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ORIGINAL ARTICLE

The use of STarT BACK Screening Tool in emergency departments for patients with acute low back pain: a prospective inception cohort study

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Abstract

Purpose (1) To analyse the clinical utility of the STarT Back Screening Tool (SBST) in emergency departments by describing changes in classification over time and; (2) to identify what would be the best time to use the SBST to predict long-term clinical outcomes in patients with acute nonspecific low back pain (LBP) seeking emergency care.

Methods A 6 months prospective inception cohort study was conducted. 200 participants with LBP seeking emergency medical treatment were included. Pain intensity, disability and SBST were collected at baseline, 6 and 26 weeks. Categories of improvement, clinical worsening, and stability were created to calculate the changes in the SBST subgroups. Linear regression models were built to analyse the predictive ability of SBST when applied at baseline, 6 weeks as well as changes in the subgroup from baseline to 6 weeks. These models were adjusted for potential confounders.

Results 45% of patients were classified as high risk of chronicity at baseline. Most patients classified as medium (86.7%) or high (52.4%) risk changed their risk subgroup after 6 weeks and most of them improved. The SBST improved the prediction for all outcomes when applied at 6 weeks ($R^2 = 22.1\%$ for disability and $R^2 = 15.6\%$ for pain intensity), but not at baseline.

Conclusion Most of patients seeking care in emergency departments with a new episode of acute LBP improved after 6 weeks. The use of SBST to guide initial treatment and to predict clinical outcomes are most indicated when the instrument is applied after 6 weeks after presentation to emergency care.

Keywords Acute low back pain · Emergency department · STarT Back Tool · Inception cohort · Prediction models · Prognosis

Introduction

Low back pain (LBP) is very common [1] and is associated with high costs [2] and disability [3]. Although the prognosis of patients with acute LBP is favourable [4, 5], many patients with severe LBP seek care in emergency departments (ED) [6]. EDs are known to be chaotic due to the amount of patients seeking care on a daily basis. 2.5 million patients/year visited EDs due to acute LBP in the USA [6].

To better organise chaotic services as well as to stratify care for patients with LBP, the STarT Back Screening Tool (SBST) was developed [7]. The SBST is a triage instrument that stratifies patients with LBP in three subgroups to receive different levels of care [7]. Patients can be classified in low, medium or high risk of unfavourable prognosis with regards to disability [7]. Patients classified as low risk should receive only general advice about their problem [8]. Medium risk patients should be referred to evidence-based physiotherapy care [8] and high-risk patients should receive both physiotherapy associated with cognitive behavioural therapy [8].

Although the SBST was developed to stratify and direct treatment shown to be effective and cheaper compared with current best care in primary care [7, 8], a number of studies investigated the clinical utility of the SBST in different

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settings such as physiotherapy [9–12] and chiropractors [13–16]. These studies have shown that the SBST can be useful in different levels of care [9, 12]. Currently, there are no studies investigating the use of the SBST in EDs.

Therefore, the aim of this study was to analyse the clinical utility of the SBST to stratify care in EDs by describing changes in SBST classification that occur over time and by identifying what would be the best time to use the SBST to predict long-term clinical outcomes.

Methods

Study design and setting

A prospective inception cohort study with a 6-month follow-up was conducted. This study was approved by the Research Ethics Committee of the Universidade Cidade de São Paulo (CAAE: 25315713.7.0000.0064) and was conducted in EDs of three Brazilian public hospitals.

Participants

To be eligible, participants had to be aged between 18 and 80 years, presenting a new episode of acute nonspecific LBP with or without leg pain and seeking emergency care. We defined a new episode of acute LBP as pain in the lower back lasting for more than 24 h but less than 6 weeks, and preceded by a period of at least 1 month without LBP [17]. Participants were excluded if they present any serious spinal pathologies (e.g., vertebral fracture, tumours, spinal infection, ankylosing spondylitis and cauda equina syndrome), as well as patients presenting inflammatory conditions, spinal stenosis, pregnancy or kidney diseases.

