**Recent update and futuristic trends in diagnosis and treatment of “*Celiac Disease”.***

**Abstract**

Foods containing gluten can cause celiac disease, which is a long-term immunological and digestive illness that harms and affects the small intestine. Our body is unable to receive all the nutrients it needs because of this disease, which also causes serious digestive issues. Gluten is a protein found in grains such as wheat, barley, rye, and others. Gluten makes dough stretchy and gives bread its chewy texture. The dough is made more elastic by gluten, which also gives bread its chewy texture. The small intestine and villi, tiny finger-like projections seen on the small intestine wall, are damaged when the patient with celiac disease consumes food containing gluten because their body overreacts to the gluten protein. The small intestine cannot absorb enough nutrients from food when these villi are destroyed. In the end, this causes starvation, miscarriage, infertility, bone density loss, and neurological disorders. Researchers still don't have a firm understanding of the cause of celiac disease. Due to its inherited nature, celiac disease may pass on to certain genes. Any traumatic emotional experience or a severe medical incident can set it off. To help identify celiac disease, a tissue test for transglutaminase IgA (tTg-IgA) is employed. In this autoimmune illness, the immune system misinterprets the protein gluten as an outside invader.

**Key words**: Celiac disease, Gluten, tissue transglutaminase IgA (tTg-IgA), Gluten free diet.

**Introduction**

Foods containing gluten triggers celiac disease which is considered as a chronic digestive and immune disorder in this it affects and damages the small intestine. Gluten containing food triggers the celiac disease. It causes long lasting digestive problems and insufficient amount of nutrients are absorbed from the food. Other names for celiac disease include celiac sprue, gluten-sensitive enteropathy, and non-tropical sprue. A protein named gluten is present in barely, wheat, rye and other grains. Gluten gives elasticity to the dough and gives bread its chewy texture.

When a person with celiac disease consumes food containing gluten, their body overreacts to the gluten protein, causing damage to the small intestine and villi, microscopic projections that resemble fingers and are visible on the small intestine wall. When these villi are lost, the small intestine is unable to absorb enough nutrients from food. In the end, this results in neurological diseases, infertility, bone density loss, miscarriage, and famine. When the patient is on gluten free diet for a year and isn’t getting better then it is called refractory or non responsive celiac disease. Most of the times the patient never know they have celiac disease due to slow damage of small intestine and varied symptoms leads to several years to diagnose the disease.

Even though the patient is on a gluten-free diet and exhibits the same symptoms, the body does not display intestinal damage. [1-2]

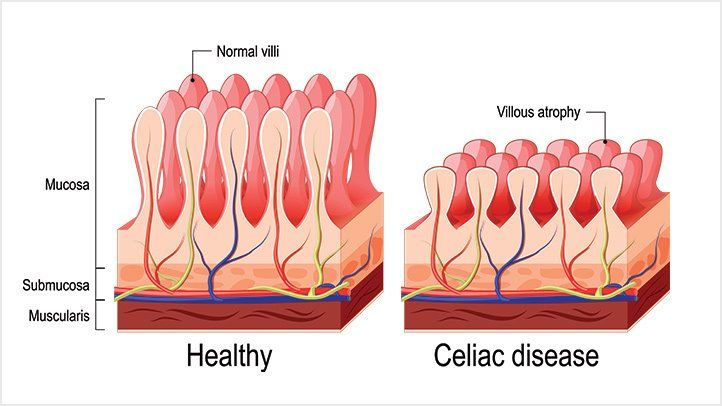


Fig.1-Figure showing the difference in shape of villi in celiac disease.

Fig.2-Figure showing the complications related to celiac disease in other organs of body.

**Celiac Disease Symptoms**

Food allergy can’t be concluded as celiac disease as the symptoms are varied. If the patient is allergic to wheat and consumes wheat then they may have symptoms like itchy or watery eyes or hard time breathing.

**Symptoms of celiac disease in adults**:

If a celiac disease patient accidentally consumes gluten-containing food, they may have symptoms such as:

•iAnaemiai

•iAbdominalidiscomfort

i•iBoneiorijointipain

i•iBloatingiorifeelingifullnessi

•iConstipationi

•iDiarrhea

i•iGas

i•iHeartburn

•iItchy,iblisteryirashi(dermatitisiherpetiformis,iaccordingitoidoctors)

•iHeadachesioriexhaustion

i•iMouthiulcers

•iNausea

i•iNervousisystemiinjury,isuchiasinumbioritinglingihandsiorifeet,ibalanceiissues,iorichangesiiniconsciousness

i•iPoopithatiisipale,istinks,iorifloatsi(steatorrhea)

•iWeighti reduction

Celiac disease can also result in decreased spleen function (hyposplenism) and a loss of bone density.

