Kinematic Characteristics of Sit-to-Stand Movements in Patients With Low Back Pain: A Systematic Review

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Abstract

Objective: The purpose of this review was to identify different kinematic characteristics between the movements of sit-to-stand-to-sit, sit-to-stand, or stand-to-sit of individuals with and without low back pain (LBP).
Methods: A systematic search was conducted on scientific databases. The analyzed kinematic variables were duration of the movement, reproduction of the movement, ranges of motion, velocity, and acceleration. The studies were appraised for methodological quality using the Downs & Black scale and for the level of evidence using the Grading of Recommendations Assessment, Development, and Evaluation approach.
Results: After all screening stages, this systematic review comprised 8 cross-sectional studies. When comparing the patients with LBP vs controls, patients with LBP take longer to perform the sit-to-stand-to-sit, sit-to-stand, and stand-to sit movements (eg, 9.33 ± 1.49 seconds vs 8.29 ± 1.23 seconds in the sit-to-stand-to-sit movement), show decreased mobility of the lumbar spine (eg, 26.21° ± 8.76° vs 32.07° ± 6.77° in the sit-to-stand-to-sit movement) and the hip (eg, 51.0° vs 77.25° in the sit-to-stand movement), present decreased velocity of the trunk (eg, 95.31° ± 25.13°/s vs 138.23° ± 23.42°/s in the sit-to-stand-to-sit movement) and the hip (eg, 46° ± 13°/s vs 69° ± 13°/s in the sit-to-stand movement), and decreased overall acceleration of the trunk (eg, 280.19° ± 113.08°/s^2 vs 460.16° ± 101.49°/s^2 in the sit-to-stand-to-sit movement), besides presenting greater variability of the trunk (eg, 5.53° ± 0.48° vs 4.32° ± 0.46° in the sit-to-stand movement).
Conclusion: There are kinematic alterations in the lumbar spine, the hip, and the trunk of patients with LBP. However, information about pelvic and overall trunk mobility, velocity, and acceleration of the lumbar spine; and mobility, speed, and acceleration of hip and pelvis remain incipient in individuals with LBP. Based on the Grading of Recommendations Assessment, Development, and Evaluation criteria, the results of this review indicate that there is low scientific evidence on the characteristics of the kinematic variables (duration of the movement, reproduction of the movement, range of motion, velocity, and acceleration) of the trunk, lumbar spine, pelvis, and hip in patients with LBP. (J Manipulative Physiol Ther 2019;42:532-540)
Key Indexing Terms: *Low Back Pain; Movement; Biomechanical Phenomena*

Introduction

Low back pain (LBP) is currently one of the most common disorders in the population, and it also results in serious professional and social disability.[1,2] Concerning the prevalence of LBP in the local community, 2 cross-sectional studies has been carried out in different Brazilian cities, and they have found rates of 40%[3] and 50.2%,[4] respectively, for the presence of reported episodes of LBP during 12 months previously to the studies. A recent systematic review published mean lifetime and annual prevalence rates of 38.9% and 38.0%,[5] respectively, whereas individual epidemiologic cross-sectional surveys point to lifetime prevalence rates as high as 70% to 80%.[6]

Also, LBP can cause substantial functional losses and may affect not only postural control in static postures but also the performance of dynamic tasks, like sitting and standing.[7] The movements of sit-to-stand and stand-to-sit are common and functionally important tasks[8] in the pool of the daily living activities, and because they have been associated with the worsening of the symptoms of pain in the low back,[7] the study of these movements is essential in LBP research. For this reason, numerous studies have aimed to investigate the

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biomechanical aspects and adaptations of LBP patients during the performance of the sit-to-stand movement.

Claeys et al[7] have identified that patients with LBP need more time to completely perform the sit-to-stand movements, and they also present delayed onset of pelvic anteversion. Shum et al[8] have reported that patients with LBP showed decreased speed and range of motion (ROM) of the lumbar spine and the hip, decreased contribution of lumbar movement in relation to the hip, and significantly altered motor coordination between these regions. On the other hand, Crosbie et al[9] have demonstrated that patients with LBP did not present limitation of the trunk ROM, but a delay in the motion of the lumbar region and decreased inferior thoracic ROM and increased ROM of the hip joint.

