

Low back pain (LBP) is a highly prevalent and complex condition. These combined modalities have already showed promising and beneficial effects in patients with knee osteoarthritis.<sup>44</sup> Therefore, the aim of this study is to evaluate the short-term effects of TENS combined with heat (HeatTens device (HV-F311-E, OMRON Healthcare Co., Ltd., Japan.) on pain relief (primary outcome), PPT, CPM response, quality of life, and medication use in patients with CLBP. There is conflicting evidence for the beneficial effects of TENS and therefore its use in the management of CLBP is not typically recommended.<sup>13</sup> However, recent clinical research has advanced our understanding of TENS.<sup>14</sup> TENS triggers a complex neuronal network that activates descending inhibitory systems, resulting in reduction of hyperalgesia.<sup>15, 16</sup> There is growing evidence that the transition from acute to persistent LBP can be explained by sensitized central pain mechanisms.<sup>17, 18</sup> Symptoms of central sensitization (CS) were recently identified in a subgroup of patients experiencing CLBP.<sup>19</sup> Numerous studies have previously demonstrated significant dysfunction in descending inhibitory pathways and widespread hyperalgesia in chronic pain conditions, including CLBP.<sup>18, 20, 21, 22</sup> CS consists of altered sensory processing in the brain,<sup>23, 24, 25</sup> malfunctioning of descending anti-nociceptive mechanisms,<sup>23, 24, 26</sup> increased activity of pain facilitatory pathways, and temporal summation of second pain or wind-up.<sup>25, 26</sup> It is important to note that CS is a neurophysiological concept<sup>27</sup> and that the underlying processes cannot directly be measured in clinical practice.<sup>28</sup> Persistent CS negatively affects treatment outcome and quality of life in patients with LBP.<sup>29</sup> Not only from a clinical point of view, but also to design appropriate and tailored treatments, assessing the presence of CS is important.<sup>30, 31</sup> To study altered sensory processing, including signs of CS, quantitative sensory testing is used.<sup>32, 33</sup> Studies in people with fibromyalgia indicate restored central pain modulation (CPM) and lower pressure pain thresholds (PPT).<sup>34</sup> However, while the effects of TENS on PPTs have been investigated in patients with CLBP,<sup>35, 36</sup> results on its effectiveness on CPM seem to be lacking. In addition to TENS, superficially applied heat is another often-used treatment modality.<sup>12, 40</sup> Moderate-quality research showed that superficial heat improved pain and function in a CLBP population (weighted mean difference: 1.06, 95% CI: 0.68, 1.45).<sup>12</sup> In contrast, several clinical practice guidelines found insufficient evidence to support the effectiveness of superficial heat for relieving pain in patients with LBP.<sup>41, 42</sup> It is concluded that, as a sole treatment, heat may not provide enough pain relief to warrant inclusion in clinical guidelines. Furthermore, TENS studies show promising results for pain control in movement-evoked pain (MEP).<sup>34, 35, 37</sup> MEP refers to pain that is experienced as a result of physical activity.<sup>38</sup> Because study findings suggest that pain at rest (or spontaneous pain) and MEP are likely driven by different underlying mechanisms,<sup>39</sup> it seems appropriate to assess both as possible treatment outcomes. It is associated with significant socio-economic costs.<sup>1, 2</sup> Currently, it is the leading cause of disability worldwide.<sup>3, 4, 5, 6</sup> Most episodes of LBP resolve within 6 weeks<sup>7</sup> but 10–15% become chronic. However, inappropriate and non-optimal drug prescribing is common.<sup>9, 10</sup> These patients may benefit from nonpharmacological treatment, such as transcutaneous electrical nerve stimulation (TENS) and heat.<sup>11, 12</sup> TENS is an inexpensive treatment modality that delivers electrical impulses through the skin. As both heat and TENS appear to result in small clinical improvements in patients with LBP,<sup>11, 12, 43</sup> combining both interventions may result in a synergistic effect.