PERGAMON

International Journal of Nursing Studies 40 (2003) 45–50

INTERNATIONAL JOURNAL OF NURSING STUDIES

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A comparison of effectiveness of bladder training and pelvic muscle exercise on female urinary incontinence

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Received 16 February 2001; received in revised form 28 March 2002; accepted 29 April 2002

Abstract

This study compared the effectiveness of bladder training versus pelvic muscle exercises in the treatment of urinary incontinence in women. It was revealed that the two intervention groups showed improvement compared with the control group, but differed in their effects on outcome measures. The pelvic muscle exercise group was more effective in increasing the peak and the average pressures of pelvic muscle contraction. The bladder-training group was more effective in reducing urinary frequency and in increasing voided volume. Further research is needed to explore the relationship among the various outcome measures of urinary incontinence.

1. Introduction

Urinary incontinence in women is a common, distressing and costly health problem (Urinary Incontinence in Adults Guideline Update Panel, 1996; O'Brien et al., 1991). It usually begins to affect women at age 30–40, and its incidence and severity gradually increase with age (Burgio et al., 1991; Harrison and Memel, 1994). Urinary incontinence often causes a loss of self-esteem, social isolation and restriction of normal activity (Wagner et al., 1996; Wyman et al., 1987). Older people and their families find it difficult to manage the urinary incontinence at home, and urinary incontinence has been reported to play a major role in the decision to place older people in a nursing home (Smallegan, 1985; Ouslander et al., 1990). Thus, prevention and treatment of urinary incontinence in its early stage are important factors in maintaining health and independence among men and women. The International Continence Society defines urge incontinence as "the involuntary loss of urine proceeded by urgency" and genuine stress incontinence as "the involuntary loss of urine occurring when the intravesical pressure exceeds the intra-abdominal pressure in the absence of detrusor contraction" (Abrams and Wein, 1999).

The most common treatments for urinary incontinence include surgery, drug therapies, and behavioral interventions (Urinary Incontinence in Adults Guideline Update Panel, 1996). Behavior interventions involve educating incontinent persons and provide positive reinforcement for progress. Surgery is effective in treating stress urinary incontinence, but it is not without risks; medications such as anticholinergics and spasmodics have adverse effects: however, behavioral interventions such as pelvic floor muscle exercises and bladder training have potential benefits with few risks and no side effects. Pelvic muscle exercises, initiated by Kegel in 1948, strengthen the tone and contraction of periurethral and pelvic floor muscles. Pelvic muscle exercises (Kegel exercises) have been found to be efficacious for stress incontinence (Dougherty et al., 1993; Dumoulin et al., 1995), and also for urge incontinence (Stein et al.,

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0020-7489/02/$ - see front matter
PII: S0020-7489(02)00031-7

1995). Bladder training, recommended by Jeffcoate and Francis in 1966, is a behavioral intervention in which the interval between voluntary voiding is gradually extended, and is effective not only for urge incontinence (Jarvis and Millar, 1980; Pengelly and Booth, 1980), but also for stress incontinence (Jarvis and Millar, 1980; Elder and Stephenson, 1980).

Previous studies using parallel groups designs did not in general investigate bladder training and Kegel exercises as separate treatments protocols, but typically examined the combined effects of these approaches in one treatment condition or have incorporated either bladder training or exercises or both with electrical stimulation (O'Brien et al., 1991; Jarvis and Millar, 1980; Pengelly and Booth, 1980; Burgio et al., 1986; Fantl et al., 1991; Burns et al., 1993). Furthermore, treatment efficacy was in general measured simply by self-reported frequency of urinary incontinence, in which subjects may have overestimated or underestimated their true response to treatment. Consequently, it is difficult to determine from previous studies the relative effectiveness of bladder training and Kegel exercises on the different outcome measures.

The aim of this study was to compare the efficacy of bladder training and pelvic muscle exercises, relative to an untreated control group, on female urinary incontinence. Intervention efficacy was assessed by subjective and objective outcome variables including a pad test, peak/average pressures and duration of pelvic muscle contraction, leaked urine amount and amount ratio (the leaked urine amount divided by voided volume), frequencies of micturition and nocturia, and voided volume.

