

# A revisit of soreness and acidosis-related pain

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## 1. Introduction

The famous Shakespearean quote from *Romeo and Juliet*

*What's in a name? That which we call a rose*  
*By any other word would smell as sweet*

highlights the nature of naming. Although a word is supposed to signify its reference, such “mode of presentation” illuminates only a single aspect of the referent.<sup>11</sup>

Such linguistic underdeterminacy is especially true in translation across languages. For instance, the German expression “*Ich habe Muskelkater*” (literally “*I have a tomcat in the muscles*”) and the Polish saying “*Mam zakwas*” (literally “*I have sourdough*”) describe the same somatosensory perception of having “sore muscles” or “achy pain.” It is quite interesting how such discomfort could be expressed by *tomcat* “*kater*” or *zakwas* “*sourdough*.”

To ascertain such linguistic mystery, we conducted a survey of 10 languages from different language families and found that 3 of them use words related to the “sour” taste to depict musculoskeletal discomforts.<sup>3,9</sup> Among them, Chinese specifically distinguishes the “sour” type of physical discomfort as a sensation different from pain. This finding has intrigued many Taiwanese scientists, prompting them to explore this linguistic phenomenon further (Table 1). Researchers noticed that the Taiwanese word SNG/səŋ/ or Mandarin *suān* (meaning sour taste or acid) is used to encode both gustatory “sour taste” and somatosensory experience of “muscle soreness” as reported by patients. In addition, it was noticed that many physicians adopt the word SNG to label musculoskeletal soreness and the response of the somatosensory nervous system to tissue acidosis.<sup>4,6,17,20,29,32,40,42</sup> The term “*sngeception*,” analogous to nociception in pain perception, was then introduced to describe the physiological process of encoding pathophysiological stimuli that result in the perception of soreness.<sup>17,29</sup> Clinicians used this term to label the soreness symptom

in fibromyalgia (FM) and chronic lower back pain (CLBP), leading to several noteworthy observations.<sup>3,6,9,16,18,21</sup> For instance, in FM, the distribution of morbid soreness has been reported to be independent of pain manifestations.<sup>18,21</sup> In addition, most patients with CLBP can differentiate between pain and soreness discomforts, providing separate intensity ratings for each.<sup>6,28</sup>

## 2. A linguistic account of soreness

By analyzing informants’ subjective experiences of muscle soreness, our previous linguistic investigation addressed how people brought meaning to their linguistic expressions regarding musculoskeletal discomforts.<sup>13</sup> Data were collected from 100 native speakers across 10 languages (10 subjects per language), representing 5 language families: *Germanic* (German, Dutch), *Romance* (French, Italian), *Slavic* (Polish, Russian), *Altaic* (Japanese, Korean), and *Sino-Tibetan* (Mandarin and Taiwanese Southern Min, both referring to Chinese) (Table 1). Despite linguistic heterogeneity, all speakers reported having experienced the sensation of “soreness.” Each language had at least 1 descriptor for muscle soreness but adopted different strategies to encode the term. Furthermore, all the languages, except Chinese, tended to rely on pain-based expressions for “soreness.” Speakers of different languages responded differently to using sour/acid taste for muscle soreness. The findings manifested how soreness sensation behaves across 5 different language families.

Significant linguistic discrepancies were observed in soreness descriptions across languages. Taiwanese Southern Min and Mandarin directly applied sour taste (SNG/səŋ/and *suān*, respectively, meaning “sour” or “acid”) to muscle soreness. In contrast, German, Russian, Korean, Japanese, and French used pain-based or pain-related expressions without referencing any specific descriptor. Dutch commonly used *stijf* (stiff) or *pijn* (pain) but occasionally applied a sourness-based expression (*Mijn spieren zijn verzuurd*: My muscles are “sour”) to describe muscle discomfort, resembling Chinese. Some Polish informants described their soreness using *zakwas* (the plural of *zakwas* [sourdough]), a metaphorical use derived from *kwas* (acid) or *kwaśny* (sour). The Italian speakers used *l'acido lattico* (lactic acid), a biochemical term, to describe their muscular soreness. Using sourness to describe soreness appears quite to the Chinese language.

