# Effects of Seated Cycling Exercise on Grip Strength, Lower Limb Strength, and Five Times Sit-to-Stand Test in Elderly Women with Dementia

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# 여성 치매 노인을 대상으로 한 고정형 자전거 운동이 쥐기 근력, 하지 근력 및 Five Times Sit-to-Stand 검사에 미치는 영향

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Abstract

As dementia prevalence rises among older adults, maintaining physical function has become a key therapeutic goal. Seated cycling is a low-impact, accessible exercise modality that may help improve muscular strength and functional mobility in older adults with dementia. A single-group pre-post intervention study was conducted with 10 elderly women (mean age: 79.1 ± 4.15 years) diagnosed with dementia and enrolled in a daycare center. Participants completed 30-minute sessions of seated cycling three times per week for four weeks, in addition to conventional exercise therapy. Outcome measures included grip strength, lower limb strength (hip flexion, extension, abduction, knee extension, ankle plantar flexion), and the 5×STS. Post-intervention results revealed significant improvements in grip strength ($p < 0.05$, Cohen's $d = 0.23$), 5×STS performance ($p < 0.01$, Cohen's $d = 1.01$), and all measures of lower limb strength ($p < 0.01$). The largest effect sizes were observed in hip flexion ($d = 1.36$) and knee extension strength ($d = 1.09$). Seated cycling was effective in improving upper and lower limb strength, as well as functional mobility in elderly women with dementia. This intervention may serve as a practical exercise modality to support physical function and independence in this population.

## 1. Introduction

The growing prevalence of dementia among older adults is accompanied by a decline in physical function, including reduced muscle strength and mobility. These impairments increase the risk of falls and dependence, underscoring the need for effective physical interventions [1, 2].

Seated cycling is a low-impact exercise modality that is safe, accessible, and feasible for individuals with cognitive decline. While it has shown benefits for lower body strength and cardiovascular function in the general elderly population, evidence on its functional effects in older adults with dementia is limited [3].

Previous studies have often included mixed intervention types or focused on cognitively intact participants, making it difficult to isolate the specific impact of seated cycling in dementia care [4]. This study addresses this gap by using a single-group pre-post design focused solely on elderly women with dementia, aiming to evaluate the effects of seated cycling on grip strength, lower limb strength, and functional mobility (5×STS).

## 2. Methods

### 2.1 Participants

This study included 10 elderly women (mean age: 79.1 ± 4.15 years) diagnosed with dementia and enrolled in a community-based daycare center in D city, South Korea[Table 1]. Inclusion criteria were: age ≥ 65 years, a confirmed diagnosis of dementia by the National Health Insurance Service, ability to walk independently for at least 10 meters, and a Korean Mini-Mental State Examination (MMSE-K) score ≥ 18. Individuals with significant musculoskeletal pain, severe visual or sensory

impairments, or medical contraindications to exercise were excluded.

[Table 1] General participant characteristics(N=10)

| | Intervention group |
|---|---|
| Age(year) | 79.10±4.15 |
| Height(㎝) | 148.70±7.18 |
| Weight(㎏) | 57.15±10.79 |
| MMSE-K | 20.50±0.58 |

MMSE: Mini-Mental State Examination

## 2.2 Study Design and Intervention

This was a single-group pre-post intervention study. Participants performed seated cycling exercises three times per week for four weeks. Each session lasted 30 minutes and included a 5-minute warm-up (upper and lower limb stretching), 5 minutes of sit-to-stand strengthening, 5 minutes of seated gymnastics, and 15 minutes of seated cycling using a stationary exercise bike. All sessions were supervised by a licensed physical therapist to ensure safety and protocol adherence.

## 2.3 Outcome Measures

Grip strength was measured using a hand-held dynamometer (dominant hand, average of 3 trials). Lower limb strength was measured using a hand-held dynamometer (Commander Muscle Tester; JTech, USA) for hip flexion, extension, abduction, knee extension, and ankle plantar flexion. Five Times Sit-to-Stand (5×STS) was time taken to stand up and sit down five times without using arms. This test was used to evaluate functional lower limb strength.

## 2.4 Statistical Analysis

Data were analyzed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA). Paired t-tests were used to compare pre- and post-intervention outcomes. Effect sizes were calculated using Cohen's d. A p-value < 0.05 was considered statistically significant.

# 3. Results

Grip strength increased ($p = 0.019$, $d = 0.23$), and 5×STS performance time decreased significantly ($p = 0.005$, $d = 1.01$). Lower limb strength improved in all muscle groups, with the greatest gains observed in hip flexion ($p < 0.001$, $d = 1.36$) and knee extension ($p < 0.001$, $d = 1.09$). Moderate improvements were also seen in hip extension, hip abduction, and ankle plantar flexion (all $p < 0.001$).

[Table 2] Comparison of Pre-Post Changes in Outcome measure

| Variable | Pre | Post | t | p-value | Effect size |
|---|---|---|---|---|---|
| Grip strength (kg) | 11.39±3.74 | 11.60 ±3.85 | −2.85 | 0.019* | 0.23 |
| 5xSTS (sec) | 10.26±4.01 | 9.08 ±3.40 | 3.69 | 0.005* | 1.01 |
| Hip Flexion (kg) | 13.55 ±5.21 | 18.76 ±4.56a | −12.14 | 0.000* | 1.36 |
| Hip Extension (kg) | 8.87 ±3.23 | 10.54±3.24 | −12.56 | 0.000* | 0.42 |
| Hip Abduction (kg) | 4.53±1.62 | 4.85±1.60 | −4.33 | 0.002* | 0.23 |
| Knee Extension (kg) | 9.99 ± 4.26 | 15.09±3.94 | −14.74 | 0.000* | 1.09 |
| APF (kg) | 7.91 ± 3.40 | 8.98 ±3.03 | −7.45 | 0.000* | 0.46 |

*p<0.05 (Mean±SD), CON: Seated Cycling group, 5xSTS: Five Times Sit to Stand test, APF: Ankle Plantar Flexion

# 4. Discussion

This study examined the effects of seated cycling on muscle strength and functional mobility in elderly women with dementia. After four weeks of intervention, significant improvements were observed in grip strength, lower limb strength, and 5×STS performance.

The increase in grip strength, although modest, suggests that seated cycling may contribute to upper limb stability, possibly due to the need for trunk and arm engagement during pedaling. This finding is consistent with previous studies reporting whole-body benefits of stationary cycling in older adults.

The 5×STS performance improved significantly, indicating enhanced lower limb function and mobility. This test is a key predictor of fall risk and independence, and the observed improvements highlight the functional relevance of cycling exercise in this population.

Among lower limb muscle groups, the largest gains were seen in hip flexion and knee extension strength, with large effect sizes. These results are consistent with prior research demonstrating that seated cycling effectively targets proximal lower limb muscles, particularly the quadriceps and hip flexors, due to the repetitive concentric muscle activation required for pedaling.

The improvements in ankle plantar flexion strength may also contribute to better gait propulsion and balance, which are often compromised in individuals with dementia. Although the intervention period was relatively short, the observed changes are clinically meaningful and suggest that seated cycling is a feasible and effective method to improve physical function in

cognitively impaired older adults.

## 5. Conclusion

Seated cycling was effective in improving grip strength, lower limb strength, and functional mobility, as measured by the Five Times Sit-to-Stand test, in elderly women with dementia. The exercise particularly enhanced hip and knee strength, which are critical for maintaining mobility and independence. These findings support the use of seated cycling as a safe and practical intervention to promote physical function in dementia care settings. Further studies with larger and more diverse populations are warranted to validate these results.

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