2. Materials and methods

2.1. Subjects

We conducted the study in a community setting from February to June 1997. Participants were recruited through public advertisements in a local city and these women were all parous and aged 35–55. Patients under 35 and over 55 were excluded because age is likely to affect the results of behavioral interventions (Henderson and Taylor, 1987). They were informed about the study, and a written consent to participate was received before attaining any study data. Selection criteria were: (a) a urine loss of 1.0 g or more on a 30 min pad test (Dumoulin et al., 1995; Fantl et al., 1991), and (b) 14 voids or more during a period of 48 h before the preliminary evaluation. In addition, subjects were required to measure voided volume, to record a urinary diary, and to practice bladder training or Kegel exercises for 8 weeks. Subjects with any of the following characteristics were excluded: (a) the presence of urinary tract infection tested by urinalysis and urine culture, (b) previous experience of surgery for urinary incontinence, or (c) presently under a hormonal or medication therapy for urinary incontinence.

A design incorporating two experimental groups and one control group was employed to test the effectiveness of bladder training and pelvic muscle exercises for the treatment of urinary incontinence. Fifty women were recruited from local community and among them 50 women were screened. These women were then assigned randomly to the control and treatment groups by using random numbers. During intervention two women from the control group and two from the Kegel exercise group were withdrawn from the study due to family problems. Two women from the bladder training group were withdrawn due to complaints about swelling in wrists and ankles, and they previously had hypertension. Finally, data of 13 women in the control group, 19 in the bladder training group and 12 in the Kegel exercise group were analyzed.

2.2. Methods

The baseline assessments were completed before random allocation of subjects, and these included a health history, a general physical and pelvic muscle assessment, and a urinalysis.

2.2.1. Evaluation of the intervention program

A nurse who works in a urinary incontinence clinic at Gachon university hospital and who was blinded to the treatment allocations measured subjective and objective outcomes at 4 and 8 weeks. Peak pressure, an average pressure and duration of pelvic muscle contraction were measured with a digital perineometer (Peritro 9300+, Cardio Design Co., Australia), and the duration of pelvic muscle contraction was obtained by averaging three measurements after subjects exercised the contraction and relaxation of pelvic muscles twice.

The subjects were asked to void 120 min earlier than arriving at the clinic. When subjects arrived at the hospital, they were asked to drink 500 ml of water or juice, and check a 5-Likert scale concerning the severity of urine loss for 18 different types of activity associated with urine loss (i.e., coughing, sneezing, etc.). The urinary incontinence score was obtained by summing these self-rated severities of urine loss problems.

After preweighing perineal pads, subjects conducted maneuvers and activities for 30 min to provoke urinary incontinence, and then the perineal pads were weighed. Provocative maneuvers of urinary incontinence included going up and down steps for 5 min, rising from a sitting to a standing position 10 times, coughing as vigorously as possible 10 times, bouncing on heels for 1 min, lifting 20 kg weights over the waist 5 times, and washing hands in the running water for 3 min. The amount of leaked

urine was recorded in terms of grams of urine lost during a 30 min pad test based on the procedures described by Fantl et al. (1987). After the pad test, measures of voided volume, the ratio of leaked urine to voided volume and pelvic muscle contraction were recorded.

Micturition, nocturia and voided volume were obtained with a 48 h urinary diary based on the methods described by Wyman et al. (1988). As a menstrual period or diarrhea occurring more than twice a day would affect the frequency of micturition, subjects were instructed not to keep a urinary diary in such cases.

2.2.2. Treatment protocol

Treatments consisted of either bladder training or pelvic muscle exercises, lasting for 8 weeks. The bladder training was a progressive program in which the interval between voluntary voidings was gradually extended weekly for 8 weeks. Subjects in the Kegel exercise group were instructed to contract and relax pelvic muscles everyday for 8 weeks and were provided with immediate and simultaneous visual feedback of pelvic muscles during a 20 min weekly biofeedback session with electromyography (COMPACT ELITE, ECL Co., France). The session was run by a therapist who is a nurse working in a urinary incontinence clinic at Gachon university hospital, but a different person from the one who measured the treatment outcomes. The pelvic muscle exercise protocols included pelvic muscle contractions for strength and endurance. Strength exercises that involve muscle contraction with bursts of intense activity lasting a few seconds would induce muscle hypertrophy and strengthen tendons and ligaments, and endurance exercises involve maintaining the pressure developed by the muscle contraction for 12 s, but starting with 6 s at the first week and extending 1 s more each week (Dougherty et al., 1989; Saltin et al., 1977). The exercise protocols require subjects perform 30 pelvic muscle contractions for strength and endurance per day and overall it takes from 15 to 20 min every day.

