

Factors influencing adherence to a home-based strength-training programme for young people with cerebral palsy

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Abstract

Background and purpose There is evidence that strength training can be beneficial for young people with cerebral palsy. To successfully implement a strength-training programme the physiotherapist should consider factors that can affect adherence. This study explored factors that influence adherence to a home-based strength-training programme for young people with cerebral palsy.

Methods Eleven young people with cerebral palsy and their parents were interviewed after completing a six-week home-based strength-training programme that led to improved lower limb strength. The in-depth interviews explored issues related to adherence. Transcripts of the interviews were coded independently and themes on adherence to strength training were developed.

Results Two themes emerged categorised as: environmental factors and personal factors. Environmental factors optimising adherence included emotional and physical support from family members, provision of equipment, provision of an exercise logbook, having a programme with a small number of exercises, and the role of the physiotherapist as exercise coach. The main personal factors influencing adherence were motivation, autonomy, and the effort involved in completing the exercises, while some participants commented on health issues and time management.

Conclusions The personal and environmental factors that influenced adherence to a simple yet effective strength-training programme for young people with cerebral palsy can be influenced and facilitated by the physiotherapist.

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Keywords: Strength-training; Adherence; Qualitative; Interviews; Cerebral palsy

Introduction

Strength training can be beneficial for young people with cerebral palsy. A recent review of 10 empirical studies [1–10] concluded that strength training can increase muscle strength in young people with cerebral palsy and that there were no adverse effects, such as increased spasticity [11]. Further, there was evidence in the review that strength-training improved motor activities including walking ability.

The key elements of a strength-training programme are that

- sufficient resistance is applied so that only a relatively small number of repetitions (usually less than 12) can be completed before fatigue;
- resistance is progressed as strength increases;

- the programme runs for a sufficient time (usually a minimum of six weeks) for the benefits to accrue [11–13].

As strength training involves effort, it is necessary that time for recovery be allowed between training sessions. For this reason, most strength-training programmes comprise only three exercise sessions per week.

Many programmes have required intensive supervision or expensive equipment. For example, isokinetic dynamometers with individual supervision have been used in a number of studies [2,3,5,9]. It may not be feasible for a physiotherapist working independently and with limited resources to implement such a programme. A home-based programme using simple equipment may be more feasible.

To successfully implement the programme, the physiotherapist must also consider factors that affect adherence. Adherence is the extent to which a client completes the active element of treatment effectively following advice and instructions [14] and comprises a wide variety of behaviours including entering into and continuing a treatment

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programme, attending therapy appointments and performing home-based exercises [15]. Adherence has been identified as an area of high priority for research in physiotherapy [16]. Investigation of the factors associated with adherence to a home-based strength-training programme in young people with cerebral palsy lends itself to a qualitative analysis, by exploring the perceptions of the people who complete the programme.

The aim of this study was to identify factors that may influence adherence to a home-based strength-training programme for young people with cerebral palsy, based on the perceptions of participants who had completed a programme.

Methods

Design

This study used a qualitative research design utilizing in-depth interviews. The study received ethics approval from Hospital and University Human Ethics Committees. The participants in this study comprised the experimental group in a randomised controlled trial evaluating the effects of strength training [17]. At a follow-up measurement session held three months after completing a 6-week strength-training programme, the participants in the strength-training group and their parents were invited to an interview for the qualitative study. All 11 young people with cerebral palsy and their parents accepted and gave informed consent. This study focused on the factors that influenced participation and adherence to the strength-training programme. The results of the outcomes of the strength-training programme, based on the perceptions of the participants, have been published elsewhere [18].

