

The Effects of Mode of Exercise Instruction on Correctness of Home Exercise Performance and Adherence

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Objective: To evaluate the effects of (i) face-to-face verbal instructions, (ii) illustrated brochures, (iii) audiotapes, and (iv) videotapes on correctness of exercise performance and home exercise adherence.

Design: Systematic search and critical evaluation of the literature.

Method: A comprehensive systematic literature search using electronic databases and cross-referencing yielded five studies that satisfied all the following criteria: (i) investigation on the effectiveness of home exercise instruction via verbal instruction, brochure, audiotape, or videotape; (ii) prospective experiments; and (iii) quantitative outcomes for correctness of exercise performance or exercise adherence. In addition, instruction methods in adults who were prescribed exercises in hospital setting that need to be continued at home were eligible for inclusion if they met the other criteria. Excluded were papers not written in English, retrospective studies or studies that evaluated the performance of passive exercises, relaxation, or movement skills in sport.

Results: The provision of verbal exercise instructions together with illustrated handouts led to greater correctness of exercise performance and home exercise adherence than either method in isolation. In comparison to illustrated brochures, videotaped instructions were shown to enhance exercise accuracy and adherence.

Conclusion: The weight of the evidence suggests that videotaped instructions provide the most effective modality for optimising correctness of exercise performance as well as adherence. Face-to-face verbal instructions combined with an illustrated brochure enhanced correctness of exercise performance and home exercise adherence in people with back pain. Videotaped instructions in addition to verbal and written instructions were effective for older adults who had undergone hip arthroplasty. Although there is modest support for providing videotaped instructions, it is recommended that physiotherapists also consider using verbal instructions and illustrated brochures with optimal readability when prescribing home exercises for older people.

Key words: exercise therapy, adherence, patient compliance, instruction, supervision, handout, brochure, videotape, audiotape

Introduction

The purpose of this systematic review of the literature is to compare the effects of different types of exercise instruction methods used by physiotherapists to improve correctness of exercise performance and adherence to home exercise

routes. Although clinicians frequently use verbal instructions, written instructions, illustrated brochures, videotapes and audiotapes, the relative benefits of these modes of instruction on the outcome of home exercise performance has not been established.

Regardless of the mode of exercise instruction, it can be argued that exercises need to be targeted to individual needs and performed correctly (1, 2), consistently (3-5) and at the appropriate intensities (6, 7) to achieve beneficial outcomes. The instructions should therefore be clear and comprehensible to those who use them. Modes that have been used in young as well as older adults include verbal instructions (8), exercise demonstration (8, 9), written information, with or without illustrations (9, 10), audiotapes (11) and videotapes (12, 13).

Face-to-face verbal instruction is frequently used to teach therapeutic exercises (14). It enables direct communication

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between the clinician and client, and allows feedback on performance. Friedrich et al (8) found that adults aged 21 to 67 who received face-to-face instructions performed their exercises more correctly and reported a significant decrease in pain compared with those who only received an exercise brochure. The comparison group was required to learn the exercises from a handout, which may not be pitched at their level of literacy and comprehension. However, face-to-face verbal instructions might diminish in value for people with recall difficulties (15) as can occur with some older people (16, 17).

Literacy problems have been recognised as one of the obstacles to effective exercise instruction in older people. A survey conducted by the Australian Bureau of Statistics of a group of 9302 adults (18) found that almost half those aged 65 to 74 years had limited prose skills (e.g., text, newspaper), document comprehension skills (e.g., graphs) and quantitative literacy skills (e.g., numbers). Written information can be screened for readability to determine whether the literacy ability required to comprehend the material matches the reader's literacy or educational level. Instruments commonly used to evaluate the readability of written material include the Flesch Reading Ease (19, 20) and Flesch-Kincaid Grade Level (19, 20). The layout of written information (21), the use of a narrative style of writing (22) and illustrations (23, 24) can enhance comprehension of written information.

