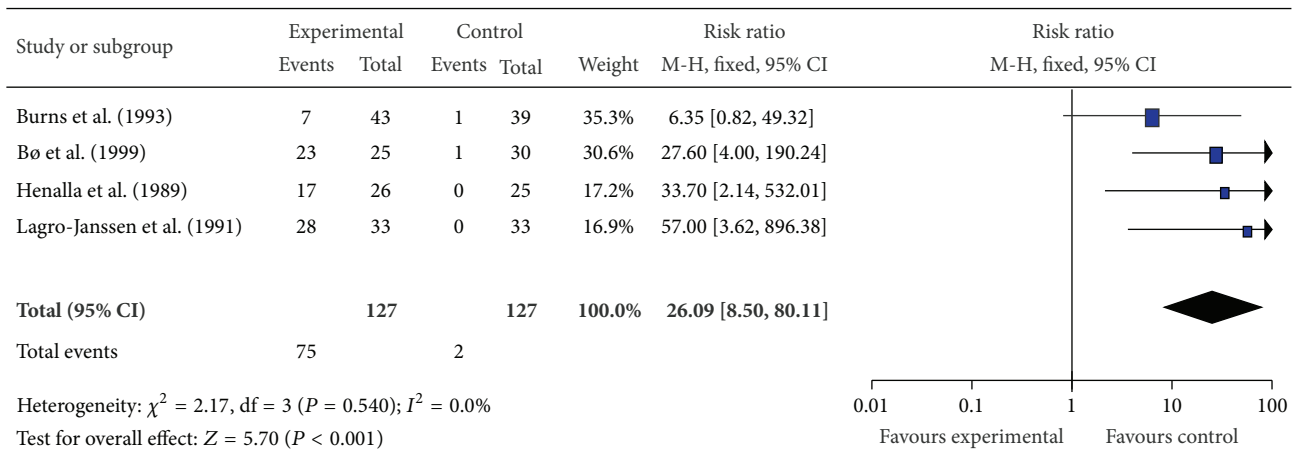
of $P = 0.002$. The studies using standardized bladder volumes [15, 19] reported significantly lower ones in the Kegel exercise group than the control (MD -21.49 , 95% confidence interval, -38.84 to -4.15 ; $Z = 2.43$, $P = 0.020$) but heterogeneity was high ($I^2 = 91.0\%$, $P = 0.001$) (Figure 3(e)).

3.3.5. Pelvic Floor Muscle Pressure. Pelvic floor muscle pressure was measured in five studies [16, 17, 20, 22, 23] by using perineometer. Pelvic floor muscle pressures were improved after Kegel exercises with a standardized mean difference (SMD) of 1.06 (95% confidence interval, 0.76 to 1.37), showing statistical significance ($Z = 6.81$, $P < 0.001$) and low heterogeneity ($I^2 = 36.0\%$, $P = 0.180$) (Figure 3(f)).

