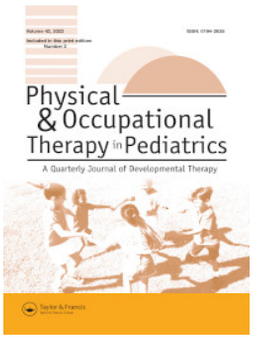

Physical & Occupational Therapy In Pediatrics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ipop20

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To cite this article: Neta Vitman, Devora Hellerstein, Aviva Zeev, Yael Gilo, Oren Nakdimon, Asaf Peretz & Sigal Eilat-Adar (2022) A Comparison between Different Types and Frequency of Physiotherapy Treatment for Children and Adolescents with Postural Problems and Low Back Pain, Physical & Occupational Therapy In Pediatrics, 42:2, 215-226, DOI: 10.1080/01942638.2021.1977759

To link to this article: https://doi.org/10.1080/01942638.2021.1977759

PHYSICAL & OCCUPATIONAL THERAPY IN PEDIATRICS
2022, VOL. 42, NO. 2, 215–226
https://doi.org/10.1080/01942638.2021.1977759

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A Comparison between Different Types and Frequency of Physiotherapy Treatment for Children and Adolescents with Postural Problems and Low Back Pain

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ABSTRACT

Aim: To examine the effect of a once-a-week group physiotherapy session in addition to a once-a-month individual physiotherapy treatment, in comparison to a monthly individual physiotherapy treatment.

Methods: Fifty children and adolescents aged 10-18 years with poor back posture, some of whom had LBP, met individually with a physiotherapist once a month. The intervention group received an additional once-a-week group physiotherapy session for 12 weeks. Thorax curve angle, postural behavior, and low back pain (LBP) were measured before and after intervention.

Results: The thorax curve angle decreased from 39.2 ± 9.3 to 28.2 ± 6.8 ($p < 0.001$) in the group + individual therapy group and from 38.9 ± 9.3 to 27.9 ± 7.8 in the individual therapy only group ($p < 0.001$). LBP decreased from 5.6 ± 2.2 to 1.6 ± 1.9 ($p < 0.001$) and from 5.5 ± 2.1 to 2.8 ± 2.0 ($p < 0.001$). A significantly greater improvement in postural behavior was found in the group + individual therapy group ($p = 0.04$). Moreover, attrition rates were lower in the experimental group.

Conclusion: A lower-frequency individual physiotherapy treatment for 12 weeks proved as beneficial as the same program with an additional higher-frequency group physiotherapy in improving thorax curve angle and LBP. However, the higher-frequency group physiotherapy in addition to the lower-frequency individual treatment was significantly more effective in improving postural behavior and adherence to treatment.

ARTICLE HISTORY
Received 24 March 2021
Accepted 1 September 2021

KEYWORDS
Adolescents; children; low back pain (LBP); physiotherapy; posture

Low back pain (LBP) is one of the most common complaints for which people seek help from their physicians. An LBP episode can result in healthcare costs, absence from work or school, and the likelihood of another episode (Babatunde et al., 2015; Kumar Dhanesh et al., 2012; Ndahimana & Frantz, 2012; O'Sullivan et al., 2012). According to the World Health Organization (WHO), the lifetime prevalence of LBP among adults in industrialized countries is 60% to 70%, with a one-year prevalence of 15% to 45%

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Supplemental data for this article is available online at https://doi.org/10.1080/01942638.2021.1977759.

(WHO, 2013). The prevalence of LBP among children and adolescents ranges from 32% to 66% (Calvo-Munoz et al., 2013; Fabricant et al., 2020). LBP prevalence increases with age, and among 17-year-olds it is similar to the prevalence among adults worldwide.

There are a number of potential risk factors for LBP in children and adolescents, including school-bag weight, rigorous physical activity (PA) among competitive athletes (Ayed et al., 2019; Calvo-Muñoz et al., 2018; Kikuchi et al., 2019), a sedentary lifestyle, lack of PA, and high BMI (Harreby et al., 1999; Schmidt et al., 2014). Prolonged slouched sitting while preparing homework or watching TV was also found to be related to LBP (Meziat Filho et al., 2015).