As previously mentioned, some kinematic characteristics of the sit-to-stand still show divergent results in the literature, which hinders the true understanding of their mechanism. Considering that the sit-to-stand movement is successively executed on a day, a good performance is crucial[7] because alterations in the performance of this movement, when constantly executed, may overload body structures and could represent a risk factor for the onset and perpetuation of back pain.[10] Therefore, the purpose of this systematic review was to identify different kinematic characteristics among the movements of sit-to-stand-to-sit, sit-to-stand, or stand-to-sit of individuals with and without LBP.

Methods

This systematic review has followed the recommendations proposed by the Preferred Reporting Items for Systematic reviews and Meta-Analyses statement.[11] The project was registered on PROSPERO from York's University Center for Reviews and Dissemination (http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017052881).

Information Source and Search Strategy

On December 5, 2016, a search was conducted on the PubMed, Embase, BIREME, and Scopus databases. The publication year of the studies was not delimitated, so the systematic search traced publications from the initial indexation year of each database until the date of the search. To minimize the loss of studies, manual searches were performed based on the referenced articles of the included studies.

The search strategy was developed based on the Patient/Population, Intervention/Exposure, Comparison, and Outcome strategy.[12] Individuals with LBP were defined as the patient/population; as exposure, the sit-to-stand-to-sit, sit-to-stand, and stand-to-sit movements; as comparison, asymptomatic control group; and as outcomes, kinematic variables (duration of movement, reproduction of the movement, ROM, velocity, and acceleration). Table 1 presents an example of the search performed on the PubMed database.

Eligibility Criteria

Eligible articles were written in English, Spanish, or Portuguese. Any study design could be included except for literature reviews, systematic reviews, or meta-analyses. Although inclusion of randomized controlled trials was not restricted during the database searches, they were excluded in the screening stage because they involve clinical interventions and do not present the outcomes investigated by this review.

Study Selection and Data Extraction

All studies found in the electronic search had titles and abstracts screened. Potentially eligible studies were then integrally read and assessed using the eligibility criteria. For data extraction, each assessor filled a standard spreadsheet with the information presented in the results section.

Assessment of the Risk of Bias and the Level of Evidence

The risk of bias and the level of evidence were critically appraised by 2 independent assessors who reached consensus and used the same criteria with adjudication by a third reviewer if needed. The studies were appraised for methodological quality using the Downs & Black scale,[13] which assesses observational studies and clinical trials. Because there is no consensus on a single cutoff point for defining risk of bias,[14] the scores were interpreted using a percentage of 75% or higher. Studies were therefore defined as high quality if 75% of applicable checklist items were scored as "yes," that is, 9 of the 12 assessed items.

The GRADE (Grading of Recommendations Assessment, Development, and Evaluation) methodological approach was used to classify the level of evidence of the studies as very low when further research will very unlikely change the results presented by the systematic review, as low when further research probably will have an important impact and could change the results presented by the systematic review, as moderate when further research will very likely have an impact and probably will alter the results presented by the systematic review, and as high when any estimate of results presented by the systematic review is uncertain and requires new studies. Nevertheless, the GRADE approach classifies observational studies as low quality of evidence.[15]

Data Analysis

The extracted data were grouped by similarity to compose a synthesis of the outcomes with the purpose of demonstrating the kinematic characteristics of the sit-to-stand movements in patients with LBP.

