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REVIEW ARTICLE

The Effect of Timing of Physical Therapy for Acute Low Back Pain on Health Services Utilization: A Systematic Review

Elizabeth Arnold, BS,[a] Janna La Barrie, MS,[a] Lisley DaSilva, BS,[a] Meagan Patti, MS,[a] Adam Goode, DPT, PhD,[a,b] Derek Clewley, DPT, PhD[a]

From the [a]Department of Orthopedics, Division of Physical Therapy, Duke University School of Medicine, Durham, North Carolina, the United States; and [b]Duke Clinical Research Institute, Department of Orthopaedic Surgery, Duke University School of Medicine, Durham, NC.

Abstract

Objective: To synthesize literature about the effect of early physical therapy (PT) for acute low back pain (LBP) on subsequent health services utilization (HSU), compared to delayed PT or usual care.

Data Sources: Electronic databases (MEDLINE, CINAHL, Embase) were searched from their inception to May 2018.

Study Selection: Study selection included randomized control trials and prospective and retrospective cohort studies that investigated the association between early PT and HSU compared to delayed PT or usual care. Two independent authors screened titles, abstracts, and full-text articles for inclusion based on eligibility criteria, and a third author resolved discrepancies. Eleven out of 1146 articles were included.

Data Extraction: Two independent reviewers extracted data on participants, timing of PT, comparisons to delayed PT or usual care, and downstream HSU, and a third reviewer assessed the information to ensure accuracy and reach consensus. Risk of bias was assessed with the Downs and Black checklist using the same method.

Data Synthesis: Eleven studies met eligibility criteria. Early PT is within 30 days of the index visit for acute LBP. Five out of 6 studies that compared early PT to delayed PT found that early PT reduces future HSU. Random effects meta-analysis indicated a significant reduction in opioid use, spine injection, and spine surgery. Five studies compared early PT to usual care and reported mixed results.

Conclusions: Early PT for acute LBP may reduce HSU, cost, and opioid use, and improve health care efficiency. This review may assist patients, health care providers, health care systems, and third-party payers in making decisions for the treatment of acute LBP.

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Low back pain (LBP) is a significant and expensive health issue that is the leading cause of years lived with disability.[1] It is estimated that the direct cost of LBP in the United States is between $12.2 and $90.6 billion, not including indirect costs associated with reduced work productivity or unemployment.[2] Additionally, the cost of treatment for LBP has grown significantly between 1997 and 2005, without concurrent improvement in health status.[3]

Many instances of acute LBP (<4wk)[4] resolve spontaneously without intervention; however, roughly 1 in 3 patients still have symptoms after 1 year of a new episode of LBP. Relapses are also common, with about 1 in 10 episodes ultimately not resolving.[5] Conservative care, such as physical therapy (PT), are recommended as initial interventions for acute LBP.[6] The American Physical Therapy Association (APTA) recommends that physical therapists treat acute and subacute LBP (lasting between 4 and 12wk)[4] by implementing interventions that reduce recurrences of LBP and a transition to chronic pain (lasting longer than 12wk),[4] such as manual therapy, trunk coordination, strengthening exercises, endurance exercises, and patient education.[7] Adhering to these guidelines for the treatment of acute LBP has been found to result in decreased pain, disability, and utilization of medication, magnetic resonance imaging (MRI), and injections.[8]

Despite these recommendations, most patients who are evaluated by a physician for acute LBP receive a delayed referral or no referral to PT.[9] This may be due in part to conflicting guidelines

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from the American College of Physicians and American Pain Society recommending self-care and passive modalities as a first-line treatment for acute and subacute LBP.[4,10] Nevertheless, recent evidence suggests that early PT for acute LBP is associated with improved outcomes and reduced future health services utilization (HSU) and costs.[9,11-13] The timing of PT referral and treatment appears to be instrumental in determining LBP outcomes and HSU. Three studies have found a dose-response relationship between the timing of PT treatments for acute LBP and future HSU.[9,14,15] Furthermore, Medicare Part A and Part B beneficiaries with a new onset of LBP who received PT within the first 45 days of diagnosis accrued less costs than those who received PT after 45 days.[16] These findings contradict the argument that waiting for spontaneous recovery of LBP might limit potential overuse of resources.[5]

One recent systematic review found evidence to suggest that early PT was associated with decreased HSU compared to delayed PT for the treatment of acute musculoskeletal disorders.[17] While this review provided valuable insight into the potential economic effect of early vs delayed PT, it excluded a comparison of early PT to usual care. Given that most patients with an acute episode of LBP receive usual care recommendations,[4,10] a synthesis of research is needed to investigate the cost effect of early PT vs the usual care approach for acute LBP. The purpose of this systematic review was to determine if early access to PT for the treatment of acute LBP is associated with future HSU compared to both delayed PT and usual care.

Methods

Data sources and searches

Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were followed in the development of this systematic review. In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, this review was registered with PROSPERO. A medical librarian conducted the literature search from inception to May 2018 in MEDLINE, CINAHL, and Embase databases. The search included articles in English with no additional limits from the inception of each respective database. Two authors independently reviewed the articles with a third author settling discrepancies. The comprehensive search strategy for each database can be found in appendix 1.

Study selection

Studies were eligible for inclusion if the following criteria were met: (1) studies were peer-reviewed randomized control trials (RCTs), prospective cohort, or retrospective cohort designs; (2) participants were at least 18 years old and had a new episode of LBP within 6 months prior to the primary index date (entry into health system); (3) 1 group received early access to PT after the index date; (4) the comparison group(s) received delayed PT or usual care (defined as no PT or additional intervention beyond education); and (5) studies assessed future HSU, such as cost, health care visits, imaging, medications, injections, and surgery.

The exclusion criteria were as follows: (1) onset of LBP or primary index date were not explicitly stated; (2) study participants had red flag conditions, neurologic symptoms, or prior back surgery; (3) the study only investigated an isolated PT intervention or included interdisciplinary interventions with PT; and (4) the study was a case report, editorial, qualitative study, systematic review, or nonpeer reviewed article.

After removal of duplicates, the titles and abstracts were screened independently by 2 reviewers (J.L., L.D.) for inclusion based on eligibility criteria. Full-text articles were then independently assessed by J.L. and L.D in the same manner. Discrepancies between the 2 reviewers was resolved by a third reviewer (M.P.) after abstract and full-text review.

List of abbreviations:

APTA	**American Physical Therapy Association**
CI	**confidence interval**
HSU	**health services utilization**
LBP	**low back pain**
MRI	**magnetic resonance imaging**
OR	**odds ratio**
PT	**physical therapy**
RCT	**randomized control trial**

Data extraction and quality assessment

Two reviewers (E.A., M.P.) extracted the data and a third reviewer (L.D.) reviewed the information to ensure accuracy and agreement. The information was organized in a table that included study design, participants, interventions, definitions of early PT and comparison groups, and HSU measures, such as cost, use of advanced imaging, injections, surgery, medications, additional physician or specialist visits, and emergency care.