Postural problems due to the above risk factors are typically the main cause of LBP. Adolescents with a neutral posture had a lower prevalence of LBP (37%) compared with those with a non-neutral posture (51%) (Smith et al., 2008). Ideal posture exists when the alignment between each body part and joint demands minimal muscular effort and minimal load on passive tissues such as the bones, ligaments, joints, and intervertebral disks (May & Lomas, 2010). Good posture when standing in the sagittal plane is specified by 25-40 degrees of thorax kyphosis and 35-50 degrees of lumbar lordosis (Gil & Bocoş, 2013). Each person has unique anthropometric characteristics, and therefore individual muscular work is needed in order to achieve neutral, symmetric, and effortless posture. Poor back posture may lead to LBP, but whether improving back postural behavior at a younger age may improve thorax curve and thereby reduce LBP warrants investigation.

When reviewing the literature, it appears that the jury is still out regarding precise frequency and type of treatment for poor posture and LBP. According to Ojha and colleagues (2020) the frequency of treatment can depend on the type of population, the type of health insurance, individual needs, or the type of intervention, among other factors. According to Hoeijenbos et al. (2005), treatment should not be pre-defined, but rather individually designed following the first three weeks of treatment. Ojha et al. (2020) conducted a systematic review of eight randomized controlled trials (1153 participants) comparing "typical" physiotherapy treatment (three visits or more) with minimal physiotherapy treatment (one or two visits) in adults with LBP. They found no differences in outcome measures of pain, disability, or quality of life between the higher- and lower-frequency treatments. However, their conclusions were qualified by the small number of studies examined, the diversity of populations studied, and the different types of treatment given. It can also be argued that the difference between two and three visits is not pronounced enough for making decisive conclusions.

Research on the influence of type and frequency of treatment on LBP in children and adolescents is scant and has had mixed results (see Hill & Keating, 2015; Lee et al., 2013; Michaleff et al., 2014). In a meta-analysis of 19 prevention intervention trials of 4519 children (average age 11.3 years), studies that combined acquisition of knowledge on posture hygiene with physiotherapy training yielded the most effective results in knowledge and posture behaviors (Calvo-Munoz et al., 2013). Moreover, the greater the intensity and number of hours of the intervention, the more effective the treatment. However, these were preventive trials conducted on healthy children. The outcome measure in most of the trials was mainly knowledge acquisition. As such, optimal frequency and intensity of physiotherapy for LBP has yet to be determined in adults (NICE Guideline NG59, 2020), let alone in children and adolescents.

While the majority of physiotherapy treatments are individual, some studies have found group physiotherapy to be beneficial. In a randomized controlled clinical trial on 74 adult patients with nontraumatic inoperable shoulder pain, five weeks of group physiotherapy in comparison to five weeks of individual home therapy yielded similar results in reducing pain. However, group physiotherapy proved more effective in decreasing functional limitations and reducing attrition (Asensio-García et al., 2018). In another randomized controlled trial on 114 adult patients with nonspecific LBP, the effect of intensive group physiotherapy was compared with individual treatment (van der Roer et al., 2008). The experimental group received 10 individual sessions and 20 group sessions that included exercise therapy and education on back and postural behavior, while the comparison group received individualized treatment according to Dutch guidelines of LBP treatment which included as many sessions as the physiotherapist found necessary, with an average of 13 sessions. The experimental group showed greater improvement in pain reduction, coping, and self-efficacy. However, a one-year follow-up indicated that the differences were small and statistically insignificant. The researchers concluded that intensive group physiotherapy was not more effective than "standard" care. To the best of our knowledge, the effect of group physiotherapy on children and adolescents with LBP has yet to be investigated.

The aim of this comparison trial was to examine the effect of a once-a-month 40-minute individual physiotherapy treatment session and a weekly 45-minute group session with two physiotherapists (experimental condition) in comparison to a once-a-month individual physiotherapy treatment session, the current standard of care. The outcomes were thorax curve angle, postural behavior, and LBP. We hypothesized that participants who received the additional weekly group physiotherapy would benefit more significantly in all three outcomes.

