Current Osteoporosis Reports (2018) 16:754–762
https://doi.org/10.1007/s11914-018-0488-y

BONE AND JOINT PAIN (T KING AND S AMIN, SECTION EDITORS)

Celiac Disease—Musculoskeletal Manifestations and Mechanisms in Children to Adults

Haley M. Zylberberg[1] · Benjamin Lebwohl[1] · Peter H.R. Green[1]

Published online: 22 October 2018

Abstract

Purpose of Review We aim to review the current literature on the association of musculoskeletal disorders and celiac disease that is a common disorder, affecting about 1% of the population. Extra-intestinal symptoms and presentations predominate.

Recent Findings While the literature supports an association with reduced bone mineral density and increased fracture risk and celiac disease, there is little evidence supporting associations with other rheumatological conditions. Patients frequently report musculoskeletal symptoms; however, studies of specific disease entities suffer from a lack of standardization of testing for celiac disease and a lack of control groups.

Summary Well-controlled, preferably population-based studies are required to further explore a relationship between celiac disease and musculoskeletal disorders.

Keywords Celiac disease · Bone density · Osteoporosis · Fracture · Fibromyalgia · Myopathy · Hypermobility · Sjogren's syndrome

Introduction

Celiac disease (CD) is an autoimmune inflammatory disorder that causes destruction of the lining of the small intestine in genetically predisposed individuals who consume gluten, a component of grains, including wheat, rye, and barley. Worldwide, approximately 1% of children and adults have CD [1]. Despite increased awareness, many people with CD remain undiagnosed [2].

The definitive diagnostic test for CD is biopsy of the duodenum via esophagogastroduodenoscopy (EGD) to assess for villous atrophy. Testing for the serum concentration of immunoglobulin A against the enzyme tissue transglutaminase (TTG) is recommended given its high sensitivity for CD (90.9%) [3]. Other serological tests that are used include IgA against endomysial (EMA) and deamidated gliadin peptides (d-GP) antibodies and IgG against TTG, EMA, and d-GP, of value mainly in the presence of selective IgA deficiency [1]. Patients may also undergo genetic testing for the related human leukocyte antigen (HLA) class II variants, as virtually 100% of patients with CD possess HLA-DQ2 or HLA-DQ8 compared to 40% of the general population [1].

Classically, patients with CD were thought to have gastrointestinal symptoms and signs of malabsorption, such as diarrhea, abdominal pain, and weight loss [4••]. However, patients with CD are increasingly not experiencing gastrointestinal symptoms [1, 4••]. Instead, they often exhibit a large range of extra-intestinal symptoms and manifestations such as iron deficiency, arthritis, low bone mineral density, fatigue, headache, peripheral neuropathy, ataxia, and depression as well as vague cognitive symptoms termed "brain fog" by patients [5–7•]. The subtle quality of these symptoms tends to delay the diagnosis of CD; individuals with non-gastrointestinal symptoms have a median delay in celiac diagnosis of 42 months compared to 2.3 months in those with gastrointestinal symptoms [8]. Patients with CD may also be entirely asymptomatic. In these cases, the diagnosis is made by serologic screening after a family member is diagnosed with CD or after the diagnosis of an associated disease, such as type 1 diabetes mellitus [4••].

A high prevalence of autoimmune diseases has been reported in patients with CD, with studies suggesting a burden of 15

This article is part of the Topical Collection on *Bone and Joint Pain*

✉ Peter H.R. Green
pg11@cumc.columbia.edu

[1] Celiac Disease Center, Columbia University Medical Center, 180 Fort Washington Ave, New York, NY 10032, USA

to 30% [9, 10]. After diagnosis of CD, the risk of developing new autoimmune diseases is significantly less in those that adhere to a gluten-free diet (GFD) compared to those who are not adherent [10, 11]. Given the multisystem nature of CD, there has been increasing interest in studying the connection between autoimmune, rheumatologic, and musculoskeletal conditions and CD. The aim of this article is to review the literature on musculoskeletal manifestations of CD.

Metabolic Bone Disease

Both osteopenia and osteoporosis are well-known features of CD and have been widely studied [12]. Reduced bone mineral density has a prevalence as high as 75% in patients with CD [13–15] and can occur in the absence of gastrointestinal symptoms [13, 16, 17]. Patients with CD are also at increased risk of fracture [18–20], with a 30% overall risk reported in a 2015 meta-analysis [20]. A 2017 study that used a nationally representative sample of people from the USA found that CD predicted the fracture risk assessment tool score (FRAX) and predicted higher scores in males greater than 40 years, though not in women [17].

Many skeletal sites have been implicated in CD, including the femoral neck and lumbar spine [12]. Trabecular bone is frequently the location of bone deterioration as opposed to the less metabolically active cortical bone [21•, 22]. A 2015 study of 31 premenopausal women with CD that used high-resolution peripheral quantitative computed tomography to measure the microarchitecture components of bone found that women with CD had a 26% reduction in trabecular bone compared to control women [22]. In a 2017 follow-up study of 26 of these women, the authors found that the trabecular compartments of the radius and tibia increased more than the cortical compartments after 1 year on a GFD [23].

Both bone mineral density and fracture risk improve in patients with CD who adhere to a GFD [23–26], though they can persist even on the diet [16, 27, 28]. Recent studies point to a link between bone pathology and malabsorption and villous atrophy. Persistent villous atrophy has been linked to increased risk of hip fracture in a 2014 study [18]. A 2017 study of CD patients treated with a GFD found that improved bone mineral density was the only variable independently associated with mucosal healing [29]. Another 2017 study demonstrated that the severity of villous damage could be a predictor of lower lumbar bone mineral density [30]. A 2018 study found that among patients with biopsy-diagnosed CD, those with the lowest serum calcium value at baseline had the greatest subsequent improvement in bone mineral density in response to a GFD [31].

The villous atrophy inherent in untreated CD is likely one of the mechanisms of reduced bone mineral density [12]. Villous atrophy leads to malabsorption of calcium, which in turn causes a compensatory increase in parathyroid hormone (i.e., secondary hyperparathyroidism), leading to bone resorption [12]. Serum calcium levels are subsequently optimized, but the bone microarchitecture becomes altered and predisposes to fracture [12]. Additionally, given the inflammatory nature of CD, secretion of pro-inflammatory cytokines and autoimmune factors may lead to the development of reduced bone density in patients with CD [12, 32, 33].