Control subjects were asked to return after 8 weeks without further intervention or clinic contact and assessments were performed as with the other intervention groups.

2.3. Statistical analysis

Socio-demographic and treatment outcome measures were presented as means plus or minus standard deviation. A repeated-measures analysis of variance (ANOVA) was performed using the SAS (Statistical Analysis System, 1996) to determine if there were any differences in improvement after 4 and 8 weeks of intervention with respect to micturition, nocturia, urinary incontinence score, voided volume, amount of leaked urine and pelvic muscle contraction (Crowder and Hand, 1990). The test of intervention effects was signified by the group × time interaction term, since this evaluated the group differences (intervention versus control) in the change from baseline to post-intervention. Significant interaction effect of group-× time implies that the outcome patterns during 8 weeks differ from group to group more than we expect just from chance variation (Altman, 1991). For a study that includes a control and several intervention groups, substantial improvement in the intervention groups compared to minimal or no improvement in the control group will result in a significant interaction term. The significant interaction of group × time was probed with separate analyses of variance within each group in order to determine if treatment had a differential impact with time. Further exploration of the differences in the mean of control and two intervention groups were done by the Scheffé post hoc procedure and exploration of the differences in outcome measures of baseline, and at 4 and 8 weeks were done by the Bonferroni post hoc procedure. A probability level of <0.05 was adopted as statistically significant.

3. Results

A statistical analysis comparing relevant variables for the control and the treatment groups revealed no baseline differences (all $P > 0.05$). Intervention effects are summarized in Tables 1 and 2. When overall mean of 8 weeks is examined, the Kegel exercise group showed a pattern of improvement in peak and average pressures relative to the control group but with a marginal statistical significance (Repeated-measures ANOVA, $P = 0.054$ and 0.11, respectively). When the intervention outcomes during 8 weeks are examined, both intervention groups showed compared with baseline values a significantly increased duration time and index of pelvic muscle contraction after 4 and 8 weeks of treatment, with the longest duration time and the highest index occurring for the exercises group after 8 weeks (all $P<0.01$), while control group showed no significant change. No significant differences were found among the three groups for the amount of leaked urine, although the Kegel exercises group showed somewhat a decreased pattern throughout the 8-week period ($P > 0.05$) (Table 1).

While the frequency of micturition and nocturia did not change during the 8-week treatment period in the control group, both measures decreased significantly in the bladder training group (repeated-measures ANOVA, $P<0.01$). The voided volume in the bladder training group increased significantly throughout the period, but it remained unchanged in the Kegel exercises and the control group ($P<0.01$) (Table 2).

Table 1
Urodynamic variables before and after treatment by intervention and control groups

Group/time	Pelvic muscle contraction				Leaked urine	
	Peak pressure (mmHg)	Average pressure (mmHg)	Duration (s)	Index[a]	Amount (g)	Amount ratio (g/ml)
Pelvic muscle exercises ($n = 13$)						
Baseline visit	32.8±17.4	15.6±8.5	6.4±3.7	102.2±72.4	10.5±16.2	0.0750±0.1397
4 weeks visit	39.6±10.8	22.6±10.3	12.4±3.9	281.5±119.4	5.0±5.5	0.0228±0.0262
8 weeks visit	39.7±20.0	26.1±12.5	14.5±3.0	392.4±237.1	3.3±4.5	0.0140±0.0175
Bladder training ($n = 19$)						
Baseline visit	31.7±16.2	17.4±13.7	4.4±1.8	86.3±82.3	5.4±6.1	0.0337±0.0449
4 weeks visit	31.5±13.1	19.5±8.2	10.2±3.9	210.9±147.6	4.7±6.3	0.0282±0.0379
8 weeks visit	30.5±9.1	18.3± 6.4	11.7±3.7	222.9±126.7	4.6±6.2	0.0244±0.0312
Control ($n = 12$)						
Baseline visit	25.8±15.6	14.1±6.9	6.4±2.4	90.4±60.8	7.7±9.2	0.0370±0.0449
4 weeks visit	21.9±8.0	13.3±5.2	5.9±2.4	81.8±52.1	8.2±10.1	0.0411±0.0456
8 weeks visit	19.9±7.5	12.2±5.3	5.9±1.7	71.5±26.4	8.4±9.8	0.0413±0.0455