Methods

Sample size calculation

Sample size was calculated based on the change in thorax curve angle in an intervention trial among 56 students aged 18-25 years (Seidi et al., 2014). For $\alpha = 0.05$ and $1\text{-}\beta = 0.95$ with a standard deviation of 2°, a total sample size of 30 children was required. In order to adapt to other comparisons made in the current study, a sample size of 50 children was selected for the current study.

Participants

Fifty children and adolescents aged 10-18 years, 24 boys and 26 girls, participated in the study. All of them were referred by a pediatrician or an orthopedist to the physiotherapy clinic due to LBP ($n = 33$) and/or poor back posture. Children and adolescents were excluded from the study if they suffered from a structural column condition with deterioration risk – scoliosis cob angle $> 20°$ riser sign ≤ 3, kyphosis thorax curve $> 45°$, or Scheuermann's kyphosis, or if they suffered from a severe active medical condition, such as cerebral palsy or rheumatoid arthritis. The study protocol was approved by the Medical Ethics Committee of Assuta Hospital. Both children

Table 1. Demographic and anthropometric variables*.

	Experimental group	Comparison group	Entire group	P
n (%)	17(34)	33(66)	50(100)	—
Age (Years)	14.2(2.1)	14.0(1.9)	14.2(1.9)	0.78
Mean weight (Kg)	47.4(9.9)	48.7(11.8)	48.8 ± 10.9	0.51
Mean height (Cm)	159.7(10.7)	158.7(10.4)	159.4 ± 10.2	0.40
BMI percentile > 85%	0(0)	5(15)	5(10)	0.09
Male (%)	7(41)	17(51)	24(48)	0.53
Father's education > 12Y	12(70)	29(88)	44(82)	0.13
Mother's education > 12Y	15(88)	24(73)	42(79)	0.21
At least one parent with LBP	9(53)	24(73)	33(66)	0.35

*Continuous variables are presented as mean (SD); categorical variables are presented as n (%).

and parents provided their signed informed consent. The trial was registered in ClinicalTrial.gov:NCC03046472.

Of the 60 new admission referrals, six did not meet the inclusion criteria. The 54 participants who provided informed consent were assigned to either the experimental (group and individual therapy) or comparison (individual therapy) condition. Four participants (7.4%) dropped out from the study due to lack of time. Among the 27 participants allocated to the experimental condition, 10 could not commit to attending all the group sessions and therefore continued to receive individual therapy, the standard of care. While this compromised the randomization process, it was necessary for ethical reasons. As such, 33 participants received individual therapy and 17 received group and individual therapy (experimental condition).

Demographic and anthropometric variables are presented in Table 1. No significant differences were found between groups in anthropometric data, gender, parents' education, or prevalence of LBP in parents, although 73% of parents of children who received individual therapy reported having had LBP compared with 53% of parents of children who received group and individual therapy. There was a trend toward a statistically significant higher percent of children with BMI percentile > 85 in the children who received individual therapy. Participation in leisure-time activity, time spent in sedentary behavior and sleeping, as well as sleeping habits, are presented in Table 2. No significant differences were found between groups in leisure-time activity or in sedentary and sleeping habits.

Measures

Thorax curve angle was measured by a Smartphone application. This App was validated against a "Saunders" digital inclinometer, and its reliability has been established (Kolber et al., 2013). The thorax angle is calculated as the sum of two measurements: C7/T1 and T12/L1. The participants were instructed to stand up straight, barefoot, and shirtless, based on the validated method designed by Gil and Bocoş (2013).

Postural behavior was assessed using a method developed by Cardon et al. (2001) which comprises eight observations. While this method is typically applied in school settings, this method was adapted to an in-clinic setting. Observations were divided to two categories, spontaneous and non-spontaneous postural behavior. The operational definition of "spontaneous postural behavior" in the current study is the patient's natural unconscious postural behavior, including waiting in the waiting room, walking into

Table 2. Leisure-time activity, sedentary activities, and sleeping habits n (%).

