Serological Screening for Celiac Disease in Adult Chinese Patients With Diarrhea Predominant Irritable Bowel Syndrome

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Abstract: Celiac disease (CD) is common in Caucasians, but thought to be rare in Asians. Our aim was to determine the prevalence of CD in Chinese patients with chronic diarrhea predominant irritable bowel syndrome (IBS-D).

From July 2010 to August 2012, 395 adult patients with IBS-D and 363 age and sex-matched healthy controls were recruited in Zhongnan Hospital of Wuhan University and Xiaogan Central Hospital in Hubei province, central China. Patients with IBS-D were diagnosed according to the Rome III criteria. Serum Immunoglobulin (IgA/IgG) anti-human tissue transglutaminase (anti-htTG)-deamidated gliadin peptide (DGP) antibodies were measured in a single ELISA (QUANTA Lite h-tTG/DGP Screen). Upper endoscopy with duodenal biopsies and HLA-DQA1 and HLA-DQB1 genotyping were performed in seropositive subjects and a gluten-free diet was prescribed.

Seven IBS-D patients (7/395, 1.77%) and 2 healthy controls (2/363, 0.55%), were positive for anti-htTG/DGP antibodies. Of these 9 cases, 1 was lost to follow-up, 3 were suspected to have CD and 5 were eventually diagnosed as CD with intestinal histological lesions classified as Marsh Type II in 2 and Type III in 3. Of these 5 diagnosed CD patients, 4 (4/395, 1.01%) were from the IBS-D group and 1 (1/363, 0.28%) from the healthy control had asymptomatic CD. Two Type III CD patients with relatively high titers in the serologic assay were homozygous and heterozygous for haplotype HLA-DQA1*03-DQB1*03:03 (HLA-DQ9.3), respectively.

In the present study, CD was present in 1.01% of patients with IBS-D and in 0.28% of the control group. We like to suggest that the haplotype HLA-DQA1*03-DQB1*03:03 (HLA-DQ9.3), which is common in Chinese, is a new susceptibility factor for CD in Asians.
China. Larger screening and genetic studies are needed in the Chinese population of different regions.

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**Abbreviations:** anti-hTGG = anti-human tissue transglutaminase, BMI = body mass index, CD = celiac disease, DGP = deamidated gliadin peptide, DNA = deoxyribonucleic acid, ELISA = enzyme-linked immunosorbent assay, GFD = gluten-free diet, HLAA = human leukocyte antigen, IBS = irritable bowel syndrome, IBS-D = diarrhea-predominant irritable bowel syndrome, IEL = intraepithelial lymphocyte, Ig = immunoglobulin, NCGS = nonceliac gluten sensitivity, NSAID = nonsteroidal anti-inflammatory drug, SD = standard deviation, SPTs/slGE = skin prick tests/specific immunoglobulin E, tTG2 = tissue transglutaminase-2.

**INTRODUCTION**

Celiac disease (CD) is one of the gluten-related disorders including also nonceliac gluten sensitivity (NCGS) and wheat allergy. CD is characterized by chronic mucosal inflammation with infiltration of intraepithelial lymphocytes (IELs) in the epithelium and plasma cells in the lamina propria, with crypt hyperplasia and villous atrophy primarily in the upper small intestine. The classical form of CD presents with symptoms and signs of malabsorption such as chronic diarrhea, bloating, weight loss, and abdominal pain but more recent clinically silent nonclassical presentations in adults include iron-deficiency anemia, osteoporosis, gastroesophageal reflux, constipation, weight loss, neurologic symptoms, dermatitis herpetiformis, hypoproteinemia, hypocalcemia, and elevated liver enzyme levels. CD occurs in genetically susceptible individuals exposed to dietary gluten. Approximately 90% of Caucasian patients with CD are carriers of the human leukocyte antigen (HLA)-DQ2.5 (DQA1*05-DQB1*02) heterodimers encoded in cis (DQ2.5cis) or trans (DQ2.5trans) configuration and the remainder carry either DQ8 (DQA1*03-DQB1*03.02), HLA-DQ2.2 (DQA1*02-DQB1*02) heterodimers, or HLA-DQA1*05 only. These HLA-DQ gene variants at the major histocompatibility complex on chromosome 6p21.3 are present in 30% to 43% of the general European population and explain ~40% of the disease heritability, whereas large genome-wide association studies have brought the number of non-HLA loci each contributing only a small risk to explaining where large genome-wide association studies have brought the number of non-HLA loci each contributing only a small risk to explaining.