Interventions

All participants underwent an emergency medical care. The treatment was not standardized and it depended on the judgment of the on-call doctor working in the ED. The doctor performed a routine anamnesis, physically examined and screened for red flags in all patients. In all cases where serious spinal pathologies or nerve root compromise was likely, the patient was referred for more specific tests. The interventions delivered in the ED could involve education, radiological examinations, prescription of medications, referral to physiotherapy or the association of these procedures based upon the patient's presentation.

Procedures

Consecutive patients who attended EDs with LBP went through an evaluation process. The medical doctor performed a full anamnesis and physical examination during the consultation; these procedures included an assessment on red flags. In all cases of where the probability of serious spinal pathologies were likely, further examination with regards to imaging or laboratory tests were conducted. After this examination, patients with a new episode of acute nonspecific LBP were then invited to participate in the study and asked to sign a consent form if they agreed to participate. The physiotherapist who further assessed these patients had access to the medical records for all potentially eligible participants. During the screening for eligibility, this physiotherapist checked the medical notes, as well as conducted a clinical neurological examination in patients with potential signs of nerve root compromise. Subsequently, a baseline assessment was performed face to face in which information on sociodemographic characteristics, general health status, pain intensity, disability and the SBST subgroup classification were collected. All patients were contacted by telephone to perform the assessment of pain intensity, disability, global perceived effect and the SBST after 6 weeks and 6 months. We called patients as many times as possible to achieve optional follow-up rates in all cases where patients were difficult to be found.

Measures

Pain intensity—Numerical Pain Rating Scale (NPRS)

The NPRS assesses the levels of pain intensity perceived by the patient based on the last 7 days. The scale ranges from 0 (no pain) to 10 (worst pain possible) [18].

Disability—Roland Morris Disability Questionnaire (RMDQ)

The RMDQ is used to assess the level of disability associated with LBP. The RMDQ has 24 (yes/no) items related to common activities that patients might have difficulty due to LBP. The total score is determined by the sum of all positive answers. The higher the score, the higher the disability [18–20].

Global impression of recovery—Global Perceived Effect Scale (GPE)

The GPE evaluates the patient's impression of recovery compared to the onset of symptoms. This 11-item Likert scale ranges from −5 (extremely worst), 0 (no modifications) to +5 (fully recovered) [18].

STarT (Subgroups Target Treatment) Back Screening Tool (SBST)

The SBST consists of nine items that classifies patients with LBP into low, medium or high risk if the patient presents

an unfavourable prognosis in terms of disability [7, 21, 22]. Each SBST item addresses a modifiable prognostic factor that is unfavourable, being the items 1–4 addressing physical aspects of LBP. Items 5–9 address psychosocial aspects related to fear, depression, catastrophizing, bothersomeness and anxiety, respectively. The SBST response options are dichotomous (agree/disagree) in which each positive response is scored. The ninth item of the instrument uses a 5-category scale as a response option, in which only the two last categories (very and extremely) add up one point in the total score.

The total score ranges from 0 to 9 points. Patients are classified as low risk if the sum of the total score is less than four points. If the total score is above three points, patients can be classified as medium or high risk, and what determines this classification is the sum of the subscale of the instrument, corresponding to items 5–9 of the instrument (0–5). If the sum of the subscale score is less than four, the patient is classified as medium risk, but if the sum is equal to or greater than four, the patient is classified as high risk of presenting an unfavourable prognosis [7, 21].

Categories of SBST subgroup changes

To describe the changes in the SBST subgroups between baseline and 6 weeks, three categories of change were used [9, 12]:

1. *Improved* patients who changed from high to medium risk, from high to low risk, or from medium to low risk.
2. *Stable* patients classified as low or medium risk and remained in the same classification.
3. *Worsened* patients who changed from low to high risk, from low to medium risk, from medium to high risk, or who remained at high risk.

