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Temporal stability of self-reported visual back pain trajectories

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Abstract

Low back pain (LBP) follows different pain trajectories, and patients seem to recognize their trajectory. This allows self-reported visual pain trajectories (SRVTs) to support patient–provider communication. Pain trajectories appear stable over time for many patients, but the evidence is sparse. Our objectives were to investigate the (1) temporal stability of SRVTs over 1 year concerning pain intensity and course patterns and (2) association of transitions between SRVTs and changes in pain and disability. This study used data from 2 prospective primary care cohorts: the Danish Chiropractic LBP Cohort (n = 1323) and the GLA:D Back cohort (n = 1135). Participants identified one of the 8 SRVTs at baseline and 12-month follow-up, each asking about LBP trajectories the preceding year. Trajectories were described using 2 subscales (intensity and pattern). Temporal stability was quantified by "stability odds ratios" (ORs), depicting the likelihood of staying in the same SRVT after 12 months compared with baseline, and by "preference ORs," depicting the likelihood of choosing a specific alternative SRVT at follow-up. Both ORs compare the observed proportion with the chance level. Finally, we examined associations between transitioning to a different trajectory and changes in clinical outcomes. Approximately 30% stayed in the same SRVT. The stability ORs were all >1. The preference ORs indicated that transitions occurred mainly to similar SRVTs differing in only 1 subscale. Transitions to less or more intense SRVTs were associated with changes in clinical outcomes in the expected direction. Despite distinctly different SRVTs identified, individuals reported relatively stable LBP phenotypes but with potential for change.

Keywords: Pain trajectories, Stability, Low back pain, Primary care, Self-reported visual pain trajectories

1. Introduction

Low back pain (LBP) follows distinctly different pain trajectories,[23] and our understanding of the development of LBP has moved beyond the classification of pain as "acute" or "chronic," recognizing the existence of varying types of LBP that differ by pattern and intensity, particularly when viewed over the long term.[2,7–9,11,13,24]

Trajectory types have previously been identified by data-driven subgroup analysis using longitudinal data (eg, latent class modeling).[26] One challenge to this approach is that individuals must be followed over time before trajectories can be uncovered, limiting their clinical usefulness. To overcome this, self-reported visual pain trajectories (SRVTs) allow patients to describe their LBP course by identifying, from predefined trajectory classes, the pattern that best describes their experienced LBP trajectory. The work developing SRVTs, and a qualitative study comparing data-derived trajectories to peoples' descriptions of their LBP course in interviews,[15] indicates that people can recall their trajectory type. Self-reported LBP trajectory classes are immediately available to support clinical decision making and facilitate further scientific investigations, particularly on their clinical usefulness.[10,27]

Trajectories are not only of interest to obtain detailed knowledge of recovery but also have been suggested to represent phenotypes of LBP because they are associated with key functional and psychological patient characteristics largely independent of care seeking or treatment delivered.[23] For such phenotypes to be clinically useful, they would have to reflect an underlying condition with a predictable likelihood to change over time and ideally help inform treatment choices. From the patient perspective, knowledge about their pain trajectory may be important. Patients with LBP value information about what to expect[17] and express frustration with unpredictable pain that behaves in a way that makes little sense.[6]

One previous study, using monthly measures of LBP during 2 periods 7 years apart, found that most adults did not change their trajectory type when classified with ongoing mild or severe pain but were more likely to shift to a different trajectory type if initially classified with fluctuating pain.[9] Neck pain measured weekly over a 1-year period has also shown high stability.[19] There is also evidence that persistent pain patterns represent similar patient profiles

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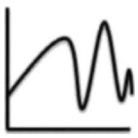
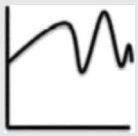
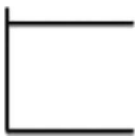
Table 1

Self-reported visual back pain trajectories.

Figure	Description used in the data collection	Label used in this study	Intensity dimension	Pattern dimension
	I do not recognize any of these patterns as similar to my LBP	Unrecognized	Mild	—
	No prior LBP, or a single episode of LBP	Single episode	Mild	Episodic
	Episodic LBP, with at least 1 month of no pain in between	Episodic	Mild	Episodic
	Mild LBP most of the time	Mild persistent	Mild	Persistent
	Mild fluctuating LBP	Mild fluctuating	Moderate	Fluctuating
	Fluctuating LBP of varying intensity shifting between mild and severe	Intermediate fluctuating	Intense	Fluctuating
	Severe fluctuating LBP	Intense fluctuating	Intense	Fluctuating
	Severe LBP most of the time	Intense persistent	Intense	Persistent

The figures and description presented to the patients, the label used in this study, and the 2 trichotomous categorizations.
LBP, low back pain.

independent of the actual pain intensity and that episodic pain patterns seem to represent a type of LBP with less burden.[18,22]

Investigating the stability of SRVTs will shed light on whether patients view themselves as having a "fixed" type of LBP in belonging to a single trajectory class or if classes are modifiable over time. If transitions occur between trajectory classes, they should be associated with changes in clinical outcomes to support the idea that transitions between SRVTs reflect a transition in the LBP condition. No studies have investigated the

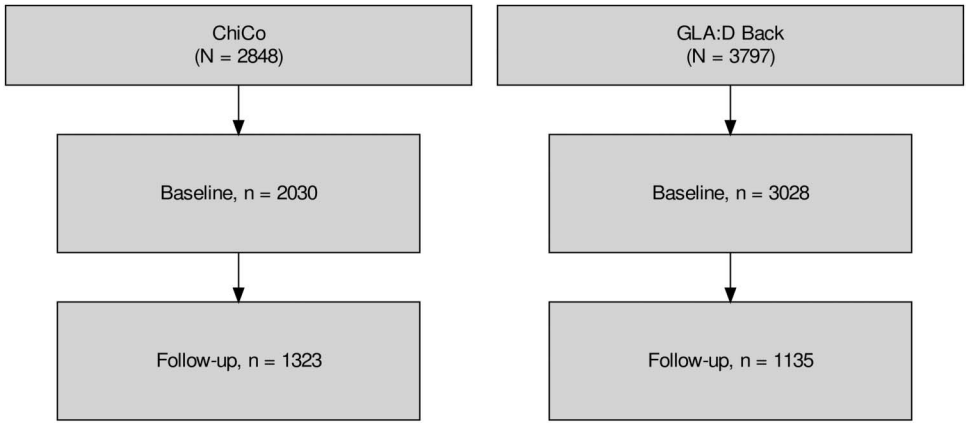


Figure 1. Study flow of participants consenting to participate in 2 primary care cohorts.

stability of SRVTs or otherwise investigated the stability of self-reported trajectory classes differentiating between the dimensions of pain intensity and pain pattern.

Using 2 primary care cohorts, we investigated (1) the temporal stability of individual SRVTs that reflect differences in pain intensity and pattern and (2) the association between transitions to a different SRVT and changes in clinical pain and disability outcomes.

