

## A PRELIMINARY STUDY ON THE POSSIBLE ASSOCIATION BETWEEN DENTAL ANXIETY AND DIGESTIVE MANIFESTATIONS IN HEALTHY JAPANESE INDIVIDUALS

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**Abstract:** *Background:* As highlighted in ROME IV, irritable bowel syndrome (IBS) is a multifactorial psychosocial disorder marked by the presence of several changes in intestinal transit. Not only is difficult for patients to perform daily practice but for health professional as well since there is still uncertainty regarding the measurement of these symptoms and effect of prescribed treatment. *Material and methods:* This is why the present study aimed to assess the incidence of gastrointestinal symptoms through the VAS-IBS questionnaire in healthy Japanese individuals. To establish if there is causation, we also applied a dental anxiety form. *Results:* Following the allocation of both VAS-IBS and dental anxiety questionnaires, we observed that there are no statistically significant differences between sexes in terms of anxiety perceived regarding dental procedures ( $p > 0.05$ ). On the other hand, we noted that males are more prone to physical symptoms than women, especially abdominal pain and diarrhoea ( $p < 0.05$ ; Tukey HSD and Bonferroni for "abdominal pain" ( $p = 0.0229$ ) and "diarrhoea" ( $p = 0.0181$ )). *Conclusions:* In this way, the present study brings additional evidence regarding the usefulness of these questionnaires in human patients regardless of their health status.

**Keywords:** IBS; ROME IV; anxiety; gastrointestinal deficiencies; VAS-IBS; dental anxiety

### 1. Introduction

Irritable bowel syndrome (IBS) has gradually become the most common functional gastrointestinal (GI) disorder (FGID). It is currently viewed as the main psycho-social burden of the 21st century. Consequently, the latest figures issued in this context indicate a prevalence between 11% and >20% worldwide, a trend that has constantly increased in recent decades.

Recent studies demonstrated a multifactorial substrate behind IBS's etiology, which is why ROME IV brought a new perspective. Precisely, IBS is recognized as a disturbance of the gut-brain axis (GBA) once the neurological component was incor-

porated within the current classification guideline.

There was a long debate concerning the brain's involvement in GI-related deficiencies triggering. Usually, IBS patients also suffer from distinct psychiatric comorbidities, anxiety being the first incriminated. Exploring this correlation is pivotal for future management strategies, but also to elucidate its pathophysiology. In this context, the recurrence risk for IBS and other associated comorbidities could be lower.

Although, several meta-analyses have been performed and aimed to assess the prevalence of anxiety in IBS patient. Unfortunately, none of the articles reunited by the authors were focused on how dental

manifestations, reflected by an elevated level of anxiety.

Dental interventions can elicit a lot of distress for the patient, inducing dental phobia or anxiety [10]. Further, under prolonged exposure it disrupts the integrity of the hypothalamic-pituitary-adrenal (HPA) axis and led to significant changes in the brain's chemistry [11]. As has been extensively discussed already by our team, there is an un-dereexplored connection between IBS and dental manifestations in correlation with psychiatric comorbidities.

Thus, the present study aims to establish the prevalence of GI abnormalities and dental anxiety in healthy individuals through two questionnaires dedicated to these parameters of interest.

## 2. Materials and Methods

### 2.1. Participants

A total of thirty-eight healthy volunteers (n = 19 female and their sex-matched counterparts n = 19 male) from Matsumoto Dental University, Shiojiri, Japan, aged between 11 and 81 years old (mean -  $40.92 \pm 18.50$  SD, IQR: 26.25), were enrolled in this study.

### 2.2. Questionnaires

Visual Analogue Scale for Irritable Bowel Syndrome (VAS-IBS) is a questionnaire developed and psychometric tested in 2007 by Bengtsson and co-authors aiming to assess the severity of gastrointestinal deficiencies in humans patients based on ten scales grouped on three dimensions. The response(s) range from 0-100 (0; nothing, 100 every day). Since then, another two articles have been published by the same team further validating the VAS-IBS and its use in clinical practice.

The second questionnaire was for dental anxiety and consisted of nine questions. Using as support the VAS-IBS

scores, participants were subsequently asked the degree of anxiety about Q1: reservation for dental treatment, Q2: at the entrance of the dental clinic, Q3: sitting on the dental chair, Q4: the explanation of treatment method, Q5: moving of dental chair, Q6: showing your mouth, Q7: getting dental anesthesia, Q8: sound to sharpen your teeth, Q9: feeling of vibration of the dental machine. The VAS have a response range of 0-100 (0: no anxiety, 100: anxiety).