Prediction of clinical outcomes

Long-term (6 months) predictive capability of SBST was investigated to predict the outcomes of pain intensity and functional disability from three different predictions:

1. Through the stratification of patients at baseline.
2. Through the stratification of patients after 6 weeks.
3. Taking into account the difference between baseline stratification and 6 weeks' stratification (through the changes in categories).

Statistical analysis

We built three regression models for pain intensity and three models for disability as dependent variables. Each model was formed by two blocks. In the first block, the score of the outcome analysed at the 6 months follow-up was considered as a dependent variable, adjusted for potential confounders (gender, age and outcome assessed at baseline). The second block was formed with the same variables, in the same arrangement adding only the SBST subgroups as independent variables. All models were constructed similarly. However, the last variable added in block two (SBST subgroups) varied across all models. Each model represents a point in time (model 1 = subgroup stratification using SBST at baseline, model 2 = subgroup stratification using SBST at 6 weeks, and model 3 = change categories). Dummy variables were created to code the SBST subgroups as well as to code the change in categories. The subgroup having low risk and the category worsening were considered as reference groups.

Results

We recruited 261 participants of whom 61 were not included due to chronic LBP or refusal to participate. Therefore, a total of 200 patients were included and completed the baseline assessment. A total of 15 (7.5%) and 25 (12.5%) patients missed follow-up at 6 weeks and 6 months' assessments, respectively. Just one patient went on to operative treatment 2 months after baseline assessment at ED. The highest percentage of patients (45%) was classified as high risk of SBST at baseline. The SBST was re-applied in all patients and only 28.6% of patients were classified as high risk at the 6 weeks' assessment. When SBST was applied at 6 months, the percentage of high risk remained low (19.4%) as described in Fig. 1.

The characteristics of the participants are described in Table 1. Most patients (71%) sought emergency treatment with less than 2 weeks of the onset of symptoms. Patients classified as high risk tend to receive more previous sick leave, to be absent from work and to have more leg pain compared to patients classified as having medium or low risk. The same pattern occurs in patients who have worsened compared to those who have improved or become stable.

Table 2 describes the clinical characteristics of patients at baseline, 6 weeks and the difference between these assessments. In general, patients classified as low risk have lower levels of pain intensity, disability and GPE compared to patients classified as medium or high risk. The mean pain intensity for low-risk patients changed from 6.2 points at baseline to 2.4 points at 6 weeks. The mean disability for high-risk patients changed from 18.6 points at baseline to 12.4 points at 6 weeks. Finally, patients classified in worsened category have the poorest outcomes, with a mean GPE score of −0.7 points compared to a mean GPE score of 3.4 points of the improved patients.