2. Methods

2.1. Study design and population

We used data from 2 prospective, observational cohorts of patients seen in Danish primary chiropractic and physiotherapy practice. One cohort was the Danish *Chiropractic low back pain Cohort (ChiCo)*: 10 chiropractic clinics located in the Central Administrative Region of Denmark included participants who consulted a chiropractor to initiate care for LBP with or without leg pain, from November 2016 to December 2018. All patients were 18 years or older and could complete electronic questionnaires in Danish. The care provided was not affected by study participation. Further descriptions of recruitment and procedures are published elsewhere.[25]

The second cohort was data obtained from the Danish *GLA:D Back* register (GLA:D Back). This is a clinical registry of patients 18 years or older who can answer electronic questionnaires in Danish and have participated in a GLA:D Back program in a chiropractic or physiotherapy practice in Denmark. In short, the GLA:D Back program is a group-based patient education and exercise program targeting patients with persistent or recurrent LBP and a need for improved self-management.[21,31] Active registration in the registry is mandatory when the chiropractor or physiotherapist enrolls the patient in the program.

A key difference between the cohorts was the inclusion criteria. ChiCo included patients initiating new chiropractic treatment for an LBP episode. This was mainly patients with an acute episode of LBP, but they could have had pain for a long time or previously sought other treatment. GLA:D Back consists of participants who were often already undergoing treatment at a chiropractor or physiotherapist. Thus, the main difference is that ChiCo included patients seeking care for a new episode of LBP, whereas GLA:D Back patients are starting a supervised self-management program in continuation of other care.

Participants in the cohorts provided consent for data to be used for research, and all data achieved were anonymized. For the data collection, authorization was obtained from the Danish Data Protection Agency as part of the University of Southern Denmark's institutional authorization (Data Protection Agency no. 2015–57-0008, SDU no. 17/30591 and 16/47215). No approval was needed from the Regional Scientific Committee to extract and store the data or conduct the analyses.[35]

Table 2

Descriptive data at baseline for the included participants.

	ChiCo	GLA:D Back
Characteristic	N = 1323	N = 1135
Sex (% female)	578 (44%)	785 (70%)
Age (y)	48 (30-65)	59 (43-74)
Back pain (0-10)	6.65 (4.00-9.00)	5.27 (2.00-8.00)
Leg pain (0-10)	2.98 (0.00-8.00)	3.03 (0.00-7.00)
Disability (0-10)*	5.50 (2.17-8.26)	2.40 (1.00-4.00)
The STarT Back Screening Tool		
Low	590 (45%)	563 (51%)
Moderate	475 (36%)	305 (27%)
High	258 (20%)	244 (22%)
Current episode duration†		
Short	930 (71%)	223 (20%)
Medium	179 (14%)	258 (23%)
Long	207 (16%)	646 (57%)
Work ability index (0-10)	7.32 (4.00-10.00)	7.14 (5.00-10.00)
Back beliefs scale (9-45)	32.8 (26.0-40.0)	
Illness perception scale (0-100)		42 (27-56)

All continuous variables are presented as mean (10th-90th percentile range), all categorical as count (frequency).

* ChiCo: disability was measured using the Roland–Morris Disability Questionnaire. GLA:D Back: disability was measured using the Oswestry Disability Index.

† CHICO: episode duration was split into <4 weeks (short), >4 to <52 weeks (medium), and >52 weeks (long). GLA:D Back: episode duration was split into <12 weeks (short), >12 to <52 weeks (medium), and >52 weeks (long).

2.2. Variables of interest

Patients provided the variables of interest for both cohorts at enrollment (*baseline*) and again after 1 year (*follow-up*). All questionnaires were completed electronically through REDCap (Vanderbilt University, Tennessee) by the patients at home. The link to the baseline questionnaire was emailed to patients on the day of enrollment. Thus, consent of inclusion and provision of a unique identifier occurred directly at the clinical encounter, whereas the baseline questionnaire was answered from home, resulting in a dropout before completing baseline questionnaires.[25]

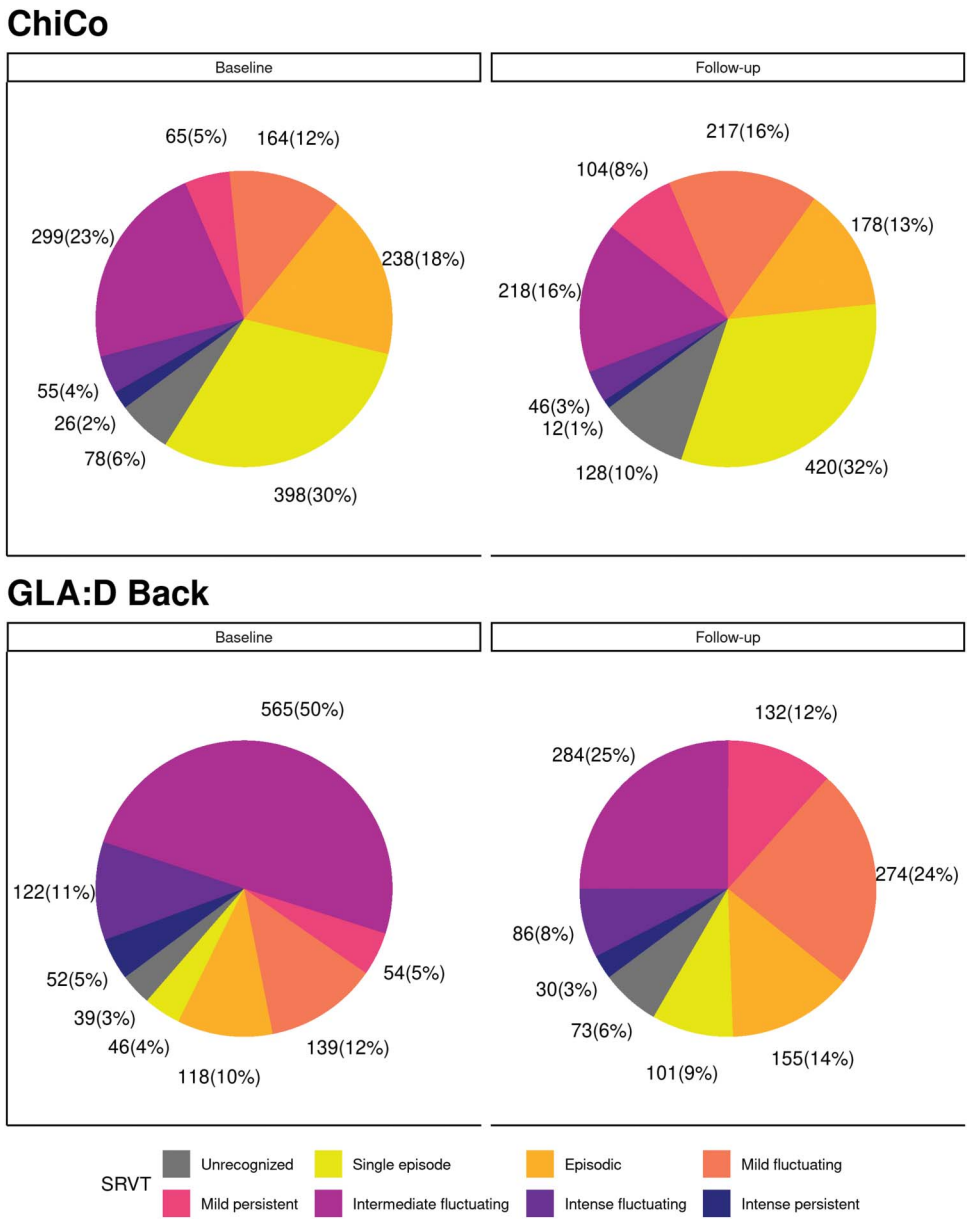


Figure 2. Distribution of self-reported visual pain trajectories at baseline and after 12-month follow-up in 2 primary care cohorts. SRVT, self-reported visual pain trajectory.