Participants

Participants were 11 young people with cerebral palsy and their parents (Table 1). Inclusion criteria were that the young people with cerebral palsy were aged between 8 and 18 years, had spastic diplegic cerebral palsy, and were able to follow simple instructions. Four boys and seven girls (mean age 12.7 years, S.D. 2.8) were all verbally articulate and attended mainstream schools. Seven walked independently with an assistive device, while four walked unaided. Two of the participants were classified at level I, two at level II, and seven at level III (indicating more disability) on the Classification of Gross Motor Function [19]. All participants had been managed by orthopaedic specialists and at the time of this study had no orthopaedic deformity or demonstrated a major equinus deformity. Orthopaedic management included multilevel surgery (at least 24 months prior to this study), isolated calf lengthening or botulinum toxin for the management of dynamic equinus. Parents of the participants were also interviewed. For nine of the participants in the strength-

Table 1
Participant details

Pseudonym	Age (years)	Parent interviewed	Mobility level/assistance
Susie	14	Mother	Walked without assistive devices
Petria	16	Mother	Two single point sticks
Cathy	12	Mother	Walked without assistive devices
Samantha	14	Mother	Walked without assistive devices
Ian	14	Father and mother	Two sticks and two ankle foot orthoses
Nicole	17	Mother	Two sticks
Grant	8	Mother	Walker and two ankle foot orthoses
Tracy	9	Mother	Two forearm crutches and two ankle foot orthoses
Kieran	11	Father	Two forearm crutches and two ankle foot orthoses
Michael	14	Father and mother	One forearm crutch
Hayley	11	Mother	Walked without assistive devices

ening programme, one parent was interviewed (eight mothers, one father). For the remaining two both parents were interviewed.

Strength-training programme

Participants completed a home-based programme of exercises designed to strengthen the major support muscle groups of the lower limb: the ankle plantar flexor, knee extensor and hip extensor muscle groups. The exercises were: bilateral heel raises off the edge of an aerobic step; bilateral half squats using a large inflatable ball (55 cm) to guide the movement; and step-ups on an aerobic step. At the first session, the physiotherapist supplied the equipment (large inflatable ball, aerobic step, backpack and free weights), taught the exercises and adjusted training load to ensure a strengthening effect. The training load was adjusted by adding free weights to a backpack worn by the participant so that they could complete between eight and ten repetitions of each exercise correctly before fatigue [13]. Participants were instructed to complete three sets of each exercise three times a week for the 6 weeks of the programme. Participants were provided with a logbook to record the details of exercises completed at each session. The physiotherapist visited the participant at home at the end of the second and fourth weeks to check that exercises were performed correctly, provide advice and progress the training load.

All participants were instructed to continue with their usual daily activities, including school and sport. They also attended their normal physiotherapy program, typically limited to a school consultation of about 45 min once or twice a month providing therapy did not include strength training. It was not expected that this physical activity at school, sport or physiotherapy would lead to any strength changes, as specific requirements of progressive resistance exercise are required to increase strength [13].

Analysis of the logbooks showed that participants were adherent to their prescribed programme, completing an average of 16.9 (S.D. 2.3) of the scheduled 18 training sessions. The logbooks also showed that training load progressed with the average load added for each exercise more than doubling in that time. Compared with a control group, participants in the strength-training group significantly increased lower limb strength at 6 weeks (experimental (mean increase = 5.6 kg, S.D. 6.3); control (mean = -0.2 kg, S.D. 6.3); $F(1, 19) = 4.58, P = 0.046$) and at the follow-up session 12 weeks later (experimental (mean increase = 10.6 kg, S.D. 12.0); control (mean = 0.7 kg, S.D. 7.0); $F(1, 19) = 6.25, P = 0.041$) [17]. During the interview, each participant’s evaluation of the benefits of the programme was recorded on a 10-cm visual analogue scale with the anchors ‘not worthwhile’ and ‘extremely worthwhile’. Responses were all towards the ‘extremely worthwhile’ end of the scale, with parents giving a mean rating of 8.9 (range 7.1–10.0, S.D. 1.0) and young people a mean rating of 7.9 (range 5.5–10.0, S.D. 1.7) out of 10 [18].

Interviews

One of the investigators (HMcb) conducted all the interviews, and the participants chose the times and settings of the interviews. Nine participants were interviewed in their homes and two were interviewed at the University. Parents were not present when their child was interviewed; and the young person was not present during the parental interview. The interviewer was not known to the participants and had not been involved in the strength-training programme.

In-depth interviews were used to explore the factors that affected the ability to participate in a strength-training programme. A preliminary schedule of questions was developed to guide the interview. The schedule contained broad areas to be discussed and was revised as new topics were raised

during the interview. The broad areas were the practicality of doing the programme, the effort involved in the exercise programme, and the usefulness of the exercise logbook.