Arthritis

Arthritis and arthralgia are common features of CD, occurring in both children and adults [5, 34–41]. A recent meta-analysis reported a cumulative incidence of arthritis (type unspecified) of 22.1% in patients with CD, though there was no increased risk of arthritis in CD compared to controls (OR: 0.76, 95% CI: 0.16–3.66) [36]. Arthritis and arthralgia may be the first presenting feature of CD in adults and children and occur with or without gastrointestinal symptoms [35, 40]. A 2016 study found newly diagnosed CD in 2% of 2125 children with musculoskeletal symptoms presenting for rheumatology evaluation, with arthralgia and myalgia being the most frequent symptom [40]. The authors of this study concluded that guidelines should be amended to include testing for CD in children undergoing rheumatologic evaluations, especially as majority of patients did not experience any GI symptoms [40]. Additionally, ultrasound studies have detected joint abnormalities, such as effusion, synovitis, and hypertrophy, in approximately 30% of children with CD, even when no clinical symptoms of arthritis were present [42, 43]. Patients with CD also commonly experience back pain [37, 38, 44] and display sacroiliitis and enthesitis on imaging [44–46].

Many of these signs and symptoms can improve in adults and children on a GFD [5, 40], though the degree of improvement varies. Iqbal et al. reported only a modest improvement in arthritis; 30% of patients with CD who adhered to a GFD reported improvement in symptoms of arthritis [37]. In comparison, 70% of patients with CD who adhered to a GFD reported improvement in diarrhea [37]. Norstrom et al. similarly reported no statistically significant improvement in joint pain in majority of 897 patients with CD after initiating a GFD ($p = 0.184$), though improvement was found in all other gastrointestinal and systemic symptoms, including body pain ($p = 0.002$) [41]. Another study, reported a significantly larger percentage of arthritis in patients with recently diagnosed and untreated CD (41%) compared to those on a GFD (22%, $p < 0.005$) [38]. Several other studies also showed that joint abnormalities and enthesitis occur significantly more often in untreated CD compared to treated CD [42, 43, 45].

Despite the frequency of arthritis in patients with CD and the improvement with the GFD, the literature covering the association between CD and autoimmune arthritis is sparse. Few studies of high-quality evidence have investigated the relationship between CD and rheumatoid arthritis (RA),

juvenile idiopathic arthritis (JIA), and the seronegative spondyloarthopathies (SpA).

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an autoimmune disorder characterized by joint destruction [47]. Patients with RA tend to experience joint pain, stiffness, swelling, and functional impairment [47]. Several studies have explored the presence of CD-related autoantibodies in patients with RA. While some have shown elevated antibodies in RA patients [48–50], others have not [51, 52]. Comparisons between these studies are challenging due to the varied types of antibodies tested, each with different sensitivities for CD. For example, some studies searched for IgG anti-TTG and anti-gliadin antibodies, which have poor specificity for CD [48, 49]. Even when testing for the more sensitive IgA anti-TTG or IgA EMA, many studies failed to rule out IgA insufficiency or deficiency, which commonly occurs in patients with CD [49–52]. All studies of RA patients that sought to confirm elevated celiac serology by duodenal biopsy failed to diagnose any patients with biopsy-confirmed CD [53–58].

In contrast, the prevalence of RA in patients with CD ranges from 0.6 to 4.5% [9, 11, 37, 59–63], which is larger than the 0.5–2.0% prevalence of RA reported in industrialized countries [47]. However, only two of these studies included a comparison group, and both found no increased prevalence of RA [37, 60]. In 1994, Collin et al. reported RA in 1.8% of 335 patients with CD compared to 2.1% of 335 controls [60], and in 2013, Iqbal et al. reported RA in 4.5% of 356 patients with CD compared to 9.8% of 234 controls [37].

Overall, the evidence exploring the relationship between RA and CD is lacking in high-quality studies with large sample sizes and comparator groups. Currently, there does not appear to be an association between the two diseases, though a large population-based cohort study or meta-analysis is warranted.

Juvenile Idiopathic Arthritis

Juvenile idiopathic arthritis (JIA), previously referred to as juvenile rheumatoid arthritis, is a chronic disease that causes joint pain and inflammation and occurs in children younger than 16 years of age [64]. Only one study to date, by Neuhausen et al., evaluated the presence of JIA in 408 patients with CD and found no cases of JIA [9]. However, several case series of patients with JIA have found a prevalence of CD ranging from 0 to 3.8% [39, 54, 65–73]. The majority of these series reported a prevalence of CD of ≥ 1.5%, thereby suggesting an increased prevalence of CD in JIA patients [39, 65, 68–72]. Two of the three studies with a comparator group corroborated this finding. In 2005, Stagi et al. found CD in 6.7% of 151 children with JIA compared to 0.6% of 158 sex- and age-matched controls ($p < 0.005$) [74]. Similarly, in 2016, Skrabl-Baumgartner et al. diagnosed CD in 4.2% of 95 children with JIA compared to 0% of 110 controls ($p < 0.02$) [75]. In contrast, in 2013, Robazzi et al. found CD in 1.89% of 53 patients with JIA compared to 2.5% of 40 healthy controls, though no statistical analysis was performed [76]. Again, there are few quality studies indicating a relationship with JRA and CD. Larger population-based studies are necessary.

The HLA-DQ2.5 haplotype may serve as a link between the two diseases. This haplotype has been reported in 80.8% of patients with JIA compared to 51.5% of controls ($p < 0.022$) [75]. The shared presence of the HLA-DQ2.5 allele may also explain why two studies found JIA to be common among family members of patients with CD [9, 66].

Seronegative Spondyloarthropathies

Seronegative spondyloarthropathies (SpA) encompasses a range of disorders that are all characterized by inflammatory arthritis, usually of the axial spine and asymmetrical peripheral joints [77]. Studies assessing the relationship between SpA and CD are scarce. Two studies assessed for serologic evidence of CD with subsequent biopsy confirmation in patients. One detected a single patient with CD among 74 patients with SpA [78] and the other failed to detect any patients with CD among 41 patients with SpA [53]. A 2013 study using only serology for celiac diagnosis, found no evidence of IgA EMA antibodies in 70 patients with SpA [51].

Studies of specific subtypes of SpA have also failed to show an association with CD. A study of 356 patients with CD reported 1 patient with psoriatic arthritis (PsA) and 2 with ankylosing spondylitis (AS) compared to 5 and 1 among the 234 healthy controls, respectively [37]. In a case control study, biopsy-confirmed CD was found in only 1 of 30 patients with AS [79]. Two studies assessing the presence of AS in patients with CD also failed to show an association with rates of 0.3% of AS in CD [60, 61]. In a retrospective chart review of 3161 patients with PsA and 3161 sex- and age-matched controls, CD was found in 11 PsA patients (0.35%) compared to 74 controls (0.23%), though multivariate logistic regression showed no statistical difference between the groups (OR 1.49, 95% CI 0.79–2.81) [80].

Fibromyalgia

Fibromyalgia is a disorder characterized by chronic widespread pain that most often occurs in females [81]. Given the broad range of systemic and gastrointestinal symptoms present in fibromyalgia, there has been an interest in linking fibromyalgia to CD. A 2015 study that did not involve testing for CD among patients with fibromyalgia found that common symptoms of CD occur more often in these patients compared to controls and even compared to patients with CD only [82].