Table 1. *Search Strategy on PubMed Database*

Item	Search Terms
Patient (low back pain)	"Low Back Pain[MESH]" OR "Low Back Pain" OR "Back Pain, Low" OR "Back Pains, Low" OR "Low Back Pains" OR "Pain, Low Back" OR "Pains, Low Back" OR "Lumbago" OR "Lower Back Pain" OR "Back Pain, Lower" OR "Back Pains, Lower" OR "Lower Back Pains" OR "Pain, Lower Back" OR "Pains, Lower Back" OR "Low Back Ache" OR "Ache, Low Back" OR "Aches, Low Back" OR "Back Ache, Low" OR "Back Aches, Low" OR "Low Back Aches" OR "Low Backache" OR "Backache, Low" OR "Backaches, Low" OR "Low Backaches" OR "Low Back Pain, Recurrent" OR "Recurrent Low Back Pain" OR "Low Back Pain, Postural" OR "Postural Low Back Pain" OR "Low Back Pain, Mechanical" OR "Mechanical Low Back Pain" OR "Low Back Pain, Posterior Compartment"
Outcome (sit-to-stand)	"Sit-to-stand" OR "Stand-to-Sit" OR "sit to stand" OR "Stand to sit" OR "sitting to standing" OR "sit-to-stance-to-sit" OR "sitting" OR "Sit-stand-sit" OR "back-to-sit"

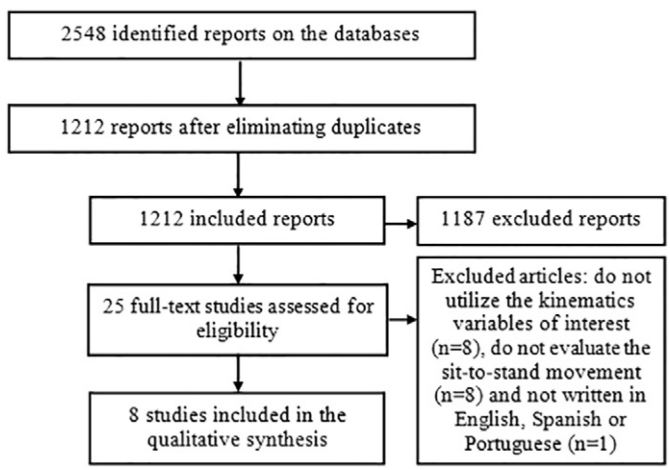

Fig 1. *Flow diagram of the inclusion of studies according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses.*[11]

Results

Of the 2548 articles found in the searches on databases, 1212 articles had the title and abstract assessed, and then 25 articles were screened for eligibility. After all screening stages, this systematic review comprised 8 cross-sectional studies (Fig 1).

Five studies presented a low risk of bias, whereas 3 studies scored a high risk of bias. Claeys et al[7] and Coghlin and McFadyen[16] did not clearly describe their outcomes, which can be considered as lacking internal validity. Galli et al[17] did not describe the characteristics of participants lost to follow-up, which represents a failure in general quality, according to Downs & Black scale (Table 2).[13] Also, these 3 articles did not report probability values for the main outcomes.

Given that this review included only observational studies, according to the criteria established by the GRADE,[15] it is ranked as low level of evidence. Also, the studies present contradictory outcomes and heterogeneous methodologies, and thus it is possible that further research is likely to change the results presented for the kinematic characteristics analyzed by this current systematic review. Table 3 presents the characterization of the methodology of the included studies, whereas Figure 2 shows the summarization of the analyzed kinematic variables comparing patients with LBP versus healthy participants. It was not possible to perform meta-analyses owing to the distinct methodologies used in the studies, which probably led to the divergent outcomes.

Discussion

This review sought to identify differentiations in the kinematic characteristics during the performance of the sit-to-stand-to-sit, sit-to-stand, and stand-to-sit movements, between patients with LBP and healthy individuals. The outcomes showed kinematic differences between participants with LBP and healthy participants, but also demonstrated divergent findings comparing the variables.

Regarding the duration of the movement, some authors reported that patients with LBP take longer to stand, sit, and stand again.[7,18,19] But Claeys et al[7] found that these time differences were determined by the stance and sit moments (transition phases) owing to later onsets of the movements, but when separately comparing the sit-to-stand and the

Table 2. *Score of Methodological Risk of Bias According to Downs & Black Checklist*[13]