**METHODS**

**Recruitment of Patients With Chronic Diarrhea and Healthy Controls**

Between July 2010 and August 2012, 417 consecutive patients diagnosed with IBS-D in Zhongnan Hospital of Wuhan University in Wuhan city and Xiaogan Central Hospital near Wuhan, both in Hubei Province, central China were recruited. All the patients were Han Chinese patients with chronic diarrhea predominant IBS (IBS-D) that is the most frequent form of IBS and represents a high risk group to suffer from CD and healthy individuals. In addition, in serologic positive subjects we performed endoscopic and biopsy examinations, HLA-DQ genotyping, to estimate the prevalence of CD in central China.
study; were diagnosed with villous adenomas, microscopic colitis, or inflammatory bowel disease; had a history of gastro-intestinal cancer; were positive for antibody to human immunodeficiency virus, hepatitis B antigen, or hepatitis C virus; or were syringe drug users or cocaine inhalers.

In addition, 363 age and sex-matched healthy controls taking the annual routine health examinations in Zhongnan Hospital of Wuhan University and Xiaogan Central Hospital were recruited in this study. Healthy individuals did not fill out the above-mentioned questionnaire but were confirmed to be normal in the examination during the period of the study and were excluded when chronic diarrhea or the same exclusion items used for IBS-D patients were apparent. A total of 173 men and 190 women, mean age 47.47 ± 15.18 (years), and BMI 24.13 ± 3.95 (kg/m², mean ± SD) were included. BMI of healthy controls was significantly higher than of IBS-D patients (P < 0.001). The study protocol was approved by the Medical Ethics Committee of Zhongnan Hospital of Wuhan University. All included subjects signed the consent form for the project.

**Diagnostic Criteria for Celiac Disease**

CD was diagnosed when the anti-h-tTG/DGP antibodies test was positive, a Marsh II or III abnormality was found in the small intestinal biopsy specimen, and an objective response to a GFD was obtained. The Marsh classification was used for histological grading of the duodenal biopsy specimens.17

**H-tTG/DGP Enzyme-Linked Immunosorbent Assay**

Approximate 3 mL venous blood was obtained from each individual, and then centrifuged at 3000rpm for 10 minutes. The serum samples were stored at −80°C until use. All serum samples were subjected to IgA/IgG anti-h-tTG/DGP ELISA (QUANTA Lite, h-tTG/DGP ELISA; number 704575, Inova Diagnostics Inc., San Diego, CA), which is a solid phase enzyme immunoassay for the quantitative detection of IgA/IgG antibodies to synthetic DGP and the native h-tTG. In accordance with recommendations by the manufacturer, serum samples were defined to be positive for anti-h-tTG/DGP ELISA antibodies when the measured values were 20 Units or above.