Most studies do not show an increased prevalence of CD in patients with fibromyalgia, with rates between 0 and 2% [83–85]. Only two studies with biopsy-confirmed CD were performed, with conflicting results. A 2016 study restricted to women found CD in none of 94 patients with fibromyalgia and 94 healthy controls [83]. A 2013 study by Rodrigo et al. found a 7% prevalence of CD in patients with fibromyalgia and IBS compared to 2% with IBS only ($p < 0.001$) [86]. However, this study included patients with IBS, which has a known association with CD [87]. Though fibromyalgia can occur in all age ranges, only one case series was performed exclusively in adolescents and found a rate of biopsy-confirmed CD of 2% [85]. In contrast, the presence of fibromyalgia may be increased in patients with CD, with studies reporting a prevalence of 9–11%, though none of these studies had a comparator group [84, 88].

It remains unclear if the GFD is effective in resolving non-gastrointestinal symptoms of fibromyalgia in patients with comorbid disease. In a follow up study of the 7 patients with coexisting fibromyalgia, IBS, and CD 1 year after initiation of a GFD, Rodrigo et al. found a statistically significant improvement of over 50% from baseline of systemic and gastrointestinal symptoms, quality of life, and use of prescription drugs [89]. Much is still unknown about the relationship between CD and fibromyalgia; the quality of evidence does not suggest an association, though patients with fibromyalgia who have gastrointestinal symptoms or IBS, and a family history of CD should be tested for CD.

Inflammatory Myopathies

The inflammatory myopathies are a group of autoimmune disorders characterized by proximal muscle weakness that includes three main subtypes: polymyositis, dermatomyositis, and inclusion body myositis [90]. Several case series have reported an association between CD and inflammatory myopathy subtypes: polymyositis [91, 92], dermatomyositis [93], and inclusion body myositis [91, 94]. In a 2009 study of 99 patients with inflammatory myopathy, mean titers of IgA anti-TTG were slightly elevated compared to healthy controls (0.36 units ± 1.12 vs 0.20 units ± 0.00, $p = 0.08$) and mean IgA anti-gliadin antibodies were significantly elevated compared to controls (0.37 units ± 0.44 vs 0.24 units ± 0.15, $p = 0.02$), though none of these patients underwent histological evaluation for CD [95]. In a study of 41 children with juvenile dermatomyositis, none had serologic evidence of CD [96]. Only two studies that evaluated patients with biopsy-diagnosed CD included patients with all three subtypes [97, 98]. Selva-O'Callaghan et al. found biopsy-diagnosed CD in 3 of 51 patients (5.9%) [98], and Danielsson et al. reported biopsy-diagnosed CD in 4 of 88 patients (4.5%) [97]. The majority of CD diagnoses were found in patients with inclusion body myositis [97, 98].

Inclusion body myositis and CD may share the HLA-DQ2 subtype. A case control study by Badrising et al. found the HLA-DQ2 haplotype present in 79% of patients with inclusion body myositis compared to 37% of healthy blood donors ($p < 10^{-5}$) [99]. In Selva-O'Callaghan et al., the HLA-DQ2 subtype was found in 63% of patients with the inflammatory myopathies (subtypes combined) [98].

To date, studies report conflicting results regarding improvement and include patients who were treated with immunosuppressive therapy which may impact the symptom profile [94, 97, 98]. Future studies should evaluate if patients with coexisting disease experience relief of muscle weakness following adoption of the GFD.

Joint Hypermobility Syndrome/Ehlers–Danlos Syndrome

Joint hypermobility syndrome and Ehlers–Danlos syndrome hypermobility type (JHS/EDS) are two genetic connective tissue disorders that are considered to be variants of the same disease [100]. Although JHS/EDS is not an autoimmune disorder, evidence suggests an association with CD. In 2011, a case series found biopsy-confirmed CD in 5 of 31 patients with JHS/EDS (16%), which was significantly increased compared to the Italian celiac population (1%, $p = 0.002$) [101]. In 2015, a prospective case control study diagnosed JHS/EDS in 31% of patients with newly diagnosed CD, though all patients in the cohort had either functional or organic gastrointestinal disorders [102]. In 2016, a population-based cohort study found JHS/EDS in 0.15% of Swedish patients with CD, compared to 0.11% of controls, which corresponded to a 49% increased risk of JHS/EDS in the CD cohort (HR 1.49, 95% CI: 1.07–2.07) [103•]. While the mechanism for the association between the two diseases is unknown, one theory suggests that in CD, gliadin peptides may bind to collagen in the intestinal extracellular matrix, facilitated by the enzyme tissue transglutaminase, and cause intestinal inflammation [104].

Scleroderma

Scleroderma is an autoimmune connective tissue disorder characterized by fibrosis of the skin and other internal organs [105]. The presence of positive celiac serology among patients with scleroderma varies, with studies reporting positive serology anywhere from 0 to 50% [50, 51, 55, 56, 106–108]. In only two of these studies did patients meet the necessary criteria to undergo duodenal biopsy to diagnose CD. In 2009, Rosato et al. found positive IgA anti-TTG antibodies in 5 of 50 patients with scleroderma, with 4 of these patients having CD on biopsy (8% total prevalence) [108]. In 2013, Forbes et al. found no histologic evidence of CD among 2 patients with scleroderma who had positive serology (1 with positive IgG anti-TTG and the other with positive IgA anti-d-

GP) among 72 total patients with scleroderma [106]. On the other hand, the prevalence of scleroderma among patients with CD has only been reported by two studies [60, 61]. Both reported an increased prevalence of scleroderma (0.6%) in patients with CD [60, 61], which is larger than the estimated prevalence of scleroderma of between 50 to 300 out of one million adults [105]. Given the shortage of literature and the lack of any population-based cohort studies, more evidence is needed to fully understand the possible relationship between scleroderma and CD.

Sjogren's Syndrome

Sjogren's syndrome is a progressive autoimmune disorder caused by destruction of the lacrimal and salivary glands and characterized by xerostomia and keratoconjunctivitis sicca [109]. Though malabsorption in Sjogren's syndrome is rare [109], studies suggest an association with CD, possibly related to the presence of HLA-DQ2 in patients with Sjogren's syndrome [110].