Risk of bias was assessed using the Downs and Black checklist without the power analysis, which has been shown to be a reliable and valid tool for measuring the methodological quality of randomized and nonrandomized studies of health care interventions.[18,19] The tool consists of 4 subscales: reporting, external validity, bias, and confounding. Each are defined as follows: (1) reporting assesses if the study sufficiently includes all information needed to interpret results; (2) external validity determines generalizability; (3) bias evaluates the measurement of the interventions and outcomes; and (4) confounding assesses selection bias. Two reviewers (E.A., M.P.) evaluated each study independently to determine risk of bias in 26 items of study design. A third reviewer (J.L.) settled discrepancies between the first 2 reviewers. Cohen kappa coefficient was calculated to determine agreement among raters.

Data synthesis and analysis

A quantitative and qualitative analysis of the results was performed, including a report of results from individual studies. DerSimonian and Laird random effects models with inverse-variance weighting were used to account for between study variation where there was homogeneity in reported outcomes. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for opioid use, spine injection, and spine surgery and were aggregated from 3 studies comparing early PT to delayed PT. Forest plots were created to illustrate individual study estimates and summary effects. Heterogeneity was assessed using I^2 values with >50% indicating significant heterogeneity. A formal meta-regression was not performed due to the small number of included studies. All quantitative analyses were performed in Stata v15.[a]

Results

Study selection

The search strategy resulted in 1146 articles. After screening for eligibility, 11 studies met the inclusion criteria and were included in the analysis. Figure 1 details the study flow.

Study characteristics

The extracted data from the 11 studies is organized in table 1. Four studies were RCTs, 1 was a prospective cohort study, and 6 were retrospective cohort studies. Two studies reported different measurements from the same RCT, with one[13] reporting health services and the other[22] reporting an economic evaluation. The RCTs had sample sizes ranging from 60 to 220 individuals, the prospective cohort study had a sample of 4723 individuals, and the retrospective cohort studies had sample sizes ranging from 454 to 753,450 individuals. The RCT and prospective cohort participants were recruited from primary care settings, with one RCT recruiting military service members at 2 large military hospitals. The retrospective cohort samples were collected using medical records, claims data, databases, or national samples of patients with LBP receiving initial care from outpatient medical settings. Eight studies assessed individuals 18 to 65 years old, 2 studies assessed individuals over the age of 65, and 1 study assessed individuals 24 to 48 years old.

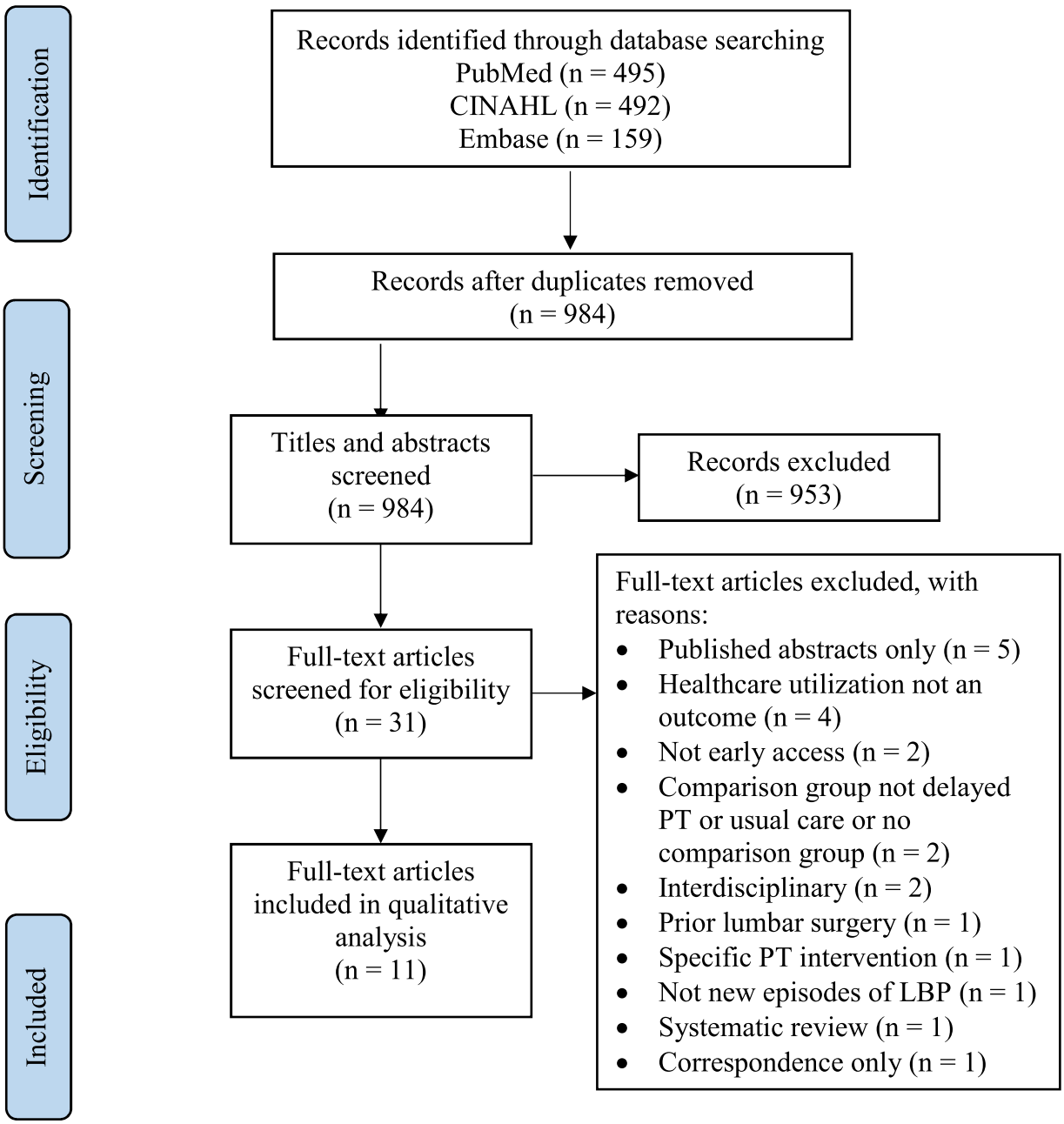

Fig 1 Flow diagram showing study selection.