**HLA-DQ Typing**

Genomic DNA of seven (No. 1, No. 2, No. 3, No. 4, No. 5, No. 8, No. 9) serologic positive subjects was extracted from 250 μL serum using the EasyMAG NuclSens extraction system (BioMérieux Benelux BV, Zaltbommel, The Netherlands). 2 mL NuclSens lysis buffer was added to the serum and incubated for 10 minutes at room temperature. The mixture was then added to the EasyMAG vessel and 50 μL of magnetic silica was subsequently added. The DNA was extracted on the EasyMAG machine (BioMérieux Benelux BV, Zaltbommel, The Netherlands) using the Generic 2.0.1 program. Elution was performed in 25 μL NuclSens Extraction buffer 3.18 EDTA-anticoagulated peripheral blood nucleated cells of the other 2 serologic positive subjects (No. 6 and No. 7) were available for extraction of genomic DNA. For HLA-DQA1 and HLA-DQB1 genotyping, polymerase chain reaction-amplified exon 2 amplicons were generated for low- to medium resolution typing in a combined, single-stranded conformation polymorphism–heteroduplex assay by a semiautomated electrophoresis and gel-staining method on the PhastSystem (Amersham Pharmacia Biotech, Uppsala, Sweden). This method has been validated by using a panel of reference DNA against the Dynall Allset sequence-specific primers high-resolution typing kits (Dynal A.S., Oslo, Norway).19,20

**Endoscopic and Histological Assessments and Intraepithelial Lymphocyte Counting in Patients Positive for Anti-h-tTG/DGP ELISA Antibodies**

Patients positive for IgA/IgG anti-h-tTG/DGP antibodies were asked to accept endoscopic examination of the duodenum and biopsies. At the endoscopy, 4 to 6 biopsies were obtained from the descendent duodenum at different levels distal to the papilla. The biopsies were fixed with 10% buffered formalin, embedded in paraffin blocks, and stained with hematoxylin and eosin. Two experienced pathologists blindly evaluated the histologic pattern under the microscope and assigned a Marsh classification to the biopsy findings. Type 0 indicates a normal small intestinal architecture sufficient to exclude celiac disease, type I (infiltrative) is characterized by increased IELs, type II (hyperplastic) indicates also crypt hyperplasia, and an additional partial, subtotal, or total villous atrophy characterizes the type III (destructive) lesion.21 Moreover, all histological sections were examined by light microscopy (×400 magnification), and the numbers of epithelial cells and IELs in a randomly chosen, uninterrupted length of the villous epithelium (>500 cells) were counted. The average number of IELs within 100 intestinal epithelial cells was calculated, and 40 IELs/100 epithelium cells was defined as the upper limit of the normal.22–24

**Treatment of a Gluten-Free Diet for Patients Positive for Anti-h-tTG/DGP IgA/IgG**

Patients positive for anti-h-tTG/DGP IgA/IgG were asked to receive GFD treatment. During a GFD, it was advised to avoid all gluten-containing food. Patients were monitored by periodic hospital visits for assessment of symptoms, physical examinations, and adherence to the GFD (Figure 1). Positive response to GFD treatment was defined when strictly compliant patients had improvement of clinical symptoms including chronic diarrhea, abdominal pain, and decreased serum antibody level compared with pre-GFD.

**FIGURE 1.** Treatment and monitoring of patients positive for IgA/IgG anti-h-tTG/DGP antibodies.
Evaluation of Clinical Symptoms

The criteria for evaluating clinical manifestations was based on 4 symptoms: abdominal pain; abdominal discomfort (eg, bloating, abnormal stress sense); change in bowel habits; change in bowel traits. The severity score for each symptom was evaluated as: 0, asymptomatic; 1, mild (no influence on daily life or sleep); 2, moderate (obvious symptoms with mild limitation of daily life); 3, severe (symptoms significantly affect the daily life). The clinical symptoms were assessed before and after GFD therapy and the total score (0–12) was calculated according to the above rating standard.

Statistical Analysis

The overall prevalence was reported using relative frequencies and percentages with the corresponding 95% confidence interval (95% CI) on the basis of the binomial distribution. Mean, standard deviations (SD), or median and range were used as continuous statistics while evaluating using Student t test. Frequency differences were compared using Fisher exact test. Statistical significance was established at the P value <0.05. All calculations were performed using SPSS for Windows, version 17.0 (SPSS, Inc, Chicago, IL). Figures were drawn using GRAPHPAD Prism 5.0 (GraphPad Software, Inc, San Diego, CA).