Interviews were tape-recorded and each conversation was fully transcribed. Copies of transcripts were returned to participants to check for accuracy and to add any new information [20]. No alterations were suggested. To ensure participant anonymity each participant was given a pseudonym.

Analysis

The transcripts were independently read and re-read by three of the researchers (KD, NT, HMcb), and all passages were coded with a descriptive word to identify the category. One researcher coded the data using software (QSR NUD*IST 4, Non-numerical Unstructured Data Indexing Searching and Theorizing, Qualitative Solutions & Research Pty Ltd., Australia), while two researchers coded responses manually. After initial coding the research team met and compared results. Similar codes were grouped together as themes. At this stage the research team identified the relationships between the themes and the key elements of a strength-training programme identified from a search of the literature [11–13].

Results

Thematic analysis identified two categories of variables affecting adherence to a home-based strength-training programme: environmental and personal factors (Fig. 1).

Environmental factors

The major environmental factor influencing adherence to a home-based strengthening programme was reported to be

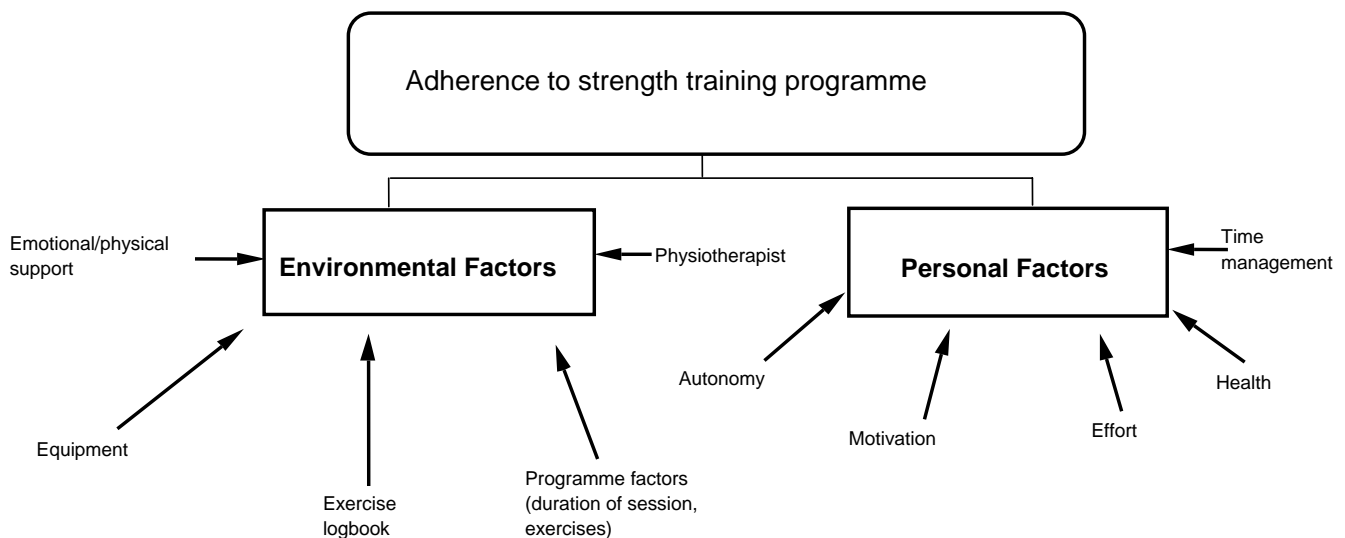


Fig. 1. Factors contributing to adherence to strength-training programme for young people with cerebral palsy.

emotional and physical assistance from family members, particularly the parents. Many participants emphasised the importance of emotional support: “It would need verbal encouragement to just keep going” (Nicole’s mother). Ian said “it was more that I wanted to know if I was doing them right . . . Mum would be there and say go up harder or do this better or something like that”. Physical support to help with tasks such as setting up the equipment, adding weight or providing assistance with balance was also important for most participants: “I don’t believe I could have done it completely without help” (Nicole). “He couldn’t do the exercises unless we were around . . . we had to be here to help” (Ian’s father).