Table 1 Study characteristics

Early PT vs Delayed PT					
	Participants		Intervention		Outcome
Study Design	Sample Size	Age (y)	Early	Delayed	Health Services Utilization
Childs et al[11] Retrospective Cohort	753,450	18-60	PT within 14 days of index date	PT between 14 and 90 days after index date	Early PT was associated with lower utilization of advanced imaging, spinal injections, lumbar surgery, and opioid use, and total LBP-related costs were an average $1202.29 lower after 2 years.
Fritz et al[12] Retrospective Cohort	32,070	18-60	PT within 14 days of index date	PT between 14 and 90 days after index date	Early PT was associated with lower utilization of advanced imaging, lumbar injections, lumbar surgery, opioid use, and additional physician visits, and total LBP-related costs were an average $2736.23 lower after 18 months.
Gellhorn et al[9] Retrospective Cohort	439,195	>66	PT within 30 days (acute phase) of index date	PT between 31 and 90 days (subacute phase) and between 91 and 365 days (chronic phase)	Early PT in acute phase resulted in lower utilization of lumbosacral injection, lumbar surgery, and frequent physician visits (>11 visits per year) after 1 year.
Liu et al[15] Retrospective Cohort	46,914	18-64	PT within 3 days of index date	PT between 4 and 14 days, PT between 15 and 28 days, and PT between 29 and 90 days after index date	Immediate and early PT was associated with reduced advanced imaging, spinal injections, spine surgery, opioid use, specialist visits, ED visits, and costs after 1 year.
Nordeman et al[20] Prospective RCT	60	18-65	PT within 48 hours of enrollment	PT received 4 weeks after enrollment	There were no significant differences in physician visits after 6 months.
Zigenfus et al[14] Retrospective Cohort	3867	24-48	PT within 48 hours of day of injury	PT between 2 and 7 days after day of injury and PT between 8 and 197 days after day of injury	Early PT resulted in fewer physician visits during case duration.

Early PT vs Usual Care					
	Participants		Intervention		Outcome
Study Design	Sample Size n	Age (y)	Early	Usual Care	Health Services Utilization
Fritz et al[21] RCT	220	18-60	PT within 72 hours of enrollment	No further intervention	There were no significant differences in advanced imaging, spine injections, spine surgery, specialist visits, and ED or urgent care visits between groups after 1 year.

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Table 1 (*continued*)

Early PT vs Usual Care					
	Participants		Intervention		Outcome
Study Design	Sample Size n	Age (y)	Early	Usual Care	Health Services Utilization
Fritz et al[22] Economic evaluation of an RCT	220	18-60	PT within 72 hours of enrollment	No further intervention	Early PT resulted in $580 higher adjusted direct health care costs and a cost-effectiveness ratio of $32,058 per QALY after 1 year.
Karvelas et al[23] Prospective Cohort	4723	>65	PT within 28 days of index date	No PT within 28 days of index date	Early PT was associated with increased use of PT, total imaging, injections, and physician visits. There was no significant difference in radiographs, advanced imaging, surgery, opioid use, ED visits, and total spine-related RVUs after 1 year.
Rhon et al[24] RCT	119	18-60	PT within 72 hours of enrollment	No further intervention	Early PT was associated with increased use of advanced imaging and increased LBP-related costs. There was no significant difference in radiographs, opioid use, and total health care costs between groups after 1 year.
Thackeray et al[25] Retrospective Cohort	454	17-60	PT consult within 7 days of index date	No PT consult within 7 days of index date	A PT consult was associated with reduced opioid prescriptions at follow-up. There was no difference in advanced imaging, radiographs, spinal injection, surgery, ED visits, and LBP-related costs after 1 year.

Abbreviations: ED, emergency department; RVU, relative value unit; QALY, quality-adjusted life-year.

Table 2 Results from the Downs and Black risk of bias tool

Subscale	κ	Childs et al[11]	Fritz et al[12]	Fritz et al[13]	Fritz et al[22]	Gellhorn et al[9]	Karvelas et al[23]	Liu et al[15]	Nordeman et al[20]	Rhon et al[24]	Thackeray et al[25]	Zigenfus et al[14]
Reporting (Max 10)	0.78	8	8	10	9	8	9	8	9	9	8	7
External (Max 3)	-0.12	1	1	2	2	2	3	1	2	3	1	2
Bias (Max 7)	0.58	3	3	5	4	3	4	4	5	5	4	3
Confounding (Max 6)	0.73	3	3	6	6	3	3	3	6	6	4	3
Total Score (Max 26)	0.62	15	15	23	21	16	19	16	22	23	17	15

NOTE. κ=Cohen kappa coefficient.

Risk of bias

Table 2 summarizes the findings and reports the Cohen kappa coefficients from the risk of bias assessment using a modified Downs and Black checklist without power analysis. The reliability among the raters was substantial for reporting (κ=0.78) and confounding (κ=0.73) variables and moderate for the bias subscale (κ=0.58). There was no agreement on external validity (κ=-0.12). Agreement was lower on the bias and external validity subscales due to initial misinterpretation of items 12 and 19 on the Downs and Black checklist. Overall, the 2 raters had substantial agreement on the checklist.[26] Risk of bias was variable across the studies with scores ranging from 15 to 23 with a maximum score of 26. In the reporting subscale (max score=10), the scores ranged from 7 to 10. In the external validity subscale (max=3), the scores ranged from 1 to 3. In the internal validity subscale (max=7), scores ranged from 3 to 5. Lastly, scores on the confounding and selection bias subscale (max=6) ranged from 3 to 6.

Description of PT

Seven studies provided a detailed description of the specific PT interventions received by the participants,[11,12,14,20-22,24] and the remaining 4 did not.[9,15,23,25] PT services included education, exercise and progression, modalities, and manual therapy (including thrust and nonthrust techniques). Six studies specified the use of active treatments in each session (eg, therapeutic exercise, neuromuscular reeducation, self-training management, etc).[11-14,22,24] One study reported that 37.5% of the early access group participated in active exercise during treatment sessions, while 33% of its participants only received advice and self-care instruction.[20]

Definitions of early PT, delayed PT, and usual care

Definitions of early PT and delayed PT are variable between the studies. Five studies defined early PT as initiating services within a 48- to 72-hour window after the primary index date,[13,14,20,22,24] 1 study defined an early PT consult as occurring within 7 days of the index date,[25] 2 studies used a 14-day window,[11,12] and 2 studies defined early PT as occurring within 28 to 30 days of the index date.[9,23] One study was unique in that it defined immediate PT as initiating services within 3 days of the index date and defined early PT as initiating services between 4 and 14 days after the index date.[15]

Six studies compared early PT to delayed PT.[9,11,12,14,15,20] Of those 6, 3 studies defined delayed PT as receiving PT between 14 and 90 days after the index date.[11,12,15] One of those 3 studies separated this time period into 2 groups, labeling them as delayed PT initiation (between 15 and 28d) and late PT initiation (between 29 and 90d).[15] One study defined delayed PT as those receiving PT within the subacute stage (31-90d) or chronic stage (91-365d).[9] Another study also separated delayed PT into 2 groups, in which the first group received PT between 2 and 7 days after initial injury and the second group received PT between 8 and 197 days after initial injury.[14] The last of the 6 studies defined delayed PT as undergoing the same treatment as the early access group except PT services were initiated 4 weeks after the primary index date.[20]