[a] Index is computed as average pressure multiplied by duration.
Results are mean±SD.Table 1
Urodynamic variables before and after treatment by intervention and control groups

Table 2
Urinary frequency, urinary incontinence scores and voided volume before and after treatment by intervention and control groups

Group/time	Frequency of		Urinary incontinence scores	Voided volume (ml)
	Micturition (no./day)	Nocturia (no./night)		
Pelvic muscle exercises ($n = 13$)				
Baseline visit	15.1±1.6	1.8±1.2	12.5±4.5	212.5±42.3
4 weeks visit	14.8±2.0	1.9±1.4	11.3±6.6	221.0±32.2
8 weeks visit	14.3±2.4	1.9±1.1	10.8±6.2	239.7±53.4
Bladder training ($n = 19$)				
Baseline visit	17.3±4.2	2.5±2.0	17.2±8.9	178.5±39.3
4 weeks visit	12.8±1.7	1.2±1.1	14.2±7.6	240.2±44.8
8 weeks visit	10.4±1.8	0.7±0.8	12.1±7.8	271.9±47.3
Control ($n = 12$)				
Baseline visit	16.3±1.8	1.4±1.1	17.8±8.6	202.2±49.6
4 weeks visit	15.8±1.5	1.2±1.1	14.5±5.1	212.5±48.5
8 weeks visit	17.4±1.6	1.5±1.0	14.2±3.6	193.3±37.8

Results are mean±SD.Table 2
Urinary frequency, urinary incontinence scores and voided volume before and after treatment by intervention and control groups

4. Discussion

The aim of this study was to evaluate the efficacy of bladder training and pelvic muscle exercises on female urinary incontinence. Bladder training has been used to manage urge incontinence while pelvic muscle exercises are intended for women with stress incontinence (Urinary Incontinence Guideline Panel, 1996). However, past research indicates that bladder training may also control stress incontinence (Jarvis and Millar, 1980; Fantl et al., 1991; Burgio et al., 1985). Pelvic muscle exercises have also been reported to be effective in reducing urgency, urge incontinence and diurnal and nocturnal frequencies (Stein et al., 1995). Therefore, a comparison of the efficacy of bladder training relative to pelvic muscle exercises was needed.

Our study confirms the benefits of Kegel exercises in significantly increasing the peak pressure of pelvic

muscles after 4 weeks and maintaining the same level after 8 weeks. This is consistent with the results of Henderson and Taylor (1987), Dumoulin et al. (1995), and Baigis-Smith et al. (1989). Our study also shows that Kegel exercises significantly increased the peak and the average pressure. In both intervention groups, it is observed that the duration time of pelvic muscle contraction significantly increased after 8 weeks. However, even though increased duration time of pelvic muscle contraction as well as peak and average pressures indicate an improvement of pelvic muscle strength with Kegel exercises (Dougherty et al., 1993), the mechanism by which clinical improvement occurs remains unknown in urodynamics (Elser et al., 1999). The improvement in the duration time for the bladder training group was made possible by increasing the interval between voids. Therefore, the present study and the study of Burgio et al. (1986) suggest that the duration time of pelvic muscle contraction can be a significant indicator of urinary incontinence. In Burgio et al.'s (1986) study, the duration time of sphincter contraction in the Kegel exercises group was 9.1 s, while it was 2.9 s in the control group.

In the present study, the amount of leaked urine decreased somewhat only in the Kegel exercises group. This confirms the findings of Burns et al. (1993), but contradicts that of Fantl et al. (1991), in which bladder training was very effective in decreasing urine loss. A closer examination indicates that the subjects of Fantl et al.'s (1991) study were aged 66 on average, had a frequency of 61 voids a week, and thus might have had both stress and urge incontinence. Furthermore, while the intervention lasted 2 months in our study, it lasted for a period of 6 months in Fantl et al.'s (1991) study. In contrast to our results, Nygaard et al. (1996) reported that pelvic muscle exercises decreased the daytime frequency in stress incontinence. They also reported that pelvic muscle exercises decreased the nighttime frequency in detrusor instability but did not decrease the daytime frequency in detrusor instability and mixed incontinence. We think it necessary to conduct further research on the effect of pelvic muscle exercises on void frequency.