Videotapes and audiotapes can also be used to communicate information. For example, in a cohort of participants (mean age = 60.6) with limited literacy, videotapes were successfully used to enhance knowledge about illness (25). In addition, Terpstra et al (11) found an audiotape provided with written exercise information improved the performance of prescribed home exercises in older adults with rheumatoid arthritis. Combining videotapes or audiotapes with illustrated brochures may optimise comprehension, correct performance and adherence to prescribed exercises in older persons.

The purpose of the current investigation was to evaluate the effectiveness of four modes of exercise instruction to enhance correctness of exercise performance and adherence to home exercise programs. The modes were: face-to-face verbal instructions, illustrated exercise brochures, audiotapes and videotapes. For the purpose of the review "correctness of exercise performance" refers to a therapist's judgement of how accurate the demonstrated exercises have been carried out by an individual. "Home exercise adherence" refers to how well the prescribed exercise program is followed.

Methods

Electronic databases were searched using a comprehensive strategy and citations of papers found by the search were manually checked for additional relevant studies. The search strategy used exploded terms for conditions, interventions and outcomes.

Conditions

Exercise; exercise therapy; physical activity.

Interventions

Education; patient education; programmed instruction; pamphlets; brochure; teaching materials; handout; videotape recording or videotape; tape recording.

Outcomes

Correctness or accuracy of exercise performance; patient participation; patient compliance or adherence.

Databases

MEDLINE (January 1966 to June 2001); CINAHL (January 1982 to June 2001); HealthSTAR (1975 to June 2001); EMBASE (1984 to May 2001); the Cochrane Database of Systematic Reviews (Musculoskeletal Group Trials Register and The Cochrane Central Register of Controlled Trials (CENTRAL)) (1st Quarter 2001).

Inclusion criteria

Papers with the following characteristics were included:

1. Investigated the effectiveness of therapeutic home exercise instructions via face-to-face verbal instructions, brochure, audiotape, or videotape;
2. Prospective, with at least one experimental group and one control group;
3. Reported quantitative outcome assessment of the correctness of exercise performance and home exercise adherence; and
4. Subjects were older or younger adults who were instructed in home exercise routines or hospital inpatient routines.

Exclusion criteria

Papers not written in English. Retrospective studies or studies that evaluated the performance of passive exercises, relaxation or the acquisition of movement skills in sport.

Data Extraction

Demographic and methodological details of the studies were systematically extracted using a data form developed for the review and are presented in Tables 1 and 2. The method quality for each study was assessed using criteria in Table 3.

Results

The computerised search yielded 197 studies that used verbal instructions, written handouts, audiotapes or videotapes. In addition, citation checking identified two studies. After screening the 199 studies, five met the inclusion criteria (Table 1).

Although the studies tested a variety of exercise instruction methods, there were methodological differences that limited the comparison of the findings. Some studies that investigated

Table 1. Effects of exercise instruction modes on exercise performance: data extracted from the five papers that met the inclusion criteria

First author + Design	Instructional mode Control/Experiment	Sample + Setting	Educational level of sample	Readability of written text	Results for experimental groups	Other outcomes for experimental groups
Friedrich et al 1996 RCT	Illustrated brochure (three versions), or illustrated brochure + face-to-face verbal	87 patients with neck pain or low back pain referred to a physiotherapy department	College education: yes/no	Not disclosed	<ul style="list-style-type: none"> • A higher level of home exercise adherence, and • Better quality of exercise performance for those instructed verbally 	<ul style="list-style-type: none"> • Improved muscle status according to a classification of Janda • Less pain
Jackson 1994 RCT	No booklet, a booklet, or a booklet with cues to enhance credibility of doctor	68 back pain patients attending an osteopathic clinic	Not disclosed	Tested on high school students	<ul style="list-style-type: none"> • Better home exercise adherence in the group who received the booklet with cues 	<ul style="list-style-type: none"> • Greater confidence in medical advice
Lin et al 1997 Quasi-experimental	Verbal instruction + booklet, or verbal instruction + booklet + videotape	60 patients pre/post arthroplasty in an orthopaedic hospital	Primary Junior high Senior high > College	Not disclosed, but lay-out was considered	<ul style="list-style-type: none"> • Better exercise adherence and quality of exercise performance for the videotape group 	<ul style="list-style-type: none"> • Increased knowledge on self-management • Better postoperative knee flexion
Schneiders et al 1998 RCT	Verbal, or verbal + personalised illustrated brochure	96 low back pain patients at private physiotherapy clinics	Not disclosed	Not disclosed	<ul style="list-style-type: none"> • Better home exercise adherence for those who received the illustrated brochure 	<ul style="list-style-type: none"> • Both groups showed comparable improvements in outcome measures
Weeks et al 2002 RCT	Illustrated Brochure, or Videotape	20 college-aged subjects	University	Not disclosed	<ul style="list-style-type: none"> • Higher acquisition and retention scores in the videotape group 	<ul style="list-style-type: none"> • Preference for videotape • Greater confidence in correct performance