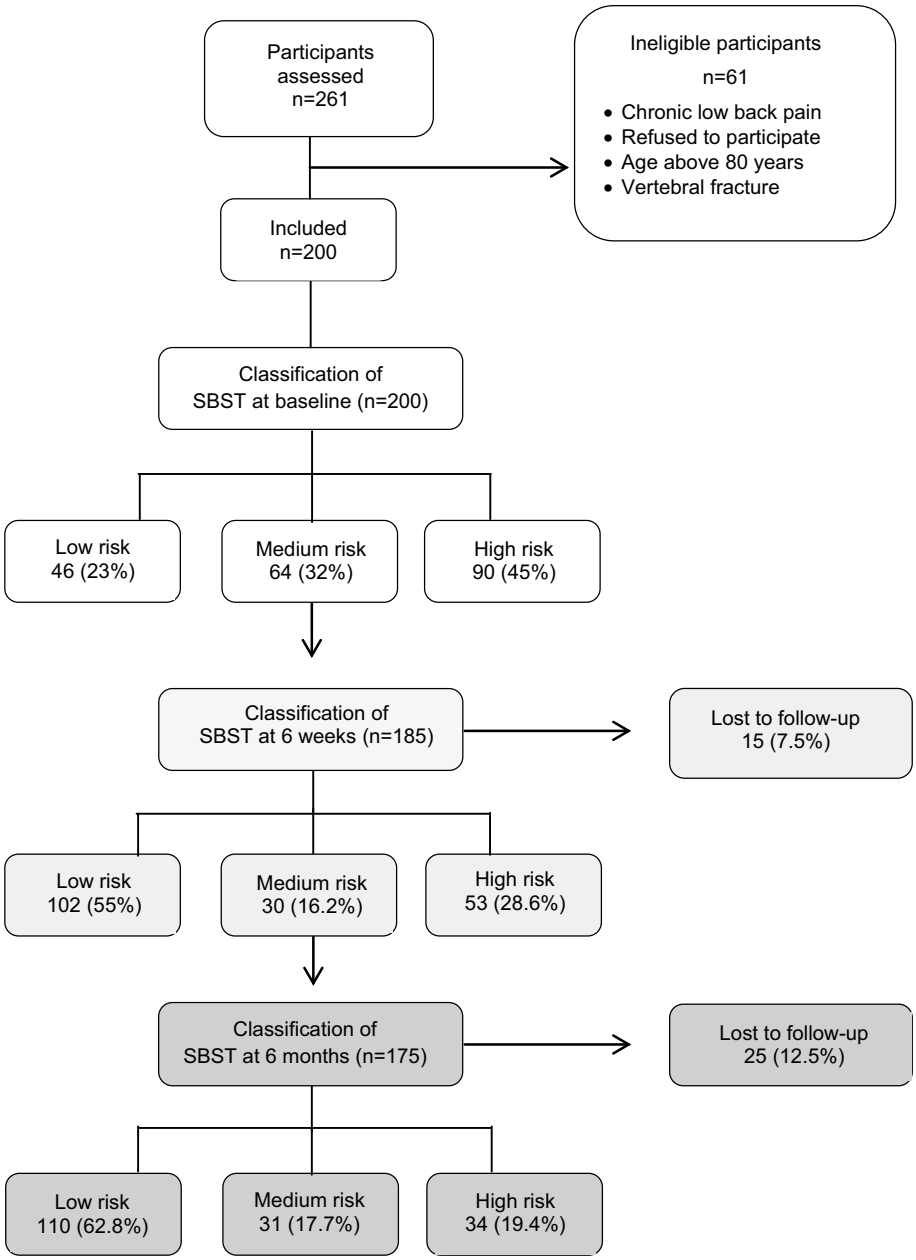

Fig. 1 Flow diagram of the study

Figure 2 shows that most of the participants were classified as high risk at baseline changed to low (28.1%) or medium risk subgroup (24.3%) after 6 weeks. Most of the patients classified as medium risk also changed subgroup after 6 weeks (86.7%), being 65% of them improving and changing to the low-risk subgroup. Of the patients classified as low risk at baseline, the majority remained stable in the subgroup after 6 weeks (93.1%); only two patients changed from subgroup to medium risk (4.6%) and one patient changed to high-risk subgroup (2.3%) at 6 weeks.

The SBST prediction models for long-term clinical outcomes are presented in Table 3. This table is divided into two sections: 3a (three models referring to disability) and 3b (three models referring to pain intensity). Overall, the SBST was able to predict pain intensity and disability in the long term in all models observed, except for disability in Model 1 that refers to use of the SBST at baseline assessment. The best time to use the SBST to predict the pain intensity and disability was at 6 weeks (Model 2), in which explained 22.1 and 15.6% ($p < 0.001$),

Table 1 Sample characteristics of all patients, for each SBST subgroup and for change categories