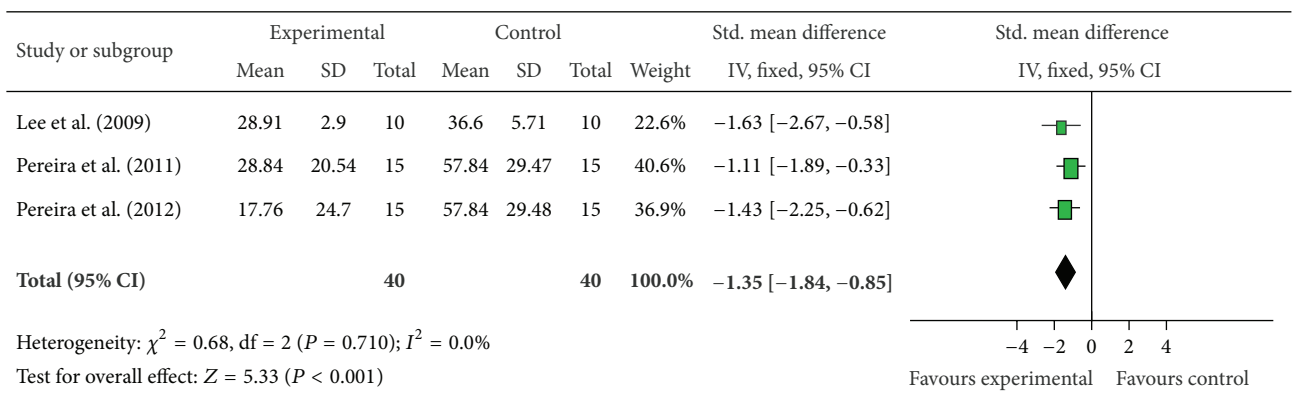
4. Discussion

This study was a meta-analysis of the effects of Kegel exercises on SUI as a nursing intervention through the systematic consideration of the characteristics and methods of Kegel exercises of a total of 510 subjects over 11 RCT studies. The references analyzed in this study were determined considering the following. First, many studies of urinary incontinence have analyzed the effects of applying biofeedback or electrical stimulation together with Kegel exercises or the use of vaginal cones, but this paper analyzed only studies of Kegel exercises without the use of other equipment or devices to provide insight into independent nursing intervention. Furthermore, in order to draw reliable conclusions only randomized controlled trials with high levels of evidence were analyzed.

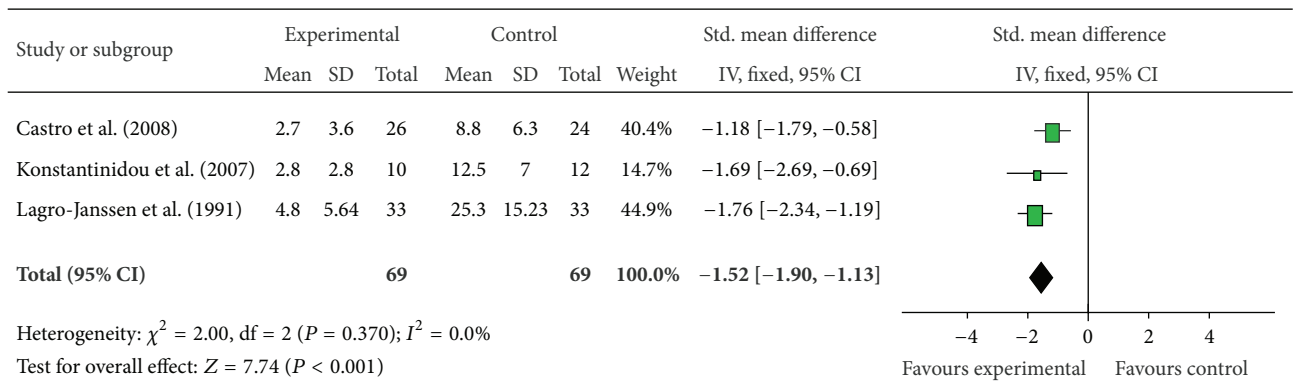
Kegel exercises were originally devised by Dr. Arnold Kegel in 1948 to prevent urinary incontinence in postpartum women [26] and they are one of the safest behavioral therapies without side effects [27] and complications. It treats urinary incontinence symptoms by reinforcing weakened pelvic floor muscle and improving elasticity. The Kegel exercise models analyzed were within the recommended parameters of the International Continence Society [28], although there were differences between the papers in terms of the method of muscle contraction and relaxation, the frequency of exercises,



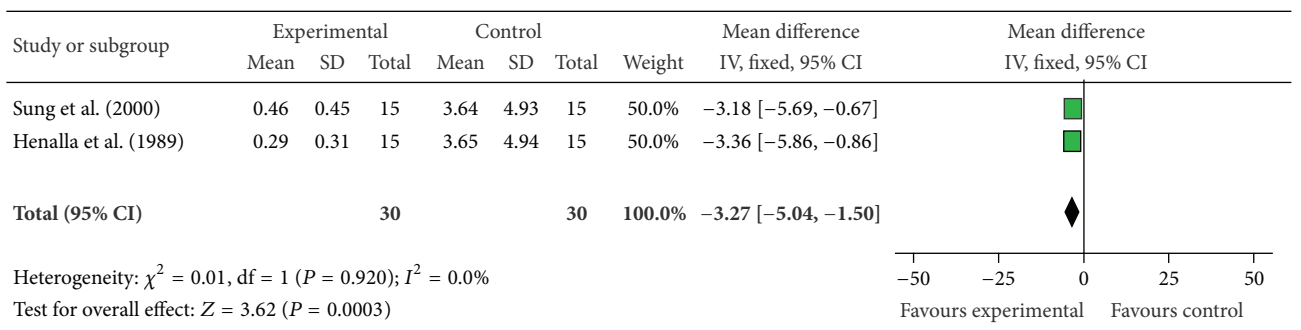
(a) Subjective assessment of improvement in stress urinary incontinence