the effectiveness of written information did not report details on the skills required to read the handouts (e.g., Weeks et al, 2002), the levels of education or literacy of the subjects (e.g., Schneiders et al, 1998), or the layout of the text (e.g., Friedrich et al, 1996). Hence it is possible that mismatches occurred between readability of the written material and levels of education in some of the studies. The studies were therefore analysed individually and grouped by the instruction method(s) investigated.

The effects of verbal instructions on exercise performance

Friedrich et al (8) examined the effects of instructions provided by a brochure alone or a brochure combined with instructions and advice delivered by a physical therapist. Thirty-three females and 54 males with neck pain and lower back pain were studied. The mean age was 48 years (range of 21 to 67 years). All exercises could be performed without the assistance of another person. Correctness of exercise

performance, back pain, muscle length and muscle strength of cervical flexors, rhomboids, abdominals, and gluteus maximus and medius were assessed before and after therapy. Correctness of exercise performance was rated by using a three-point scale (1 = most correct, 2 = not quite correct although not harmful, 3 = not correct). Participants in the group that received physical therapy instruction in addition to brochures, performed their exercises more correctly compared to those who received brochures alone (median correctness of exercise performance = 1.0 versus 1.6, $p < 0.01$). The interquartile ranges were 1-1.3 and 1.4-1.9, respectively, indicating that few participants performed the exercises incorrectly. It was found that exercises performed using a brochure without supervision were only executed correctly by 50% of patients. Face-to-face exercise instructions resulted in better correctness of exercise performance, although some participants who received a brochure alone may have been disadvantaged due to the reading skills required.

The effects of written instructions on exercise performance
 Schneiders et al (9) examined the influence of written instructions in addition to face-to-face verbal instructions on adherence and health outcomes in a randomized, prospective survey of people with back pain. Short-term adherence to prescribed therapeutic home exercises was measured in 40 females and 56 males with acute or sub-acute spinal pain who received manipulative physiotherapy. Participants were given an exercise diary that they had to complete after each exercise session. The number of consultations, type of exercises, exercise frequency and exercise intensity were prescribed by the treating physiotherapist. The experimental group received a personalised computer generated handout with illustrations and detailed instructions on the performance of the selected exercises. The participants in the control group did not receive any forms of written reinforcement. The results showed that exercise adherence was greater in the experimental group (74.4%) than the control group (38.1%). It was concluded that patients, who received their exercise program using verbal instructions, coupled with written reinforcement had

greater adherence to home exercise routines than patients who received verbal instructions alone. The study had a number of methodological limitations that could have influenced the results (see Tables 1, 2, 4). These include differences at baseline in participants' expectations of receiving exercises as a part of their treatment and variations in the number of exercises prescribed. Also, although no comparison was made between the groups, the number of visits to the treating physiotherapist was not the same for each participant.