Variables	All patients n=200	Low risk γ n=46	Medium risk γ n=64	High risk γ n=90	Improved β n=82	Stableβ n=48	Worsened β n=55
Gender							
Female	109 (54.5)	19 (41.3)	35 (54.7)	55 (61.1)	48 (58.5)	18 (37.5)	34 (61.8)
Male	91 (45.5)	27 (58.7)	20 (45.3)	35 (38.9)	34 (41.5)	30 (62.5)	21 (38.2)
Age (years)	39.3 ± 13.16	33.5 ± 11.20	38.7 ± 13.53	42.8 ± 12.84	39.6 ± 14.19	32.5 ± 10.98	44.1 ± 11.83
Weight (kg)	73.4 ± 15.25	72.3 ± 12.22	75.2 ±18.80	72.7 ± 13.81	72.7 ± 17.57	74.1 ± 12.88	73.7 ± 13.89
Height (m)	1.67 ± 0.09	1.70 ± 0.09	1.69 ± 0.10	1.67 ± 0.10	1.67 ± 0.11	1.71 ± 0.09	1.66 ± 0.08
Education level							
Primary School	61 (30.5)	5 (10.9)	17 (27.0)	39 (43.8)	22 (27.2)	5 (10.4)	26 (48.1)
High school	98 (49.5)	23 (50.0)	33 (52.4)	42 (47.2)	47 (58.0)	25 (52.1)	20 (37.0)
University	39 (19.7)	18 (39.1)	13 (20.6)	8 (9.0)	12 (14.8)	18 (37.5)	8 (14.8)
Smoker	35 (17.5)	7 (15.2)	11 (17.2)	17 (18.9)	14 (17.1)	9 (18.8)	10 (18.2)
Duration of symptoms							
Up to two weeks	142 (71.0)	34 (73.9)	45 (70.3)	63 (70.0)	58 (70.7)	34 (70.8)	37 (67.3)
Three weeks	37 (18.5)	8 (17.4)	10 (15.6)	19 (21.1)	17 (20.7)	9 (18.8)	10 (18.2)
Four weeks	14 (7.0)	3 (6.5)	7 (10.9)	4 (4.4)	5 (6.1)	4 (8.3)	5 (9.1)
Five weeks	3 (1.2)	1 (2.2)	1 (1.6)	1 (1.1)	0 (0)	1 (2.1)	1 (1.8)
Six weeks	4 (2.0)	0 (0)	1 (1.6)	3 (3.3)	2 (2.4)	0 (0)	2 (3.6)
Health status							
Excellent	24 (12.0)	8 (17.4)	8 (12.5)	8 (8.9)	8 (9.8)	9 (18.8)	4 (7.3)
Very good	37 (18.5)	16 (34.8)	13 (20.3)	8 (8.9)	16 (19.5)	17 (35.4)	1 (1.8)
Good	105 (52.5)	21 (45.7)	34 (53.1)	50 (55.6)	47 (57.3)	20 (41.7)	31 (56.4)
Bad	28 (14.0)	1 (3.2)	9 (14.1)	18 (20.0)	11 (13.4)	2 (4.2)	13 (23.6)
So bad	6 (3.0)	0 (0)	0 (0)	6 (6.7)	0 (0)	0 (0)	6 (10.9)
Referred leg pain	101 (50.5)	11 (23.9)	32 (50.0)	58 (64.4)	40 (48.8)	16 (33.3)	40 (72.7)
Comorbid pain in neck	49 (24.5)	8 (17.4)	16 (25.0)	25 (27.8)	19 (23.2)	8 (16.7)	20 (36.4)
Comorbid pain in shoulder	50 (25)	7 (15.2)	13 (20.0)	30 (33.3)	19 (23.2)	7 (14.6)	23 (41.8)
Previous LBP episode	138 (69)	30 (65.2)	45 (70.3)	63 (70.0)	55 (67.1)	32 (66.7)	44 (80.0)
Absence from work	15 (7.5)	1 (2.2)	4 (6.3)	10 (11.1)	7 (8.5)	1 (2.1)	6 (10.9)
Previous sick leave	29 (14.5)	5 (10.9)	7 (10.9)	17 (18.9)	11 (13.4)	4 (8.3)	13 (23.6)
Sudden onset pain	176 (88)	41 (89.1)	58 (90.6)	77 (85.6)	74 (90.2)	42 (87.5)	46 (83.6)
Exercise*	46 (23.0)	12 (26.4)	14 (21.9)	20 (22.2)	15 (18.3)	12 (25.0)	13 (23.6)
Medication	92 (46)	14 (30.4)	25 (39.1)	53 (58.9)	41 (50.0)	15 (31.3)	28 (50.9)