2.2.1. Self-reported visual back pain trajectories

The participants chose one of the 8 visual pain trajectories, presented with a description and an illustration, which best fit their LBP during the past 12 months (**Table 1**).

2.2.1.1. Dimensions of pain intensity and pain pattern

The 8 SRVT classes were classified by 2 trichotomized subscales depicting the dimensions of intensity and pattern (**Table 1**). The intensity dimension allowed us to rank the overall pain intensity for each trajectory class as *mild*, *moderate*, or *intense*. The pattern dimension was classified into *episodic*, *fluctuating*, and *persistent* pain trajectory classes. The pattern dimension had no ordinal rank. This choice of trichotomization was supported by a visual analysis of the association of the 8 SRVT classes with baseline characteristics (Supplementary material 1, available at http://links.lww.com/PAIN/B631). In addition, this approach aligns with the domains previously suggested for a uniform description of data-derived trajectory types.[23] Finally, we used descriptors that were pragmatic and feasible for clinicians to understand.

2.2.2. Clinical outcome measurements

Typical back and leg pain intensity the previous week was scored on an 11-point numerical rating scale, 0 = no pain to 10 = worst pain imaginable. In ChiCo, disability was scored using the 23-item Roland–Morris Disability Questionnaire with binary answering options yes or no, with summary scores of 0% = no disability to 100% = completely immobile.[29] In GLA:D Back, disability was scored using the 10-item Oswestry Disability Index, each item scored from 0 to 5, with summary scores of 0% = no disability to 100% = bedbound.[3] All disability scores were rescaled to 0 (no disability) to 10 (high disability). All outcomes were reported at

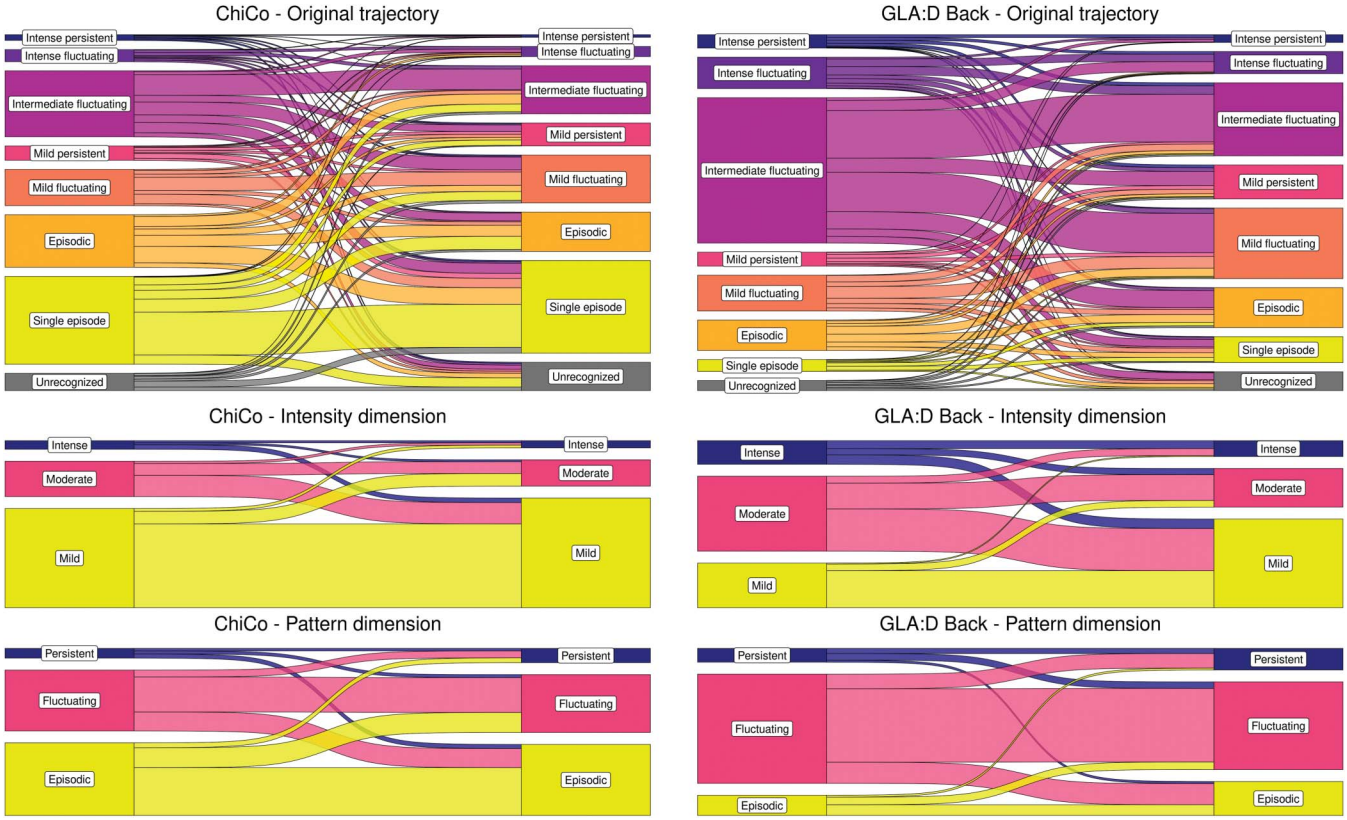


Figure 3. Sankey diagrams showing the proportions of participants in each self-reported visual pain trajectory at baseline and follow-up for the ChiCo and GLA:D Back cohorts. The height of the bars and lines represents the number of participants.

baseline and follow-up. Changes in pain and disability were calculated as differences in outcomes between baseline and 12-month follow-up (range of −10 to 10, a negative change indicating improvement).

The cohorts were described on the characteristics age, sex, STarT Back Screening Tool (low, moderate, or high risk for developing long-term disability),[16] pain duration (short [ChiCo < 4 weeks and GLA:D Back < 12 weeks], medium [up to 52 weeks], and long duration [> 52 weeks]), work ability (0 = low work ability to 10 = high work ability),[1] back beliefs (9 = negative beliefs to 45 = positive beliefs),[12] and illness perception (0 = no negative health perceptions to 100% = high negative health perceptions).[5]

2.3. Statistical analyses

All statistical analyses are presented separately for each cohort. We completed data cleaning, visualization, and analyses in R[30] (Linux, v. 4.0 with RStudio v. 1.4), using the *tidyverse* programming language.[36] The *ggsankey* package was used to construct the Sankey diagrams,[33] and the *gtsummary* package was used to illustrate results from the logistic regressions.[34] Patient demographics were tabulated using means and 10th to 90th percentile range for continuous variables or absolute counts and relative frequency for categorical ones.

2.3.1. Attrition analysis

In the ChiCo cohort, all participants who provided a baseline assessment were eligible for this analysis because they had the chance to participate in the 1-year follow-up. In the GLA:D cohort, the eligible participants were enrolled at least 13 months before May 2020, the point of data extraction (ie, we could expect a response after 1 year). The effect of attrition was depicted by comparing patients who provided the SRVTs at the 1-year follow-up (responders) with the remaining eligible patients who were regarded as nonresponders.