RESULTS

Serum IgA/IgG Anti-h-tTG/DGP Antibodies in IBS-D Patients and Healthy Controls

The values of cases positive for the IgA/IgG anti-h-tTG/DGP antibodies are shown in Table 1 and Supplemental Digital Content, http://links.lww.com/MD/A463 (see Figure, Supplemental Digital Content, http://links.lww.com/MD/A463 which illustrates the serum IgA/IgG anti-h-tTG/DGP antibodies as determined by ELISA in patients with IBS-D and healthy controls, in relation to sex). There was no significant difference between the values in males and females in both IBS-D patients and healthy controls. Seven (1.77%) IBS-D patients and 2 (0.55%) healthy controls were positive for IgA/IgG anti-h-tTG/DGP antibodies. However, this difference was not significant (1.77% vs. 0.55%, P = 0.41). Two IBS-D patients (No. 6 and No. 7) had relatively high titers (≥50 Units) compared with the other serologic screening test positive subjects.

Duodenal Biopsy and Histological Assessment

Table 1 shows features of the 9 IgA/IgG anti-h-tTG/DGP positive subjects. Of these, 5 subjects (No. 1, No. 4, No. 6, No. 7, and No.9) underwent upper endoscopy and duodenal biopsies for histological assessment and showed increased numbers (range: 47–61) of IELs per 100 epithelial cells. In addition, subject No. 1 had enlargement of the crypts (Marsh II; Figure 2A); subject No. 4 villous atrophy and cryptic hyperplasia (Marsh III; Figure 2B); subjects No. 6 and No. 7 villous atrophy and cryptic hyperplasia (Marsh III; Figures 2C and D), respectively; subject No. 9 enlargement of crypts (Marsh II; Figure 2E).

Change in the IgA/IgG Anti-h-tTG/DGP Antibody Levels and Clinical Responses in Positive Subjects Following Treatment With a Gluten-Free Diet

Among the 9 subjects positive for IgA/IgG anti-h-tTG/DGP antibodies, all except 1 (No. 3) who was lost to follow-up were advised to receive a GFD treatment. Of the 8 subjects, patients No. 1, No. 2, No. 5, No. 6, No. 7, and No. 8 strictly followed the GFD requirements for a median duration of 4.9 months, whereas patients No. 4 and No. 9 refused a GFD. The changes of serum IgA/IgG anti-h-tTG/DGP antibodies during follow-up in months in these 6 subjects with GFD and the other 2 without GFD are shown in Figure 3. The post-GFD clinical responses, as well as the categories of the patients’ compliance with the GFD, are demonstrated in Table 1. All the subjects refused to undergo upper endoscopy.

HLA-DQ Genotyping

HLA-DQA1 and DQB1 genotypes of all subjects except No. 2 were established (Table 2). Subject No. 8 was heterozygous for the CD-associated haplotype HLA-DQA1*05-DQB1*02 (DQ2.5cis). Subject No. 6 was homozygous and subject No. 7 was heterozygous for the haplotype HLA-DQA1*03-DQB1*03:03 (DQ9.3), and both were negative for the CD-associated DQ2.5 and DQ8 (HLA-DQA1*03-DQB1*03:02). Subject No. 4 was a heterozygous carrier of HLA-DQA1*02:01-DQB1*02 (DQ2.2). Subjects No. 1 and No. 9 were heterozygous for the haplotype HLA-DQA1*05-DQB1*03:01 (DQ7.5) containing only half of DQ2.5 (ie, HLA-DQA1*05) with subject No. 1 also containing half of DQ9.3 (ie, heterozygous for HLA-DQB1*0303). Subjects No. 3 and No. 5 did not carry any of these allelic combinations mentioned in either the cis or trans configuration.