Children's celiac disease symptoms: Intestinal problems are more likely in children with celiac disease, including:

* Bellyiswellingioribloating
* Diarrhea
* Pale,ifoul-smellingipoop
* Weightiloss
* Constipation
* Upsetistomachiorivomiting

If celiac disease prevents a child's body from absorbing the nutrients they require, they may experience the following symptoms: • Anaemia

• Damaged tooth enamel

• Infant failure to thrive

• Slow growth and short stature

• Delayed puberty

• Crankiness or mood changes

• Neurological issues such as learning impairments and attention deficit hyperactivity disorder (ADHD)

These symptoms are not experienced by everyone who has celiac disease. Some people do not notice any abnormalities, making diagnosis difficult.

Dermatitis herpetiformis (celiac rash)

Out of 4 people 1 with celiac disease gets blisters and itchy rashes. Adults and women are more prone to celiac rashes and it mostly happens in these body parts.

* Knees
* Scalp
* Elbows
* Buttocks
* Loweriback[1-3]

**Celiac Disease Causes and Risk Factors**

There is no definite cause of celiac disease known yet. Celiac disease is inheriting in nature and may continue to certain genes. Any emotional trauma or stressful medical events can trigger it. A transglutaminase IgA (tTg-IgA) tissue test is used to help diagnose celiac disease.

If the family member is diagnose to celiac disease, and then there is 1 in 10 chance of getting celiac disease.

Caucasians are more prone to celiac disease and people with other diseases, including:

* Addison’sidisease
* [Downisyndrome](https://www.webmd.com/children/understanding-down-syndrome-basics)
* [Hashimoto](https://www.webmd.com/women/hashimotos-thyroiditis-symptoms-causes-treatments)’sithyroiditis
* [Typei1idiabetes](https://www.webmd.com/diabetes/type-1-diabetes)
* Chronici[pancreatitis](https://www.webmd.com/digestive-disorders/digestive-diseases-pancreatitis)
* IgAinephropathy
* Idiopathicidilatedicardiomyopathy
* [Lupus](https://www.webmd.com/lupus/arthritis-lupus)
* Rheumatoidiarthritis
* iTurnerisyndromei(iniwhichiaifemaleilacksianiXichromosome)i
* iMultipleisclerosisi(MS)i
* iAutoimmuneihepatitisiSjogren’sisyndrome
* [Psoriasis](https://www.webmd.com/skin-problems-and-treatments/psoriasis/understanding-psoriasis-basics)
* Williamsisyndrome
* Primaryibiliaryi[cirrhosis](https://www.webmd.com/digestive-disorders/cirrhosis-liver)
* Intestinali[lymphoma](https://www.webmd.com/cancer/lymphoma/lymphoma-cancer)
* Intestinali[cancer](https://www.webmd.com/cancer/default.htm)
* [Lactoseiintolerance](https://www.webmd.com/digestive-disorders/digestive-diseases-lactose-intolerance)
* [Irritableibowelisyndrome](https://www.webmd.com/ibs/default.htm)i(IBS)
* [Scleroderma](https://www.webmd.com/skin-problems-and-treatments/scleroderma)

**Celiac Disease Complications**

If not treated the celiac disease can be threatening to life. Complications may include:

* Malnutrition
* Lactoseiintolerance
* Infertilityiandimiscarriage
* iToothienamelidamage
* iPancreaticidisease
* iCancer,iespeciallyiintestinalilymphomaiandismalliintestineicanceri
* iNervousisystemiissuesisuchiasiseizuresioripainiandinumbnessiiniyourihandsiandifeeti(peripheralineuropathy)
* Boneiweakness[3-5]

**Celiac Disease Tests and Diagnosis**

To diagnose celiac disease, blood tests and other procedures are performed:

• Metabolic panels assess the function of the liver and kidneys.

• Iron and ferritin tests are used to detect iron deficiency.

• Swallowing a tiny camera can reveal digestive system issues.

• Serology tests search for specific antibodies.

• Blood tests examine different aspects of your immune system.

• Intestinal fatty acid binding protein assays detect intestinal damage.

• A complete blood count detects anemia (low red blood cell count).

• C-reactive protein testing reveal whether or not there is inflammation.

• Vitamin D, B12, and folate tests are used to detect vitamin deficits.