Continuous data are described in the table as mean (standard deviation). Categorical data are described in the table as frequency (percentage)

LBP = low back pain

[a]If patient performs exercises for at least 30 min, three times a week or more

γ Data from SBST subgroup classification at baseline

β Data from change categories of subgroups between baseline and 6 weeks

Table 2 Patients' symptoms at baseline and after 6 weeks

	Variable	Low risk (*n* = 46)	Medium risk (*n* = 64)	High risk (*n* = 90)	Improved (*n* = 82)	Stable (*n* = 48)	Worsened (*n* = 55)
Baseline assessment	Pain intensity (0–10)	6.2 (2.04)	7.3 (2.22)	8.5 (1.76)			
	Disability (0–24)	8.5 (4.36)	16.0 (4.36)	18.6 (4.39)			
6 weeks assessment	Pain intensity (0–10)	2.4 (2.89)	4.0 (3.46)	5.9 (3.42)	3.2 (3.04)	2.7 (2.90)	8.1 (2.00)
	Disability (0–24)	3.0 (4.13)	7.3 (6.99)	12.4 (8.09)	5.9 (6.14)	3.9 (5.07)	16.6 (6.17)
	Global perceived effect (−5 to +5)	3.3 (2.37)	2.6 (2.74)	1.2 (3.30)	3.4 (1.88)	3.3 (2.26)	−0.7 (3.16)

Data described as mean (standard deviation). Negative values in the global perceived effect scale represent clinical worsening and positive values represent clinical improvement

n total number of patients

respectively, of the variability from block 1 to block 2. In model 3 (change between baseline and 6 weeks), both disability and pain intensity were predicted by the worsened category and this model explained 11.3% of the variability in both outcomes. The stable category (compared to those who improved) was able to predict only pain intensity score with beta coefficient of − 1.57 points (95% CI − 2.89 to − 0.25).