Studies First Author (Year)	Downs & Black Criteria Checklist 01	02	03	06	07	09	10	11	12	16	18	20	Number of ✓	% of ✓	Risk of Bias
Claeys (2012)[7]	✓	✓	✓	✓	✓	✓	X	?	?	✓	✓	X	8	66.7	High
Coghlin (1994)[16]	✓	✓	✓	✓	✓	✓	X	?	?	✓	✓	X	8	66.7	High
Galli (2000)[17]	✓	✓	✓	✓	✓	?	X	?	?	✓	✓	✓	8	66.7	High
Mehravar (2012)[18]	✓	✓	✓	✓	✓	✓	X	?	?	✓	✓	✓	9	75	Low
Peydro (2011)[19]	✓	✓	✓	✓	✓	✓	✓	?	?	✓	✓	✓	10	83.3	Low
Sanchez-Zuriaga (2011)[20]	✓	✓	✓	✓	✓	✓	X	?	?	✓	✓	✓	9	75	Low
Shum (2005)[8]	✓	✓	✓	✓	✓	✓	X	?	?	✓	✓	✓	9	75	Low
Svendsen (2013)[21]	✓	✓	✓	✓	X	✓	✓	?	?	✓	✓	✓	9	75	Low

Downs & Black Criteria: (01) Is the objective and hypothesis of the study clearly described? (02) Are the main outcomes to be measured clearly described in the introduction or materials and methods section? (03) Are the characteristics of the participants included in the study clearly described? (06) Are the main findings of the study clearly described? (07) Does the study provide estimates of the variability in the data for the main outcomes? (09) Have the characteristics of participants lost to follow-up been described? (10) Have actual probability values been reported for the main outcomes? (11) Were the participants asked to participate in the study representative of the entire population from which they were recruited? (12) Were those participants who were prepared to participate representative of the entire population from which they were recruited? (16) If any of the results of the study were based on "data dredging," was this made clear? (18) Were the statistical tests used to assess the main outcomes appropriate? (20) Were the main outcome measures used accurate? Answers to the criteria: ✓ = Yes; X = No; ? = Unable to determine.

stand-to-sit movements, there was no significant difference between the LBP group and controls. Also, they observed later onsets of anterior pelvic rotation initiation to start both movement sequences. However, Coghlin and McFadyen[16] reported contrary results, demonstrating that individuals with LBP required less time than healthy individuals to perform the sit-to-stand movement.

Based on these studies, there seems to be a consensus on patients with LBP taking longer to complete the sit-to-stand-to-sit. However, when only 1 movement phase is evaluated, there are divergences in the literature because Claeys et al[7] found no difference and in the study of Coghlin and McFadyen,[16] the LBP patients took less time to perform the sit-to-stand. There are methodological differences between these studies because Clayes et al[7] evaluated young men and women (mean age 18.5) and Coghlin and McFadyen[16] evaluated only men (mean age 36.7). Besides, these studies presented high risk of bias. Nevertheless, it is possible that proprioceptive impairments in the lumbosacral region in patients with LBP may need attention.[7]

Regarding the motion of the lumbar spine, the authors mentioned about a decreased lumbar ROM[18,19] and a smaller flexion peak.[8] However, when the movement of the trunk is globally evaluated, the results are contradictory. Galli et al[17] reported a decreased trunk flexion whereas Coghlin and McFadyen[16] found an increased flexion. Nevertheless, other authors did not report significant difference in the ROM between the patients with LBP and healthy participants.[19,20] Also, the only study that found a decreased mobility of the trunk was performed with obese patients with LBP.[17] So, the reduction of the mobility could be related to this second condition. And the studies from Galli et al[17] and Coghlin and McFadyen[16] presented a high risk of bias.

Regarding the hip analyses, 2 studies suggested a decreased mobility of this region in the sit-to-stand-to-sit[8] and the sit-to-stand[16] movements. However, in the study of Coghlin and McFadyen,[16] the statistical level of significance was not informed. Nevertheless, in the study of Svendsen et al,[20] no differences were found in the hip angles between individuals with LBP and healthy individuals in stand-to-sit-to-stand, but this study did not inform the values of this variable. Furthermore, only 1 study approached the hip displacement velocity, and it observed a decreased velocity in the performance of sit-to-stand-to-sit in the LBP group.[8] Thus, because studies with a low risk of bias presented divergent results, we cannot draw a conclusion about the hip behavior of patients with LBP.