• Imaging scans detect changes in the intestine, such as wall thickening or blood vessel alterations.

• To rule out celiac disease, genetic testing searches for human leukocyte antigens.

If blood testing and other tests reveal that you have celiac disease, an endoscopy is required for confirmation. Endoscopy is a procedure in which a small piece of tissue is removed to confirm intestinal injury. [6]

**Causes**

Theiimmuneisystemiisitriggeredibyiglutenitoidamageivilli.iMostiofitheinutrientsiareiabsorbedifromitheifoodiandisentitoibloodstreamiwithitheihelpiofiVillii(VIL-eye)iwhichiareifingerilikeiprojectionsiliningitheismall iintestine.i

IfitheiVilliigetsidamagediitidoesinotiabsorbitheivitaminsiandimineralsiwhichiaichildineedsitoigrow.

Thereiisinoidefiniteicauseioficeliacidiseaseiknowniyet.iCeliacidiseaseiisiinheritingiininatureiandimayicontinueitoicertainigenes.iCaucasiansiareimoreiproneitoiceliacidiseaseiandipeopleiwithiotheridiseases,iincludingiDownisyndrome,iWilliams’sisyndrome,itypei1idiabetes,iandiautoimmuneithyroididisorders.i[7-8]

### Celiac Disease Diagnosis

Aiblooditesticonfirmsitheipresenceioficeliacidisease,iandiantibodiesiareitestediforigluteniandiotheriproteinsionitheivilli.iAntibodiesiareichemicalsithatioperateiagainstiundesirableicompoundsiinitheibodyibyiblockingiorikillingithem.iTheseiareicreatedibyitheiimmunologicalisystem.

Aibiopsyiisiperformeditoidetermineitheiamountiofiantibodiesiinitheiblood.iAilongithinitubei(Endoscope)iisipassediviaitheimouthiandistomachiintoitheismalliintestineiduringithisisurgery,iandiailittleitissueisampleiisiobtainediforitesting.

Aiblooditestitoiscreeniforiantibodiesitoigluteniandiotheriproteinsiinitheigutiliningiisicommonlyiuseditoidiagnoseiceliacidisease.iAntibodiesiareiproteinsiproducedibyitheiimmuneisystemithatirecogniseiandieliminateipathogensiandiotheridangers.iTheyitypicallyiremainiiniouribodiesiinicaseiweineeditoitackleitheisameivirusioridiseaseiagain.iIfitheiblooditestirevealsihighilevelsiofigluteniantibodies,itheidoctoriwillimostilikelyiperformiaisampleiofitheismalliintestineiforitesting.iInipaediatrics,itheipatientiisisedatedibyigeneralianesthesiaiandiputitoisleepiforitheibiopsy.ii[8-13]

**Diagnosis - Tissue Transglutaminase Iga (Ttg-Iga)**

### The tissue transglutaminase (tTg-IgA) test is used to diagnose celiac disease. Celiac disease is an autoimmune condition in which the body's immune system views gluten as a foreign invader.

### In the intestine, antibodies assault an enzyme called tissue transglutaminase (tTG). Antibodies (immunoglobulins) bind to pathogens and kill them.

### tTG-IgA Tests

### If a patient has celiac disease and exhibits symptoms such as vomiting, diarrhea, constipation, gut pain, poor growth, or rashes, a tTG-IgA test may be ordered. The test is also performed on patients who have type 1 diabetes, thyroid disease, or a family member who has celiac disease.

### Prepare for a tTG-IgA Test

For the accurate results of the blood test, the patient should be on normal diet or the gluten containing diet until the test is completely performed.

### Immunoglobulin Test

Theiimmunoglobulinitestimeasuresitheiamountsiofidifferentitypesiofiantibodiesiinitheiblood.iTheiimmuneisystemiprotectsitheibodyifromigerms,iviruses,iandiallergies.iDifferentiantibodiesiareiproducedibyitheibodyitoiprotectiagainstivariousithreats.iiInitheiinstanceiofiautoimmuneidisease,itheibodyiproducesiantibodiesiagainstiitselfiorihealthyiorgansianditissues,imistakingithemiforiforeigniinvaders.