To examine differences between responders and nonresponders, we used logistic regression to examine the association between baseline characteristics and being a nonresponder (calculated as odds ratios [ORs] with 95% confidence intervals). In addition, we compared the distribution of the SRVTs at baseline between responders and nonresponders.

2.3.2. Assessment of stability and transition

We assessed stability in several ways. First, the distribution of SRVTs was illustrated at both time points using pie charts. Second, we used Sankey diagrams to illustrate the frequency of the different transitions from baseline to follow-up. Third, we investigated the probability of stability by regarding patients as *stable* if they did not change their SRVT from baseline to follow-up or as *stable for the dimension of intensity or pattern*, respectively, if they did not change in the corresponding dimension. Finally, we considered transition probabilities for the SRVTs, (ie, the probability of choosing a specific SRVT at follow-up that is different from the one at baseline). This aimed to detect the most *preferred* (common) transition target.

Because the frequencies of SRVTs varied between the 2 cohorts and changed substantially between the 2 time points, the above-defined probabilities cannot directly be compared between SRVTs or cohorts. We transformed these probabilities into ORs to assist interpretation, comparing the observed relative frequencies with the chance level. The chance level was defined as the expected probability under the assumption of independence between the 2 time points.

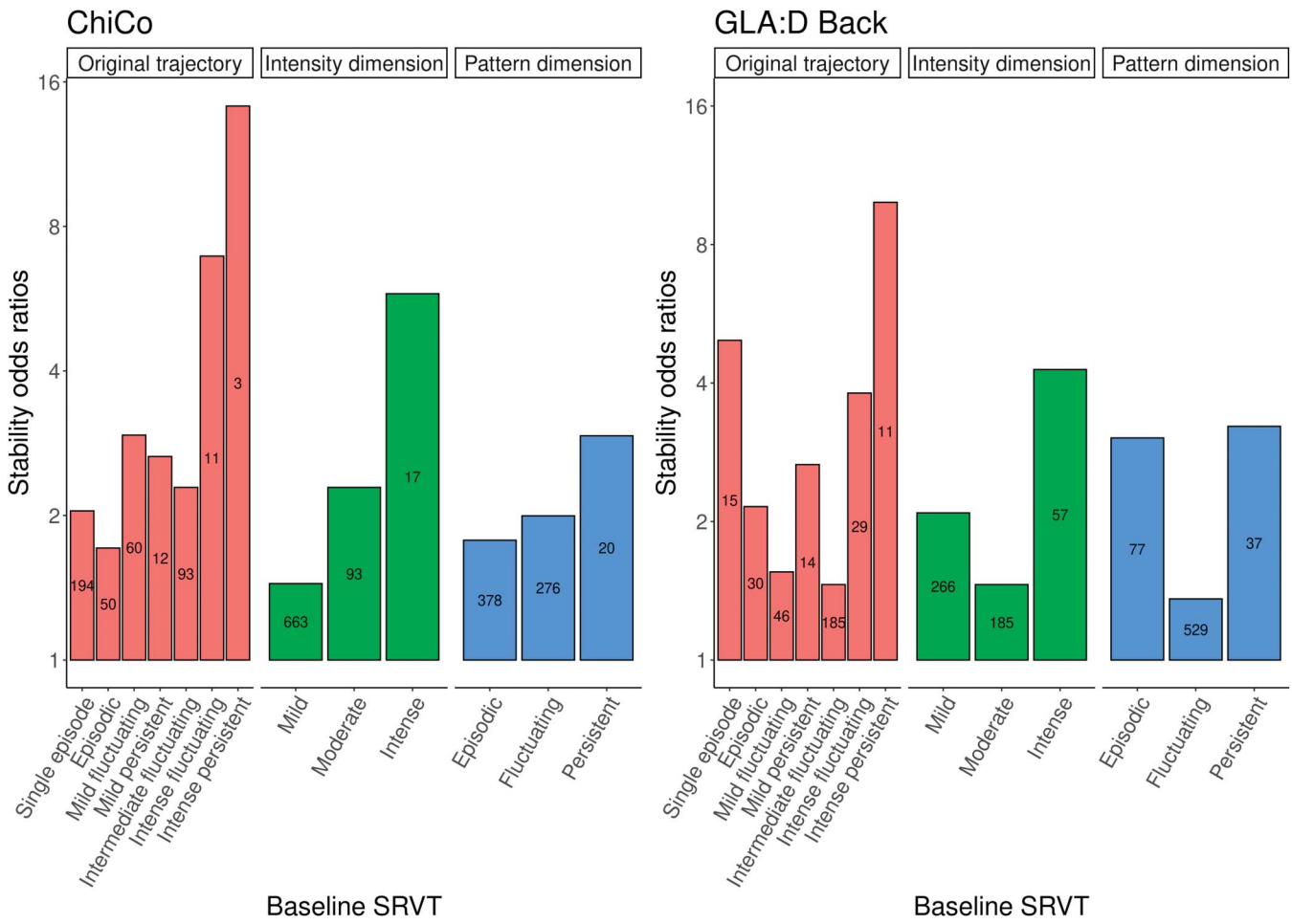


Figure 4. Stability odds ratios of the 8 self-reported visual pain trajectories and the classes defined by the intensity and pattern subscales. The y-axis is illustrated on a logarithmic scale, and the numbers indicate the number of participants staying. SRVT, self-reported visual pain trajectory.

Details are provided in Supplementary material 2 (available at http://links.lww.com/PAIN/B631). This way, we obtained *stability ORs* and *preference ORs*. The *stability ORs* are presented as bar plots and the *preference ORs* as heat maps. For the instances with *preference ORs* higher than 1 for both cohorts, we described how these related to transitions in the intensity and pattern dimensions.

2.3.3. Assessment of associations between changes in pain and disability and transitions to a different self-reported visual pain trajectory

For this part, we investigated associations between transitions within the intensity and pattern SRVT subscales and changes in back pain, leg pain, and disability. Participants who chose the *unrecognized* SRVT at baseline or follow-up were excluded from these analyses.

2.3.3.1. Intensity dimension

The association between change scores in pain and disability and transitions in the intensity dimension was investigated by 2 separate binary logistic regression analyses. The first depicts the transition to a more intense SRVT (compared with staying or transitioning to a less intense SRVT). The second depicts the transition to a less intense SRVT (compared with staying or transitioning to a more intense SRVT). For instance, a transition to a more intense SRVT could be from a *mild* to *moderate* or *intense* SRVT. In the "more intense" analysis, those who started in an *intense* subscale were excluded because they could not become worse. Similarly, for the "less intense" analysis, we omitted those who started in a *mild* subscale.

The regression analyses were performed unadjusted and adjusted for the baseline SRVT subscale. The latter considered that the baseline SRVT subscale could act as a confounder as baseline SRVTs may differ in mean change scores and the likelihood of a transition. Odds ratios refer to a 1-point difference in change scores ranging from −10 to 10.

2.3.3.2. Pattern dimension

As there is no precise ordinal rank on the pattern dimension, we presented the mean change scores in pain and disability outcomes for each possible transition (eg, from *episodic* to *persistent*). In addition, a scatterplot showed the baseline and follow-up values for each outcome stratified by the transition.