The effects of verbal and written instructions with "credibility enhancing cues" or illustrations

The term "credibility enhancing cues" refers to favourable suggestions that increase the reader's perception of the trustworthiness of the practitioner delivering the exercises. For example, exercise handouts can provide information on the academic and professional achievements of a practitioner. Jackson (10) provided information booklets to participants in two experimental groups in a study involving patients with low back pain. The booklets included educational information

Table 2. Strengths of the studies that examined the effect of exercise instruction methods on correctness of exercise performance and adherence

First author	Validity and reliability of exercise accuracy or regularity instruments	Nature of data	Analyses	Size of the groups	Evidence
Friedrich et al 1996	Accuracy interrater reliability agreement yielded a kappa coefficient of 0.88	Ordinal (3-point scale)*	Mann-Whitney U test	47 participants (29 males) received verbal instruction and supervision, and 40 (25 males) received a brochure alone	Support for verbal instruction and supervision over a brochure alone to enhance exercise accuracy
Jackson 1994	Not disclosed	Ordinal (4 yes/no questions)	MANOVA	68 participants (27 males) were divided into three groups (group sizes not disclosed)	Support for enhanced exercise adherence when handouts include a practitioner credibility-enhancing cue
Lin et al 1997	Accuracy interrater reliability agreement of 94%. No details on the 3-point exercise adherence scale	Ordinal (3 yes/no accuracy tasks)	T-test ANCOVA	Two groups of 30 (11 males in the experimental group, 18 males in control group)	Support for the use of videotapes over a brochure alone to enhance exercise accuracy and adherence
Schneiders et al 1998	Not disclosed	Continuous (percentage of exercise adherence)	T-test, ANOVA, Mann-Whitney U	Two groups, 49 (30 males) in the control group and 47 (26 males) in the experimental group	Support for the use of illustrated brochures over verbal instruction alone to enhance exercise adherence
Weeks et al 2002	Chronbach's alpha accuracy interrater reliability agreement of 0.80	Ordinal (3-point scale)*	ANOVA	Two groups of 10 (five males and five females)	Support for videotapes over brochures to enhance exercise accuracy

* Weeks et al and Friedrich et al used a 3-point instrument to measure exercise accuracy (not accurate to accurate)

Table 3. Criteria for methodologic assessment of instructional studies¹

Criteria	Description	
1	Was the level of education or literacy comparable across groups?	Yes/No
2	Were at least 85% of the subjects able to comprehend the instructional material?	Yes/No
3	Were primary outcome measurements sensible (face validity)?	Yes/No
4	Was information provided on point measures and variability for at least one primary outcome measure?	Yes/No
5	Were participants randomly allocated to the groups?	Yes/No
6	Was group allocation concealed?	Yes/No
7	Were groups comparable at baseline in relation to the most important prognostic indicators?	Yes/No
8	Did all participants for whom outcome measures were available receive their allocated intervention, or were data analysed by intention to treat?	Yes/No
9	Was attrition rate less than 15%	Yes/No
10	Were groups treated equally?	Yes/No
11	Were outcomes assessed by a blind assessor	Yes/No

¹ The PEDro scale was adopted for criteria 4-9 (<http://ptwww.cchs.usyd.edu.au/pedro/>)

on soft-tissue injuries, common interventions for these conditions, the rationale for exercise as a part of the rehabilitation and the importance of active participation in this rehabilitation process. The credibility enhancing cues were provided in the form of a photograph of the practitioner in which his diplomas were visible in the background and text that made frequent references to the practitioner. All groups received therapeutic exercises to be performed during a two-week period. One group ($n = 16$) received a copy of the booklet and another group ($n = 16$) received the same educational information in addition to reinforcements from their osteopath. A third group ($n = 19$) did not receive a booklet. The group who received the booklets with credibility-enhancing cues had greater confidence in the medical advice and reported a significantly higher level of exercise adherence than the group who did not receive a booklet (92% versus 50%, $F(2,48) = 5.05, p < 0.01$). Whether the findings are generalizable remain unknown.

The effects of videotaped instructions on exercise performance

In a study by Weeks et al (13), videotaped exercise instructions were compared with written instructions to enable young adults to learn therapeutic exercises. The sample included ten female and ten male college-aged students who were randomised into two groups. Participants

were tested on the acquisition and memory retention of the exercises, their preferred modes of instruction and their confidence in performing the exercises correctly. In comparison with the participants who received illustrated written material, the group with the videotaped exercise instructions demonstrated greater quality of exercise performance and had more confidence in performing the exercises correctly. At the completion of the study, the participants were provided with the alternative instruction methods. All agreed that videotapes were their preferred method of instruction.