### 2.3. Statistical analysis

We used Microsoft Excel 2010 for sorting, coding and editing of raw data. Subsequently, they were exported into Minitab 19 software (Minitab Inc., 2019). Statistical analyses performed were One-way Single Factor ANOVA and student's t-test followed by post-hoc analyses (Bonferroni and Tukey HSD) using IBM SPSS (v.26.0.0). F values for  $p < 0.05$  were considered statistically significant.

### 2.4. Ethical approval

This study was conducted in accordance with the Helsinki Declaration of Human Rights regarding Biomedical Research. Also is under the incidence of both National and European regulation. This research was approved by the Ethics Committee of Matsumoto Dental University, Shiojiri, Japan, with the approval number 0278 from 28 February 2019.

## 3. Results

Following the centralization of participant's answers and analysis of data (Figure 1), we observed that men are more prone to Physical Symptoms ( $p < 0.05$ ) in contrast with their sex-matched counterparts as indicated through VAS-IBS' scores in Q1 ( $p = 0.009$ ), Q2 ( $p = 0.009$ ) and Q5 ( $p = 0.046$ ). However, there were no significant differences among other parameters such as Q3 ( $p = 0.4974$ ), Q4 ( $p = 0.7620$ ). Analogous

observations have been made for “Emotional Status” criteria within there were no statistically significant differences among Q6 ( $p = 0.1685$ ), and Q7 ( $p = 0.0962$ ). As expected, the post-hoc analyses performed through Tukey HSD and Bonferroni revealed that the only statistically significant differences were in Q1 ( $p = 0.0229$ ) and Q2 ( $p = 0.0181$ ) parameters. Our post-analyses

revealed no significant differences in Q5 (0.0941) despite that F p-value was  $< 0.05$ . The rest of the results attributed to “physical symptoms” criteria were: for Q3 ( $p = 0.2569$ ) and Q4 ( $p = 0.6940$  Tukey and  $p = 0.6825$  Bonferroni), The associated results following Tukey HSD and Bonferroni for “Emotional Status” were: for Q6 ( $p = 0.4053$ ), whereas for Q7 ( $p = 0.3326$ ).

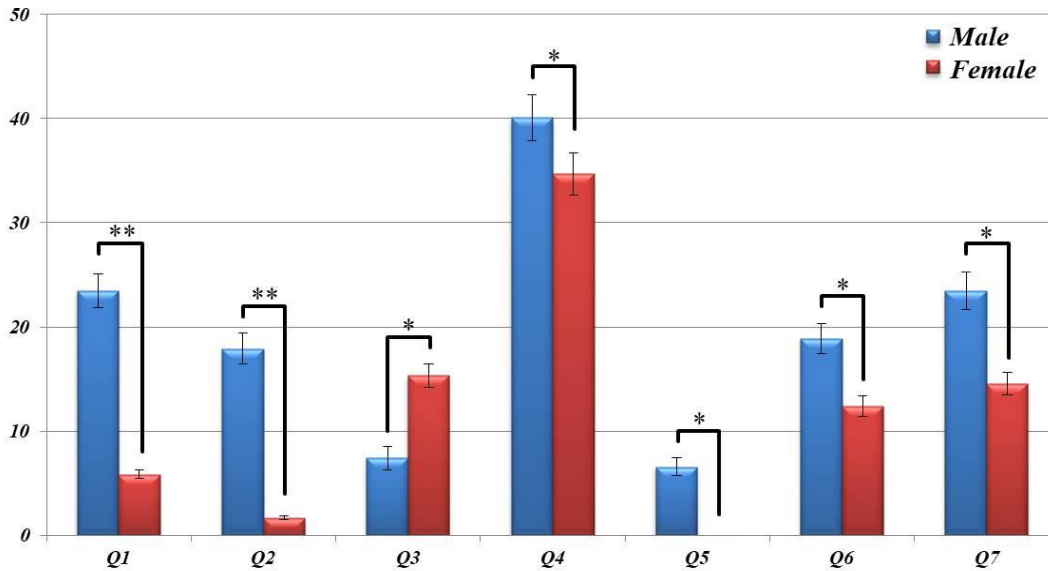


Figure 1. VAS-IBS scores obtained by the healthy individuals. The results are expressed as Mean  $\pm$  SEM ( $n = 19$  male and  $n = 19$  female, \*  $p > 0.05$ , \*\*  $p < 0.05$ ).