3. Results

A total of 1323 participants from the ChiCo cohort and 1135 GLA:D Back cohort participants were included, representing 46% and 30% of all eligible participants, respectively (**Fig. 1**). The cohorts differed substantially in their composition (**Table 2**), with ChiCo participants being on average younger, more often males, having a higher level of back pain and disability, and in

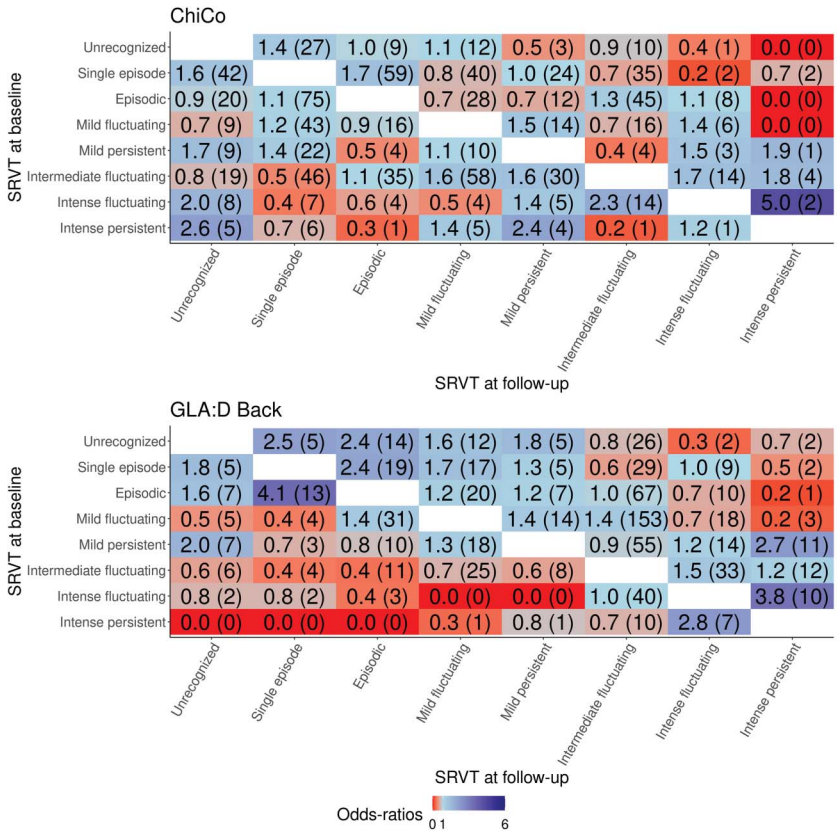


Figure 5. Preference odds ratios of transitioning from 1 self-reported visual pain trajectory at baseline to another at follow-up. The figure shows preference odds ratios for each possible transition with the number of participants who transition in brackets. SRVT, self-reported visual pain trajectory.

particular reporting shorter current episodes. The cohorts also differed in their distribution of SRVTs (**Fig. 2**). In ChiCo, most participants were categorized as *single episode* (n = 398 [30%]), *intermediate fluctuating* (n = 299 [23%]), or *episodic* (n = 299 [23%]) at baseline. In GLA:D Back, the most common SRVT was, by far, *intermediate fluctuating* (n = 565 [50%]). A total of 6% and 3% selected the *unrecognized* SRVT, respectively, for the 2 cohorts at baseline.

3.1. Attrition analysis

Nonresponse was associated with higher pain scores, higher disability, higher risks of long-term disability according to the STarT Back Screening Tool, longer pain duration, lower work ability, and poorer beliefs or illness perceptions related to LBP (Supplementary material 3, available at http://links.lww.com/PAIN/B631). Associations between patient characteristics and nonresponse were generally stronger for GLA:D Back than ChiCo. The nonresponders

Table 3

Transitions with a preference odds ratio > 1 for both cohorts.

SRVT transition	ORs	Dimension
	ChiCo/GLA:D Back	Intensity/Pattern
Intense fluctuating to intense persistent	5.0/2.8	Stable/Transition
Single episode to episodic	1.7/4.1	Stable/Stable
Intense persistent to intense fluctuating	1.2/3.8	Stable/Transition
Single episode to unrecognized	1.6/2.5	Transition/Transition
Mild persistent to unrecognized	1.7/1.8	Transition/Transition
Episodic to single episode	1.1/2.4	Stable/Stable
Unrecognized to single episode	1.4/1.8	Transition/Transition
Mild fluctuating to single episode	1.2/1.7	Stable/Transition
Mild fluctuating to mild persistent	1.5/1.3	Stable/Transition
Mild persistent to single episode	1.4/1.3	Stable/Transition
Mild persistent to mild fluctuating	1.1/1.4	Stable/Transition

The transitions are ordered by the average log OR over the 2 cohorts. Stable indicates transition without change in this dimension, and transition indicates transition with a change in this dimension.
OR, odds ratio; SRVT, self-reported visual pain trajectory.

Table 4

Unadjusted and adjusted odds ratios for associations between transition to a more or less intense self-reported visual pain trajectory subscale and change in patient-reported outcome measures.

Transition status	Change scores	ChiCo		GLA:D Back	
		Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
More intense transition	Back pain (−10 to 10)	1.24 (1.17-1.33)***	1.29 (1.21-1.38)***	1.27 (1.17-1.38)***	1.26 (1.16-1.37)***
ChiCo: n = 1065	Leg pain (−10 to 10)	1.05 (0.99-1.12)	1.05 (0.99-1.12)	1.12 (1.04-1.20)***	1.12 (1.04-1.21)***
GLA:D Back: n = 860	Disability (−10 to 10)	1.26 (1.17-1.35)***	1.30 (1.21-1.40)***	1.87 (1.53-2.32)***	1.86 (1.51-2.31)***
Less intense transition	Back pain (−10 to 10)	0.71 (0.64-0.77)***	0.71 (0.64-0.78)***	0.72 (0.67-0.77)***	0.71 (0.66-0.76)***
ChiCo: n = 361	Leg pain (−10 to 10)	0.83 (0.77-0.90)***	0.83 (0.77-0.90)***	0.81 (0.76-0.86)***	0.81 (0.76-0.86)***
GLA:D Back: n = 713	Disability (−10 to 10)	0.68 (0.61-0.76)***	0.68 (0.60-0.76)***	0.51 (0.43-0.61)***	0.50 (0.42-0.60)***

Unadjusted ORs are based on a logistic regression model with the change score as single covariate. Adjusted ORs are adjusted for the SRVT intensity subscale at baseline by adding this covariate to the model. Positive change scores indicate worse outcomes, 95% CI.

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

95% CI = 95% confidence interval; OR, odds ratio; SRVT, self-reported visual pain trajectory.

tended to select more severe SRVTs at baseline than the responders, which was most pronounced in ChiCo.

3.2. Stability and transition

3.2.1. Transition frequency

Transitions to a different SRVT was relatively common, with the frequency of specific transitions varying between the cohorts (**Fig. 3**). In ChiCo, 33% of the cohort stayed in the same SRVT; similarly, in GLA:D Back, this was 30%. As expected, stability increased when considering the dimensions of intensity and pattern separately, with 60% and 45% staying in the same intensity class and 52% and 57% in the same pattern class for ChiCo and GLA:D Back, respectively.