## 3. Biological and clinical aspects of soreness

### 3.1. Etiological and phenotypic divergences of soreness in clinical conditions

Postexercise discomfort is the most well-known soreness condition: lactate accumulation during exercise triggers acute soreness, while muscular micro-injury results in delayed-onset muscular soreness (DOMS) through ASIC3 and TRPV1 activation.<sup>25,33,37,41</sup> Soreness also occurs in chronic painful disorders, such as FM<sup>6,9,18</sup>; over 90% of FM cases complained morbid

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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<http://dx.doi.org/10.1097/j.pain.0000000000003595>

Table 1

## A linguistic survey of soreness sensation across 10 languages from 5 language families.

Language [language family]	No. of participants	Experience of soreness	Linguistic descriptor	“Sour” or “acid”-based expression for soreness	Distinguishing soreness from pain	Acceptability of Sng for soreness (number)
Dutch [Germanic]	10	Yes	<i>stijf</i> : stiff [pain-based] <i>verzuurd</i> : sour [from “sour”]	Yes	No	10
*German [Germanic]	10	Yes	<i>Muskelkater</i> : muscle tomcat [pain-related]	No	No	0
*French [Romance]	10	Yes	<i>courbature</i> : muscle stiffness [pain-based]	No	No	0
Italian [Romance]	10	Yes	<i>l'acido lattico</i> : lactic acid [chemical]	Yes	No	6
Polish [Slavic]	10	Yes	<i>zakwasz</i> : sourdough [related to “sour”]	Yes	No	3
*Russian [Slavic]	10	Yes	<i>Боль</i> : pain [pain-based]	No	No	0
*Japanese [Altaic]	10	Yes	<i>Kinikutsu</i> : muscle pain [pain-based]	No	No	0
†Korean [Altaic]	10	Yes	<i>geun-yug-issusida</i> : muscle pain [pain-based]	No	No	0
Mandarin [Sino-Tibetan]	10	Yes	<i>suān-tòng</i> : [from “sour”] [Sng-based]	Yes	Yes	10
Taiwanese Southern Min [Sino-Tibetan]	10	Yes	<i>Sng-tiāng</i> : [from “sour”] [Sng-based]	Yes	Yes	10

\* Marks languages that do not allow the sour taste to be applied to physical sensation.

† Marks special linguistic behavior as further found in Korean:

1. Both *sida* (the preferred 1) and *sirida*, 2 etymologically unrelated words, can be found to describe Sng-based discomfort in joints, eyes, tooth, especially because of coldness, but never that in muscles.

2. Both *suśida* and *apeuda* code sng-pain. *Apeuda* is often used for general pain.

3. For discomfort in specific body parts loaned from Chinese, such as *jirou* “muscle” (肌肉); *guanjie* “joint” (關節), Korean adopts the Chinese character *tong* (痛)/*tongzeung* (痛症) “pain” instead any of the sng-pain terms given above.

soreness, and this type of soreness is likely to involve excessive oxidative stress, rather than lactate production or tissue injury.<sup>18</sup> Unlike transient postexercise soreness like DOMS (typically resolving within a week), FM soreness persists beyond 3 months. In addition, DOMS responds well to nonsteroid anti-inflammatory drugs, whereas FM dose not.<sup>18</sup> A comparison between post-exercise and morbid soreness is shown in **Table 2**.

### 3.2. Similarities and differences between soreness with pain and soreness without pain

In most exertion situations, soreness sensation occurs without pain, especially after exercise. Acute exertional soreness predominantly features isolated soreness sensation.<sup>10</sup> Individuals with DOMS report severe soreness discomforts in exercised muscle.<sup>7,19</sup> In FM and CLBP, nonexertional soreness commonly coexists with pain, but with irrelevant anatomical distributions.<sup>6,18</sup> Unlike avoidance behaviors associated with pain conditions,

soreness—whether accompanied by pain or not—often prompts active relief-seeking behaviors, such as massage or stretching.<sup>29</sup> Furthermore, soreness and pain exhibit clear differences in disease contexts. For example, soreness distribution is inherently unrelated to pain patterns in FM,<sup>18</sup> and soreness intensity in CLBP is not correlated with pain levels.<sup>6</sup>

### 3.3. Clinical impacts of soreness on diseases

Soreness and pain have different impacts on disease conditions and treatment responses.<sup>6,18</sup> In FM, soreness intensity is significantly associated with restless conditions and stiffness, while pain symptoms show no such interaction.<sup>18</sup> In CLBP, surgical interventions often contribute to remarkable alleviation in pain but not in soreness,<sup>6</sup> highlighting their distinct nature. Notably, after lumbar spine surgery, leg soreness serves as the primary sensory symptom determining clinical improvement, illustrating its significance in outcomes.

**Table 2**  
**Pathophysiological aspects of pain and soreness subtypes.**

	Pain		Soreness (sng)	
Subtypes	Nociceptive pain	Neuropathic pain	Exertional soreness	Nonexertional soreness; morbid soreness
Etiology	Coping responses	Maladaptive	Lactate accumulation or micromuscular injury	Unknown (maladaptive?)
Trigger	Noxious stimuli	Spontaneous	Exercise	Undetermined; not related to exercise
Course	Self-limiting	Chronic	Self-limiting	Chronic
Example	Trauma, burn	Diabetic neuropathic pain	Fatiguing exercise, DOMS	Fibromyalgia, radiculopathy
Responses to NSAID	Good	Poor	Good	Poor

DOMS, delayed onset muscle soreness; NSAID, nonsteroidal anti-inflammatory drugs.