Another environmental factor reported to influence adherence was the availability of suitable exercise equipment. Some participants reported that providing equipment suitable for use in the home-based training programme was “an essential part of the programme” (Petria’s mother). Participants also reported that without the equipment it would be difficult because “it’s not there ready for you, it’s not accessible so you tend to say “oh, I’m too busy at the moment” (Petria’s mother). However, a small number of problems were reported with some pieces of equipment, particularly the backpack. Susie found that the straps on the backpack “were rather thin and it felt uncomfortable”, while Nicole said “it was difficult to have the weights on my back in the backpack because they weren’t evenly fitted and they sometimes seemed to pull me over or put me off balance.” Although there were some equipment problems, these did not appear to affect adherence, with several parents developing solutions to these problems in consultation with the physiotherapist. For example, Petria’s mother “put two of the smaller weights on her arms as arm bands and a foam exercise belt, like a kidney support belt with the rest of the weights placed around her waist”. To stop the weights moving round in the backpack during the exercises Susie “velcro’d them to the bottom of the bag”.

Provision of an exercise logbook was another factor mentioned as important for adherence by many of the participants. The exercise logbook which contained a description of each exercise and enabled participants to record the amount of weight lifted and the number of sets and repetitions done each session as well as any comments about the session, was regarded by almost all participants as being “very useful” (Michael’s mother). “I really liked that logbook. It was a useful reminder of what to do and how much weight, and we needed that, but I liked it specifically for comments” (Grant’s mother). The logbook was also helpful because “it kept me on track” (Nicole) and it was reported to be a motivational tool: “It gave him something to work against and set the challenge for next time to work against . . . If we didn’t write down what he did, I don’t think he would have done half as much because there wouldn’t have been the incentive” (Ian’s mother). “Having it (the logbook) there visually was a reminder and it was a motivator too” (Nicole’s mother).

Other environmental factors reported related to programme factors such as the number of exercises prescribed each session: “the fact that it was just three simple exercises made it a lot easier . . . keeping it simple to three practical exercises was important” (Nicole’s mother). “I wouldn’t be looking to increase the programme. I thought the three exercises was enough” (Grant’s mother). The relatively short amount of time it took to complete each exercise session “was a selling point for Tracy” (Tracy’s mother).

Support from a physiotherapist was a further factor identified by some participants. It was considered important for the physiotherapist who developed and monitored the programme to understand the principles of strength training and be “an experienced leader” (Cathy’s mother). Petria’s mother stated that it was important to have a “visiting physiotherapist as a back up” and Samantha found that she was more confident in doing the programme once “the physiotherapist came and showed me how to do it all”. Another important role for the physiotherapist was to act as an exercise coach. For example, Nicole’s mother reported that “the home visiting physiotherapist helped me get back on track”. Some parents reported that it was beneficial to have an expert who was external to the family to take on this role: “I think she would take more notice of someone else not their mother” (Cathy’s mother). A further role identified was for the physiotherapist to be available to work with the family to problem solve individual issues that arose during the programme. This was particularly related to solving equipment issues and monitoring how the exercises were performed. Grant’s mother reported that it was important for the physiotherapist to “watch Grant do a set and for her (the physiotherapist) to be able to say look, posturally, this is not great for your child and that perhaps you could do that (reduce the weights or modify the exercise).”

Personal factors

A personal factor important for adherence was the participant’s ability to decide whether to participate in the programme: “My daughter undertook to do the programme and she was quite in agreement with it, so we had an agreement at home that she would undertake the responsibility for setting aside the space and the time of day and so forth” (Tracy’s mother). “He did it because we agreed that we were going to do it” (Grant’s mother).

One of the main personal factors influencing adherence was reported to be motivation on the part of the young person. Belief that the programme could lead to meaningful changes to their lives was important in providing motivation for some young people: “I did it because I want to walk” (Kieran). Others emphasised that trying to increase the effort put in each exercise session was motivating: “He knew he wanted to improve on each session so it became a very important goal for him . . . he didn’t quit and he was determined” (Michael’s father). “She was happy with herself for progressing things” (Petria’s mother). “He wanted to do the exercises

and to do better and to increase the effort... competing with himself gave him added motivation" (Ian's father).