The prevalence of CD appears to be increased in patients with Sjogren's syndrome, with estimates ranging from 2 to 15% [55, 110–113]. However, many of these studies have been small, including fewer than 50 patients with Sjogren's syndrome [55, 110, 111], and have been performed over a decade ago [55, 56, 110–113]. Of the larger studies, Szodoray et al. diagnosed CD in 4.5% of 111 patients [112], and in a case series by Alvarez et al., CD was reported in 2.13% of 141 patients [113], but because both studies lacked a non-Sjogren's syndrome control group, risk could not be calculated. In contrast, most studies report rates of Sjogren's syndrome among patients with CD that are lower [11, 59, 114] than the general Sjogren's syndrome prevalence of 2% [109]. However, of the two cohort studies that included a non-celiac control group, both found higher rates of Sjogren's syndrome in CD patients respective to controls [37, 60]. In 1994, Collin et al. described Sjogren's syndrome in 3.3% of 335 patients with CD compared to 0.3% of 335 controls ($p = 0.006$) [60]. In 2013, Iqbal et al. reported Sjogren's syndrome in 0.8% of 356 patients with CD compared to 0.4% of 234 controls, though small numbers of subjects precluded a formal comparison [37]. As most studies assessed for the presence Sjogren's syndrome using chart review or questionnaire, the true prevalence of physician-diagnosed disease may be overestimated [11, 37, 59, 60]. Only one study by Erbasan et al., performed in 2017, used the American College of Rheumatology's criteria to actively diagnosis Sjogren's syndrome [114]. They found Sjogren's syndrome in only 1 case among 82 patients with CD (1.2%) [114].

Despite a scarcity of evidence, the current literature seems to suggest that there may be a benefit in screening patients with Sjogren's syndrome for CD, but not vice versa. Studies of higher quality are needed to confirm the association between the diseases and to determine which patients with Sjogren's syndrome may be at risk of acquiring CD.

Systemic Lupus Erythematosus

Systemic lupus erythematosus (SLE) is a clinically heterogeneous autoimmune disease that can affect many organs, including the skin, central nervous system, joints, circulatory system, and kidneys [115]. In patients with CD, the reported prevalence of SLE ranges from 0.2 to 2.4% [11, 37, 59–61, 116•, 117], which is higher than the US prevalence of SLE, which ranges from 9 to 159 per 100,000 (0.009–0.159%) individuals [115]. Only one of these studies, performed by Ludvigsson et al., included a control group and conducted a formal comparison [116•]. Ludvigsson et al. found SLE in 0.19% of 29,048 patients with CD, which corresponded to a 3-fold increased risk of acquiring SLE (HR 3.49, 95% CI 2.48–4.90) [116•]. Despite this, the absolute risk of acquiring SLE remained low at 17/100,000 person-years [116•].

On the other hand, small studies ($n < 70$) have found the prevalence of CD in patients with SLE to be anywhere from 0 to 4% [53, 55, 118, 119]. Several studies that included over 100 patients failed to show an increased prevalence of CD, which was diagnosed by serologic screening with confirmatory biopsy [56, 120–122]. In 2001, Rensch et al. found no evidence of CD in 103 patients with SLE [122]. In 2003, Bizzaro et al. diagnosed CD in 1% of 100 patients with SLE compared to 0% of 120 controls (no p value reported) [56]. In 2004, Marai et al. found CD in 1% of 100 patients with SLE compared to 0% of 120 controls (no p value reported) [120]. In 2013, Picceli et al. found no evidence of CD among 194 patients with SLE and 103 controls [121]. However, the largest study to date, performed in 2016 by Dahan et al., showed an increased prevalence of CD [123]. After medical record review, Dahan et al. found CD in 0.8% of 5018 Israeli SLE patients, which was significantly larger than the 0.2% among 25,090 age- and sex-matched controls ($p < 0.001$) [123]. Given the low rate of CD in controls compared to the rate reported worldwide (0.2% [123] vs 1%), the increased prevalence of CD among Israeli patients with SLE may not be generalizable to other populations.

Though SLE can occur in children and adolescents, few studies have been performed in this group. Aikawa et al. reported a 2.4% prevalence of biopsy-diagnosed CD among 41 children with SLE [96], and Ludvigsson et al. reported a 2-fold risk of SLE in patients diagnosed with CD before 20 years of age [116•].

Given the varied results in the literature, it is unclear if there is an association between SLE and CD. Any association may be explained by the presence of the HLA-DR3 haplotype, which often occurs with the HLA-DQ2 allele in patients with CD and is a high-risk allele for SLE [124]. Patients with SLE and CD have both been shown to have elevated levels of

interleukin-21, a cytokine that has also been suggested as a possible mechanism connecting the diseases [125].

Conclusion

CD is a multisystem autoimmune condition with a wide spectrum of clinical presentations including musculoskeletal and rheumatological complaints. The relationship between CD, reduced bone density, and increased fracture risk has been well established. While those with CD appear to have an increased risk of having another autoimmune disorder, the relationship between CD and rheumatological conditions is less clear. Larger, population-based studies are needed.

Compliance with Ethical Standards

Conflict of Interest Peter Green reports personal fees from ImmusanT, Celimmune, and J&J for serving on the medical advisory boards, outside the submitted work.