On the other hand, 5 studies did not specifically evaluate delayed PT. Rather, they compared early PT to usual care.[13,22-24,25] In one study, the usual care group did not receive PT within 4 weeks of the index date, and 19.4% of the these individuals initiated PT after 4 weeks.[23] Another study compared early referral to no PT consult

Table 3 HSU risk and differences in early PT vs delayed PT or usual care

Effect of Early PT vs Delayed PT on HSU								
		Downstream Health Services Rendered						
		Imaging					Additional Visits	
Study	Data Analysis	Advanced (MRI or Computed Tomography)	Radiographs	Spine Injection	Spine Surgery	Opioid Use	Physician	ED or Urgent Care
Childs et al[11]	aOR (99% CI)	0.52 (0.50-0.54)*		0.56 (0.53-0.59)*	0.59 (0.54-0.65)*	0.62 (0.60-0.64)*		
Fritz et al[12]	OR (95% CI)	0.34 (0.29-0.41)*		0.42 (0.32-0.64)*	0.45 (0.32-0.64)*	0.78 (0.66-0.93)*	0.26 (0.21-0.32)*	
Gellhorn et al[9]	OR (95% CI)			0.46 (0.44-0.49)*	0.38 (0.36-0.41)*		0.47 (0.44-0.50)*	
Liu et al[15]	Unadjusted % of patients	Immediate: 17.30 Early: 28.26 Delayed: 43.77 Late: 52.62		Immediate: 5.31 Early: 9.10 Delayed: 12.07 Late: 16.93	Immediate: 1.32 Early: 3.02 Delayed: 5.56 Late: 7.83	Immediate: 28.31 Early: 39.52 Delayed: 46.26 Late: 48.12	Immediate: 32.46 Early: 34.88 Delayed: 46.17 Late: 51.59	Immediate: 17.54 Early: 21.18 Delayed: 22.41 Late: 25.42
	P value	<.0001*		<.0001*	<.0001*	<.0001*	<.0001*	<.0001*
Nordeman et al[20]	Visits Median (Q1, Q3)						Early: 1 (0.0-1.0) Delayed: 0 (0.0-0.5)	
	P value						0.11	
Zigenfus et al[14]	Visits Mean ± SD						Early: 3.1±1.4 Delayed 1: 3.4±1.5 Delayed 2: 3.9±1.7	
	F ratio						38.97	
	P value						<.01*	

Effect of Early PT vs Usual Care on HSU								
		Downstream Health Services Rendered						
		Imaging					Additional Visits	
Study	Data Analysis	Advanced (MRI or Computed Tomography)	Radiographs	Spine Injection	Spine Surgery	Opioid Use	Physician	ED or Urgent Care
Fritz et al[13]	No. (%)	Early: 3 (2.8) Usual Care: 4 (3.6)		Early: 2 (1.9) Usual Care: 3 (2.8)	Early: 2 (1.9) Usual Care: 1 (0.9)		Early: 8 (7.5) Usual Care: 11 (9.9)	Early: 9 (8.4) Usual Care: 9 (8.1)
	P value	.74		.68	.62		.53	.94
Karvelas et al[23]	aOR (95% CI)	1.30 (1.04-1.62) 1.18 (0.94-1.47)	 1.03 (0.78-1.35)	1.42 (1.02-1.97)	0.75 (0.37-1.54)	1.13 (0.90-1.43)	1.47 (1.01-2.13)	0.97 (0.78-1.19)
	P value	.02* .16	 .85	.04*	.43	.29	.04*	.75
	Adj ratio of mean RVUs (95% CI)	1.37 (1.09-1.71)		1.33 (0.89-2.00)	1.03 (0.50-2.12)			
	P value	.01*		.17	.94			

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Table 3 (*continued*)

Study	Data Analysis	Effect of Early PT vs Usual Care on HSU						
		Downstream Health Services Rendered						
		Imaging					Additional Visits	
		Advanced (MRI or Computed Tomography)	Radiographs	Spine Injection	Spine Surgery	Opioid Use	Physician	ED or Urgent Care
Rhon et al[24]	No. (%)	Early: 13 (22.4) Usual Care: 5 (8.2)	Early: 14 (24.1) Usual Care: 13 (21.3)			Early: 27 (46.6) Usual Care: 31 (50.8)		
	P value	.030*	.713			.995		
Thackeray et al[25]	No. (%)	Early PT Consult:17 (7.9) No PT Consult: 31 (13.0)	Early PT Consult: 37 (17.2) No PT Consult: 42 (17.6)	Early PT Consult: 6 (2.8) No PT Consult: 16 (6.7)	Early PT Consult: 0 No PT Consult: 3 (1.3)	Early PT Consult: 78 (40.4) No PT Consult: 114 (51.4)		Early PT Consult: 33 (15.3) No PT Consult: 26 (10.9)
	P value	.09	1.00	.08	.25	.03*		.17

Abbreviations: Adj, adjusted; aOR, adjusted odds ratio; ED, emergency department; Q1, 25th percentile; Q3, 75th percentile; RVU, relative value unit.

* Significant result (CI for OR does not include 0 or 1; $P<.05$).

within 7 days of the index date.[25] In the 3 RCTs that compared early PT to usual care, the usual care group received education and followed up with their primary care provider as needed.[13,22,24] Furthermore, the education from 2 RCTs involved advice to remain active and instruction on key messages from *The Back Book*, which all participants received.[13,22] In the other RCT, the usual care group, along with the early access group prior to initiating PT, participated in a self-management course that involved pain education, evidence for and against the use of imaging exams and pain medication, and the influence of expectations and physical activity.[24]

Health services utilization

HSU measures included cost, radiographs, advanced imaging (MRI or computed tomography), lumbosacral injections, lumbar surgery, medication use, primary care physician visits, specialist physician visits, emergency department or urgent care visits, and relative value units. Table 3 reports significant differences and identifies the variability in downstream HSU from 10 studies. Table 4 summarizes the findings from 5 studies that assessed the effect of early PT on health care costs.