The types of antibodies are:

* **ImmunoglobuliniAi(IgA):iThisiproteiniisifoundiinitheiliningsiofitheirespiratoryiandidigestiveitracts,iasiwelliasisalivai(spit),itears,iandibreastimilk.**
* **ImmunoglobuliniGi(IgG):iThisiisitheimosticommonlyiencounterediantibody.iItiisifoundiinibloodiandiotheribodilyifluidsiandiprovidesiprotectioniagainstibacterialiandiviralidiseases.iAfterianiinfectionioriimmunization,iIgGicanitakeisomeitimeitoidevelop.**
* **ImmunoglobuliniMi(IgiM):iFoundiprimarilyiinibloodiandilymphifluid,ithisiisitheifirstiantibodyiproducedibyitheibodyiwheniitiencountersiainewiinfection.**
* **iImmunoglobuliniEi(IgiE):iFoundiatilowilevelsiinitheiblood.iWhenitheibodyioverreactsitoiallergensioriisifightingiaiparasiteiinfection,ithereimayibeiincreasedilevels.**
* ImmunoglobuliniDi(IgiD):iThisiantibodyiisitheileastiunderstood,iwithijustitraceilevelsiseeniinitheiblood.[14-18]

**Commonly Used Diagnostic Tests for Celiac Disease**

|  |  |  |
| --- | --- | --- |
| **TEST** | **ADVANTAGES** | **DISADVANTAGES** |
| Tissue transglutaminase tTG IgA antibodies | Most reliable noninvasive test first level screening test  High sensitivity and specificity | Falsely negative with IgA deficiency (3% of patients with celiac disease)  May be negative if on low – gluten diet |
| Tissue transglutaminase tTG IgG antibodies | Useful in patients with IgA deficiency | Widely variable sensitivity and specificity |
| IgA antiendomysial antibodies | May be useful in patients with borderline results for tTG antibodies | Sensitivity for celiac disease less than IgA anti- transglutaminase antibody test |
| IgG deamidated gliadin peptide antibodies | Useful in patients with IgA deficiency and in young children | Not as sensitive or specific as tTG IgA antibodies |
| HLA-DQ2 or HLA-DQ8 | High negative predictive value for celiac disease | Test is complex and expensive |
| Small bowel biopsy | Reliable test considered gold standard  Reflects response to treatment | Requires endoscopy and biopsy very expensive |

### Why Are Immunoglobulin Tests Done?

### Immunoglobulinitestsiareiuseditoidetermineiwhetheriaipersoniisiinfectedioriatiriskiofiinfection.iTheiimmunoglobulinitestiisiuseditoidiagnoseiimmunodeficiency.iImmunodeficienciesiareipossibleiinichildreniwhoiareiexposeditoiuncommoniillnesses.iThisitesticanidetectiallergiesioriautoimmuneiillnessesisuchiasiarthritis,ilupus,iandiceliacidisease.i

### How Is Celiac Disease Treated?

Thereiisicurrentlyinoicureioritreatmentiforiceliacidisease.iManyistudiesiareibeingiconductedioninewitreatments.iForitheitimeibeing,iaigluten-freeidieticanihelpimenditheiintestinaliliningiorivilliiandialleviate isymptoms.ii[19-22]

#### Dietary Changes

Professionalsiadviseioniwhichidietitoifollowiandiwhichifoodsitoiavoid.iTheseiminoriimprovementsiwillialleviateisymptomsiandihaveiaisignificantiimpactionidailyiliving.iDietitiansicaniadviseiyouioniwhichidietitoifollow.

Gluten-freeifoodsishouldinoticontainirye,ibarley,iwheat,ioriotherisimilarigrains.iInimosticountries, allifoodilabelsimustiincludeianyiofitheitopieightifoodiallergens,iincludingigluten-containingicereals. Many wheat-freeigoodsimayicontainigluten-containingigrainsisuchiasiryeioribarley.

Beforeipurchasing,icarefullyireaditheilabels.iManyifoodsiandibeveragesiareilistedionitheiceliacidiseaseifoundation'siwebsite.

Gluten-free foods include

1. Fruits
2. Vegetables
3. Meat and poultry
4. [Fish](https://www.webmd.com/food-recipes/ss/slideshow-foolproof-fish) and other seafood
5. Dairy
6. Beans and nuts

Some Gluten-free starches and grains include:

* Rice
* [Corn](https://www.webmd.com/food-recipes/corn-health-benefits) or maize
* Soy
* Potato
* Tapioca
* Beans
* Sorghum
* Quinoa
* Millet
* Amaranth
* Flax
* Chia
* Nut flours
* Common things such as pharmaceuticals and toothpaste might contain gluten, so read the label carefully.[23-27]