Haley M Zylberberg and Benjamin Lebwohl declare no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Lebwohl B, Sanders DS, Green PHR. Coeliac disease. Lancet. 2017;pii: S0140–6736(17)31796–8.
2. Choung RS, Unalp-Arida A, Ruhl CE, Brantner TL, Everhart JE, Murray JA. Less hidden celiac disease but increased gluten avoidance without a diagnosis in the United States: findings from the National Health and Nutrition Examination surveys from 2009 to 2014. . Mayo Clin Proc. 2016;pii: S0025–6196(16):30634–6.8. **This study updates the prevalence of celiac disease and gluten avoidance in the USA using a population-based data resource (NHANES).**
3. Hopper AD, Hadjivassiliou M, Hulstone DP. What is the role of serologic testing in celiac disease? A prospective, biopsy-confirmed study with economic analysis. Clin Gastroenterol Hepatol. 2008;6:314–20.
4. •• Ludvigsson JF, Leffler DA, Bai JC, Biagi F, Fasano A, Green PHR, et al. The Oslo definitions for coeliac disease and related terms. Gut. 2013;62:43–52. **This consensus paper puts order into the confusing nomenclature defining the different types/ stages of celiac disease.**
5. Jericho H, Sansotta N, Guandalini S. Extraintestinal manifestations of celiac disease. J Pediatr Gastroenterol Nutr. 2017;65(1): 75–9.
6. Leffler DA, Green PH, Fasano A. Extraintestinal manifestations of coeliac disease. Nat Rev Gastroenterol Hepatol. 2015;12:561–71.
7. • Lichtwark ITNE, Robinson SR, Shepherd SJ, Hosking P, Gibson PR, Yelland GW. Cognitive impairment in coeliac disease improves on a gluten-free diet and correlates with histological and serological indices of disease severity. Aliment Pharmacol Ther. 2014;40(2):160–70. **This paper puts a clinical face to the term used by patients, "brain fog."**.
8. Paez MA, Gramelspacher AM, Sinacore J, Winterfield L, Venu M. Delay in diagnosis of celiac disease in patients without gastrointestinal complaints. Am J Med. 2017;130(11):1318–23.
9. Neuhausen SL, Steele L, Ryan S, Mousavi M, Pinto M, Osann KE, et al. Co-occurrence of celiac disease and other autoimmune diseases in celiacs and their first-degree relatives. J Autoimmun. 2008;31(2):160–5.
10. Bai D, Brar P, Holleran S, Ramakrishnan R, Green PH. Effect of gender on the manifestations of celiac disease: evidence for greater malabsorption in men. Scan J Gastroenterol. 2005;40(2):183–7.
11. Cosnes J, Cellier C, Viola S, Colombel JF, Michaud L, Sarles J, et al. Incidence of autoimmune diseases in celiac disease: protective effect of the gluten-free diet. Clin Gastroenterol Hepatol. 2008;6(7):753–8.
12. Zanchetta MB, Longobardi V, Bai JC. Bone and celiac disease. Current Osteoporosis Reports. 2016;14(2):43–8.
13. Larussa T, Suraci E, Nazionale I, Abenavoli L, Imeneo M, Luzza F. Bone mineralization in celiac disease. Gastroenterol Res Pract. 2012;2012:198025.
14. Lucendo AJ, García-Manzanares A. Bone mineral density in adult celiac disease: an updated review. Rev Esp Enferm Dig. 2013;105: 154–62.
15. Grace-Farfaglia P. Bones of contention: bone mineral density recovery in celiac disease–a systematic review. Nutrients. 2015;7(5): 3347–69.
16. Meyer D, Stavropolous S, Diamond B, Shane E, Green PH. Osteoporosis in a North American adult population with celiac disease. Am J Gastroenterol. 2001;96(1):112–9.
17. Kamycheva E, Goto T, Camargo CA Jr. Celiac disease is associated with reduced bone mineral density and increased FRAX scores in the US National Health and Nutrition Examination Survey. Osteoporos Int. 2017;28(3):781–90.
18. Lebwohl B, Michaëlsson K, Green PH, Ludvigsson JF. Persistent mucosal damage and risk of fracture in celiac disease. J Clin Endocrinol Metab. 2014;99(2):609–16.
19. Olmos M, Antelo M, Vazquez H, Smecuol E, Mauriño E, Bai JC. Systematic review and meta-analysis of observational studies on the prevalence of fractures in coeliac disease. Dig Liver Dis. 2008;40(1):46–53.
20. Heikkilä K, Pearce J, Mäki M, Kaukinen K. Celiac disease and bone fractures: a systematic review and meta-analysis. J Clin Endocrinol Metab. 2015;100(1):25–34.
21. • Stein EM, Rogers H, Leib A, McMahon DJ, Young P, Nishiyama K, et al. Abnormal skeletal strength and microarchitecture in women with celiac disease. J Clin Endocrinol Metab. 2015;100: 2347–53. **This is a good update on fracture risk for celiac disease patients**.
22. Zanchetta MB, Costa F, Longobardi V, Longarini G, Mazure RM, Moreno ML, et al. Significant bone microarchitecture impairment in premenopausal women with active celiac disease. Bone. 2015;76:149–57.
23. Zanchetta MB, Longobardi V, Costa F, Longarini G, Mazure RM, Moreno ML, et al. Impaired bone microarchitecture improves after one year on gluten-free diet: a prospective longitudinal HRpQCT study in women with celiac disease. J Bone Miner Res. 2017;32(1):135–42.
24. Kotze LM, Skare T, Vinhooli A, Jurkonis L, Nisihara R. Impact of a gluten-free diet on bone mineral density in celiac patients. Rev Esp Enferm Dig. 2016;108(2):84–8.