Another study tested the effectiveness of videotaped exercise instruction in people undergoing total knee arthroplasties. Lin et al (27) compared the effectiveness of pre-admission and post-admission educational programs on the correctness of exercise performance and exercise adherence. Each participant in the control group received an instruction booklet with accompanying exercise instructions after admission to the ward, while participants in the experimental group received the same booklet and exercise instructions during a pre-admission outpatient clinic visit. This enabled the experimental group subjects to read the instructions at home before admission to the ward. The videotaped exercise instructions were presented upon admission. The experimental group had a higher mean knowledge score (15.3 versus 11.5, $p < 0.05$), performed the exercises more regularly ($M = 14.93$ versus 8.87, $p < 0.05$) and accurately ($M = 2.43$ versus 1.57, $p < 0.05$) and had greater flexion of the knee joint than the control group ($M = 77.84$ versus 70.16, $p < 0.005$) post-operatively.

Discussion

The results of this systematic review showed that the combination of videotapes, face-to-face verbal instructions and illustrated handouts was an effective method of exercise instruction for enhancing the correct performance of home exercises, as well as, adherence to home exercise programs. Face-to-face verbal instructions combined with illustrated brochures were effective for enhancing exercise performance; they relied on the person's ability to interpret written information and recall verbal instructions. This can be difficult for some people, particularly when they are elderly or have low levels of literacy. The addition of credibility enhancing cues has shown to improve home exercise performance by increasing adherence.

The effects of verbal and written instructions on exercise performance

The positive exercise performance results of studies that had examined the effectiveness of face-to-face verbal instructions together with written instructions have to be interpreted with some caution. For example, the literacy level to read the brochures in a study by Friedrich et al (8) was not disclosed. Partitioning participants into a minority that received college

training and a larger group that did not receive college training did not assist identification of material that was likely to be understood by most participants. A discrepancy between the required level of literacy to interpret and carry out written instructions, and the levels of education, had negative impact on the results with written brochures, as noted in the study by Cardinal and Seidler (28). In addition, there appeared to be differences in the levels of education and the incidence of concomitant treatment between a group that received exercise brochure alone, and a group that received exercise brochure and verbal instructions in the study by Friedrich et al (8). Participants in the control group were more educated and received less concomitant treatment. The possibility that people with higher levels of education were less exercise adherent (29) and those who had less opportunities to receive positive feedback provided during treatment sessions were less exercise adherent (30), could have contributed to the lower level of exercise adherence in the control group.

Although the study by Schneiders et al (9) showed that illustrated instructions could be accessed at home in order to increase adherence, it did not control for the number of exercises, the types of exercises, the required number of repetitions, exercise duration, exercise intensity, perceived pain, dysfunction and concomitant treatment. It has been argued that a greater number of prescribed exercises (31), pain (32) and higher levels of exercise intensity were associated with decreased exercise adherence (33-35).

The effects of verbal and written instructions with credibility enhancing cues

The inclusion of credibility enhancing cues in handouts was shown to increase adherence to instructions in one study. Jackson (10) found that credibility enhancing cues about the practitioner in exercise handouts used by patients with low back pain increased home exercise adherence. The results of

this study need to be interpreted with some caution. Sixty-eight patients with a mean age of 43 years were included in the study and randomly assigned into the three groups. However the results for 49 patients were analyzed, which could have introduced a Type I error. No further breakdown, baseline characteristics or concomitant intervention were provided for the final sample. The additional interventions provided might have influenced the pain perceived and subsequently, exercise adherence. Other factors such as the types of exercises prescribed, the number of repetitions and the required exercise intensity were also not disclosed.

It was not clear if better adherence was achieved by the inclusion of a photograph or by the text, which might be more narrative (22) or referred specifically to the osteopath's instructions to the patients. Despite these limitations, it appears that an instructional booklet in addition to face-to-face verbal instructions may be an effective strategy to increase home exercise adherence.