**Conclusion**

Theiextensiveiliteratureireviewiindicatesithatiglutencontainingifoodsicauseiceliacidisease,Iwhichisiaichronicidigestiveiandiimmunologicaliillnessithatiaffectsiandidamagesitheismalliintestine.iThisidiseaseicausesisevereidigestiveiissuesiandipreventsiouribodiesifromireceivingialliofitheinutrientsitheyirequire.iGluteniisiaiproteinifoundiiniwheat,ibarley,irye,iandiothericereals.iGlutenigivesidoughiflexibilityiandigivesibreadiitsichewyitexture.iGlutenigivesitheidoughiflexibilityiandigivesibreadiitsichewyitexture.iWheniaiceliacidiseaseipatienticonsumesigluten-containingifoods,itheir bodyiover re-actsitoitheigluteniprotein,icausingidamageitoitheismalliintestineiandivilli,iwhichi areilittleifinger like projectionsionitheismalliintestinaliwall.iGluteniisiaiproteinifoundiinigrainsi suchiasibarely,iwheat,irye,iandiothers.iGlutenigivesitheidoughiflexibilityiandigivesibreadiitsichewyitexture. Wheniaiceliacidiseaseipatienticonsumesigluten-containingifoods,itheiribodyiover reactsitoitheiglut eniprotein,icausingidamageitoitheismalliintestineiandivilli,iwhichiareilittleifin ger-likeiprojections onitheismalliintestinaliwall.iWhenitheseivilliiareidestroyed,itheismalliintes tineiisiunableitoiabsorbienoughinutrientsifromifood.iThisieventuallyileadsitoistarvation,imiscarriage,iinfertility,iboneidensityiloss,iandineurologicaliproblems.

Aibiopsyiisiperformeditoidetermineitheiamountiofiantibodiesiinitheiblood.iAilongithinitubei(Endoscope)iisipassediviaitheimouthiandistomachiintoitheismalliintestineiduringithisisurgery,iandiailittleitissueisampleiisiobtainediforitesting.i

Theitissueitransglutaminasei(tTg-IgA)itestiisiuseditoidiagnoseiceliacidisease.iCeliacidiseaseiisiani autoimmuneiconditioniiniwhichitheibody'siimmuneisystemiviewsigluteniasiaiforeigniinvader.iInitheiintestine,iantibodiesiassaultianienzymeicalleditissueitransglutaminasei(tTG).iAntibodiesi(immunoglobulins)ibinditoipathogensiandikillithem.iThereiisicurrentlyinoicureioritreatmentiforiceliacidisease.iManyistudiesiareibeingiconductedioninewitreatments.iForitheitimeibeing,iaigluten-freeidieticanihelpito mend the intestinaliliningiorivilliiandialleviateisymptoms.