Activity and habits	Experimental group	Comparison group	P of χ^2
Leisure-time PA	10(59)	18(55)	0.77
Watching TV 3-4 hours/day	11(65)	11(34)	0.14
Working on a computer 1-2 hours/day	11(65)	17(52)	0.84
Side sleeping position	7(42)	13(40)	0.89
Sleeping 8-9 hours/night	11(65)	23(68)	0.87

the examination room, sitting in front of the therapist, and transition between exercises. "Non-spontaneous postural behavior" was defined as movements made consciously and deliberately by the participant, and included laying on a mattress on the floor, exercises in the four-point position (knees and hands on mattress), sitting exercises, and standing exercises. Each observation was graded as 0 = poor, 1 = fair, or 2 = good. Postural behavior was given a score in each category between 0-8, and overall postural behavior was summed up from 0-16.

Assessments were made and scored by a physiotherapist who was blinded to the group allocation. Reliability was assessed prior to data collection among eight healthy children and adolescents. Each assessment was conducted and scored by one of three physiotherapists who were blinded to the group allocation. Inter-observer reliability was assessed by comparing the observations conducted by the three physiotherapists of eight healthy children and adolescents who did not participate in the study. There was an agreement of at least 2 out of 3 observers in all measurements.

The *Back Pain and Body Posture Evaluation Instrument (BACKPEI)*, a questionnaire developed by Noll et al. (2013) and validated in 260 children, was given to the participants prior to and following the intervention. This questionnaire includes demographic details, eight questions about activity habits, and six photos of different sitting and lifting poses, from which the participant chooses those reflecting his or her usual behavior. Eight questions assessed the participants' LBP using a 10-point Visual Analogue Scale (VAS).

A forward-backward translation protocol was followed, with permission from the authors. The original questionnaire which is in English was translated to Hebrew by a professional translator. A second translator translated the Hebrew version back to English and the two English versions were compared to check for any differences in conceptual or cultural meanings which were then rephrased to ensure the same meaning was maintained (Banville et al., 2000).

Procedure

This was a 12-week controlled intervention trial that took place between February and December 2017. At the first meeting, participants were checked for eligibility, both parent and child singed informed consent, and scheduled therapy appointments were conducted.

Outcomes were measured at the first and the last individual meeting by a physiotherapist blinded to the participants' assigned treatment group.

All new admission participants had an individual meeting once a month, as provided and covered by Health Management Organizations (HMOs) in Israel. This intervention is therefore operationally defined in the current study as "standard" treatment. The monthly individual 40-minute physiotherapy session (comparison group) for all participants consisted of a personally-tailored comprehensive training for muscle endurance (Seidi et al.,

Table 3. Mean thorax curve angle and LBP in VAS Scale 0-10 at baseline and at the end of the study (mean) SD)).

	Experimental group			Comparison group			
	Baseline	End	P within group	Baseline	End	P within group	P between group's end of intervention
N	17			33			
Mean thorax curve angle (degrees)	39.2 (9.3)	28.2 (6.8)	<0.001	38.9 (9.3)	27.9 (7.8)	<0.001	0.90
participants with LBP							
N	12			21			
Mean LBP intensity level	5.6 (2.2)	1.6 (1.9)	<0.001	5.5(2.1)	2.8(2.0)	<0.001	0.38

2014), flexibility, and strength, as well as instructions on how to develop body awareness and apply biomechanical and ergonomic principles. Participants also were given 5-6 written exercises to perform – adjusted to the individual participant – with instructions to repeat each exercise 10 times, once a day, for 10-15 minutes at home. Exercises were subject to change according to each participant's progress. Participants were required to keep a follow-up diary so that their home practice could be monitored.

Participants allocated to the experimental condition (n = 17) also received 12 weekly 45-minute group sessions with two physiotherapists. The detailed 21-exercise group therapy program is presented in the Supplemental Table. participants practiced in the same hall, enabling an interaction between them.