For ChiCo, the SRVT with the highest frequency of staying was the *single episode* (49%) and *mild fluctuating* (37%), and the lowest frequency was observed for the *intense persistent* SRVT (12%). In GLA:D Back, all frequencies of staying varied between 21% and 33% (Supplementary material 4, available at http://links.lww.com/PAIN/B631).

3.2.2. Stability odds ratios

The odds of staying were above chance for any SRVT and any SRVT subscale (all ORs >1) (**Fig. 4**). Considering the original SRVTs, the highest stability ORs could be observed in both cohorts when *intense fluctuating* or *intense persistent* was selected at baseline. By contrast, the differences in stability were less pronounced across the other SRVTs (**Fig. 4**). However, the SRVTs with the highest ORs were often based on a limited number of participants. Considering the 2 dimensions, the only typical pattern we observed across the 2 cohorts was the highest ORs for the intense subscales, which replicated the observations for the original SRVTs.

In general, the ORs for both dimensions were of similar magnitude, suggesting that intensity and pattern have the same degree of stability.

3.2.3. Transition odds ratios

For participants who did not stay in the same original SRVT at follow-up as at baseline, the preference ORs for the SRVTs chosen at follow-up ranged from 0.0 to 5.0 (**Fig. 5**).

For the transitions with an OR > 1 in both cohorts (**Table 3**), the most preferred transitions were characterized by a shift in only one of the 2 dimensions, intensity or pattern. In addition, among the most preferred transitions, we often observed the same pair appearing twice with both possible directions, indicating a high degree of similarity from the participant perspective.

The transitions with an OR < 1 in both cohorts (the least preferred transitions) were mainly transitioning by changing both dimensions (Supplementary material 5, available at http://links.lww.com/PAIN/B631).

3.3. Associations between changes in pain and disability and transitions to a different self-reported visual pain trajectory

3.3.1. Intensity dimension

Transitioning to either a *more intense* or *less intense* SRVT was associated with a change in back and leg pain intensity and disability across cohorts in the expected direction. Across cohorts, the association with leg pain was weaker than for the other outcomes (**Table 4**).

3.3.2. Pattern dimension

In the GLA:D cohort, the differences in mean change scores across the transitions between patterns were not very pronounced, whereas, in the ChiCo cohort, some interesting patterns were observed (**Fig. 6**).

Participants classified as stable in a *fluctuating* or *persistent* SRVT displayed the lowest change scores for back pain and disability. The most considerable improvements were observed for staying in or transitioning to an *episodic* pattern. The clinical improvements were generally larger for transitioning to a *persistent* than a *fluctuating* subscale. In the interpretation of the latter, it should be noted that persistent was often minor in intensity (Supplementary material 6, available at http://links.lww.com/PAIN/B631). For leg pain, the differences across the transitions are not very pronounced. Finally, the differences in change scores observed cannot be explained by differences in baseline values (Supplementary material 6, available at http://links.lww.com/PAIN/B631).

In summary, being in a stable pattern was associated with the smallest clinical changes, whereas transitioning to an episodic pattern was associated with the largest clinical improvements or complete remission. Leg pain was not clearly associated with changes in pattern.

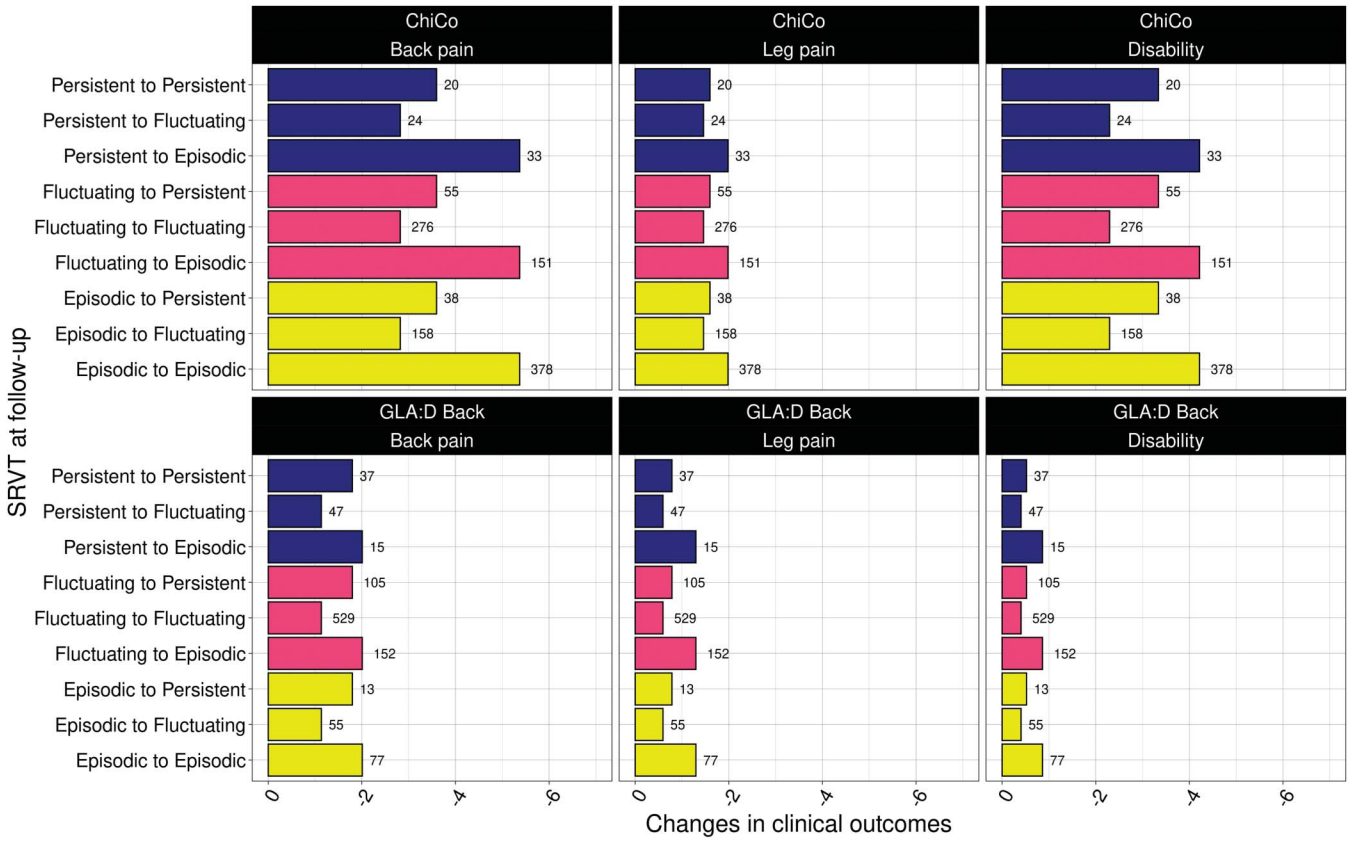


Figure 6. Clinical changes across transitioning to different self-reported visual pain trajectory patterns. Results are illustrated as mean values. A higher negative score indicates more improvement. Numbers next to the bar indicate the number of participants. SRVT, self-reported visual pain trajectory.

