



Diet therapy in the management of chronic pain: better diet less pain?

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Evidence suggests that an integrative lifestyle approach that addresses all aspects of chronic pain experience is more beneficial than traditional pharmaceutical approaches on their own [1]. A variety of modifiable lifestyle factors coexist with chronic pain including obesity, smoking, alcohol, employment and occupation status, sleep and nutrition [2]. There are six categories of nutrients that the body needs to acquire from food: protein, carbohydrates, fat, fiber, vitamins and minerals. Appropriate nutrition is essential for health and the prevention of chronic disease. Previously, in *Pain Management*, Horton argued that fibromyalgia may be associated with low dietary intake of micronutrients (e.g., omega-3 fatty acids, vitamin B6, magnesium, zinc and antioxidants) and high dietary intake of glutamate and aspartate (e.g., from meat, soy sauce, fish sauces and aged cheeses, monosodium glutamate and yeast extract) [3]. Nutrients such as magnesium, vitamin B12 and zinc have been shown to reduce hyperalgesia and allodynia in animal models of neuropathic pain induced by nerve injury through actions on N-methyl-D-aspartate receptors [4–6].

Previously, in *Pain Management* we have argued that a social model care with health promotion strategies that include diet therapy would be beneficial for the management of chronic pain [7]. The aim of this editorial to explore the role of diet in the management of persistent pain by considering nutritional strategies that may be beneficial for pain management.

Diet therapy

Prescribed diet modification, known as diet therapy, includes approaches that manipulate the whole diet to supplement diet with specific nutrients and/or manipulate dietary pattern to induce a fasted state. Diet therapy can confer benefits in the form of calorie reduction, increased antioxidants and prebiotic supplementation for gastrointestinal health. These approaches have a positive impact on common comorbidities of chronic pain including obesity, Type 2 diabetes, cardiovascular mortality and rates of depression [8], although definitive evidence of efficacy and risk factors remains elusive [9]. Evidence is emerging from systematic reviews and meta-analyses that diet therapy may have beneficial effects on chronic pain [10–12].

Chronic pain is associated with pro-inflammatory states that drive peripheral and central sensitization and resultant hyperalgesia, allodynia and spontaneous pain [13]. Pro-inflammatory mediators that sensitize nociceptors include cytokines, interleukins, TNF- α , 5-hydroxytryptamine, histamine, bradykinin, acidic pH, free radicals and eicosanoids such as prostaglandins, leukotrienes and thromboxanes. Western diets tend toward deficiencies in fruits and vegetables and excessive amounts of processed meat, refined grain products containing starches (e.g., commercially baked foods), sweet sugary foods, caffeine and alcohol causing an imbalance of essential fatty acids and the production of pro-inflammatory mediators [14]. A Dietary Inflammatory Index can aid categorization of a person's diet on an anti-to-pro inflammatory continuum and diet modification can reverse the dietary imbalance [14].

Modifying dietary content

Dietary modification has the potential to alleviate chronic pain by reducing intake of pro-inflammatory foodstuffs and increasing intake of fruits, vegetables and unsaturated fats, particularly omega-3 fatty acids. Plant-based diets

and Mediterranean diets that are high in fish, whole-grains, legumes, fruit and green vegetables, moderate in olive oil, and low in red meat and butter are associated with lower levels of inflammation [11,15]. Rondanelli *et al.* [12] conducted a review of 172 studies and recommended that daily consumption of carbohydrates with a low glycemic index and a minimum of five portions of fruits and vegetables would be optimal for reducing pro-inflammatory states associated with chronic pain. This includes weekly consumption of four portions of legumes and fish, no more than two portions of white meat, eggs and fresh cheese, and one portion of red or processed meats, with sweets consumed only occasionally. Rondanelli *et al.* [12] suggested that daily consumption of extra virgin olive oil could support antioxidant capacity and reduce oxidative stress, and daily consumption of yogurt and fiber could preserve the microbiota from the negative consequences of opioid therapy.