Data Analysis

Dichotomy variables were compared using a χ^2 test (demographic variables). Normal distribution was assessed using the Kolmogorov-Smirnov test. Normally distributed continuous variables were compared using a t-test (back postural behavior change, demographic variables) or a two-way ANOVA (thorax curve angle by degrees and LBP by VAS Scale 0-10). The Kruskal Wallis test was used to compare the frequency of home practice between groups. Significance was defined as $\alpha = 0.05$

Results

Mean thorax curve angles and LBP intensity levels are presented in Table 3. A two-way ANOVA with repeated measures indicated a significant effect of time. Thorax curve angle decreased at post-test in both treatment groups: $F_{(1,48)} = 113.1$ ($p < 0.001$). However, no statistically significant difference was found between them. No difference in thorax curve angle was found between groups ($p = 0.90$), nor was there an interaction ($p = 0.99$) between group and time. The same pattern was found for LBP. There was a within group effect of time; LBP was decreased at post-test ($F_{(1,31)} = 56.68$ $p < 0.001$), but no difference between groups ($p = 0.38$) nor a group by time interaction ($p = 0.16$) was found. Worsening of LBP (n = 2) or a new episode of pain (n = 1) occurred only in the comparison group.

The results of overall postural behavior (sum of eight observations) and spontaneous postural behavior (sum of four observations) are presented in Table 4. The experimental

Table 4. Changes in overall and spontaneous back postural behavior.

Mean differences of back behavior	Experimental group	Comparison group	Entire group	P
n	17	33	50	
Overall behavior	9.0(2.3)	6.7(3.1)	7.5(2.8)	0.010
Spontaneous behavior	4.1(1.7)	3.0(1.9)	3.49(1.8)	0.041

group showed a significantly greater improvement in overall postural behavior ($t_{(1,48)} = 2.70$, $p = 0.01$) and spontaneous postural behavior ($t_{(1,48)} = 2.10$, $p = 0.04$) than the comparison group. In addition, participants in the experimental group reported higher adherence to additional practice at home, with a median of five times per week, as compared to three times per week for those who received the comparison group ($p < 0.001$), using the Kruskal Wallis non-parametric test.

Discussion

We examined the effect of 12 weekly group physiotherapy sessions in addition to monthly individual physiotherapy on thorax curve angle, LBP, and postural behavior in children and adolescents. We assumed that after 12 weeks, more frequent meetings with a physiotherapist and the social influence of a group practice would result in a greater improvement in the thorax curve angle, LBP intensity, and postural behavior. The results partially refuted this assumption, and showed a significant improvement in thorax curve angle and LBP intensity in both groups, without a significant difference between them. The results, however, did support the assumption that group physiotherapy in addition to monthly individual treatment (experimental group) would yield greater benefits in postural behavior in comparison to only monthly individual treatment (comparison group).

Parents' LPB was reported by 20% more participants in the non-intensive treatment group, but this difference did not achieve statistical significance. In a study among 287 children, LBP among parents was associated with increased risk of life prevalence of LBP [Odds ratio (OR), 2.07, 95% confidence interval (95%CI) 1.06 to 4.04; $p = 0.03$] but this difference was not found in a multivariate analysis (Szpalski et al., 2002). In another study a family history of LBP was associated with LBP among 693 elementary school children (OR, 2.49; 95% CI, 1.58 to 3.91; $p < 0.001$) (Samartzis et al., 2014).

Interventions combining knowledge acquisition with physiotherapy training are more effective than intervention with knowledge acquisition alone, for LBP in children (Calvo-Munoz et al., 2012). However, unlike in Calvo-Munoz et al. (2012), in our study, a greater intensity and number of hours of treatment were not found more effective. Similar results were observed in a cost-effectiveness analysis comparing an intensive training protocol compared with usual care physiotherapy in 114 patients aged 18-65. After 52 months, LBP intensity didn't differ between the groups in pain intensity (−1.02 points; 95% CI: −2.14; 0.09), nor in functional status and quality of life (van der Roer et al., 2008).

Ojha et al. (2020), also concluded that higher frequency physiotherapy does not yield greater benefits than lower frequency treatment in adults. However, worsening of LBP ($n = 2$) or a new episode ($n = 1$) were observed only in the standard treatment group. As such, it can be suggested that the monthly individual plus group physiotherapy as

implemented in the experimental group, may have prevented deterioration of the condition as compared to a monthly individual physiotherapy (comparison group) but further studies are needed to strengthen this assumption.

When comparing between group and individual treatment, van der Roer et al. (2008) found that among adults higher-frequency group physiotherapy yielded greater benefits in comparison to lower-frequency individual therapy for pain reduction, coping, and self-efficacy. However, the benefits were not sustained at one-year follow-up. The results of our study did not indicate a difference in pain reduction between children and adolescents who received group and individual therapy and those who received only individual therapy.