In addition, 1 study compared lumbar spine motion with hip motion to understand the contribution of each region to the movement of sit-to-stand-to-sit.[8] This study had a low risk of bias, and its conclusion was that the contribution of the lumbar spine movement in patients with LBP was smaller than controls, so it is possible that this group tries to protect the lumbar region when performing the movement.[8]

Only 1 study investigated the analysis of the pelvic motion, and it reported that there is no difference in the pelvic ROM between patients with LBP and healthy individuals.[19] This study presented a low risk of bias.

Table 3. *Characterization of the Studies* [a]

First Author (Year)	Sample	Age (Mean ± SD)	Sex	Movements and Variables	Assessment Instrument	Anatomical Landmarks
Claeys (2012)[7]	106 CLBP 20 controls	18.5 ± 0.5 18.5 ± 0.5	65% F 76% F	Sit-to-stand-to-sit Movement duration, anterior pelvic rotation	Two piezoresistive accelerometers (IC Sensors, Leeds, England)	T1 and S2
Coghlin (1994)[16]	5 CLBP 5 controls	36.7 32.0	M	Sit-to-stand Movement duration and lumbar and hip ROM	Video image system (3 cameras)	Acromion, mid-iliac crest, knee joint center, greater trochanter, malleolus, fifth metatarsal
Galli (2000)[17]	30 obese CLBP 10 controls	39.7 ± 12.4 27 ± 3	83% F 50% F	Sit-to-stand Angle of the trunk	Elite movement track system (6 cameras) (Elite BTS, Milan, Italy)	C7, acromion, sacrum, anterior superior iliac spine, midway between the posterior superior iliac spines, greater trochanter, femoral condyle, malleolus, fifth metatarsal, heel
Mehravar (2012)[18]	11 CLBP 12 controls	23.2 ± 2.9 23.5 ± 3.6	F	Sit-to-stand Pelvis and trunk movement reproduction	Kinemetrix video image system v. 5 (3 cameras) (Kinemetrix, Leeds, England)	External auditory meatus, acromion, humeral condyle, C7, on the skin over left pelvis, greater trochanter, femoral condyle, malleolus, fifth metatarsal
Peydro (2011)[19]	90 CLBP 51 controls	42.8 ± 14.3 45.8 ± 10.7	M, F	Stand-to-sit-to-stand Movement duration; maximal angular velocity; and acceleration of the trunk, lumbar ROM, and movement reproduction	Video image system (3 cameras) (NedLumbar/IBV, Instituto de Biomecánica de Valencia, Valencia, Spain)	C7, T12, L3, L5, S1, iliac crest, proximal and distal femur, and superior third of the fibula
Sanchez-Zuriaga (2011)[20]	39 SLBP 16 controls	45 ± 11 39 ± 11	N/A	Stand-to-sit-to-stand Movement duration; trunk, lumbar, and pelvis ROM; mean angular velocity; and acceleration of the trunk	Kinescan video image system (4 cameras) (Kinescan/IBV, Instituto de Biomecánica de Valencia, Valencia, Spain)	C7, T12, L3, L5, S1, iliac crest, proximal and distal femur, superior third of the fibula
Shum (2005)[8]	30 SLBP and negative SLR 30 SLBP and positive SLR 20 controls	38.5 ± 10.2 40.9 ± 10 41.7 ± 8.2	N/A	Sit-to-stand-to-sit Movement duration, ratio in the sagittal plane, lumbar and hip ROM and velocity	3SPACE Fastrak electromagnetic devices (3SPACE Fastrak, Polhemus Inc, Colchester, Vermont)	L1, sacrum, lateral of the thighs
Svendsen (2013)[21]	12 SLBP 12 controls	38.6 ± 9.8 37.5 ± 9.7	75% F	Stand-to-sit-to-stand Angle of the trunk, angle of the hip	Qualisys Track Manager system (8 cameras) (Qualisys AB, Göteborg, Sweden)	Acromion, iliac crest, anterior and posterior superior iliac spines, L5, greater trochanter, cluster at the tibia and femur, lateral epicondyle, first and fifth metatarsals, calcaneus

CLBP, chronic low back pain; *F*, female; *M*, male; *N/A*, not available; *ROM*, range of motion; *SD*, standard deviation; *SLBP*, subacute low back pain; *SLR*, straight leg raise test.