Early PT vs delayed PT

Five out of the 6 studies that compared early PT to delayed PT demonstrated significant reductions in HSU.[9,11,12,14,15] Physician visits were the most commonly studied service, with 4 out of 5 studies finding that early PT was associated with either lower odds of visiting a physician or a reduction in the number of visits.[9,12,14,15] Of the 5 studies that found associations with specific services, 3 studies also found significantly lower downstream costs in the early PT group.[11,12,15] Childs et al[11] found that total LBP-related costs for early PT were, on average, $1202.29 lower than delayed PT after 24 months, while non-LBP-related costs were, on average, $1011.22 lower for early PT compared to delayed PT. Fritz et al[12] found an even larger difference in total LBP-related costs with early PT resulting in, on average, $2736.23 lower costs than delayed PT after 18 months. Liu et al[15] found a dose-response relationship in the association of timing and cost for immediate, early, delayed, and late PT, with total 1-year LBP-related costs averaging $2750.97, $2879.21, $3840.43, and $5742.61, respectively. Figure 2 illustrates the pooled effect for opioid use, spine injection, and spine surgery among the studies that compared early PT to delayed PT and reported ORs. Two retrospective studies[11,12] that measured opioid use were pooled (n=785,520) and 3 retrospective studies[9,11,12] that measured spine injection and spine surgery use were pooled (n=1,224,715). A significant reduction in the odds of opioid use (OR=0.69; 95% CI, 0.53-0.84; $I^2=81.1\%$; n=2), spine injection (OR=0.49; 95% CI, 0.41-0.58; $I^2=92.4\%$; n=3), and spine surgery (OR=0.47; 95% CI, 0.31-0.64; $I^2=95.7\%$; n=3) were identified in pooled analyses.

Early PT vs usual care

Four out of 5 studies that compared early PT to usual care found mixed associations with HSU.[22-24,25] One study found that early PT led to reduced opioid prescriptions.[25] Three other studies found significant increases in cost, utilization of advanced imaging, spinal injections, and physician visits when compared to usual care.[22-24] In the studies that found associations with specific health services, there were other health services that were not significantly different

Table 4 Costs associated with health services for early PT vs delayed PT or usual care

Study	HSU Variables	Early PT	Delayed PT	Difference
		Effect of Early PT vs Delayed PT on HSU		
	HSU Over 2-Year Follow-Up Period	Unadjusted Health Care Costs, (USD), mean (SE)		USD, mean (95% CI)
Childs et al[11]	Prescription medications	772.20 (13.00)	762.74 (12.44)	
	Inpatient costs	11,089.39 (196.72)	12,840.89 (255.97)	
	Total LBP costs	1828.24 (15.28)	3030.53 (26.64)	1202.29 (1142.09-1262.49)
	Non-LBP health care costs	8687.25 (59.52)	9698.47 (69.46)	1011.22 (831.94-1190.50)
	HSU Over 18-Month Follow-Up Period	Unadjusted Health Care Costs, USD, mean (SE)		USD, mean (95% CI)
Fritz et al[12]	Imaging procedures	473.32 (63.92)	807.20 (42.12)	
	Physician visits	259.62 (9.76)	411.76 (11.89)	
	Surgical/injection procedures	1018.88 (170.65)	2760.62 (381.27)	
	Inpatient nonsurgical procedures	65.00 (30.58)	231.79 (64.52)	
	Emergency Department visits	26.21 (4.89)	25.22 (4.59)	
	Prescription medication	80.41 (10.22)	116.83 (11.27)	
	Other LBP-related costs	1225.04 (52.10)	1531.30 (67.01)	
	Total LBP-related costs	3148.49 (228.90)	5884.71 (429.92)	2736.23 (1810.67-3661.78)
	Non-LBP health care costs	7169.22 (472.39)	8430.44 (761.80)	
	HSU Over 1-Year Follow-Up Period	Unadjusted Health Care Costs, USD, mean ± SD		*P* Value
Liu et al[15]	Pain medication costs	Immediate: 86.56±622.44	Delayed: 106.19±342.69	$P<.0001$
		Early: 84.00±288.95	Late: 152.77±606.94	
	Advanced imaging costs	Immediate: 116.70±342.05	Delayed: 325.75±535.00	$P<.0001$
		Early: 221.96±558.06	Late: 412.74±666.25	
	LBP-related medical costs	Immediate: 2664.42±11,215.26	Delayed: 3734.26±9011.23	$P<.0001$
		Early: 2795.22±8966.24	Late: 5589.85±16,568.51	
	Total LBP-related costs	Immediate: 2750.97±11,248.43	Delayed: 3840.43±9057.19	$P<.0001$
		Early: 2879.21±8998.13	Late: 5742.61±16,642.56	
	Non-LBP-related costs	Immediate: 8137.37±19,364.61	Delayed: 9558.23±27,735.28	$P=.0028$
		Early: 8673.45±19,337.30	Late: 8913.92±17,935.16	

Study	HSU Variables	Early PT	Usual Care	Difference
		Effect of Early PT vs Usual Care on HSU		
	HSU Over 1-Year Follow-Up Period	Unadjusted Health Care Costs, USD, mean (95% CI)		USD, mean (95% CI), *P*-value
Fritz et al[22]	Direct costs	961 (561-1361)	427 (254-599)	535 (99-970), $P=.016$
	Health care costs	383 (88-678)	411 (102-719)	-28 (-55 to 399), $P=.897$
	Medication costs	7 (4-11)	16 (9-24)	-9 (-17 to 0), $P=.039$
	Study intervention costs	572 (564-580)	0 (0-0)	572 (564-580), $P<.001$
	Indirect cost (work loss)	360 (207-514)	399 (234-565)	-39 (-266 to 187), $P=.736$
	Total cost	1366 (929-1802)	894 (616-1172)	472 (-46 to 989), $P=.074$
	HSU Over 1-Year Follow-Up Period	Adjusted* Health Care Costs, USD, mean (95% CI)		USD, mean (95% CI), *P* Value
	Total cost	1442 (1068-1815)	862 (653-1071)	580 (175-984), $P=.005$

(*continued on next page*)

Table 4 (*continued*)

Study	HSU Variables	Effect of Early PT vs Usual Care on HSU		
		Early PT	Usual Care	Difference
	Adjusted QALY and ICER	Cost-effectiveness analysis results, mean (95% CI)		Mean (95% CI), *P* Value, ICER
	Adjusted* QALY†	0.790 (0.780-0.801)	0.770 (0.760-0.780)	0.020 (0.005-0.035), *P*=.008, ICER=$32,058 (10,629, 151,161)
	HSU Over 1-Year Follow-Up Period	Unadjusted Health Care Costs, USD, mean ± SD (95% CI)		*P* Value
Rhon et al[24]	LBP-related costs	2016.31±1928.23 (1569.56-2590.22)	1096.37±1067.06 (855.27-1405.43)	*P*=.001
	Total health care costs	5299.31±3914.75 (4367.08-6430.54)	5036.60±3723.97 (4170.63-6082.37)	*P*=.712

NOTE. ICER=$32,058 per QALY (10,629, 151,161).
Abbreviations: ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year; USD, United States dollars.
* Adjusted total cost=direct cost+indirect cost adjusted by age, sex, race, education, marital status, employment status, smoking status, previous history of lower back pain, and body mass index.
† QALY=baseline EQ−SD+[(1-year EQ−SD) / 2].

between groups.[23-25] Two out of 3 studies that assessed cost found early PT was associated with higher LBP-related costs. For example, early PT resulted in $2016.31 of LBP-related costs after 1 year compared to $1096.37 for usual care.[24] In the study by Fritz et al[22] that economically evaluated the RCT performed by Fritz et al[13] (which found no significant difference in HSU between early PT and usual care), adjusted total LBP-related costs for early PT were, on average, $580 higher than usual care at 12 months, after adjusting for covariates. The incremental cost-effectiveness ratio was an average of $32,058 per quality-adjusted life-year.