Several studies in hospital emergency departments had reported the benefits of adding illustrations or cartoons to written discharge instructions for patients (23, 24). Information with added illustrations were more likely to be read, understood and adhered to by the patient (24). Although these studies did not examine exercise prescription adding illustrations to written information was an inexpensive and easy method to increase the effectiveness of written instructions.

The effects of videotaped instructions on exercise performance

Videotaped instructions were found to be superior to written instructions when teaching therapeutic exercises (13, 27). Although videotaped instructions had been used to promote physical activity and exercise after cardiac bypass surgery

Table 4. Methodologic assessment details of studies that examined the effect of exercise instruction methods on exercise performance*

First author	Strengths	Potential bias	Other comments	Points deducted for potential bias	Quality rating (11 = maximum score)
Friedrich et al 1996	3, 4, 8, 11	1, 2, 7, 9	Differences at baseline, e.g., concomitant treatment	4	7
Jackson 1994	5	1, 2, 6, 7, 9, 11	Findings may be applicable to the patients of one doctor alone	6	5
Lin et al 1997	3, 4	1, 2, 5, 7, 10, 11	Possible confidence in exercising by seeing 'a patient' exercising	6	5
Schneiders et al 1998	5, 11	1, 2, 6, 7, 10	Differences in 'expected exercise as treatment' at baseline may have confounded the adherence results	5	6
Weeks et al 2002	3, 5, 6, 10, 11	2, 7, 8	Analyses of skewed ordinal data by using ANOVA could have overestimated the effects	3	8

*Using the criteria for methodologic assessment from Table 3.

(36) and performance of home exercise in older population (12), only one study controlled for the readability of the written educational material and involved a large sample ($n = 1100$, mean age = 60.6 years) (25). The study by Meade et al (25) used videotaped information to aid comprehension and adherence to therapeutic advice in patients with limited literacy skills. The results showed that the videotaped education and written material both increased knowledge when compared to a control group who had to rely on recalling the verbal information provided.

The effectiveness of videotaped exercise instructions was tested in people after knee arthroplasty by Lin et al (27). Unfortunately, the groups were not treated equally since the control group did not receive an information booklet prior to hospital admission whereas the experimental group did. There also appeared to be a discrepancy between the groups in relation to the level of education, which could have favoured exercise adherence in the experimental group (29, 30). While many people in the control group had college education, most people in the experimental group had primary school education. Lin and colleagues did not report the reading skills required to comprehend the booklet, although the layout was considered for the use by older people.

The effects of illustrated handouts combined with audiotaped instructions on exercise performance

The effectiveness of audiotaped instructions combined with illustrated handouts has not been tested in therapeutic exercise studies. Although audiotapes and videotapes can give additional cues and reinforcement that may not be provided by written information, a study on the performance of tennis serves suggested otherwise. There was no difference in the results between players who were given no strategy as compared to those who were instructed of a five-step strategy by videotape or audiotape with written transcripts (37). Audiotapes were easier and less expensive to produce than videotapes and may be an effective substitute for videotapes (38). A study on rheumatoid arthritis (11) included audiotapes as part of their methodology and demonstrated enhanced compliance with exercise at home after discharge from a rehabilitation clinic. Although there was no control group, Terpstra and colleagues (11) found that the combination of written exercise information and an audiotape appeared to have a positive effect on adherence results. No studies were available that tested the effectiveness of written information together with an audiotape, or studies that compared the effectiveness of additional audiotaped instructions versus videotaped instructions.

Conclusion

There is evidence that prescribed exercises have to be performed correctly and adhered to on a regular basis to be effective. The mode of exercise instruction has a differential effect on the accuracy of exercise performance, as well as,

adherence to the prescribed exercise programs. There is moderately strong evidence that face-to-face verbal instructions together with a written handout can enhance the correctness of exercise performance and adherence to a home exercise program. There is modest support for the provision of additional videotape instructions to further improve the correctness of exercise performance and adherence. The use of illustrations and "credibility enhancing cues" within the text can also enhance correctness of exercise performance and adherence.

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