[a] All articles presented cross-sectional study design.

Another analysis was movement reproduction, that is, how the kinematic aspects behave during the repetition of the task. In this sense, 2 studies found differences between groups in the stand-to-sit-to-stand movement when comparing the trunk variability: Mehravar et al[21] reported greater variability of the trunk in the LBP group, and Peydro et al[18] observed lower movement repeatability. However, when assessing the variability of the pelvis, Mehravar et al[21] found no significant difference between groups. Both studies scored a low risk of bias. Thus, it is indicative that patients with LBP may employ new strategies to reduce pain triggered by the movement.

In this way, the presence of LBP seems to influence some kinematic aspects. Patients with LBP take longer to perform the sit-to-stand-to-sit movement. They present decreased lumbar

1st author (year)	Kinematic variables in each analyzed movement	Sit-to-stand-to-sit			Sit-to-stand			Stand-to-sit		
		LBP	Controls	p	LBP	Controls	p	LBP	Controls	p
	Duration of the movement									
Claeys (2012) [7]	Stable surface	9.33±1.49s [a]	8.29±1.23s [a]	< 0.005	N/A		> 0.05	N/A		> 0.05
Coghlin (1994)[16]					1.7±0.06s	1.95±0.05s	N/A			
Peydro (2011)[19]		3.18±0.75s [b]	2.27±0.29s [b]	<0.001						
Sanchez-Zuriaga (2011)[20]		N/A		<0.05						
	Anterior pelvic rotation onsets									
Claeys (2012) [7]	Stable surface	0.14± 0.14	0.10±0.08	< 0.05	-0.04±0.00	-0.04±0.01	> 0.05	-0.26±0.03s	-0.16±0.01s	> 0.05
	Reproduction of the movement									
	Variability in the reproduction of the movement									
Peydro (2011)[19]		0.2±0.09%	0.08±0.02%	<0.001						
	Variability of the trunk									
Mehravar (2012)[18]					5.53±0.48°	4.32±0.46°	<0.05			
	Variability of the pelvis									
Mehravar (2012)[18]					3.14±0.30°	2.88±0.29°	>0.05			
	Lumbar spine									
	ROM									
Peydro (2011)[19]		26.21±8.76°	32.07±6.77°	<0.001						
Sanchez-Zuriaga (2011)[20]		25.8±9.6°	32.6±6.6°	<0.001						
	Flexion peak									
Shum (2005)[8]	Negative SLR				25±7°	41±8°	<0.05	22±7°	37±8°	<0.05
	Positive SLR				24±5°			25±6°		
	Velocity									
					Flexion					
Shum (2005)[8]	Negative SLR				17±7°/s	25±6°/s	<0.05	25±9°/s	41±13°/s	<0.05
	Positive SLR				19±5°/s			29±12°/s		
					Extension					
Shum (2005)[8]	Negative SLR				29±10°/s	43±11°/s	<0.05	12±7°/s	16±4°/s	<0.05
	Positive SLR				30±12°/s			12±4°/s		
	Lumbar movement / hip movement ratio									
Shum (2005)[8]	Negative SLR				0.40±0.13	0.52±0.15	<0.05	0.38±0.15	0.50±0.15	<0.05
	Positive SLR				0.38±0.16			0.42±0.15		
	Trunk									
	ROM									
Svendesen (2013)[21]		N/A	N/A	>0.05						
Sanchez-Zuriaga (2011)[20]		111.4±10.1°	113.1±8.2°	>0.05						
Coghlin (1994)[16]					48.5°	31.3°	N/A			
	Flexion peak									
Galli (2000)[17]					44.8±9.6°	34.5±4.6°	<0.05			

Fig 2. *Summarization of the analyzed kinematic variables (LBP patients vs controls).* [a]*Mean of 5 trials.* [b]*Mean of 1 trial.* LBP, *low back pain;* ROM, *range of motion;* SLR, *straight leg raise test.*