In terms of postural behavior, the participants who received 12 weekly group sessions in addition to monthly individual sessions showed significantly greater improvements in comparison to those who received only monthly individual sessions. This finding supports the results of a study of 361 children, aged 9-11, in a school setting (Cardon et al., 2002). Postural improvement was higher among children who took part in a 3-month group exercise program than among those in the control group. This change was maintained for one year. While the population examined was healthy children in a school setting and the control group received no treatment, the current study conducted on children who were referred to treatment also found a greater effect for children who received both group and individual physiotherapy.

Another benefit of group physiotherapy treatment among children and adolescents found in our study was higher adherence to home practice, in comparison to individual physiotherapy. This finding supports those reported by Asensio-García et al. (2018) of a lower dropout rate among adult participants in group physiotherapy for nontraumatic inoperable shoulder pain in comparison to individualized treatment. It can be assumed that, particularly among children and adolescents, the social support that group physiotherapy can provide is an important factor in adherence to treatment. Since adherence to treatment is crucial for the success of treatment, this may also explain the greater improvement in postural behavior found in the experimental group. Several other explanations can attribute to the higher adherence to home practice in the high-frequency experimental group intervention. Although in the current study the group physiotherapy was not accompanied with targeted dynamic principles or social cohesion among participants, the skilled nature of the physiotherapy (i.e. individual encouragement or feedback on performance) may have been implemented in the group practice and increased the effectiveness of the group-based program, as has been reported by others (Burke et al., 2006).

Other factors that have been found to be associated with exercise behavior include family support and attitudes, task cohesion and adherence behavior, significant others, and attitudes about exercise (Carron et al., 1996). These may have also been different between the groups before the intervention and may have influenced the results. It is also possible, that participants assigned to the individual therapy only group because they indicated they were unable to attend weekly group sessions due to lack of time commitment may also have been less committed to practice at home.

As an association between sitting and standing with incorrect spine position and LBP was reported in children (Minghelli et al., 2016) and in adolescents (Meziat Filho et al.,

2015), it was assumed that improvement in postural behavior would lead to improved thorax curve angle and a reduction in LBP. Our findings indicate improvement in all three parameters in both treatment groups, substantiating the above association. However, it is unclear why a greater benefit among participants who received the 12 weekly group sessions in addition to monthly individual treatment sessions was found only for postural behavior and not for thorax curve angle or LBP. Based on the above assumption, a greater effect on postural behavior should also be associated with greater improvements in thorax curve angle and LBP. The greater postural behavioral improvement in the experimental group may indicate better internalizing behavior. Yet, 12 weeks may not be sufficient for a difference in postural behavior improvement to be expressed in the differences in physical improvement of the thorax curve angle, and thereby differences in LBP improvement.

The current study has several limitations. This was a short-term 12-week intervention. Longer interventions and their sustainability over the long-term should be further investigated. The study sample was from a high socio-economic status, reducing its external validity. For ethical reasons, a control group could not be included for comparison as the patients could not be asked to wait for 12 weeks to receive the treatment they need. Therefore, random group assignment was compromised. Ten participants allocated to the experimental condition refused and were allocated to the comparison group.

The literature on physiotherapy treatment for children and adolescents with posture problems and LBP is scant, and the appropriate type and frequency of treatment has yet to be determined. Based on the study's findings, group physiotherapy in addition to an individual monthly physiotherapy may be advantageous to this population. It may increase adherence to treatment and improve postural behavior. However, if time or other constraints prevent group physiotherapy once a week, it appears that monthly individual physiotherapy standard care is also beneficial in improving thorax curve angle and reducing LBP intensity.

Conclusions

Individualized once-a-month physiotherapy treatment that includes body awareness development and exercise improved thorax curve angle, postural behavior, and LBP in children and adolescents. An additional weekly group physiotherapy treatment session did not yield greater benefits for thorax curve angle or LBP but did improve postural behavior changes and increased adherence to home practice among its participants. Providing children and adolescents group physiotherapy for LBP may benefit postural behavior and adherence to treatment.

Acknowledgements

The authors would like to thank Dinah Olswang for her editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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