25. Pantaleoni S, Luchino M, Adriani A, Pellicano R, Stradella D, Ribaldone DG, et al. Bone mineral density at diagnosis of celiac disease and after 1 year of gluten-free diet. Sci World J. 2014;108(5):E9.
26. Vasquez HMR, Gonzalez D, Flores D, Pedreira S, Niveloni S, Smecuol E, et al. Risk of fractures in celiac disease patients: a cross-sectional, case-control study. Am J Gastroenterol. 2000;95: 183–9.
27. Ludvigsson JF, Michaelsson K, Ekbom A, Montgomery SM. Coeliac disease and the risk of fractures-a general population-based cohort study. Aliment Pharmacol Ther. 2007;25(273–85): 273–85.
28. Sánchez MI, Mohaidle A, Baistrocchi A, Matoso D, Vázquez H, González A, et al. Risk of fracture in celiac disease: gender, dietary compliance, or both? World J Gastroenterol. 2011;17:3035–42.
29. Larussa T, Suraci E, Imeneo M. Normal bone mineral density associates with duodenal mucosa healing in adult patients with celiac disease on a gluten-free diet. Nutrients. 2017;9(2):E98.
30. Posthumus L, Al-Toma A. Duodenal histopathology and laboratory deficiencies related to bone metabolism in coeliac disease. Eur J Gastroenterol Hepatol. 2017;29(8):897–903.
31. Zylberberg HM, Lebwohl B, RoyChoudhury A, Walker MD, Green PHR. Predictors of improvement in bone mineral density after celiac disease diagnosis. Endocrine. 2018;59(2):311–8.
32. Riches PL, McRorie E, Fraser WD, Determann C, van't Hof R, Ralston SH. Osteoporosis associated with neutralizing autoantibodies against osteoprotegerin. N Engl J Med. 2009;361(15): 1459–65.
33. Sugai ECA, Pedreira S, Smecuol E, Vazquez H, Niveloni S, Mazure R, et al. Bone-specific antibodies in sera from patients with celiac disease: characterization and implications in osteoporosis. J Clin Immunol. 2002;22(6):353–62.
34. Assa A, Frenkel-Nir Y, Tzur D, Katz LH, Shamir R. Large population study shows that adolescents with celiac disease have an increased risk of multiple autoimmune and nonautoimmune comorbidities. Acta Paediatr. 2017;106(6):967–72.
35. Bourne JT, Kumar P, Huskisson EC, Mageed R, Unsworth DJ, Wojtulewski JA. Arthritis and coeliac disease. Ann Rheum Dis. 1985;44(9):592–8.
36. Daron C, Soubrier M, Mathieu S. Occurrence of rheumatic symptoms in celiac disease: a meta-analysis: comment on the article "Osteoarticular manifestations of celiac disease and non-celiac gluten hypersensitivity". Joint Bone Spine. 2017;84(5):645–6.
37. Iqbal T, Zaidi MA, Wells GA, Karsh J. Celiac disease arthropathy and autoimmunity study. J Gastroenterol Hepatol. 2013;28(1):99–105.
38. Lubrano E, Ciacci C, Ames PR, Mazzacca G, Oriente P, Carpa R. The arthritis of celiac disease: prevalence and pattern in 200 adult patients. Br J Rheumatol. 1996;35:1314–8.
39. Mäki M, Hallström O, Verronen P, Reunala T, Lähdeaho ML, Holm K, et al. Reticulin antibody, arthritis, and coeliac disease in children. Lancet. 1988;1(8583):479–80.
40. Sherman Y, Karanicolas R, DiMarco B, Pan N, Adams AB, Barinstein LV, et al. Unrecognized celiac disease in children presenting for rheumatology evaluation. Pediatrics. 2015;136(1): e68–75.
41. Norström F, Sandström O, Lindholm L, Ivarsson A. A gluten-free diet effectively reduces symptoms and health care consumption in a Swedish celiac disease population. BMC Gastroenterol. 2012;12:125.
42. Garg K, Agarwal P, Gupta RK, Sitaraman S. Joint involvement in children with celiac disease. Indian Pediatr. 2017;54:946–8.
43. Iagnocco A, Ceccarelli F, Mennini M, Rutigliano IM, Perricone C, Nenna R, et al. Subclinical synovitis detected by ultrasound in children affected by coeliac disease: a frequent manifestation improved by a gluten-free diet. Clin Exp Rheumatol. 2014;32(1):137–42.
44. Vereckei E, Mester A, Hodinka L, Temesvari P, Kiss E, Poor G. Back pain and sacroiliitis in long-standing adult celiac disease: a cross-sectional and follow-up study. Rheumatol Int. 2010;30(4): 455–60.
45. Atteno M, Costa L, Cozzolino A, Tortora R, Caso F, Del Puente A, et al. The enthesopathy of celiac patients: effects of gluten-free diet. Clin Rheumatol. 2014;33(4):537–41.
46. Usai P, Boi MF, Piga M, Cacace E, Lai MA, Beccaris A, et al. Adult celiac disease is frequently associated with sacroiliitis. Dig Dis Sci. 1995;40(9):1906–8.
47. Lerner A, Matthias T. Rheumatoid arthritis-celiac disease relationship: joints get that gut feeling. Autoimmun Rev. 2015;14(11): 1038–47.
48. Koszarny A, Majdan M, Suszek D, Dryglewska M, Tabarkiewicz J. Autoantibodies against gliadin in rheumatoid arthritis and primary Sjögren's syndrome patients. Wiad Lek. 2015;68(3):242–7.
49. Shor DB, Orbach H, Boaz M, Altman A, Anaya JM, Bizzaro N, et al. Gastrointestinal-associated autoantibodies in different autoimmune diseases. Am J Clin Exp Immunol. 2012;1(1):49–55.
50. Gheita TA, Fawzy SM, Nour El-Din AM, Gomaa HE. Asymptomatic celiac sprue in juvenile rheumatic diseases children. Int J Rheum Dis. 2012;15(2):220–6.
51. Skare T, Nisihara RM, Utiyama SR. Is it worth investigating coeliac disease in patients with rheumatic disorders? Rheumatology (Oxford). 2013;52:217–8.
52. Liao KP, Kurreeman F, Li G, Duclos G. Associations of autoantibodies, autoimmune risk alleles, and clinical diagnoses from the electronic medical records in rheumatoid arthritis cases and non-rheumatoid arthritis controls. Arthritis Rheum. 2013;65:571–81.
53. Koehene VB, Bahia M, Lanna CC, Pinto MR, Bambirra EA, Cunha AS. Prevalence of serological markers for celiac disease (IgA and IgG class antigliadin antibodies and IgA class antiendomysium antibodies) in patients with autoimmune rheumatologic diseases in Belo Horizonte, MG, Brazil. Arq Gastroenterol. 2010;47:250–6.
54. Moghtaderi M, Farjadian S, Aflaki E, Honar N, Alyasin S, Babaei M. Screening of patients with juvenile idiopathic arthritis and those with rheumatoid arthritis for celiac disease in southwestern Iran. Turk J Gastroenterol. 2016;27(6):521–4.
55. Luft LM, Barr SG, Martin LO, Chan EKL, Fritzler MJ. Autoantibodies to tissue transglutaminase in Sjogren's syndrome and related rheumatic diseases. J Rheumatol. 2003;30(12):2613–9.
56. Bizzaro N, Villalta D, Tonutti E, Doria A, Tampoia M, Bassetti D, et al. IgA and IgG tissue transglutaminase antibody prevalence and clinical significance in connective tissue diseases, inflammatory bowel disease and primary biliary cirrhosis. Dig Dis Sci. 2003;48:2360–5.
57. Francis J, Carty JE, Scott BB. The prevalence of coeliac disease in rheumatoid arthritis. Eur J Gastroenterol Hepatol. 2002;14(12): 1355–6.
58. Paimela L, Kurki P, Leirisalo-Repo M, Piirainen H. Gliadin immune reactivity in patients with rheumatoid arthritis. Clin Exp Rheumatol. 1995;13(5):603–7.
59. Escudie JB, Rance B, Malamut G, Khater S, Burgun A, Cellier C, et al. A novel data-driven workflow combining literature and electronic health records to estimate comorbidities burden for a specific disease: a case study on autoimmune comorbidities in patients with celiac disease. BMC Med Inform Decis Mak. 2017;17(1):140.
60. Collin P, Reunala T, Pukkala E, Laippala P, Keyriläinen O, Pasternack A. Coeliac disease–associated disorders and survival. Gut. 1994;35(9):1215–8.