(b) Urinary incontinence symptoms by recommended questionnaire

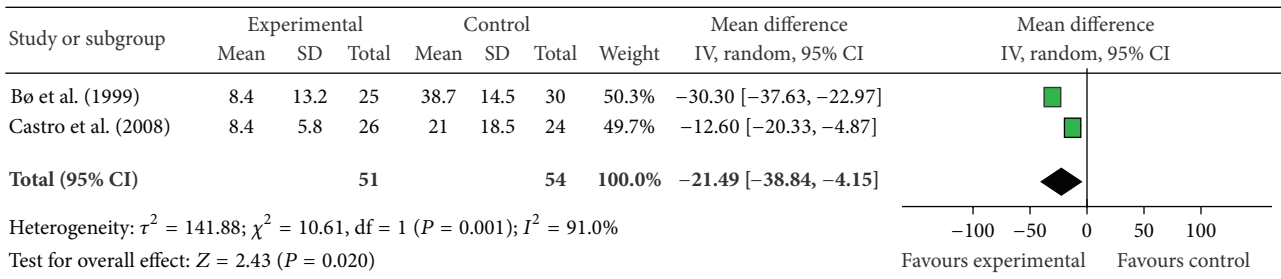


(c) Urinary incontinence episode for 7 days

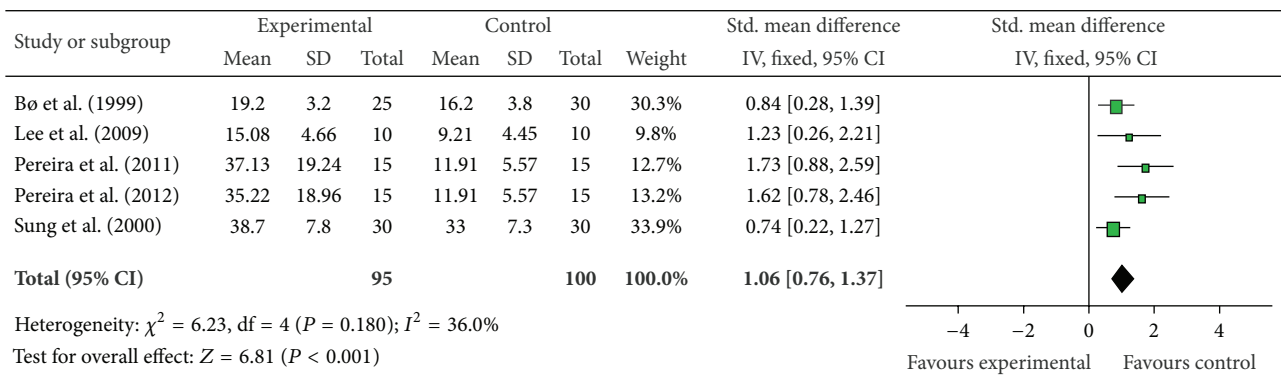


(d) One-hour pad test on pad test

FIGURE 3: Continued.



(e) Standardized bladder volume on pad test



(f) Pelvic floor muscle pressure

FIGURE 3: The results of effects of Kegel exercises.

the duration of one exercise, the number of repetitions, and the position. In general, one should not contract the muscles of the legs, hip, or abdomen when doing Kegel exercises correctly, but there is no way a patient can check this without help and they tend to give up easily because the effects are not quickly apparent [7]. To avoid this, concomitant biofeedback therapy using a finger or vaginal cone, or stimulation therapy, is used to evaluate the effects of Kegel exercises. However, a standardized guideline for Kegel exercises needs to be developed because they must be done consistently throughout life to manage menopausal urinary incontinence, and learning and implementing the correct method is more important than using an assisting device in the long run.

