



## Research paper

# Effectiveness of an application-based neck exercise as a pain management tool for office workers with chronic neck pain and functional disability: A pilot randomized trial



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## ARTICLE INFO

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## ABSTRACT

**Introduction:** Chronic neck pain in office workers is a prevalent occupational disorder. Recently, smartphone applications (apps) have increased rapidly, and provide the benefits in terms of accessibility to health information. The objective of this study was to examine the effectiveness of an app-based exercise in office workers on pain intensity, functional disability, exercise adherence, muscle strength, quality of life and fear-avoidance.

**Methods:** 20 office workers participated in the study excluding one drop-out. The app-based exercise group (n = 11) conducted neck exercise through the mobile app in the workplace environment for at least 10–15 min/day, 2 days/week for 8 weeks while the control group (n = 9) received a brochure showing how to correct their posture themselves during the same period. Evaluations using the following were performed at baseline and after 8 weeks: the Visual Analog Scale (VAS), for pain intensity; Neck Disability Index (NDI), for functional disability; level of exercise adherence; maximal voluntary flexion/extension strength (MVFS/MVES); 36-Item Short-Form Health Survey (SF-36), for quality of life; and Fear-Avoidance Belief Questionnaire (FABQ).

**Results:** Within the app-based exercise group, the VAS (P = 0.003) and NDI (P = 0.005) improved significantly after the app-based neck exercise. MVES (P = 0.013), physical component summary (P = 0.02) of the SF-36, and the work-related subscale (P = 0.011) in the FABQ improved significantly. The level of exercise adherence was high. In VAS and NDI, there were statistically significant differences in the amounts of improvement between the groups.

**Conclusion:** An app-based neck exercise positively effects pain intensity, functional disability and partially improves muscle strength, SF-36 score, and FABQ score.

## 1. Introduction

With an increase in the usage of computers for academic or business purposes, neck pain has become the most prevalent disorder in office workers who are intensive computer users [1]. Approximately 42% to 69% of office workers are reported to have experienced neck pain during the past 12 months. For occupational characteristics such as sustained posture and repetitive use of the upper extremities, hours of computer usage, work environment, incomplete work-rest cycle control

[2–5], neck pain typically is prolonged and not treated properly. Naturally, the chronicity and recurrence of pain is frequent, resulting in a high economic cost, extensive social burden, and the lower quality of life for these individuals [6]. Therefore, a specific intervention and management tool for providing regular care is needed.

Clinically, several previous studies have provided evidence-based intervention methods for chronic neck pain [7], among which the McKenzie method is a representative therapeutic and diagnostic tool used by physical therapists for treating spinal pain [8–10]. A primary

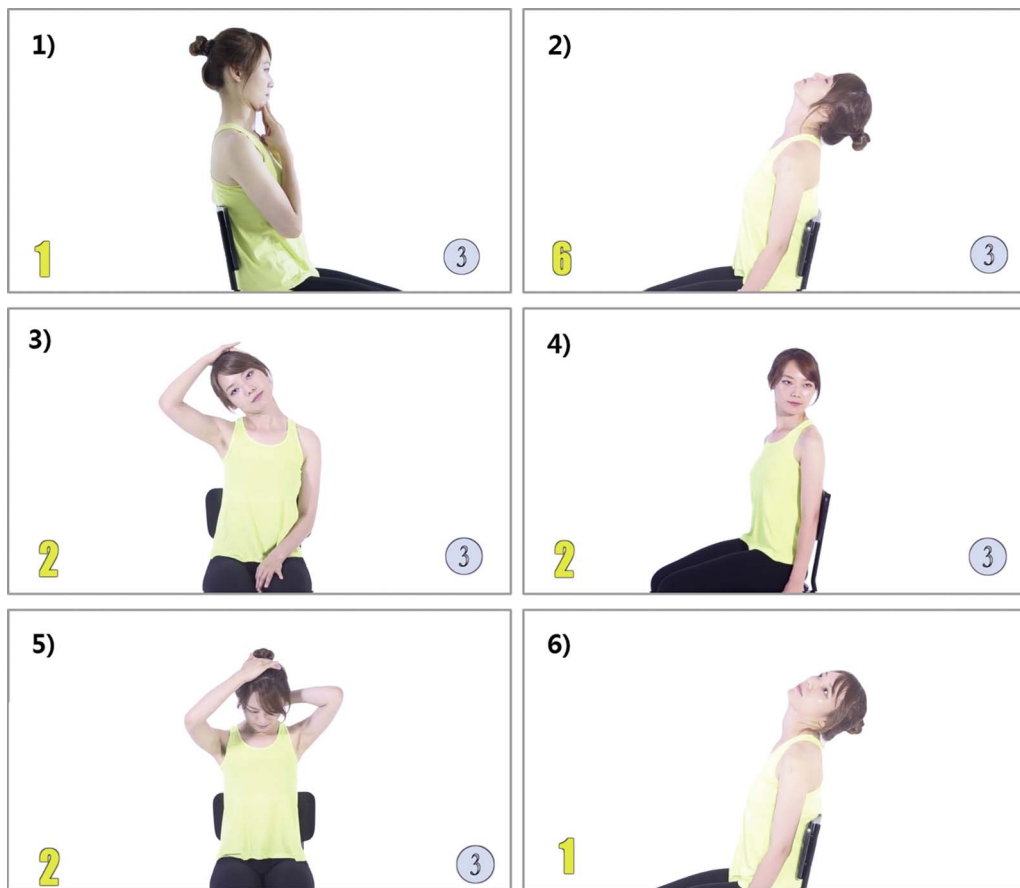
**Abbreviations:** App, Application; VAS, Visual Analog Scale; NDI, Neck Disability Index; MVS, Maximal Voluntary Strength; SF-36, Short-Form Health Survey; FABQ, Fear-Avoidance Belief Questionnaire