**References**

* 1. Iversen, R., Sollid, L.M, The immunobiology and pathogenesis of celiac disease. Annu Rev Pathol **2023**, 47–70.
  2. Carin Andren Aronsson and Daniel Agardh. Intervention strategies in early childhood to prevent celiac disease—a mini-review, Front. Immunol., Volume 14, February **2023**,
  3. Auricchio, R., Troncone, R. Can celiac disease be prevented? Front Immunol, Volume 12, **2021**, 672148.
  4. W. Quarpong, T.R. Card, J. West, et al. Mortality in people with coeliac disease: Long-term follow-up from a Scottish cohort United Eur Gastroenterol J, 7 **2019**, pp. 377-387.
  5. Parzanese, D. Qehajaj, F. Patrinicola, M. Aralica, M. Chiriva Internati, S. Stifter, et al. Celiac disease: from pathophysiology to treatment World J. Gastrointest. Pathophysiol., 8 (2) **2017**, pp. 27-38.
  6. Fasano, A.  Catassi C. Celiac disease N. Engl. J. Med., 367 (25) **2012**, pp. 2419-2426.
  7. S. Medical Advisory Clinical utility of serologic testing for celiac disease in ontario: an evidence-based analysis Ontario health technology assessment series, 10 (21) **2010**, pp. 1-111.
  8. Alharbi, I.S.  Sweid, A.M.  Memon, M.Y.  Alshieban, S.  Alanazi, A. Correlation of TTG IgA level with small intestinal histopathological changes for celiac disease among adult Saudi patients J Transl Int Med, 8 (1) **2020**, pp. 48-53.
  9. Hemati, N.  Sadeghi M., Plasma citrulline levels in patients with celiac disease: a meta-analysis of case-control studies J. Res. Med. Dent. Sci., 6 (1) **2018**, p. 397.
  10. Birot, S., Madsen, C.B., Kruizinga, A.G., Christensen, T., Cr´epet, A., Brockhoff, P.B.,. A procedure for grouping food consumption data for use in food allergen risk assessment. J. Food Compos. Anal. **2017**, 59, 111–123.
  11. Codex Alimentarius Standards for foods special dietary use for persons intolerant to gluten, 1979. Standard CXS 118. Adopted in 1979. Amended in 1983 and 2015. Revised in 2008.
  12. Tio, M. Cox, M.R.  Eslick, G.D. Meta-analysis: Coeliac disease and the risk of all-cause mortality, any malignancy and lymphoid malignancy Aliment Pharmacol Ther, 35 **2012**, pp. 540-551.
  13. Holmes, G.K.T.  Muirhead, A. Mortality in coeliac disease: a population-based cohort study from a single centre in Southern Derbyshire, UK BMJ Open Gastroenterol, 5 **2018**, Article e000201.
  14. Lebwohl, B.  Green, P.H.R  Söderling, J. *et al.* Association between celiac disease and mortality risk in a Swedish population JAMA, 323 **2020**, pp. 1277-1285.
  15. Koskinen, I.   Virta, L.J.  Huhtala, H. *et al.* Overall and cause-specific mortality in adult celiac disease and dermatitis herpetiformis diagnosed in the 21st century Am J Gastroenterol, 115 **2020**, pp. 1117-1124.
  16. Abdul Sultan, A.  Crooks, C.J.  Card, T. *et al.* Causes of death in people with coeliac disease in England compared with the general population: a competing risk analysis Gut, 64 **2015**, pp. 1220-1226.
  17. Hervonen, K. Alakoski, A.  Salmi, T.T. *et al.* Reduced mortality in dermatitis herpetiformis: a population-based study of 476 patients Br J Dermatol, 167 **2012**, pp. 1331-1337.
  18. Lohi, S. Mäki, M.  Rissanen, H. *et al.* Prognosis of unrecognized coeliac disease as regards mortality: a population-based cohort study Ann Med, 41 **2009**, pp. 508-515.
  19. Godfrey, J.D.  Brantner, T.L.  Brinjikji, W. *et al.* Morbidity and mortality among older individuals with undiagnosed celiac disease Gastroenterology, 139 **2010**, pp. 763-769.
  20. Kårhus, L.L.  Skaaby, T.  Petersen, J. *et al.* Long-term consequences of undiagnosed celiac seropositivity Am J Gastroenterol, 115 **2020**, pp. 1681-1688.
  21. Ludvigsson, J.F., Montgomery, S.M.  Ekbom, A. *et al.* Small-intestinal histopathology and mortality risk in celiac disease JAMA, 302 **2009**, pp. 1171-1178.
  22. Koskinen, I.  Hervonen, K.  Pukkala, E. *et al.* Cancer incidence and factors associated with malignancies in coeliac disease during long-term follow-up GastroHep, 3 **2021**, pp. 107-115.
  23. Kurppa, K.  Lauronen, O.  Collin, P. *et al.* Factors associated with dietary adherence in celiac disease: a nationwide study Digestion, 86 **2013**, pp. 309-314.
  24. See, J.A.  Kaukinen, K.  Makharia, G.K. *et al.* Practical insights into gluten-free diets Nat Rev Gastroenterol Hepatol, 12 **2015**, pp. 580-591.
  25. Ilus, T.  Kaukinen, K. Virta, L.J. *et al.* Incidence of malignancies in diagnosed celiac patients: a population-based estimate Am J Gastroenterol, 109 **2014**, pp. 1471-1477.
  26. Rispo, A.  Imperatore, N.  Guarino, M. *et al.* Metabolic-associated fatty liver disease (MAFLD) in coeliac disease. Liver Int, 41 **2021**, pp. 788-798.
  27. Schneider, C.V.  Kleinjans, M.  Fromme, M. *et al.* Phenome-wide association study in adult coeliac disease: role of HLA subtype Aliment Pharmacol Ther, 53 **2021**, pp. 510-518.
  28. Reilly, N.R., Lebwohl, B.  Hultcrantz, R. *et al.* Increased risk of non-alcoholic fatty liver disease after diagnosis of celiac disease J Hepatol, 62 **2015**, pp. 1405-1411.
  29. Osman, D.  Umar, S.  Muhammad, H *et al.* Neurological manifestation of coeliac disease with particular emphasis on gluten ataxia and immunological injury: a review article Gastroenterol Hepatol Bed Bench, 14 **2021**, pp. 1-7.