4. Discussion

4.1. Summary of the results

This study explored the stability of self-reported LBP trajectory classes over 1 year and investigated whether transitions between classes had a meaningful relationship with changes in clinical outcomes. LBP trajectory classes frequently transitioned as only approximately one-third identified the same SRVT at follow-up as they did 1 year before. Still, there was some stability in the classes. First, more participants stayed in the same trajectory class when examining the dimensions of intensity and pattern separately. Second, selecting any specific SRVT at baseline consistently increased the OR of selecting that same SRVT again at follow-up. Finally, although many transitions did occur, there was a clear preference to transition to similar SRVTs in the sense that LBP trajectory classes most often only change in either intensity or pattern, and very few transitions occurred between the *mild* and the *intense* SRVTs. Still, even the *intense* SRVTs were observed to transition to *mild* SRVTs in some cases.

Despite large differences in the distributions of the SRVTs and patient characteristics between the 2 cohorts, the degree of stability and the transition patterns were similar across cohorts.

Our results indicate that intensity and pattern are equally influential in understanding transitions between different trajectory classes. Both show the same degree of stability and contributed to the same degree in defining the preferred transitions.

Transitions between SRVT subscales were associated with clinical changes in the expected direction for intensity. That is, an improvement or deterioration on the intensity subscale correlated with an improvement or deterioration in back pain, leg pain, and disability.

In addition, the associations between clinical outcomes and transitions in pattern showed that a transition from a *persistent* or *fluctuating* pattern to an *episodic* pattern was associated with the largest clinical improvements, and being stable in a *persistent* or *fluctuating* pattern was related to the smallest clinical changes.

4.2. Comparisons with previous studies

No other study has examined the stability of SRVTs over 1 year. As such, we cannot compare our results directly to other studies. One previous study investigated the stability of LBP trajectories 7 years apart using repeated measures of pain intensity during two 6-month periods and identified trajectory patterns by latent class analysis.[9] Another used weekly measures to estimate the stability of neck pain during 1 year.[19] Because of different methods and time frames, the studies are not directly comparable. However, similarly to our findings, participants from those studies tended to remain in the same trajectory over time, particularly if participants were classified with a persistent pain trajectory type. The observation that patients generally did not transition between very different SVRTs supported the notion that trajectory patterns reflect LBP phenotypes that mostly remain stable over time. This was observed although the study samples were from care-seeking populations and align with evidence that LBP treatments generally are effective for episode relief but do not cure LBP for good.[20,32] In addition, the finding that a change from experiencing fluctuating or persistent pain to episodic LBP can be considered an improvement was in line with previous results on data-derived trajectory types.[22,24]

4.3. Implications for the use of self-reported visual back pain trajectories

Although transitions in trajectory classes from 1 year to the next were relatively frequent, knowing individuals' baseline trajectory class held information about their likely trajectory class 1 year later. This is promising for trajectory classes as a potentially strong predictor of individuals' future LBP, as already observed in neck pain.[28] Potentially knowing how trajectories most likely behave over time would allow SRVTs to stimulate a dialogue with patients about their prognosis. On the other hand, the observation that trajectory classes have the potential to change and that this change is associated with a change in pain and disability outcomes provides initial evidence that SRVTs may be useful as outcome measures to capture a change in patients' perceived back pain status over time. Recognizing that LBP outcomes vary substantially within individuals from day to day, there is a need for outcome measures that capture more than a single time-point snapshot.[4]

When considering the pattern dimension, the changes in clinical outcomes were less pronounced when transitioning between *fluctuating* and *persistent* pain than when transitioning from or to *episodic*. This supports previous suggestions that differentiating between *persistent* and *fluctuating* is less relevant and might be omitted because patients primarily distinguish themselves by either having episodic or ongoing pain and then by intensity and because steady, persistent pain with no variation is very seldom reported.[15,18,23]

4.4. Methodological considerations

Although acknowledging that the validity of the SRVTs has not been investigated yet, the approach of assessing previous trajectory classes was similar to the visual pain trajectory questionnaire, which has satisfying evidence for face, criterion, and construct validity.[9] In addition, only ~5% of participants chose the *unrecognized* option as a possibility at baseline, suggesting fair face validity for the SRVTs. To further increase patient recognition, adding a "complete recovery class" might be beneficial for longitudinal studies. Currently, the *single episode* SRVT states, "no pain or a single episode," but the visual representation depicts a high peak of pain.

The clinically meaningful associations between SRVTs and baseline characteristics added to the apparent validity of the SRVTs (Supplementary material 1, available at http://links.lww.com/PAIN/B631), and the difference in distribution between the 2 different cohorts was also expected. In addition, we observed similar trends for stability and association with baseline characteristics across these different cohorts, indicating overall generalizability of the SRVTs.

The study was the largest to date on LBP trajectory classes but suffered from low follow-up rates (ChiCo = 1323 [46%] and GLA:D Back = 1135 [30%]). The attrition analysis revealed that those who did not complete the SRVT at follow-up had a slightly more severe profile at baseline, including more severe SRVTs than those with eligible data at follow-up. This may make our finding less generalizable for more affected patients with LBP in primary care. However, our results indicate that stability increases with the severity of the SRVTs, and hence, we may have underestimated the overall stability.

Despite that we used 2 different cohorts with expected differences, highlighted by their dissimilarity on multiple baseline characteristics and different distributions of the SRVTs, this did not affect the level of stability when taking the chance level into account. In addition, the transitions occurred in similar patterns across the 2 samples. This indicates that transitions between LBP trajectories are similar across different primary care setups. However, our results need to be replicated, especially in general practice, where patients are generally more heavily affected than in chiropractic and physiotherapy practices.[14] Furthermore, the associations between changes in disability and transitions to a different SRVT were equal across the 2 cohorts, although different measurement instruments for disability were used.

In addition, a substantial fraction of patients included in the 2 cohorts did not participate in the baseline assessment of their trajectory class and could not be included in our analysis. Characteristics of these patients' trajectory classes are entirely unknown.

5. Conclusion

We provide evidence that SRVTs in patients with LBP are stable beyond chance over 1 year. When transitions occurred, the preferred trajectory class was similar to the original ones, typically changing in either intensity or pattern, and substantial shifts were uncommon. Overall, intensity and pattern seem to contribute to the same degree to transitions' stability and preference for specific transitions. Transitions in pain trajectory classes were related to patient-reported pain and disability changes.

Together, these findings support the concept that individual pain trajectories reflect relatively stable LBP phenotypes but with potential for change. This makes it worthwhile to explore their potential usefulness as predictors of future LBP patterns and outcome measures.

Conflict of interest statement

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Preregistration: The analysis was not preregistered with an analysis plan.

Data transparency statement: Application forms to use the described data for research projects are available from the Chiropractic Knowledge Hub (contact Orla Lund Nielsen [o.nielsen@kiroviden.sdu.dk]). The coding used for the analysis is available on request to the corresponding author.

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Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at http://links.lww.com/PAIN/B631.