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**Fig. 1.** McKenzie neck exercise program. McKenzie neck exercise program consists of six movements. 1) Sitting Chin Tuck, 2) Sitting Neck Extension, 3) Side-Bending, 4) Neck Rotation, 5) Sitting Neck Flexion, and 6) Neck Extension and Rotation. The yellow-colored number shown at the bottom left on the display indicates the number of exercise repetitions completed and the blue-colored number shown at the bottom right indicates the holding time for maintaining the posture.

advantage of the McKenzie method is its classification of the type of neck pain using self-tests without any special devices. Through repeated movement in a specific direction, the McKenzie method categorizes neck pain into three syndromes (i.e., posture, dysfunction and derangement) according to mechanical response to the repetition of movement in the preferred direction [11]. Finally, it provides an individualized self-care exercise program based on clinical presentations.

However, even though evidence-based intervention is effective in itself, adherence to the intervention must also be considered essential since it is a key factor in gaining maximal benefit from the intervention. Therefore, more specific management approaches to improving adherence are important [12,13]. In particular, pain management with a real-time application and simple accessibility is critical for musculoskeletal pain care in office workers.

Recently, with developing smartphone device market, application (app)-based interventions have extended to the area of healthcare for mental and physical illness [14–16] due to their accessibility to health information. Accessibility also enables users to care for chronic disease themselves, thereby contributing to active self-care practices [17] and the reduction of medical cost [18,19]. However, although the development of apps for pain management and studies examining the effectiveness of apps for care of chronic pain such as neck pain [20], widespread pain [21] or post-surgical pain [22] have increased, however there have been relatively few randomized controlled studies with strong evidence using app-based interventions for office workers with chronic neck pain [23].

Therefore, the primary aim of this study was to verify the feasibility and effectiveness of an app based neck exercise on chronic neck pain, functional disability and adherence to the intervention. Prior to the experiment, we developed a smartphone app that provides the

McKenzie neck exercise program. Second, we examined the additional effectiveness of the app-based neck exercise on neck strength, fear-avoidance belief, and quality of life.

## 2. Methods

### 2.1. Participants

Twenty-one office workers at the Korea University Graduate School in South Korea (11 men and 10 women, aged 25–35 years) were enrolled to participate in this pilot study. However, before the initial evaluation, one participant terminated contact with no specific reason. Therefore, 20 workers participated in this study for the initial evaluation.

Participants included in the study performed more than 6 h of work on a computer and complained of neck pain for more than 6 months. Participants were excluded if they had a score of less than 3 on the visual analog scale (VAS), a history of traumatic injury on neck, a congenital deformity, a history of surgical operation or injection on neck and any neurological symptoms. The participants were randomly assigned to either the app-based neck exercise group or control group.

All participants provided written informed consent before enrolling in the study. The experimental protocol was approved by Korea University Institutional Review Board.

### 2.2. Smartphone application (app)

The app was developed through discussion with clinical experts (4 clinicians, 6 physical therapists). The app provides the McKenzie neck exercise program [11] for the type of neck pain identified through

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