Diagnosis of Patients With IBS-D and Healthy Controls

Of 9 serological positive subjects, 5 (No. 1, No. 4, No. 6, No. 7, and No. 9) presented with type II or type III intestinal histological lesions were considered to suffer from celiac disease. One subject (No. 8) from the healthy control group was considered to be a potential CD candidate, unfortunately the control did not accept the possibility of taking a biopsy of the small intestine. Two other subjects (No. 2, No. 5) were only suspected to have CD in the absence of histologic evidence. The last subject (No. 3) was lost to follow-up. Of note, 3 individuals in IBS-D group who were negative for anti-h-tTG/DGP IgA/IgG, complained of abdominal pain, diarrhea, bloating, or tenderness after the ingestion of gluten-containing food in the questionnaire and the medical record, but they did undergo neither gluten challenge nor GFD, neither skin prick tests/specific immunoglobulin E (SPTs/sIgE) nor histological examination; therefore, they were suspected to have gluten intolerance, either nongluten gluten sensitivity or wheat allergy. No other gluten-related findings were observed in the control group due to lack of further investigation.

DISCUSSION

The present study confirms that celiac disease exists in patients with IBS and healthy subjects in the Han Chinese population. With the traditional rice staple food gradually being replaced by Western-style food containing a high content of gluten, IgA deficiency in Chinese is much lower than in Western populations. We used the IgA/IgG human-tTG/DGP ELISA with a high sensitivity of 96.8%
TABLE 1. The Demographic and Clinical Features of IgA/IgG Anti-htTG/DGP Positive Patients and Healthy Controls and Post-GFD Serum Antibody Level and Clinical Assessments

| No. of Subject | Group | Age (Yr) | Sex | BMI (kg/m²) | Value of Anti-htTG / DGP (Units) | IELs per 100 Epithelial Cells | Marsh Histological Classification | Clinical Symptoms Scores | BMI (kg/m²) | Follow-up (mo) | Compliance Categories | Value of Anti-htTG / DGP (Units) | Clinical Symptoms Scores |
|----------------|-------|----------|----|-------------|----------------------------------|-----------------------------|--------------------------------|-------------------------------|-------------|-----------------|------------------------|--------------------------|------------------------|
| 1              | IBS-D | 39       | M  | 23.1        | 24.0                             | 48                          | Type II                        | 3                             | 24.9        | 6.0             | Strict adherent        | 19.8                     | 0                      |
| 2              | IBS-D | 21       | M  | 20.0        | 26.2                             | NA                          | NA                             | 7                             | 20.1        | 5.5             | Strict adherent        | 20.0                     | 3                      |
| 3              | IBS-D | 51       | F  | 23.8        | 49.7                             | NA                          | NA                             | 11                            | NA          | NA              | NA                     | NA                      | NA                     |
| 4              | IBS-D | 24       | M  | 20.3        | 21.4                             | 47                          | Type III                       | 5                             | 22.5        | 5.2             | NA                     | 21.4                     | 6                      |
| 5              | IBS-D | 68       | F  | 22.9        | 20.1                             | NA                          | NA                             | 5                             | 22.3        | 5.0             | Strict adherent        | 18.8                     | 2                      |
| 6              | IBS-D | 44       | M  | 23.2        | 52.2                             | 49                          | Type III                       | 4                             | 23.2        | 4.0             | Strict adherent        | 50.1                     | 1                      |
| 7              | IBS-D | 75       | M  | 20.2        | 52.9                             | 51                          | Type III                       | 9                             | 20.2        | 4.0             | Strict adherent        | 52.2                     | 7                      |
| 8              | HC    | 40       | M  | 22.8        | 24.6                             | NA                          | NA                             | 0                             | 24.3        | 4.5             | Strict adherent        | 21.0                     | 0                      |
| 9              | HC    | 35       | M  | 23.1        | 22.2                             | 61                          | Type II                        | 0                             | 24.8        | 5.2             | NA                     | 25.0                     | 0                      |

BMI = body mass index, F = female, GFD = gluten-free diet, HC = healthy control, IBS-D = diarrhea-predominant irritable bowel syndrome, IELs = intraepithelial lymphocytes, M = male, NA = not available.