Discussion

The purpose of this systematic review was to determine if early access to PT for the treatment of acute LBP is associated with future HSU compared to both delayed PT and usual care. The results from this systematic review indicate that early PT is associated with reduced HSU and is a cost-effective strategy compared to delayed PT. However, when comparing early PT to usual care, the results are inconclusive. There may be several factors contributing to these findings that warrant further discussion.

Early PT vs delayed PT

Findings from this systematic review support previous literature that early PT leads to downstream reductions on HSU when compared to delayed PT.[17] Specifically, this systematic review supports this association in the acute LBP population. When PT treatment is delayed, the individuals with acute LBP may be more likely to seek out imaging, medications, and other health services that may or may not benefit them in the long term. Recent literature has also shown that participating in PT prior to other forms of treatment influences HSU. Fritz et al[27] showed that receiving imaging first, as opposed to PT first, in a patient population of acute LBP, increased the likelihood of future specialist physician visits, injections, surgery, and emergency department visits. In addition, there is evidence that supports direct access to PT in reducing HSU. For example, Fritz et al[21] compared health utilization outcomes for individuals who sought initial care in a PT setting compared to a primary health care setting. They found that receiving PT at the entry visit lowered radiography use and LBP-related costs. Another study by Frogner et al[28] demonstrated that receiving PT first compared to delayed PT and no PT resulted in lower out-of-pocket costs and a lower probability of receiving opioid prescriptions, advancing imaging, and visiting the emergency department.

Definitions of early PT and delayed PT vary in the literature. The studies examined in this review define early PT as services utilized within 30 days of the primary index date. However, some studies include their delayed comparison within the first 30 days of the index date. More recent evidence has broken up early PT into immediate (within 3 days) and early (between 4 and 14 days),[15] whereas other studies determined early PT to be within 72 hours of the index date.[13,14,20,22,24] Research is beginning to support a dose-response relationship between immediate, early, and delayed PT for acute LBP, with the earlier initiation of PT leading to more downstream reductions in HSU.[9,14,15] Therefore, it may be beneficial to separate research on the timing of PT initiation into immediate and early in order to delineate the more specific effects that timing of PT for acute LBP has on HSU. Further, delayed PT could be separated into delayed and late PT, as described by Liu et al.[15]

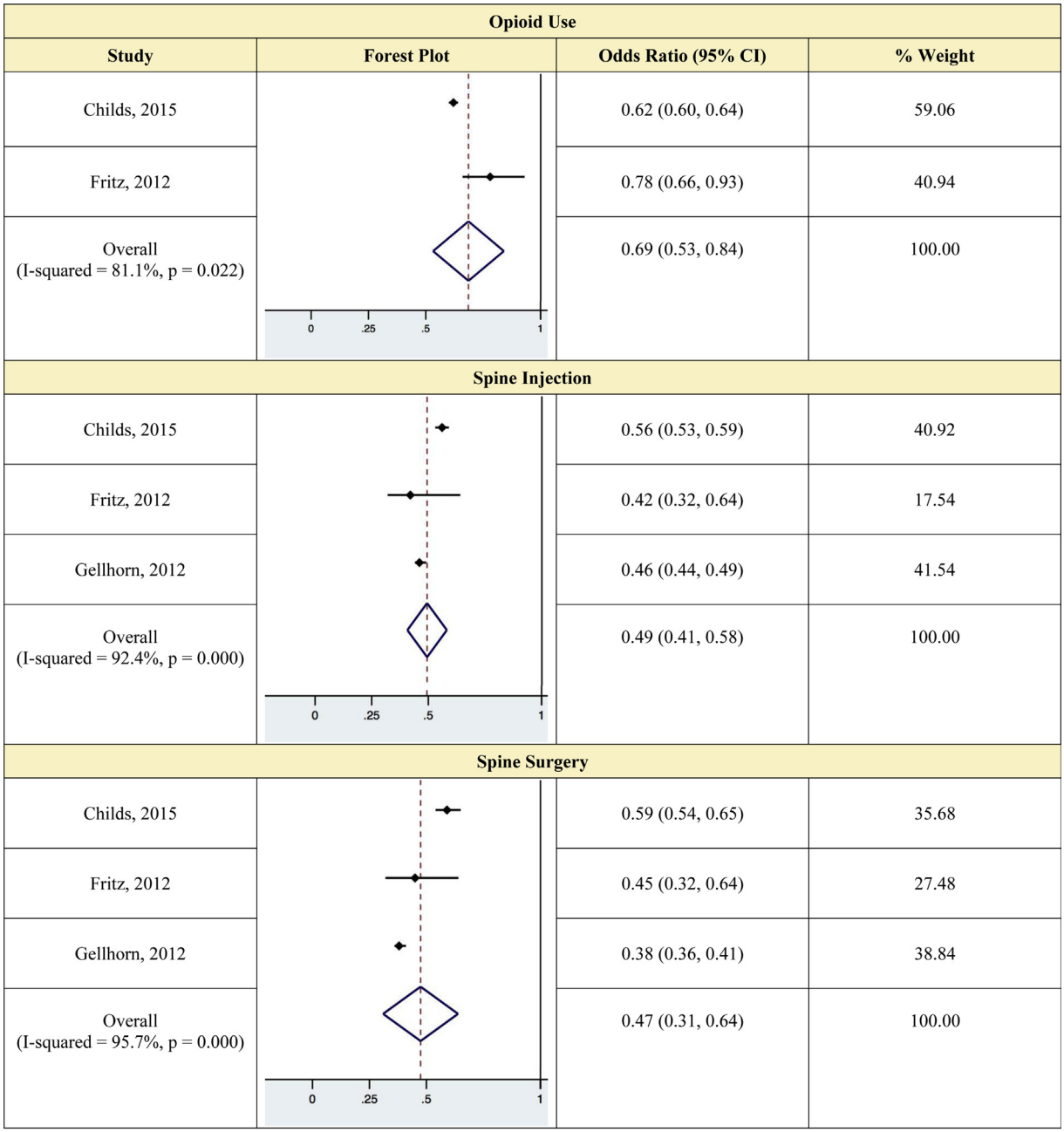

Fig 2 Pooled effect of early PT vs delayed PT on HSU.