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References

[1] Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health–a prospective study of women on long-term sick leave. Scand J Work Environ Health 2010;36:404–12.
[2] Ailliet L, Rubinstein SM, Hoekstra T, van Tulder MW, de Vet HCW. Long-term trajectories of patients with neck pain and low back pain presenting to chiropractic care: a latent class growth analysis. Eur J Pain 2018;22:103–13.
[3] Albert HB, Jensen AM, Dahl D, Rasmussen MN. Criteria validation of the Roland Morris questionnaire. A Danish translation of the international scale for the assessment of functional level in patients with low back pain and sciatica [in Danish]. Ugeskr Laeger 2003;165:1875–80.
[4] Axén I, Leboeuf-Yde C. Trajectories of low back pain. Best Pract Res Clin Rheumatol 2013;27:601–12.
[5] Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. J Psychosom Res 2006;60:631–7.
[6] Bunzli S, Smith A, Schütze R, O'Sullivan P. Beliefs underlying pain-related fear and how they evolve: a qualitative investigation in people with chronic back pain and high pain-related fear. BMJ Open 2015;5:e008847.
[7] Chen Y, Campbell P, Strauss VY, Foster NE, Jordan KP, Dunn KM. Trajectories and predictors of the long-term course of low back pain: cohort study with 5-year follow-up. PAIN 2018;159:252–60.
[8] Downie AS, Hancock MJ, Rzewuska M, Williams CM, Lin C-WC, Maher CG. Trajectories of acute low back pain: a latent class growth analysis. PAIN 2016;157:225–34.
[9] Dunn KM, Campbell P, Jordan KP. Long-term trajectories of back pain: cohort study with 7-year follow-up. BMJ Open 2013;3:e003838.
[10] Dunn KM, Campbell P, Jordan KP. Validity of the visual trajectories questionnaire for pain. J Pain 2017;18:1451–8.
[11] Dutmer AL, Schiphorst Preuper HR, Stewart RE, Soer R, Reneman MF, Wolff AP. Trajectories of disability and low back pain impact. Spine 2020; 45:1649–60.
[12] Grøn S, Jensen RK, Jensen TS, Kongsted A. Back beliefs in patients with low back pain: a primary care cohort study. BMC Musculoskelet Disord 2019;20:578.
[13] Hestbaek L, Leboeuf-Yde C, Manniche C. Low back pain: what is the long-term course? A review of studies of general patient populations. Eur Spine J 2003;12:149–65.
[14] Hestbaek L, Munck A, Hartvigsen L, Jarbøl DE, Søndergaard J, Kongsted A. Low back pain in primary care: a description of 1250 patients with low back pain in Danish general and chiropractic practice. Int J Fam Med 2014;2014:106102.
[15] Hestbaek L, Myburgh C, Lauridsen HH, Boyle E, Kongsted A. Contrasting real time quantitative measures (weekly SMS) to patients' retrospective appraisal of their one-year's course of low back pain; a probing mixed-methods study. Chiropr Man Therap 2019;27:12.
[16] Hill JC, Dunn KM, Lewis M, Mullis R, Main CJ, Foster NE, Hay EM. A primary care back pain screening tool: identifying patient subgroups for initial treatment. Arthritis Rheum 2008;59:632–41.
[17] Holt N, Pincus T, Vogel S. Reassurance during low back pain consultations with GPs: a qualitative study. Br J Gen Pract 2015;65: e692–701.
[18] Irgens P, Kongsted A, Myhrvold BL, Waagan K, Engebretsen KB, Natvig B, Vøllestad NK, Robinson HS. Neck pain patterns and subgrouping based on weekly SMS-derived trajectories. BMC Musculoskelet Disord 2020;21:678.
[19] Irgens P, Myhrvold BL, Kongsted A, Waagan K, Engebretsen KB, Vøllestad NK, Robinson HS. The clinical course of neck pain: are trajectory patterns stable over a 1-year period? Eur J Pain 2021;26: 531–42.
[20] Itz CJ, Geurts JW, van Kleef M, Nelemans P. Clinical course of non-specific low back pain: a systematic review of prospective cohort studies set in primary care. Eur J Pain 2013;17:5–15.
[21] Kongsted A, Hartvigsen J, Boyle E, Ris I, Kjaer P, Thomassen L, Vach W. GLA:D® Back: group-based patient education integrated with exercises to support self-management of persistent back pain—feasibility of implementing standardised care by a course for clinicians. Pilot Feasibility Stud 2019;5:65
[22] Kongsted A, Hestbæk L, Kent P. How can latent trajectories of back pain be translated into defined subgroups? BMC Musculoskelet Disord 2017; 18:285.
[23] Kongsted A, Kent P, Axen I, Downie AS, Dunn KM. What have we learned from ten years of trajectory research in low back pain? BMC Musculoskelet Disord 2016;17:220.
[24] Kongsted A, Kent P, Hestbaek L, Vach W. Patients with low back pain had distinct clinical course patterns that were typically neither complete recovery nor constant pain. A latent class analysis of longitudinal data. Spine J 2015;15:885–94.
[25] Kongsted A, Nielsen OL, Christensen HW, Hartvigsen J, Doktor K, Kent P, Jensen TS. The Danish chiropractic low back pain cohort (ChiCo): description and summary of an available data source for research collaborations. Clin Epidemiol 2020;12:1015–27.
[26] Mun CJ, Suk HW, Davis MC, Karoly P, Finan P, Tennen H, Jensen MP. Investigating intraindividual pain variability: methods, applications, issues, and directions. PAIN 2019;160:2415–29.
[27] Myhrvold BL, Irgens P, Robinson HS, Engebretsen K, Natvig B, Kongsted A, Vøllestad NK. Visual trajectory pattern as prognostic factors for neck pain. Eur J Pain 2020;24:1752–64.
[28] Myhrvold BL, Kongsted A, Irgens P, Robinson HS, Thoresen M, Vollestad NK. Broad external validation and update of a prediction model for persistent neck pain after 12 weeks. [miscellaneous article]. Spine 2019: 44.
[29] Patrick DI, Ra Deyo, Atlas Sj, Singer De, Chapin A, Keller Rb. Assessing health-related quality of life in patients with sciatica. Spine (Phila Pa 1976) 1995;20:1899–1908.
[30] R Development Core Team. R: A Language and Environment for Statistical Computing. 2009. Available at: http://www.R-project.org.
[31] Ris I, Broholm D, Hartvigsen J, Andersen TE, Kongsted A. Adherence and characteristics of participants enrolled in a standardised programme of patient education and exercises for low back pain, GLA:D® Back - a prospective observational study. BMC Musculoskelet Disord 2021;22:473.
[32] Silva Tda, Mills K, Brown BT, Pocovi N, Campos Tde, Maher C, Hancock MJ. Recurrence of low back pain is common: a prospective inception cohort study. J Physiother 2019;65:159–65.
[33] Sjoberg D. Ggsankey. 2021. Available at: https://github.com/davidsjoberg/ggsankey. Accessed November 25, 2021.
[34] Sjoberg D, Curry M, Hannum M, Larmarange J, Whiting K, Zabor E, Drill E, Flynn J, Lavery J, Lobaugh S, Wainberg G. Presentation-Ready Data Summary and Analytic Result Tables [R package gtsummary version 1.4.1]. 2021. Available at: https://CRAN.R-project.org/package=gtsummary. Accessed May 25, 2021.
[35] What to notify? Available at: http://en.nvk.dk/how-to-notify/what-to-notify. Accessed March 28, 2020.
[36] Wickham H, Averick M, Bryan J, Chang W, McGowan L, François R, Grolemund G, Hayes A, Henry L, Hester J, Kuhn M, Pedersen T, Miller E, Bache S, Müller K, Ooms J, Robinson D, Seidel D, Spinu V, Takahashi K, Vaughan D, Wilke C, Woo K, Yutani H. Welcome to the Tidyverse. J Open Source Softw 2019;4:1686.