Evidence suggests that supplementation of diet with specific nutrients may alleviate pain including omega-3 [16], magnesium [17], vitamin D [18] and vitamin B12 [5]. Evidence from a systematic review suggests that nutrients with antioxidant activity (e.g., omega-3 fatty acids, vitamin E, vitamin B1, vitamin B3 and magnesium) improve chronic pelvic pain without undesired effects [11]. Nutrients associated with lower levels of inflammation include omega-3 polyunsaturated fatty acids, magnesium, β -carotene and various vitamins [17,19,20]. Preclinical findings suggest that dietary omega-3/omega-6 ratio may have significance for inflammatory pain [21]. Evidence from a systematic review with meta-analysis suggests that omega-3 polyunsaturated fatty acid supplementation moderately improves chronic pain [22]. Increasing omega-3 intake reduced patient-reported joint pain and morning stiffness in patients with rheumatoid arthritis or joint pain secondary to inflammatory bowel disease [23]. Magnesium produces antinociceptive effects in animal models of neuropathic and inflammatory pain [24], and magnesium supplementation has been shown to alleviate acute postoperative and chronic neuropathic pain, and enhance the effect of opioids without a concurrent increase in side effects [4,25]. Vitamin D is deficient at a population level and is associated with the occurrence of chronic pain [18], although underlying adverse health factors, particularly obesity and depression may be contributory factors [26]. Evidence from a double-blind randomized, placebo-controlled study suggests that intramuscular vitamin B12 alleviates nonspecific chronic low back pain and related disability, and decreases paracetamol consumption in patients with no signs of nutritional deficiency [5]. Other dietary constituents that show promise include vitamin C [27], some flavonoid compounds (e.g., parsley, onions, blueberries) [28] and α -lipoic acid (e.g., in broccoli, spinach and yeast) [29].

Finally, there is growing interest in the role of gut health and its role in chronic pain. Gut health is a broad term that is used to describe characteristics of the gastrointestinal system tract that contribute to health and well-being including appropriate digestion and absorption of food, normality of the gastrointestinal microbiota, status of immune function, and absence of gastrointestinal illness and disease [30]. Microbial dysbiosis in the gastrointestinal tract is associated with visceral pain disorders such as irritable bowel syndrome [31] and evidence is growing that microbial manipulation using prebiotics and probiotics shows therapeutic promise [32]. Microbial manipulation has also shown promise for secondary gains in improved mood or symptom control [33].

Modifying dietary pattern

Calorie reduction can be achieved by continuous (daily) restriction of caloric intake (e.g., 60–80% of maintenance without reducing nutritional requirements) or intermittent restriction of caloric intake through fasting (e.g., every other day, a few times per week or randomly). Therapeutic use of fasting aims to restrict daily caloric intake to 200–500 kcal over periods of 16 h to several days each week. Therapeutic fasting techniques include intermittent fasting (e.g., 60% energy restriction every other day), partial fasting (e.g., 5-day diet providing 750–1100 kcal), and time-restricted feeding (limiting the daily period of food intake to ≤ 8 h). Therapeutic fasting achieves better adherence than continuous (daily) caloric restriction [34], and has been shown to achieve weight loss, improve multiple health indices (e.g., insulin resistance, risk factors for cardiovascular disease) [35] through activation of adaptive cellular stress response signaling pathways that enhance mitochondrial health, DNA repair and autophagy [36]. Therapeutic fasting may counteract pro-inflammatory states by reducing inflammation and oxidative stress, increasing cellular metabolism, promoting stem cell-based regeneration and increasing synaptic plasticity and the production of new neurons from neuronal stem cells [35]. Potentially beneficial effects are likely mediated by decreased peripheral and central sensitization associated with pro-inflammatory states [37], and reductions in weight decreasing mechanical stresses on painful weight bearing joints [38]. Evidence suggests that therapeutic fasting offers a wide range of secondary health benefits for individuals living with chronic pain, including extending life span, delaying age-related brain function deficits and preserving cognitive functioning [38].

Summary

Diet is a modifiable lifestyle factor associated with chronic pain and there is growing interest in the use of diet therapy as an adjunct to core treatment. At present, there is a paucity of robust high-quality evidence to determine the impact of specific diet therapies on chronic pain with any degree of certainty. Preliminary evidence suggests that daily portions of fruit and vegetables, olive oil, nuts and legumes (i.e., Mediterranean-style diet) with adequate micronutrients (omega-3, vitamin B12, and magnesium) coupled with a reduction in processed foodstuffs (meats and white flour products) is anti-inflammatory with potential benefits for chronic pain patients including reducing analgesic consumption. Intermittent fasting also shows promise, although studies are needed to optimize protocols including dosage and frequency fasting.

Diet therapy offers secondary gains including perceived control of pain, positive promotion of health and well-being, and reductions of comorbidities such as obesity and cardiovascular disease, thus reducing healthcare costs. There is a paucity of empirical research on the efficacy of diet therapy for people with chronic pain, or on the barriers to implementing diet therapy in clinical practice. This includes challenges faced by patients who may have multiple financial, physical, psychological or practical difficulties. Despite this, we believe that chronic pain services can benefit substantially from access to registered dietitians skilled in the assessment, modification and support of diets specific to pain patients.

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Accessing research materials

Underlying materials related to our paper can be accessed by contacting MI Johnson.

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