Related to the personal factors of motivation and autonomy was the realisation of the participants that strength-training involved a considerable amount of effort: "There was a lot of effort involved but I got there (Petria)". Petria's mother commented "she would get really very hot and sweaty from it because of the physical exertion". The amount of effort involved was also a novel experience for some of the participants: "It (my normal physiotherapy programme) was not half as intense (as strength-training)" (Susie). "She's never done any weights before. It's really physically challenging for her to do it and she had never encountered that type of programme" (Petria's mother). However, the amount of effort involved was perceived by some participants to be a negative factor: "I didn't like it (the programme) much because... it was pretty hard" (Hayley).

Some participants identified health factors such as fatigue and bouts of illness as having an effect on adherence to the programme. "Sometimes I got like tired or stressed out so I didn't actually feel that I could do it because I was not feeling too good" (Nicole). Although many of the young people reported that they had experienced a bout of illness during the programme, this appeared to slow progression of the programme rather than lead to missed sessions: "... I was sick as well so that made it hard... it was hard to get back" (Petria). Susie reported that "occasionally you get tired and I did have a bit of a kidney infection in the middle. That didn't help, particularly when you're a bit hunched up going 'I can't lift the weight'. So there are probably a couple of places in the logbook where I go from 15 (kgs) back to 12, and then back to 15 again".

A number of participants emphasised the importance of effective time management. Competing activities such as family, social and school functions commonly reduced the amount of time available to complete the exercise programme. Almost all of the participants commented that "... fitting it all in time-wise, that was hard" (Samantha). "We did have a bit of a problem in finding the time to do it as regularly as we should have" (Michael's mother). Despite having busy social and family lives, participants "did try to fit it in no matter what was happening" (Nicole). "With time, we just made time" (Hayley's mother).

Discussion

A growing body of evidence confirms that strength-training programmes can be beneficial for people with cerebral palsy. However, the efficacy of these programmes depends on adherence. This qualitative study provides information about factors affecting adherence to a home-based strength-training programme for young people with cerebral palsy. The environmental and personal factors affecting adherence identified have the potential to be influenced and facilitated by the physiotherapist.

One of the most important factors in implementing a strength-training programme is for the physiotherapist developing and monitoring the programme to understand the key principles of strength training. To increase muscle strength the training intensity needs to be progressed (i.e. the load is increased over time as muscles become stronger), the programme should comprise one to three sets of each exercise, within each set muscle fatigue is reached within 8–12 repetitions, rest periods of approximately 2 min are given between each set of exercises, exercise sessions are performed two to three times per week with at least one day between each exercise session, and the programme must be adhered to for at least 6 weeks [13]. Therefore, the dosage of strength-training programmes is quite different from the exercise dosages commonly prescribed by physiotherapists. Physiotherapists often prescribe exercises that emphasise sub-maximal effort repeated a number of times during the day (e.g. [21]), perhaps more concerned with training a skill rather than with gaining muscle strength.

The role of physiotherapist as coach was a factor that promoted adherence to the strength-training programme. This role included progressing exercise dosage and monitoring exercise technique, as well as providing emotional support and encouragement. Positive attention by the physiotherapist has been identified as important in helping convey value to the exercise programme [22]. Another important task for the physiotherapist is to be available to work with families to solve individual problems that arise during the programme including the need to modify exercise equipment.

Facilitating and maintaining the young person's motivation throughout the duration of the programme was one of the most important factors for adherence to the strength-training programme. Motivation is important because increased strength can only occur if the young person exerts effort. There are a number of things the physiotherapist can do to facilitate motivation. First, provision of information about the possible benefits of strength training for people with cerebral palsy because it is particularly important that the benefits are important and meaningful to the young person and their family. Improvements in physical activity, mobility and the ability to participate more fully in societal roles, have greater meaning than changes in impairments such as muscle strength, joint range of movement or muscle stiffness. Second, the physiotherapist could develop a written contract with the participant. As part of recruitment for this research project each participant and their parent was provided with detailed written information about the programme. They were given an opportunity to ask any questions and clarify any issues. Only then were they asked to provide written informed consent to participate in the programme.