In both our study and past studies (Jarvis and Millar, 1980; Pengelly and Booth, 1980; Fantl et al., 1991), bladder training was associated with a marked decrease in the frequency of micturition and nocturia during the 8-week treatment period. However, the Kegel exercises in our study did not decrease the frequency of micturition and nocturia. Although Stein et al. (1995) reported that Kegel exercises decreased the frequency of micturition and nocturia , it is noted that they combined Kegel exercises with electrical stimulation. Susset et al. (1995) have recommended electrical stimulation when bladder instability (urge incontinence) is associated with pelvic floor muscular incompetence (stress incontinence). According to O'Brien et al. (1991) and Baigis-Smith et al. (1989), stress incontinence responded better to Kegel exercises than did urge or mixed incontinence. In our study bladder training significantly increased the voided urinary volume while Kegel exercises did not.

Burns et al. (1993) reported that self-reported urine loss significantly decreased by the third intervention week. One baffling aspect of our results is that the urinary incontinence score, which is a composite one, was not in accordance with other physiologic data; the exercise group who leaked urine most among the treatment groups was shown to have the lowest urinary incontinence score at baseline and did not change much. While the peak and the average pressure of pelvic muscle contraction and the amount of leaked urine remained constant during the 8-week period for the control group, a pattern of gradually decreasing urinary incontinence scores was shown over the period of 8 weeks. Therefore, we do not rule out the possibility that our self-rated scales could be inaccurate assessments of the severity of urinary incontinence.

It is important to note that urinary frequency and urine leakage volume are quantifiable outcome measures of different aspects of urinary incontinence. How these and other outcome measures are related and the extent to which improvements on these measures are of significance clinically and subjectively to the patient are questions that require further study. Perhaps the development of more detailed and specific outcome measures is required. Such studies may shed light on an understanding of the mechanisms by which Kegel exercises and bladder training have brought about improvement.

References

Abrams, P., Wein, A.J., 1999. The overactive bladder and incontinence: definition and a plea for discussion. Neurourology and Urodynamics 18, 413–416.

Altman, D.G., 1991. Practical Statistics for Medical Research. Chapman and Hall, London.

Baigis-Smith, J., Jakovac Smith, D.A., Rose, M., Newman, D.K., 1989. Managing urinary incontinence in community-residing elderly persons. The Gerontologist 29, 229–233.

Burgio, K.L., Whitehead, W.E., Engel, B.T., 1985. Urinary incontinence in the elderly: bladder-sphincter biofeedback and toileting skills training. Annals of Internal Medicine 104, 507–515.

Burgio, K.L., Robinson, J.C., Engel, B.T., 1986. The role of biofeedback in Kegel exercise training for stress urinary incontinence. American Journal of Obstetrics and Gynecology 154, 58–64.

Burgio, K.L., Matthews, K.A., Engel, B.T., 1991. Prevalence, incidence and correlates of urinary incontinence in healthy middle-aged women. The Journal of Urology 146, 1255–1259.

Burns, P.A., Pranikoff, K., Nochajski, T.H., Hadly, E.C., Levy, K.J., Ory, M.G., 1993. A comparison of effectiveness of biofeedback and pelvic muscle exercise treatment of stress incontinence in older community-dwelling women. Journal of Gerontology 48 (4), M167–M174.

Crowder, M.J., Hand, D.J., 1990. Analysis of Repeated Measures. Chapman and Hall, London.

Dougherty, M., Bishop, K., Mooney, R., Gimotty, P., 1989. The effect of the circumvaginal muscle (CVM) exercise. Nursing Research 38, 331–335.

Dougherty, M., Bishop, K., Mooney, R., Gimotty, P., Williams, B., 1993. Graded pelvic muscle exercise: Effect on stress urinary incontinence. Journal of Reproductive Medicine 38, 684–691.

Dumoulin, C., Seaborne, D.E., DeGirardi, C.Q., Sullivan, S.J., 1995. Pelvic-floor rehabilitation, part 2: pelvic floor reeducation with interferential currents and exercise in the treatment of genuine stress incontinence in postpartum women—a cohort study. Physical Therapy 75, 1075–1081.