61. Cooper T, Holmes GKT, Cooke WT. Coeliac disease and immunological disorders. BMJ. 1978;i:537–9.
62. Lancaster-Smith MJ, Perrin J, Swarbrick ET, Wright JT. Coeliac disease and autoimmunity. Postgrad Med J. 1974;50:45–8.
63. Saleem A, Connor HJ, Regan PO. Adult coeliac disease in Ireland: a case series. Ir J Med Sci. 2012;181(2):225–9.
64. Espinosa M, Gottlieb BS. Juvenile idiopathic arthritis. Pediatr Rev. 2012;33(7):303–13.
65. Tronconi E, Miniaci A, Pession A. The autoimmune burden in juvenile idiopathic arthritis. Ital J Pediatr. 2017;43(1):56.
66. Pohjankoski H, Kautiainen H, Kotaniemi K, Korppi M, Savolainen A. Diabetes, coeliac disease, multiple sclerosis and chronic arthritis in first-degree relatives of patients with juvenile idiopathic arthritis. Acta Paediatr. 2012;101(7):767–71.
67. Pohjankoski H, Kautiainen H, Kotaniemi K, Korppi M, Savolainen A. Autoimmune diseases in children with juvenile idiopathic arthritis. Scand J Rheumatol. 2010;39(5):435–6.
68. Alpigiani MG, Haupt R, Parodi S, Calcagno A, Poggi E, Lorini R. Coeliac disease in 108 patients with juvenile idiopathic arthritis: a 13-year follow-up study. Clin Exp Rheumatol. 2008;26(1):162.
69. Al-Mayouf SM, Al-Mehaidib AI, Alkaff MA. The significance of elevated serologic markers of celiac disease in children with juvenile rheumatoid arthritis. Saudi J Gastroenterol. 2003;9(2):75–8.
70. George EK, Hertzbergertem Cate R, van Suijlekom-Smit LW, von Blomberg BM, Stapel SO, van Elburg RM, et al. Juvenile chronic arthritis and coeliac disease in The Netherlands. Clin Exp Rheumatol. 1996;14(5):571–5.
71. George EK, Mearin ML, Bouquet J, von Blomberg BM, Stapel SO, van Elburg RM, et al. Screening for coeliac disease in Dutch children with associated diseases. Acta Paediatr Suppl. 1996;412:52–3.
72. Lepore L, Martelossi S, Pennesi M, Falcini F, Ermini ML, Ferrari R, et al. Prevalence of celiac disease in patients with juvenile chronic arthritis. J Pediatr. 1996;129:311–3.
73. Lepore L, Pennesi M, Ventura A, Torre G, Falcini F, Lucchesi A, et al. Anti-alpha-gliadin antibodies are not predictive of celiac disease in juvenile chronic arthritis. Acta Paediatr. 1993;82(6–7):569–73.
74. Stagi S, Giani T, Simonini G, Falcini F. Thyroid function, autoimmune thyroiditis and coeliac disease in juvenile idiopathic arthritis. Rheumatology (Oxford). 2005;44(4):517–20.
75. Skrabl-Baumgartner A, Christine Hauer A, Erwa W, Jahnel J. HLA genotyping as first-line screening tool for coeliac disease in children with juvenile idiopathic arthritis. Arch Dis Child. 2017;102(7):607–11.
76. Robazzi TC, Adan LF, Pimentel K, Guimarães I, Magalhães Filho J, Toralles MB, et al. Autoimmune endocrine disorders and coeliac disease in children and adolescents with juvenile idiopathic arthritis and rheumatic fever. Clin Exp Rheumatol. 2013;31(2):310–7.
77. Zochling J, Smith EU. Seronegative spondyloarthritis. Best Pract Res Clin Rheumatol. 2010;24(6):747–56.
78. Kallikorm R, Uibo O, Uibo R. Coeliac disease in spondyloarthropathy: usefulness of serological screening. Clin Rheumatol. 2000;19:118–22.
79. Toğrol RE, Nalbant S, Solmazgül E, Ozyurt M, Kaplan M, Kiralp MZ, et al. The significance of coeliac disease antibodies in patients with ankylosing spondylitis: a case-controlled study. J Int Med Res. 2009;37(1):220–6.
80. Zohar A, Cohen AD, Bitterman H, Feldhamer I, Greenberg-Dotan S, Lavi I, et al. Gastrointestinal comorbidities in patients with psoriatic arthritis. Clin Rheumatol. 2016;35(11):2679–84.
81. Clauw DJ. Fibromyalgia: a clinical review. JAMA. 2014;311(15):1547–55.
82. Garcia-Leiva JM, Carrasco JL, Slim M, Calandre EP. Celiac symptoms in patients with fibromyalgia: a cross-sectional study. Rheumatol Int. 2015;35(3):561–7.
83. Nisihara R, Marques AP, Mei A, Skare T. Celiac disease and fibromyalgia: is there an association? Rev Esp Enferm Dig. 2016;108(2):107–8.
84. Tovoli F, Giampaolo L, Caio G, Monti M, Piscaglia M, Frisoni M, et al. Fibromyalgia and coeliac disease: a media hype or an emerging clinical problem? Clin Exp Rheumatol. 2013;31(6 Suppl 79):S50–2.
85. Taubman B, Mamula P, Sherry DD. Prevalence of asymptomatic celiac disease in children with fibromyalgia: a pilot study. Pediatr Rheumatol Online J. 2011;9:11.
86. Rodrigo L, Blanco I, Bobes J, de Serres FJ. Remarkable prevalence of coeliac disease in patients with irritable bowel syndrome plus fibromyalgia in comparison with those with isolated irritable bowel syndrome: a case-finding study. Arthritis Res Ther 2013;15(6):R201.
87. Ford AC, Chey WD, Talley NJ, Malhotra A, Spiegel BM, Moayyedi P. Yield of diagnostic tests for celiac disease in individuals with symptoms suggestive of irritable bowel syndrome: systematic review and meta-analysis. Arch Intern Med. 2009;169:651–8.
88. Zipser RD, Patel S, Yahya KZ, Baisch DW, Monarch E. Presentations of adult celiac disease in a nationwide patient support group. Dig Dis Sci. 2003;48(4):761–4.
89. Rodrigo L, Blanco I, Bobes J, de Serres FJ. Clinical impact of a gluten-free diet on health-related quality of life in seven fibromyalgia syndrome patients with associated celiac disease. BMC Gastroenterol 2013;13:157.
90. Dalakas MC. Inflammatory muscle diseases. N Engl J Med. 2015;372(18):1734–47.
91. Hadjivassiliou M, Chattopadhyay AK, Davies-Jones GAB, Gibson A, Grünewald RA, Lobo AJ. Neuromuscular disorder as a presenting feature of coeliac disease. J Neurol Neurosurg Psychiatry. 1997;63:770–5.
92. Henriksson KG, Hallert C, Norrby K, Walan A. Polymyositis and adult coeliac disease. Acta Neurol Scand. 1982;65(4):301–19.
93. Volta U, De Franceschi L, Molinaro N, Tetta C, Bianchi FB. Organ-specific autoantibodies in coeliac disease: do they represent an epiphenomenon or the expression of associated autoimmune disorders? Ital J Gastroenterol Hepatol. 1997;29(1):18–21.
94. Hadjivassiliou M, Chattopadhyay AK, Grunewald RA, Jarratt JA, Kandler RH, Rao DG, et al. Myopathy associated with gluten sensitivity. Muscle Nerve. 2007;35(4):443–50.
95. Orbach H, Amitai N, Barzilai O, Boaz M, Ram M, Zandman-Goddard G, et al. Autoantibody screen in inflammatory myopathies high prevalence of antibodies to gliadin. Ann N Y Acad Sci. 2009;1173:174–9.
96. Aikawa NE, Jesus AA, Liphaus BL, Silva CA, Carneiro-Sampaio M, Viana VS, et al. Organ-specific autoantibodies and autoimmune diseases in juvenile systemic lupus erythematosus and juvenile dermatomyositis patients. Clin Exp Rheumatol. 2012;30(1):126–31.
97. Danielsson O, Lindvall B, Hallert C, Vrethem M, Dahle C. Increased prevalence of celiac disease in idiopathic inflammatory myopathies. Brain Behav. 2017;7(10):e00803.
98. Selva-O'Callaghan A, Casellas F, de Torres I, Palou E, Grau-Junyent JM, Vilardell-Tarres M. Celiac disease and antibodies associated with celiac disease in patients with inflammatory myopathy. Muscle Nerve. 2007;35(1):49–54.
99. Badrising UA, Schreuder GM, Giphart MJ, Geleijns K, Verschuuren JJ, Wintzen AR, et al. Associations with autoimmune disorders and HLA class I and II antigens in inclusion body myositis. Neurology. 2004;63:2396–8.
100. Colombi M, Dordoni C, Chiarelli N, Ritelli M. Differential diagnosis and diagnostic flow chart of joint hypermobility syndrome/Ehlers-Danlos syndrome hypermobility type compared to other