As the results show, autonomy about whether to participate in the programme was reported to be an important factor for increasing adherence. The amount of effort involved in strength training means that all will not embrace this form of exercise. Formally providing participants with

a choice about whether they want to participate in exercise programmes has previously been suggested as a technique that positively influences adherence [23].

Encouraging and facilitating parental support is important. The finding that the need for emotional support, particularly from family members, is consistent with studies that have shown that psychological support can increase adherence to exercise programmes [24,25]. The results of this study show that physical support is also important for young people with cerebral palsy, who commonly have problems with balance and coordination. The physiotherapist in the role of facilitation can involve and educate the parents about their role in providing positive emotional support, and, where appropriate, demonstrating how to physically support their child.

Providing appropriate exercise equipment, suitable for use in the home environment, can increase exercise adherence. Participants reported that if they were left to find appropriate equipment this would increase the effort and the time commitment and so increase the risk of non-adherence. Previous studies have also demonstrated a positive relationship between adherence to exercise and access to appropriate equipment [26,27]. The equipment may act as a visual reminder.

The logbook had a number of positive effects. First, it provides a written record of exercise technique and the recommended exercise dosage. Providing written information has been recognised as an important factor in adherence to rehabilitation [28–30]. Second, a logbook can increase motivation and improve adherence to exercise programmes by providing a benchmark of performance from which participants can monitor improvement [31]. Although physiotherapists often provide written instructions about each of the prescribed exercises with their dosages, exercise logbooks do not appear to be used routinely.

The finding that participants liked the time efficiency of the programme, is consistent with evidence that using fewer exercises improves compliance for people participating in strength-training programmes [32]. Including only a small number of exercises reduces the duration of an exercise session, making the programme more feasible in terms of time management [33].

In conclusion, this qualitative study provides physiotherapists with clinically relevant information about factors that improved adherence in a simple yet effective home-based strength-training programme for young people with cerebral palsy. Traditionally, physiotherapists have argued against the use of strength-training programmes for people with neurological disorders because of concerns that maximal effort may lead to an increase in muscle tone and a reduction in flexibility [34]. The literature review found no evidence to support this notion. In fact, there is accumulating evidence that strength training can improve the functional activities of people with cerebral palsy [11]. Physiotherapists, with their knowledge of movement rehabilitation, skills in exercise prescription and expertise in communication and empathy are well-placed to implement this type of intervention.

Key messages

- A programme with a small number of exercises, provision of equipment and logbook, positively influenced adherence
- Support from family members is important
- The autonomy, motivation and understanding of the effort involved of the participant, all influence adherence
- The physiotherapist has an important, facilitatory role

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References

- [1] Healy A. Two methods of weight training for children with spastic type of cerebral palsy. *Res Quarter* 1958;29:389–95.
- [2] McCubbin JA, Shasby GB. Effects of isokinetic exercise on adolescents with cerebral palsy. *Adapted Phys Activity Quarterly* 1985;2(2):56–64.
- [3] Lockwood RJ. Effects of isokinetic strength training on strength and motor skill in athletes with cerebral palsy. Perth: Australian Sports Commission; 1993.
- [4] Damiano DL, Vaughan CL, Abel MF. Muscle response to heavy resistance exercise in children with spastic cerebral palsy. *Dev Med Child Neurol* 1995;37(8):731–9.
- [5] MacPhail HEA, Kramer JF. Effect of isokinetic strength-training on functional ability and walking efficiency in adolescents with cerebral palsy. *Dev Med Child Neurol* 1995;37(9):763–75.
- [6] O'Connell DG, Barnhart R. Improvement in wheelchair propulsion in pediatric wheelchair users through resistance training: a pilot study. *Arch Phys Med Rehabil* 1995;76(4):368–72.
- [7] Tweedy S. Evaluation of strength and flexibility training for adolescent athletes with cerebral palsy: full report. Belconnen, Australian Capital Territory: Australian Sports Commission; 1997.
- [8] Damiano DL, Abel MF. Functional outcomes of strength training in spastic cerebral palsy. *Arch Phys Med Rehabil* 1998;79(2):119–25.
- [9] Toner LV, Cook K, Elder GC. Improved ankle function in children with cerebral palsy after computer-assisted motor learning. *Dev Med Child Neurol* 1998;40(12):829–35.
- [10] Darrah J, Wessel J, Nearingburg P, O'Connor M. Evaluation of a community fitness program for adolescents with cerebral palsy. *Pediatr Phys Therapy* 1999;11(1):18–23.
- [11] Dodd KJ, Taylor NF, Damiano DL. A systematic review of the effectiveness of strength-training programs for people with cerebral palsy. *Arch Phys Med Rehabil* 2002;83:1157–64.
- [12] Faigenbaum AD. Strength training for children and adolescents. *Clin Sports Med* 2000;19(4):593–619.
- [13] American College of Sports Medicine. Progression models in resistance training for healthy adults. *Med Sci Sports Exercise* 2002;34(2):364–80.
- [14] Chen CY, Neufeld PS, Feely CA, Skinner CS. Factors influencing compliance with home exercise programs among patients with upper-extremity impairment. *Am J Occup Therapy* 1999;53(2):171–80.
- [15] Brewer BW. Adherence to sport injury rehabilitation programs. *J Appl Sport Psychol* 1998;10(1):70–82.