1 Declined to undergo upper endoscopy.

3 Declined to undergo upper endoscopy.

Could not be reached for a follow-up small-bowel biopsy.
and a specificity of 100.0% with a cut-off level of 20 Units established in citizens from the United States. Although CD appears to be much less common than in Western countries, the serum IgA/IgG anti-htTG/DGP antibody values showed statistical differences between the IBS-D group and the healthy control group ($8.19 \pm 2.36$ vs. $6.75 \pm 3.11$, $P = 0.0001$). Of note, using the same composite antigen ELISA, Sugai et al detected much higher antibody titers in Caucasian CD patients. The total amount of wheat in the Chinese diet is probably much less than in other countries. Unfortunately, we have not quantified and registered the age of introduction of gluten intake in our subjects. However, we think that these values do not affect the diagnosis of CD, particularly when the other diagnostic criteria such as duodenal biopsy specimen’s histological assessment, clinical symptoms, and the response to GFD were observed. Among the 9 individuals suspected of having CD on the ground of histological biopsy abnormalities, 2 of Table 1 (No. 4 and No. 9) were confirmed to have CD by FIGURE 2. Histological assessment of duodenal biopsies of subjects No. 1 (A), No. 4 (B), No. 6 (C), No. 7 (D) low ($\times 40$) and high ($\times 100$ magnification), and No. 9 (E) low ($\times 100$) and high ($\times 200$ magnification) are on the left and right respectively.
histology, 3 (No. 1, No. 6, and No. 7) were confirmed to have CD by both histology, 1 (No. 3) was lost to follow-up, and 3 (No. 2, No. 5, and No. 8) were suspected to have CD by response to GFD but without histological evidence.

Duodenum and jejunal biopsy assessments have been the gold standard diagnostic test for CD during the last 30 years. An increase in the number of IELs is the first and most sensitive index of the effects of CD.\(^{29}\) In the present study, 5 seropositive subjects agreed to undergo upper endoscopy and to have duodenal mucosa biopsies taken. Histological lesions (Type II or Type III) marked the diagnosis of CD in all 5 cases.

We noted that in 1 healthy subject (No. 9) positive for anti-hTGG/DGP antibodies, the diagnostic duodenal biopsy histological assessment was Type II and this individual probably has CD but is asymptomatic. Indeed, it has been reported that although a broad spectrum of symptoms may be associated with untreated CD, many patients, especially those presenting in adulthood, have Marsh I histological abnormalities but often anemia and osteoporosis.\(^{30–32}\) Also, long-term observation indicates that the majority of these patients will eventually develop typical histological lesions of CD at some time.\(^{33}\) Thus, we suppose that the actual prevalence of CD in China may be possibly even higher than our finding and that silent cases may underestimate it as those individuals will not be screened.

DQ2.5, DQ8, and DQ9.3 in the General Population and the Study Population

The frequency of HLA-DRB1\(^*\)03, uniquely carrying the haplotype DQ2.5cis (HLA-DQA1*05-DQB1*02), is 4.1% in the Han population of Wuhan, Hubei province in accordance with a range between 3% and 5% on mainland China.\(^{34,35}\) Since the frequency of HLA-DQB1*02 in Han Chinese from Hubei is 10.7%, the frequency of DQ2.5trans (HLA-DQA1*05/DQB1*02) amounts 6.6%. Therefore, with a frequency between 4.1% and 10.7% DQ2.5 is common in the general population under study.\(^ {35}\) The frequency of HLA-DQB1*0302, mainly present in China on haplotypes with HLA-DRB1\(^*\)04-DQA1*03, is 6.2% in the Han population of Wuhan in accordance with a range between 4.5% and 5.6% in other regions of mainland China, HLA-DQA1*0302/DQB1*0302 is strongly associated with susceptibility to childhood-onset ocular myasthenia gravis in Southern Han Chinese.\(^ {36,37}\)