Elder, D.D., Stephenson, T.P., 1980. An assessment of the Frewen regime in the treatment of detrusor dysfunction in females. British Journal of Urology 52 (4), 67–471.

Elser, D.M., Wyman, J.F., McClish, D.K., Robinson, D., Fantyl, J.A., Bump, R.C., 1999. The effect of bladder training, pelvic floor muscle training combination training on urodynamic parameters in women with urinary incontinence. Neurourology and Urodynamics 18, 427–436.

Fantl, J.A., Harkins, S.W., Wyman, J.F., Choi, S.C., Taylor, J.R., 1987. Fluid loss quantitation test in women with urinary incontinence: a test–retest analysis. Obstetrics and Gynecology 70, 739–743.

Fantl, J.A., Wyman, J.F., McClish, D.K., Harkins, S.W., Elswick, R.K., Taylor, J.R., Hadley, E.C., 1991. Efficacy of bladder training in older women with urinary incontinence. JAMA 265, 609–613.

Harrison, G.L., Memel, D.S., 1994. Urinary incontinence in women: its prevalence and its management in a health promotion clinic. British Journal of General Practice 44, 149–152.

Henderson, J.S., Taylor, K.H., 1987. Age as a variable in an exercise program for the treatment of simple urinary stress incontinence. Journal of Obstetrics, Gynecologic, and Neonatal Nursing 16, 266–272.

Jarvis, G.J., Millar, D.R., 1980. Controlled trial of bladder drill for detrusor instability. British Medical Journal 281, 1322–1323.

Nygaard, I.E., Kreder, K.J., Lepic, M.M., Fountain, K.A., Rhomberg, A.T., 1996. Efficacy of pelvic floor muscle exercises in women with stress, urge, and mixed urinary incontinence. American Journal of Obstetrics and Gynecology 174, 120–125.

O'Brien, J., Austin, M., Sethi, P., O'Boyle, P., 1991. Urinary incontinence: prevalence, need for treatment and effectiveness of intervention by nurse. British Medical Journal 303, 1308–1312.

Ouslander, J.G., Zarit, S.H., Orr, N.K., Muira, S.A., 1990. Incontinence among elderly community-dwelling dementia patients. Journal of the American Geriatrics Society 38, 440–445.

Pengelly, A.W., Booth, C.M., 1980. A prospective trial of bladder training as treatment for detrusor instability. British Journal of Urology 52, 463–466.

Saltin, B., Henriksson, J., Nygaard, E., Andersen, P., Jansson, E., 1977. Fiber types and metabolic potential of skeletal muscles in sedentary men and endurance runners. Annals of the New York Academy of Science 301, 3–29.

SAS Institute Inc., 1996. SAS/STAT Software, Release 6.12, SAS Institute Inc., Cary, NC.

Smallegan, M., 1985. There was nothing else to do: needs for care before nursing home admission. The Gerontologist 25, 364–369.

Stein, M., Discippio, W., Davia, M., Taub, H., 1995. Biofeedback for the treatment of stress and urge incontinence. The Journal of Urology 153, 641–643.

Susset, J., Galea, G., Manbeck, K., Susset, A., 1995. A predictive score index for the outcome of associated biofeedback and vaginal electrical stimulation in the treatment of female incontinence. The Journal of Urology 153, 1461–1466.

Urinary Incontinence in Adults Guideline Update Panel, 1996. Urinary Incontinence in Adults: Acute and Chronic Management. Agency for Health Care Policy and Research, Public Health Services, US Department of Health and Human Services (AHCPR publication no. 960682), Rockville, MD, p. 5.

Wagner, T.H., Patrick, D.L., Bavendam, T.G., Martin, M.L., Buesching, D.P., 1996. Quality of life of persons with urinary incontinence: development of a new measure. Urology 47, 67–71.

Wyman, J.F., Harkins, S.W., Choi, S.C., Taylor, J.R., Fantl, J.A., 1987. Psychosocial impact of urinary incontinence in women. Obstetrics and Gynecology 70, 378–381.

Wyman, J.F., Choi, S.C., Harkins, S.W., Wilson, M.S., Fantl, J.A., 1988. The urinary diary in evaluation of incontinent women: a test–retest analysis. Obstetrics and Gynecology 71, 812–817.