Early PT vs usual care

The results of early PT vs usual care are inconsistent in that early PT for acute LBP either increased, decreased, or had no effect on HSU when compared to usual care. The difference may be explained by patient characteristics, care-seeking patterns, and physician decision making. When comparing early PT to delayed PT, the differences may be related to the actual timing of physical therapy, rather than participant care-seeking or physician characteristics not captured in the analysis. Patients who participate in early PT may also be fundamentally different from patients who follow the usual care pathway. Additionally, not all people with LBP go on to seek medical care. Estimates of the proportion of individuals experiencing LBP who seek care is highly variable among studies based on individual and social factors, with percentages ranging from 9.19% in some geographic locations[29] to 44.5% in others.[30] In the United States, previous estimates of individuals in North Carolina with acute LBP who sought care were as high as 39%.[31] It is important to note that heterogeneity within the populations studied may limit the generalizability of care-seeking behavior. For example, one RCT recruited military service members who are generally younger, male, and involved in physical training and a military culture which is different from the general population that seeks treatment for acute LBP.[24]

Research suggests that individual factors associated with care-seeking include high levels of disability and pain intensity, while factors associated with not seeking care include lower socioeconomic status and passive coping styles.[32] Additional evidence shows that patients who are referred by a physician to PT for spine pain are more likely to be female, have higher levels of education, and have higher income compared to patients who had physician-only care.[33] Therefore, patients who participate in early PT following an acute LBP episode may be part of a care-seeking group that is more active in seeking treatment than those who receive usual care, who may take a more passive approach to treatment. These traits may lead the early PT group to utilize more health services compared to the usual care group.

Physician decision making and patient presentations may also play a role in determining if patients with acute LBP receive an early referral to PT and how many health services are utilized in the future. Predictors of an early PT consult in patients with Medicaid with new-onset LBP include younger age, having received a radiograph, or having a prescription for nonsteroidal anti-inflammatory drugs or muscle relaxers. On the other hand, tobacco use, chronic pain, depression, 2 or more comorbidities, and a referral to a specialist or to advanced imaging reduced the likelihood of an early PT consult.[25] An early PT consult alone correlated with reduced future opioid prescriptions by physicians, which may be due to the effectiveness of early active treatment.[25]

An additional factor to consider when interpreting the results of early PT vs usual care is guideline adherence. The importance of guideline adherence is demonstrated by Fritz et al[8] who showed that adherent PT for acute LBP, in which active modalities make up at least 75% of the episode of care, lead to better clinical outcomes, fewer PT visits, and lower charges, and reduce the likelihood of receiving MRI, medication, and injections. Both Childs[11] and Fritz[12] and colleagues defined guideline-adherent PT as an episode of care that included at least 75% active current procedural terminology codes and at least one active current procedural terminology code within every session. Not only did they find that early PT led to cost savings, but early and adherent PT for acute LBP resulted in the largest reduction in HSU and cost.[11] Conversely, Nordeman et al[20] found that 33% of the participants in the early access group received PT that involved exclusively passive modalities and education, and showed no significant effect on future physician visits. Karvelas et al[23] did not control for the content of PT, which could explain why this study actually found that early PT increased HSU compared to usual care. The results of these studies support the idea that not only does adherence to APTA guidelines for acute LBP decrease risk of future HSU, but nonadherence to APTA guidelines and ineffective PT treatments could potentially increase future use of health services.

The long-term effects of early PT for acute LBP on HSU compared to usual care may not be captured by a 12-month follow-up. Many patients will go on to have recurrent episodes of LBP and result in more HSU. Estimates of recurrence at 1 year range from 24% to 84%.[34-36] Early PT may reduce HSU associated with recurrence after 12 months, as these patients receive preventive treatment tools and methods during the course of rehabilitation that may improve self-efficacy and reduce reliance on other forms of treatment should LBP reoccur. Therefore, the timing of the second data capture at 12 months may be inadequate in demonstrating the long-term effects of early PT for acute LBP and the potential costs of reoccurrence.

Effect of early PT on patient-reported outcomes

Early PT for acute LBP has favorable effects on patient-reported outcomes, such as pain, disability, and quality of life, compared to delayed PT or usual care. This is important to consider when critiquing HSU, especially because patients with higher perceived pain and disability may be more likely to request injections, opioids, etc. The RCT by Nordeman et al[20] found that individuals who received early PT compared to a waitlist group had greater reduction in pain at 6 months. In occupational health settings, early PT for acute LBP was associated with reduced case duration, duration of restricted work, and days away from work,[14] as well as sooner return-to-work.[37] Additionally, early PT was correlated with higher quality of life after 1 year[22] and improvement in disability.[13] Therefore, individuals who have beneficial outcomes from early PT may be less likely to seek health services from other health care providers in the future.

Clinical implications

The findings from this systematic review support early access to PT as a cost-effective intervention for acute LBP that reduces HSU. The specific timing and content of PT are important in determining the extent to which early PT has an effect. The findings from this review may assist patients, health care providers, health care systems, and third-party payers in making decisions for the treatment of acute LBP.

Chronic LBP is a significant burden to the health care system and contributes to the skyrocketing health care costs in the United States. This systematic review has shown that early PT for acute LBP reduces HSU and may prevent the potential for recurrences and chronic pain, leading to downstream cost savings and better outcomes for individuals. Based on studies that have demonstrated the benefits of direct access to PT,[21,28] individuals may also be empowered to seek PT before other providers. Even if recurrences do occur, which is fairly likely, early PT can give people with new episodes of LBP strategies to manage their condition independently in the future, preventing unnecessary overuse of resources.

Receiving early PT for acute LBP could not only reduce health care costs, but it may also help combat the opioid crisis. All health care providers and health care systems should be encouraged to follow the guidelines set forth by the Centers for Disease Control and Prevention to prescribe less opioids in favor of safer alternatives like PT for pain. Initiating PT soon after acute LBP may lead to reduced opioid prescriptions, which is supported by Childs,[11] Fritz,[12] Liu,[15] and Thackeray[25] and colleagues. In addition, it has been found that receiving PT within 14 days of initial physician visit for LBP reduces the risk for long-term opioid use.[38] Health care providers, health care systems, and third-party payers across the nation should educate and empower their patients and beneficiaries to participate in PT as an option for acute pain management, as opposed to addictive medications that do not treat the underlying problem.

Study limitations

This systematic review is limited by the heterogeneity of the studies included which is the likely reason for our imprecise pooled estimates. Our pooled analyses only included a small number of the eligible studies due to variations in reporting of results between studies and some of those included studies conducted crude associations while others conducted multivariable adjustment. Due to the variability in the definitions for early PT, a consensus for the specific timing of early access could not be reached. Additionally, most studies did not control for the PT services provided to the participants, which could have affected the effectiveness of PT in general. Furthermore, follow-up time periods differed between studies.