On the other hand, participant’s responses concerning the “Quality Of Life” (Figure 2) reflected by Q8, Q9 and Q10 were: at Q8,  $n = 1$  responded with “yes” (5.26%), while the rest  $n = 18$  with “no” (94.73%). For women,  $n = 4$  responded with “yes” (21.05%), and  $n = 15$  with “no” (78.94%). At Q9,  $n = 5$  had “yes” answers

(26.31%) for both sexes, whereas  $n = 14$  responded with “no” (73.68%) also for both sexes. Finally at Q10,  $n = 4$  responded with “yes” (21.05%), whereas  $n = 15$  with “no” (78.94%). For women,  $n = 1$  had responded with “yes” (5.26%) and  $n = 17$  with “no” (89.47%).

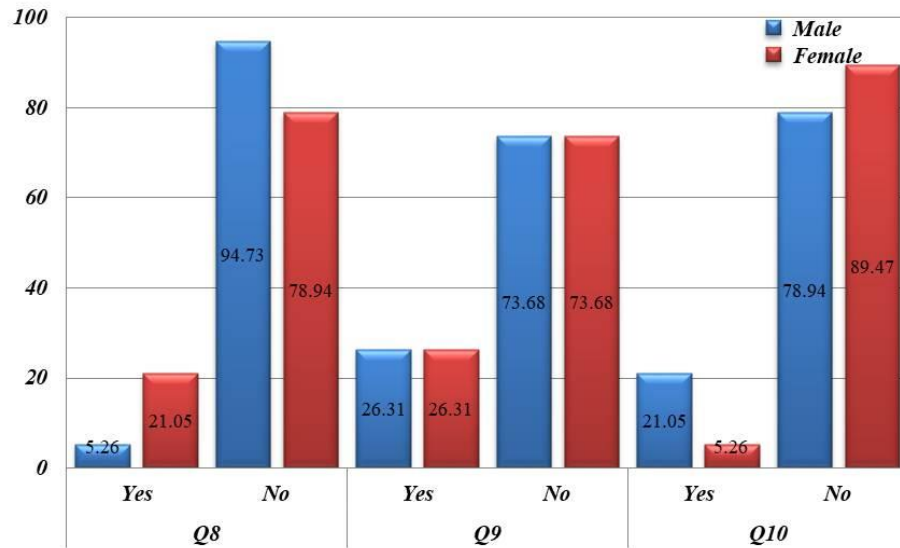


Figure 2. VAS-IBS scores obtained by the healthy individuals. Results are expressed as percent-ages (n = 19 male, and n = 19 female).

Unfortunately, there were no statistically significant differences between sexes among all questions that form the dental anxiety questionnaire ( $p > 0.05$ ). After we performed the post-hoc analyses - Tukey HSD and Bonferroni, we observed that there were also no significant changes between groups among all nine parameters. Precisely,

there were obtained the following results through Tukey HSD and Bonferroni; Q1 ( $p = 0.4792$ ), Q2 ( $p = 0.5876/0.5791$ ), Q3 ( $p = 0.3753$ ), Q4 ( $p = 0.5527/0.5468$ ), Q5 ( $p = 0.6269/0.6164$ ), Q6 ( $p = 0.3914$ ), Q7 ( $p = 0.0936$ ), Q8 ( $p = 0.3364$ ), and Q9 ( $p = 0.3363$ ) (Figure 3).

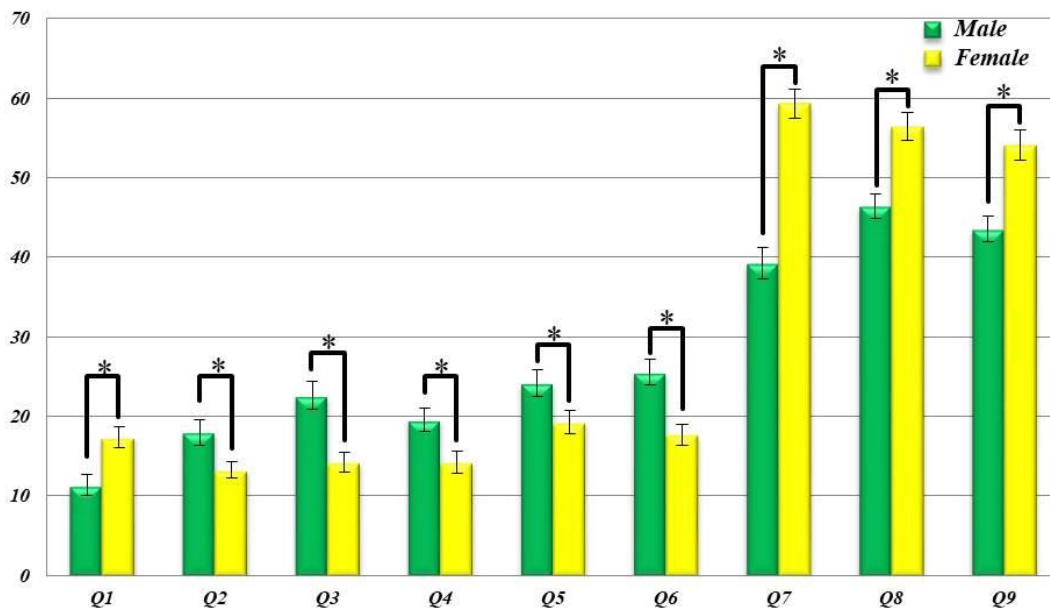


Figure 3. Dental anxiety scores obtained by the healthy individuals following the questionnaire completion (n = 19 male and n = 19 female; \*  $p > 0.05$ ).