	Maximal angular velocity									
Peydro (2011)[19]		95.31±25.13°/s	138.23±23.42°/s	<0.001						
	Maximal angular acceleration									
Peydro (2011)[19]		280.19±113.08°/s²	460.16±101.49°/s²	<0.001						
Sanchez-Zuriaga (2011)[20]	Flexion	150.9±45.6°/s²	203.3±43.5°/s²	< 0.01						
	Extension	373.2±118.9°/s²	474.7±52.5°/s²	< 0.01						
	Average speed (flexion)									
Sanchez-Zuriaga (2011)[20]	Flexion	30.4±6.8°/s	35.8±4.3°/s	<0.001						
	Extension	60.8±11.8 °/s	69.9±6.7°/s	<0.05						
	Hip									
	ROM									
Svendsen (2013)[21]		N/A	N/A	>0.05						
	Flexion peak									
Coghlin (1994)[16]					51.0°	77.25°	N/A			
Shum (2005)[8]	Negative SLR [c]				64±11°	88±11°	<0.05	66±11°	87±11°	<0.05
	Positive SLR [c]				67±6°			64±11°		
	Velocity									
								Flexion		
Shum (2005)[8]	Negative SLR [c]				46±13°/s	69±13°/s	<0.05	83±19°/s	113±16°/s	<0.05
	Positive SLR [c]				40±14°/s			71±8°/s		
								Extension		
Shum (2005)[8]	Negative SLR [c]				79±28°/s	120±24°/s	<0.05	43±15°/s	59±14°/s	<0.05
	Positive SLR [c]				66±16°/s			37±10°/s		
	Pelvis									
	ROM									
Sanchez-Zuriaga (2011)[20]					N/A	N/A	> 0.05			

[a] = mean of five trials; [b] = mean of one trial; [c] = Straight Leg Raise test (SLR); N/A = values not informed.

Fig 2. (*continued.*)

and hip mobility, slower velocity of displacement of the hip and the trunk, decreased overall acceleration of the trunk, and greater variability of the trunk. These aspects should be considered by professionals of the movement sciences (physiotherapists, physical educators, chiropractors, occupational therapists, etc) when assessing these patients and planning their treatment.

Some studies using electromyography found that compensatory mechanisms in muscle activation can take place on antagonist muscles in the presence of pain, leading to different muscle recruitment patterns, which reduce the movement velocity and the ROM in patients with LBP.[20,22,23] So, the alterations in such kinematic aspects may be a consequence of compensatory strategies. However, concerning the pelvis and the overall trunk mobility, velocity, and acceleration of the lumbar spine, the effect of LBP remains incipient as much as the mobility, velocity, and acceleration of the hip and the pelvis behave in individuals with LBP.

Thus, there is still a lack in the literature regarding the behavior of kinematic characteristics related to the sit-to-stand movement in individuals with LBP, requiring new research to investigate these aspects.

Limitations

The limitations of this study included that the search did not include all languages. It is possible that some studies were missed in our search strategy.

Conclusion

According to the findings in this review, kinematic changes occur in patients with LBP because they take longer to perform the sit-to-stand-to-sit movement, present decreased lumbar and hip mobility, and present slower velocity of the trunk and hip and overall acceleration of the trunk besides greater variability of the trunk. These aspects should be considered by professionals of the movement sciences, such as physiotherapists, physical educators, chiropractors, and occupational therapists, when planning the treatment of the patient. However, the effect of LBP in the pelvis and the overall trunk mobility and velocity and acceleration of the lumbar spine and how the mobility, speed, and acceleration of the hip and pelvis behave in individuals with LBP remain incipient. Based on the GRADE criteria, the results of this review indicate that there is low scientific evidence on the characteristics of the kinematic variables (duration of the movement, reproduction of the movement, ROM, velocity, and acceleration) of the trunk, lumbar spine, pelvis, and hip in patients with LBP.

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Contributorship Information

Concept development (provided idea for the research): J.A.S., C.T.C.
Design (planned the methods to generate the results): J.A.S., C.T.C.
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Practical Applications

- Participants with LBP may present with some unique kinematic characteristics.
- People with LBP required more time to perform the sit-to-stand movements.
- People with LBP showed reduction of lumbar mobility, slower velocity, and overall acceleration of the trunk and greater variability of trunk movement.

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