The evidence in favor of early access to PT for acute LBP was found from retrospective cohort studies, which are unable to determine cause-and-effect and may be influenced by confounding variables, such as the characteristics of the individuals who received early PT as opposed to those who did not.

Conclusions

Future studies are needed to investigate the effect of early, as well as guideline-adherent PT, for acute LBP on HSU. The lack of consistency in defining early PT leads to confusion for both medical providers and patients in determining the most beneficial time to seek PT services. Therefore, a consistent definition for early PT is required in order to clarify the differences between early PT, delayed PT, and usual care and develop a consensus for future research. Additionally, certain subgroups of people with acute LBP respond differently to PT. For instance, evidence suggests that responders to spinal manipulative therapy for LBP have distinct characteristics compared to nonresponders.[39] Further research into identifying and classifying these subgroups may be useful in identifying which patients are likely to see the greatest benefit of early PT and therefore determining the most cost-effective approach for acute LBP patients presenting to primary care. Investigators should continue to utilize electronic medical records and large databases to study the effect of early PT on HSU.

Supplier

a. Stata, version 15; StataCorp.

Keywords

Health care costs; Low back pain; Physical therapy modalities; Rehabilitation; Time factors

Corresponding author

Elizabeth Arnold, BS, Department of Orthopedics, Division of Physical Therapy, Duke University School of Medicine, 2200 W Main St, Durham, NC 27705. *E-mail address:* eaarnold27@gmail.com.

Appendix 1	Data Sources and Search Strategy
Database	**MEDLINE via PubMed**
Date	**May 7, 2018**
Strategy	((((early[tiab] OR "Early Medical Intervention"[Mesh] OR "initial management"[tiab] OR prompt[tiab] OR "Time Factors"[Mesh])) AND (("physical therapy modalities"[MeSH Terms] OR "physical therapy"[tiab] OR "physiotherapy"[tiab] OR "rehabilitation"[MeSH Terms] OR "rehabilitation"[tiab] OR "rehabilitation" [Subheading]) AND ((("Lumbosacral Region"[Mesh] OR Lumbosacral[tiab] OR "lumbar spine"[tiab] OR "low back"[ti]) AND Pain[tiab]) OR "Low Back Pain"[Mesh] OR "low back pain"[ti] OR lumbago[tiab]))))) (randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized [tiab] OR randomised[tiab] OR randomization[tiab] OR randomisation[tiab] OR placebo[tiab] OR drug therapy[sh] OR randomly[tiab] OR trial[tiab] OR groups[tiab] OR Clinical trial[pt] OR "clinical trial"[tiab] OR "clinical trials"[tiab] OR "evaluation studies"[Publication Type] OR "evaluation studies as topic"[MeSH Terms] OR "evaluation study"[tiab] OR evaluation studies[tiab] OR "intervention studies"[tiab] OR "intervention study"[tiab] OR "intervention studies"[tiab] OR "case-control studies"[MeSH Terms] OR "case-control"[tiab] OR "cohort studies"[MeSH Terms] OR cohort[tiab] OR "longitudinal studies"[MeSH Terms] OR "longitudinal"[tiab] OR longitudinally[tiab] OR "prospective"[tiab] OR prospectively [tiab] OR "retrospective studies"[MeSH Terms] OR "retrospective"[tiab] OR "follow up"[tiab] OR "comparative study"[Publication Type] OR "comparative study"[tiab] OR systematic[subset] OR "meta-analysis"[Publication Type] OR "meta-analysis as topic"[MeSH Terms] OR "meta-analysis"[tiab] OR "meta-analyses"[tiab]) NOT (Editorial[ptyp] OR Letter [ptyp] OR Case Reports[ptyp] OR Comment[ptyp]) NOT (animals[mh] NOT humans[mh])
Database	**Embase**
Date	**May 7, 2018**
Strategy	('physiotherapy'/exp OR 'physiotherapy' OR 'physical therapy':ti,ab OR 'physiotherapy':ti,ab OR 'rehabilitation'/exp OR 'rehabilitation' OR 'rehabilitation':ti,ab) AND (early:ti,ab OR 'early intervention'/exp OR 'early intervention' OR 'initial management':ti,ab OR prompt:ti,ab OR 'time factor'/exp OR 'time factor') AND ('lumbosacral region'/exp OR 'lumbosacral region' OR lumbosacral:ti,ab OR 'lumbar spine':ti,ab OR 'low back':ti AND pain:ab,ti OR 'low back pain'/exp OR 'low back pain' OR 'low back pain':ti OR lumbago:ti,ab) AND ('randomized controlled trial'/exp OR 'crossover procedure'/exp OR 'double blind procedure'/exp OR 'single blind procedure'/exp OR random*:ab,ti OR factorial*:ab,ti OR crossover*:ab,ti OR (cross NEAR/1 over*):ab,ti OR placebo*:ab,ti OR (doubl* NEAR/1 blind*):ab,ti OR (singl* NEAR/1 blind*):ab,ti OR assign*:ab,ti OR allocat*:ab,ti OR volunteer*:ab,ti OR 'clinical study'/exp OR 'clinical trial':ti,ab OR 'clinical trials':ti,ab OR 'controlled study'/exp OR 'evaluation'/exp OR 'evaluation study':ab,ti OR 'evaluation studies':ab,ti OR 'intervention study':ab,ti OR 'intervention studies':ab,ti OR 'case control':ab,ti OR 'cohort analysis'/exp OR cohort:ab,ti OR longitudinal*:ab,ti OR prospective:ab,ti OR prospectively:ab,ti OR retrospective:ab,ti OR 'follow up'/exp OR 'follow up':ab,ti OR 'comparative effectiveness'/exp OR 'comparative study'/exp OR 'comparative study':ab,ti OR 'comparative studies':ab,ti OR 'evidence based medicine'/exp OR 'systematic review':ab,ti OR 'meta-analysis':ab,ti OR 'meta-analyses':ab,ti) NOT ('case report'/exp OR 'case study'/exp OR 'editorial'/exp OR 'letter'/exp OR 'note'/exp) AND [english]/lim
Database	**CINAHL**
Date	**May 7, 2018**
Strategy	(((TI (Lumbosacral OR "lumbar spine" OR "low back") OR AB (Lumbosacral OR "lumbar spine") AND Pain) OR (MH "Low Back Pain") OR TI ("low back pain" OR lumbago) OR AB (lumbago)) AND (MH ("Time Factors" OR "Early Intervention") OR TI (early OR "initial management" OR prompt) OR AB (early OR "initial management" OR prompt)) AND (MH ("physical therapy" OR "rehabilitation") OR (TI "physiotherapy") OR AB ("physiotherapy"))

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