In our study, 1 out of 9 subjects (No. 8) was heterozygous for the CD-associated HLA-DQ2.5cis. No subject was positive
for HLA-DQ9. Subject No. 6 is homozygous for HLA-DQ9.3 (HLA-DQA1*03-DQB1*0303) and No.7 is heterozygous for HLA-DQ9.3. HLA-DQB1*0303 has a frequency of 18.4% in Hubei and is present on both DQ9.2 (HLA-DQA1*02-DQB1*0303) and DQ9.3 haplotypes. The frequency of HLA-DQ9.3 is high in mainland China, ranging from 13.8% to 21.9%. Islet autoantibodies are associated with HLA-DQ genotypes in Han Chinese patients with type 1 diabetes and their relatives. HLA-DQ9.3 carries aspartate at DQ α1 position predicted to bind DQ9.3 and DQ9.4 and to be associated with CD. Recently, a dominant DQ9-restricted gluten epitope (DQ8-glut-1) previously identified in DQ8-positive CD patients revealed a strong T-cell response and sustained strong binding to DQ9.3 demonstrating DQ9 is a susceptibility factor for CD.39 We also noticed that both subjects No. 6 and No. 7 had relatively high titers (52.2 and 52.9 Units, respectively) in the sensitive serologic screening test when compared with the other CD patients with levels just above the cut-off value of 20 Units. Thus, we hypothesize that in addition to a lower gluten intake variations in genetic background across different populations, such as the haplotype HLA-DQA1*03-DQB1*0303 (DQ9.3) (with a frequency less than 1% in American whites) determines a lower humoral response. HLA-DQ9.3 might very well be a new susceptibility factor for CD in China.

In our study, 5 subjects were finally diagnosed with CD and 3 were diagnosed as suspected CD. As for the HLA-DQ2.5/DQ8 status, subject No. 4 is associated with DQ2.2, subject’s No. 1 and No. 9 with DQ8.5, and both No. 3 and No. 5 patients have HLA status of DQ8.5, all of which obviously indicate to observe probably big differences in CD-associated genotype background between Central Han Chinese and white Caucasian patients. We noticed that in our research subject No. 8, who belongs to the healthy control group, is HLA-DQ2.5 positive, was without appearance of clinical symptoms, and had high antibody level that decreased after GFD. Thus very likely he has CD in an asymptomatic form and a close follow-up is indicated. There are some limitations in our study, such as the relatively small number of patients and controls and the selection covering 2 large referral centers in the Hubei Province. Moreover, 4 out of 9 seropositive individuals declined to undergo upper endoscopy and diagnostic biopsies taken and could therefore, at best, be diagnosed as suspected CD.

Interestingly, in response to the questionnaire of our study on CD, 3 of IBS-D patients who were negative for CD in the serological marker test reported intestinal and/or extraintestinal symptoms after ingestion of gluten containing food. This suggests that these patients were suffering from other gluten-related disorders, nonceliac gluten sensitivity, or wheat allergy. However, in our study neither double-blind, placebo-controlled gluten challenge nor SPTs/sIgE was performed, nor has the influence of “Fermentable Oligo-Di-Monosaccharides and Polyols” (FODMAPs) in their diets been studied. These aspects are certainly worth investigating in future studies with our patients.

Recently while this manuscript was in preparation Lu et al described a series of Asian, mainly Chinese, patients with IBS who were tested positive for IgA DGP, and improved on a gluten exclusion diet but without celiac disease. A recent study performed in Iran has demonstrated that many IBS patients are gluten-sensitive, and their symptoms could be adequately controlled with a gluten-free diet only. These authors suggest that gluten sensitivity should be investigated first, and then elimination of FODMAP might be considered in nonresponders for whom a gluten-free diet proves to be ineffective in controlling the symptoms. This approach is interesting to follow in future studies.

In conclusion, the prevalence of celiac disease in patients with IBS-D is 1.01% (4/395) and 0.28% (1/363) in the control group. The haplotype HLA-DQA1*03-DQB1*0303 (HLA-DQ9.3) is common in Chinese but has a low frequency in Caucasians, is probably a susceptibility factor for CD in China. Larger screening and genetic studies in different regions are needed to confirm this finding.

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