#### 4. From “sourness” to “soreness”: a conceptual transformation

The use of “sourness” to describe “soreness” is a distinctive feature of Chinese. Conceptual metaphor theory provides a culturally grounded explanation for this phenomenon<sup>1,23</sup>: gustatory sensation (“sour” or “acid”) is metaphorically mapped onto its somatosensory counterpart (soreness)<sup>21,25</sup> in Chinese. Taiwanese Southern Min and Mandarin, Taiwan’s two most spoken languages, share this usage because of the cultural association of sourness with negative connotations. Intriguingly, when soreness is conceptually linked with an acidosis-associated sensations (eg, detecting lactic acid accumulation after exercise), intramuscular injection of acidic saline has been known to evoke hyperalgesia in psychophysical studies.<sup>12,20,22,24,31</sup> Whether with soreness perception or without, animal studies demonstrate that intramuscular acidosis-induced hypersensitivity responses are mainly mediated via acid-sensing ion channels of proprioceptive muscle afferent neurons.<sup>2,5,14,15,26,30,38</sup> These ion channels not only activate nociceptive pathways but also influence other sensory processes like proprioception and antinociception.<sup>14,15,17,27,30</sup> This suggests that acidosis-triggered sensation may involve a distinct signaling pathway from nociception. In this context, Taiwanese scientists considered that the Taiwanese word SNG/səŋ/perfectly captures this conceptual conversion linking acidity/sour to muscle discomforts, probably soreness. Under the term “sngception,” clinicians use SNG to capture the musculoskeletal discomforts distinct from pain in conditions like FM and CLBP. This conceptual transformation aligns with Contemporary metaphor theory,<sup>36</sup> reflecting how Taiwanese speakers culturally conceptualize soreness and acidosis-related neurocognitive experiences. Through linking sour taste to somatic discomfort, the acidosis-related concept of soreness sensation has found expression in Taiwan.

#### 5. Recommendation

In a broader sense, soreness, as an unpleasant sensation, is considered to fall under the category of pain as defined by Internatioal Association for Study of Pain (IASP). Furthermore, from linguistic perspectives and based on cultural experience, soreness (or sng) and pain appear to be categorized as distinct umbrella terms in certain languages, particularly in Taiwanese Southern Min or Mandarin. Therefore, a more accurate term for redefining soreness is essential, along with pathophysiological definitions and nomenclature for different soreness phenotypes. Drawing from clinical and experimental evidence, an initially tentative definition of soreness (or sng) may be proposed as “An unpleasant sensory and emotional experience, primarily or partially associated with acid-sensing mechanisms, that often

evokes a motivation to take active relief efforts.”<sup>17,29</sup> Future discussions with broader scientific communities and perspectives remain essential.

Understanding an individual’s discomfort through the conventional questionnaires or clinical tools remains challenging, especially for those with chronic pain.<sup>8</sup> For a pilot definition of “soreness” in the pain taxonomy, research by Sluka et al., Schilder et al., and Arendt-Nielsen et al. offers valuable insights.<sup>24,34,35</sup> They identified distinct differences between nociceptive innervation of low back fascia and muscle in humans. Verbal descriptors from patients help discriminate muscle and fascia pain, offering an important assessment parameter. The collocational use of SNG, an alternative term for morbid soreness, may effectively differentiate soreness from pain in conditions like FM or CLBP.

As language limits cognition, a well-defined descriptor for “soreness” symptoms is needed, acknowledging its independent existence confirmed through linguistic, biological, and clinical evidence. Future tasks should include the delineation of soreness nosography and neurophysiological matrix via functional MRI. A clear nomenclature of soreness phenotypes may help clinicians classify manifestations more accurately and improve therapeutic strategies.

#### Conflict of interest statement

The authors have no conflict of interest to declare.

#### Acknowledgements

This work was supported by intramural funding of Academia Sinica (IBMS-CRC111-P02, IBMS-CRC114-P01, AS-IA111-L06) and Kaohsiung Medical University Hospital (KMUH112-2T03), grants from the National Science and Technology Council, Taiwan (NSTC112-2320-B-001-007-MY3, NSTC112-2321-B-001-009, NSTC113-B-001-013). The authors would like to thank Dr. Kathleen Sluka for her critical and constructive comments on this work.

#### Article history:

Received 3 October 2024  
Accepted 14 February 2025  
Available online 1 April 2025

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