The effects of Kegel exercises were analyzed with respect to 5 outcome variables, and the results of the meta-analyses revealed statistically significant differences in the sizes of their effects. The self-reports on urinary incontinence symptoms after doing Kegel exercises were logged in 24-hour urinary activity diaries. In the four references that used these diaries, the patients reported improvements in urinary incontinence symptoms after Kegel exercises, and the effects of Kegel exercises were verified because RR was 26.09 (95% CI 8.50 to 80.11) and there was no difference between the references. The Korean Continence Society endorses urination diaries as a reliable source of data on lower urinary tract symptoms. Papers [15, 19, 24] reporting 7 days of urinary incontinence episodes using the same diary format consistently show a reduction in episode frequency, 1.52 times on average (95% CI -1.90 to -1.13), after Kegel exercises.

The pad test has been used as a source of objective outcome data for recent urinary incontinence diagnoses

because there is adequate evidence [29, 30] that it can reflect changes after urinary incontinence treatments, despite not being standardized since patients have different activity levels during the test period and the test itself. The papers referenced in this study used various methods of measurement, such as 1-hour or 24-hour pad tests and pad tests after infusing 200 mL of normal saline into the patient's bladder. In spite of differences between the papers in terms of bladder volume pad test standardization, the effects of Kegel exercises were consistent when using the one-hour pad test standard. The reasons for the different effects in the other two papers were not thoroughly analyzed because only two papers were involved. However, these tests were the same in terms of BMI, method of Kegel exercises, and follow-up period, only differing in patient age, suggesting the cause to be the absence of standardization of the pad test method and the effects of other varying conditions.

Pelvic floor muscle contractility was measured using a perineometer. The examinee lies down with knees bent, an intravaginal tube of approximately 3.5 cm is inserted using a vaginal balloon catheter, and air is put in using a pump. Finally, the pelvic floor muscles are contracted 3 times and the average volume is used. In the five papers measuring pelvic floor muscle contractility, the variable consistently improved after Kegel exercises (SMD 1.06, 95% CI 0.76 to 1.37). In other words, all these studies showed consistent results.

This study only compared the implementation of Kegel exercises in middle-aged women with SUI with nonintervention and routine intervention such as education. Eleven RCTs were analyzed, but there may be limitations to interpretation of the study results because most of them were of a small scale

and the treatment period and the follow-up periods were short, with less than three months. But the effects of Kegel exercise on SUI were verified consistently, and all results showed statistically significant difference. In conclusion, this study provides evidence that Kegel exercises are effective and better than no treatment in the management of women with stress urinary incontinence because the outcome variables used for this meta-analysis showed excellent results for decreasing the frequency of urinary incontinence and alleviating its symptoms.

5. Conclusion

Significantly the study showed the improvement of SUI symptoms in middle-aged women who did Kegel exercises and included objectively verified data, specifically data from both the pad test and vaginal perineal muscle contractility data. Although the Kegel exercise method has not yet been standardized, these results consistently show the reinforcement of pelvic muscles and verify that Kegel exercises are indeed a safe method of intervention. However, the references used in this study mostly deal with short-term interventions of about three months, and further improvement in the prevention and management of urinary incontinence in perimenopausal middle-aged women using Kegel exercises requires longer-term studies.

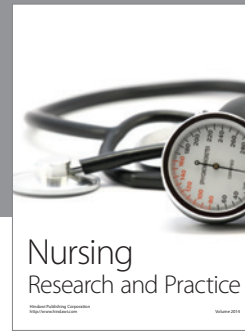
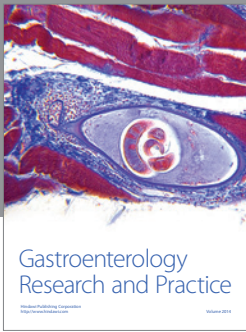
Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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