- [16] APTA. Clinical research agenda for physical therapy. *Phys Therapy* 2000;80(5):499–513.
- [17] Dodd KJ, Taylor NF, Graham HK. A randomised clinical trial of strength training in young people with cerebral palsy. *Dev Med Child Neurol* 2003;45:652–7.
- [18] McBurney H, Taylor NF, Dodd KJ, Graham HK. A qualitative analysis of the benefits of strength training for young people with cerebral palsy. *Dev Med Child Neurol* 2003;45:658–63.
- [19] Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Dev Med Child Neurol* 1997;39:214–23.
- [20] Krefting L. Rigor in qualitative research: the assessment of trustworthiness. *Am J Occup Therapy* 1991;45:214–22.
- [21] Carr JH, Shepherd RB. *Neurological rehabilitation: optimizing motor performance*. Oxford: Butterworth-Heinemann; 1998.
- [22] Sluijs EM, Kok GJ, van der Zee J. Correlates of exercise compliance in physical therapy. *Phys Therapy* 1993;73(11):771–82.
- [23] Martin JE, Dubbert PM. Adherence to exercise. *Exercise Sport Sci Rev* 1985;13:137–67.
- [24] Fisher AC, Domm MA, Wuest DA. Adherence to sports-injury rehabilitation programs. *Physician Sportsmed* 1988;16(7):47–51.
- [25] Byerly PN, Worrell T, Gahimer J, Domholdt E. Rehabilitation compliance in an athletic training environment. *J Athletic Train* 1994;29(4):352–5.
- [26] Annesi JJ. Effects of computer feedback on adherence to exercise. *Percept Motor Skills* 1988;87(2):723–30.
- [27] Sallis JF, Johnson MF, Calfas KJ, Caparosa S, Nichols JF. Assessing perceived physical environmental variables that may influence physical activity. *Res Quarter Exercise Sport* 1997;68(4):345–51.
- [28] Meichenbaum D, Turk DC. *Facilitating treatment adherence*. New York: Plenum Press; 1987.
- [29] Raynor DA. The influence of written information on patient knowledge and adherence to treatment. In: Myers LB, Midence K, editors. *Adherence to treatment in medical conditions*. Amsterdam: Harwood Academic Publishers; 1998. p. 83–111.
- [30] Schneiders AG, Zusman M, Singer KP. Exercise therapy compliance in acute low back pain patients. *Manual Therapy* 1998;3(3):147–52.
- [31] Riolo L. Commentary on correlates of exercise compliance in physical therapy. *Phys Therapy* 1993;73(11):783–6.
- [32] Henry KD, Rosemond C, Eckert LB. Effect of number of home exercises on compliance and performance in adults over 65 years of age. *Phys Therapy* 1998;78(3):270–7.
- [33] Jakicic JM, Wing RR, Butler BA, Robertson RJ. Prescribing exercise in multiple short bouts versus one continuous bout: effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. *Int J Obes Relat Metab Disorders* 1995;19(12):893–901.
- [34] Bobath B. *Adult hemiplegia: evaluation and treatment*, 3rd ed. London: William Heinemann Medical Books; 1990.

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