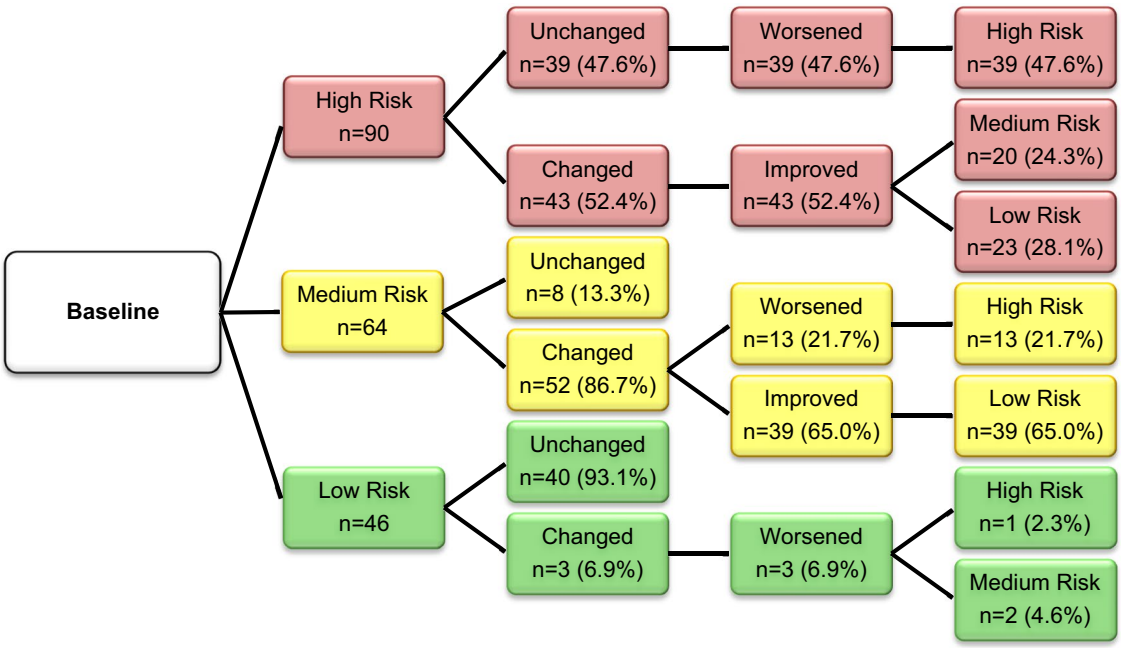

Fig. 2 Change of subgroups between an initial evaluation and 6 weeks

Table 3 Prediction models using the SBST at different time points for different outcomes

SBST classification of the variable	Block 1	Block 2	Change from block 1 to block 2	SBST unique contribution			
					Beta	95% CI	*p*
3(a) Regression models to predict disability in 6 months using RMDQ scores (0–24)							
Model 1: SBST classification at baseline							
R^2	16.6%	18.5%	1.9% ($p=0.15$)	High risk	3.85	(−0.30 to 7.98)	=0.07
Adjusted R^2	15.1%	16.0%		Medium risk	1.68	(−1.97 to 5.34)	= 0.37
Model 2: SBST classification at 6 weeks							
R^2	17.1%	39.3%	22.1% (**$p<0.001$**)	High risk	9.91	(7.33 to 12.48)	**<0.001**
Adjusted R^2	15.6%	37.3%		Medium risk	5.24	(2.28 to 8.20)	**=0.001**
Model 3: change in classification between baseline and 6-week assessment							
R^2	22.9%	34.3%	11.4% (**$p<0.001$**)	Worsened	6.50	(3.67 to 9.32)	**<0.001**
Adjusted R^2	21.2%	31.9%		Stable	−0.50	(−3.84 to 2.84)	=0.77
3(b) Regression models to predict pain in 6 months using the NPRS scores (0–10)							
Model 1: SBST classification at baseline							
R^2	12.2%	16.0%	3.8% (**$p=0.03$**)	High risk	1.92	(0.49 to 3.33)	**=0.01**
Adjusted R^2	10.7%	13.5%		Medium risk	1.56	(0.18 to 2.94)	**=0.03**
Model 2: SBST classification at 6 weeks							
R^2	12.6%	28.2%	15.6% (**$p<0.001$**)	High risk	3.61	(2.41 to 4.81)	**<0.001**
Adjusted R^2	11.0%	26.0%		Medium risk	2.02	(0.64 to 3.39)	**=0.004**
Model 3: change in classification between baseline and 6-week assessment							
R^2	17.2%	24.7%	7.4% (**$p=0.001$**)	Worsened	2.39	(1.11 to 3.67)	**<0.001**
Adjusted R^2	14.9%	21.4%		Stable	−1.57	(−2.89 to −0.25)	**=0.002**

Three hierarchical regression models for each outcome analysed. Each template is a point in time. All models were adjusted for age, gender and the total score of the outcome itself at baseline.

SBST STarT Back Screening Tool, *NPRS* Numerical Pain Rating Scale, *RMDQ* Roland Morris Disability Questionnaire, CI confidence interval

Bold values repersent statitical significance ($p < 0.05$)

Discussion

This was the first study that investigated the clinical utility of the SBST in EDs. We observed that the majority of patients with acute LBP who sought emergency medical care were classified as having a high risk of SBST and presented high levels of pain intensity and disability. However, more than half of these patients improved their risk subgroup after a period of 6 weeks. The best time to use SBST to predict outcomes was at 6 weeks, with the instrument adding a higher predictive value for disability.