heritable connective tissue disorders. Am J Med Genet C Semin Med Genet. 2015;169C(1):6–22.
101. Danese C, Castori M, Celletti C, Amato S, Lo Russo C, Grammatico P, et al. Screening for celiac disease in the joint hypermobility syndrome/Ehlers-Danlos syndrome hypermobility type. Am J Med Genet A. 2011;155A(9):2314–6.
102. Fikree A, Aktar R, Grahame R, Hakim AJ, Morris JK, Knowles CH, et al. Functional gastrointestinal disorders are associated with the joint hypermobility syndrome in secondary care: a case-control study. Neurogastroenterol Motil. 2015;27(4):569–79.
103.• Laszkowska M, Roy A, Lebwohl B, Green PH, Sundelin HE, Ludvigsson JF. Nationwide population-based cohort study of celiac disease and risk of Ehlers-Danlos syndrome and joint hypermobility syndrome. Dig Liver Dis. 2016;48(9):1030–4. **This study demonstrates an association of Ehlers–Danlos syndrome and joint hypermobility syndrome and is one of the few studies that uses a population-based cohort**.
104. Dieterich W, Esslinger B, Trapp D, Hahn E, Huff T, Seilmeier W, et al. Cross linking to tissue transglutaminase and collagen favours gliadin toxicity in coeliac disease. Gut. 2006;55(4):478–84.
105. Gabrielli A, Avvedimento EV, Krieg T. Scleroderma. N Engl J Med. 2009;360(19):1989–2003.
106. Forbess LJ, Gordon JK, Doobay K, Bosworth BP, Lyman S, Davids ML, et al. Low prevalence of coeliac disease in patients with systemic sclerosis: a cross-sectional study of a registry cohort. Rheumatology (Oxford). 2013;52(5):939–43.
107. Nisihara R, Utiyama SR, Azevedo PM, Skare TL. Celiac disease screening in patients with scleroderma. Arq Gastroenterol. 2011;48(2):163–4.
108. Rosato E, De Nitto D, Rossi C, Libanori V, Donato G, Di Tola M, et al. High incidence of celiac disease in patients with systemic sclerosis. J Rheumatol. 2009;36(5):965–9.
109. Kassan SS, Moutsopoulos HM. Clinical manifestations and early diagnosis of Sjögren syndrome. JAMA Int Med. 2004;164(12):1275–84.
110. Iltanen S, Collin P, Korpela M, Holm K, Partanen J, Polvi A, et al. Celiac disease and markers of celiac disease latency in patients with primary Sjogren's syndrome. Am J Gastroenterol. 1999;94(4):1042–6.
111. Lidén M, Kristjánsson G, Valtýsdóttir S, Hällgren R. Gluten sensitivity in patients with primary Sjögren's syndrome. Scand J Gastroenterol. 2007;42(8):962–7.
112. Szodoray P, Barta Z, Lakos G, Szakall S, Zeher M. Coeliac disease in Sjogren's syndrome–a study of 111 Hungarian patients. Rheumatol Int. 2004;24(5):278–82.
113. Alvarez-Celorio MD, Angeles-Angeles A, Kraus A. Primary Sjögren's syndrome and celiac disease: causal association or serendipity? J Clin Rheumatol. 2000;6(4):194–7.
114. Erbasan F, Coban DT, Karasu U, Cekin Y, Yesil B, Cekin AH, et al. Primary Sjogren's syndrome in patients with celiac disease. Turk J Med Sci. 2017;47(2):430–4.
115. Kaul A, Gordon C, Crow MK, Touma Z, Urowitz MB, van Vollenhoven R, et al. Systemic lupus erythematosus. Nat Rev Dis Primers. 2016;2:16039.
116.• Ludvigsson JF, Rubio-Tapia A, Chowdhary V, Murray JA, Simard JF. Increased risk of systemic lupus erythematosus in 29,000 patients with biopsy-verified celiac disease. J Rheumatol. 2012;39(10):1964–70. **A population-based study demonstrating an association with SLE and celiac disease**.
117. Freeman HJ. Adult celiac disease followed by onset of systemic lupus erythematosus. J Clin Gastroenterol. 2008;42:252–5.
118. Abdelghani KB, Mouelhi L, Hriz A, Hajri A, Najjar T, Mahfoudi M, et al. Systemic lupus erythematosus and celiac disease. Joint Bone Spine. 2012;79(2):202–3.
119. Mader R, Adawi M, Schonfeld S. Malabsorption in systemic lupus erythematosus. Clin Exp Rheumatol. 1997;15(6):659–61.
120. Marai I, Shoenfeld Y, Bizzaro N, Villalta D, Doria A, Tonutti E, et al. IgA and IgG tissue transglutaminase antibodies in systemic lupus erythematosus. Lupus. 2004;13(4):241–4.
121. Picceli VF, Skare TL, Nisihara R, Kotze L, Messias-Reason I, Utiyama SRR. Spectrum of autoantibodies for gastrointestinal autoimmune diseases in systemic lupus erythematosus patients. Lupus. 2013;22:1150–5.
122. Rensch MJ, Szyjkowski R, Shaffer RT, Fink S, Kopecky C, Grissmer L, et al. The prevalence of celiac disease autoantibodies in patients with systemic lupus erythematosus. Am J Gastroenterol. 2001;96:1113–5.
123. Dahan S, Shor DB, Comaneshter D, Tekes-Manova D, Shovman O, Amital H, et al. All disease begins in the gut: celiac disease coexistence with SLE. Autoimmun Rev. 2016;15(8):848–53.
124. Graham RR, Ortmann W, Rodine P, Espe K, Langefeld C, Lange E, et al. Specific combinations of HLA-DR2 and DR3 class II haplotypes contribute graded risk for disease susceptibility and autoantibodies in human SLE. Eur J Hum Genet. 2007;15:823–30.
125. Park SW, Park SJ, Shin JI. Another possible underlying mechanism for the positive association between celiac disease and systemic lupus erythematosus: the role of interleukin 21. J Rheumatol. 2013;40(9):1619.