An important strength of our study was that, we conducted an inception cohort study of consecutive patients with a new episode of acute LBP and who sought emergency medical service in public hospitals in a mid-income country. On the other hand, patients did not receive stratified care based upon the SBST classification and we did not monitor co-interventions. In addition, we had a lost to follow-up of 12% at 6 months and despite being within acceptable benchmarks [23]. This can be considered as a limitation of this study.

The usual pathway for back pain patients would be first going to primary care and the SBST was developed to stratify risk classifications in primary care [7]. However, this instrument has been also explored for use in other settings [10, 16, 24]. Most of the previous studies show that regardless of the setting, most patients were classified as either low or medium risk of chronicity measured by the SBST [9, 11, 13, 21]. This prevalence differs from our study, in which 45% of the patients who sought EDs were classified as high risk. It was expected that high risk would be more prevalent than medium and low risk at this study, being that it is hypothesized that back pain patients that seek ED care could have more severe symptoms compared to patients from other settings such as physiotherapy or chiropractic. In our study, we can highlight that most patients classified as high risk changed to low or medium risk after 6 weeks, receiving a minimal emergency intervention. This information is important to public health management and can reduce the costs associated with unnecessary referrals [8].

With regards to the predictive capacity of SBST, the instrument has already shown to be a good predictor of clinical outcomes in different cultures and health sectors [7, 10, 25, 26]. However, when the analyses were adjusted for potential confounders, this predictive value either decreased or disappeared in physiotherapy sectors [9, 12]. The SBST was able to predict pain intensity at baseline in the ED (even after adjusting for potential confounders), but explained only 3.8% of the model. This shows that the SBST does not add much information about patient prognosis in both the emergency and physiotherapy departments when applied at baseline [9, 12].

The current version of the NICE guidelines [27] recommends that physicians should use screening instruments such as SBST in primary health care to identify patients at risk of unfavourable prognosis and to adjust the management of these patients accordingly [27]. However, our results suggest that there is a need for caution in the use of SBST in the first visit in EDs. At this time, it is possible to identify only low-risk patients with a favourable prognosis and regardless of the treatment they received, most of them remained stable at low risk after 6 weeks. We believe that the public health care system would be inappropriately burdened if all patients are referred for treatment from baseline SBST stratification. There is high quality evidence that patients with acute LBP have a very favourable prognosis within a period of 6 weeks [4, 5] and if the instrument's stratification occurs after 6 weeks (when the prognosis curve goes into a plateau), many patients have already changed subgroups and public costs with treatment targeting may decrease. In addition, according to the use of SBST as clinical prediction rule, our results show that the instrument is also more useful when administered after 6 weeks. This information corroborates with a previous study showing that repeated assessments improves the prediction of prognosis of LBP patients [28]. Additionally, current guidelines suggest minimal intervention for all patients with acute LBP who seek primary health care, with a return of 1–2 weeks to determine if additional care is needed [29].

Implementation studies are needed to test the use of the SBST as a stratification tool in EDs. This can be done by applying minimal intervention for all patients and after 6 weeks stratify these patients to appropriate treatment. It would be also necessary to measure the costs of this implementation, by comparing the costs of patients who were stratified against the existing usual ED care. In conclusion, most patients seeking care in EDs with a new episode of acute LBP improved after 6 weeks. The use of SBST for guiding initial treatment and to predict clinical outcomes are most indicated when the instrument is applied after 6 weeks after presentation to emergency care.

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Compliance with ethical standards

Conflicts of interest The authors have no conflicts of interest to declare.

Ethical approval This study was approved by the Research Ethics Committee of the Universidade Cidade de São Paulo (CAAE: 25315713.7.0000.0064).

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