#### 4. Discussion

The present knowledge regarding IBS, in parallel with the questionnaire used certify the existence of several changes that occurred when we compared by sex the healthy participants. As presented, there were significant differences between volunteers in terms of physical symptoms ( $p < 0.05$ ), reflected by “abdominal pain” ( $p = 0.009$  ANOVA,  $p = 0.0229$  Tukey HSD/Bonferroni) and “diarrhoea” ( $p = 0.009$  ANOVA,  $p = 0.0181$  Tukey HSD/Bonferroni). It should be also mentioned that VAS-IBS has been also successfully applied in other occasions to assess the gastrointestinal deficiencies in patients. In those cases, analogous results for “abdominal pain” ( $p < 0.001$ ) and “diarrhoea” ( $p = 0.021$ ) [17].

In another study performed by Bengtsson, the authors revealed a significant Spearman correlation (“abdominal pain”  $p = 0.489$  and “diarrhoea”  $p = 0.403$ ) and following Mann Whitney U test; for “abdominal pain”  $p = 0.000$  and “diarrhoea”  $p = 0.012$  [14,15], results which are congruent with our Romanian VAS-IBS form. The associated Cronbach alpha which is a measure of internal consistency was 0.863, this further highlighting a relative high consistency [18]. Subsequently, another team adopted the same principle and translated the VAS-IBS into Korean language [19]. The only possible explanation for differences among participants is the time of exposure to stress states and age.

Unfortunately, there were no statistically significant differences among individuals regarding dental anxiety ( $p > 0.05$ ) between sexes. AL Jasser et al., [20] made similar discoveries following their cross-sectional study in which were enrolled dental, medical and nursing students. From 224 participants, medical students were accounted for the most responses (40.6%), followed by nursing (31.7%) and dental

students (27.7%), Korpela et al., [21] revealing that students with clinical expertise or greater education had the most excellent or quite good knowledge ( $p < 0.001$ ). The same argument applies for novice and experienced dentistry students ( $p < 0.001$ ) [22]. This is again demonstrated in another article where dental students registered low scores ( $p < 0.001$ ) among all three faculties and within the same group investigated (junior vs senior dental student) [23]. However, local anesthesia injection was the most fearful procedure among students ( $p < 0.05$ ) despite their activity field [24]. (i.e. biology and psychology students ( $p < 0.001$ ) [22].

Zinke et al., [25] performed a cross-section study on 1549 adults and showed that anxiety, depression, and Global Severity Index (GSI) are more frequently noted in patients below the age of 46. Women were susceptible to anxiety and had higher scores on the Dental Anxiety Scale and GSI than their counterparts. Since it is already known that women are more prone to anxiety and depression than men, the study of Caltabiano et al., [16] demonstrated that women had higher scores following The Modified Dental Anxiety Scale (MDAS) ( $M = 11.93$ ) compared to men ( $M = 9.94$ ). Also, younger patients ( $M = 12.15$ ) registered higher scores than adults ( $M = 9.34$ ), being however noted a reduction in dental anxiety between pre- ( $M = 1.92$ ) and post-treatment ( $M = 1.23$ ). There are a plethora of variables that lead to dentist avoidance regardless of age; employment status, income ( $p < 0.001$ ), gender, education level, self-perceived oral health and history of visit ( $p < 0.05$ ) [26,27].

One incriminated reason for IBS occurrence is inflammation of intestinal mucosae and neuro-inflammation [28]. The presence of *Porphyromonas gingivalis* in the oral cavity was associated with the occurrence of periodontal disease, and recently has been demonstrated its involvement in Alzheimer’s disease

development [29]. Additionally, it has been theorized to be responsible for the onset of Parkinson's disease [30].

Therefore, it is possible that this imbalance between the oral microbiome and the gut microbiome to be a contributor factor in IBS pathophysiology, considering that psychological disorders are often correlated with this GI pathology [31].

Tosello and collaborators noted that subjects with natural teeth suffer from fewer GI pathologies. In contrast, an increased prevalence of GI manifestations are correlated with partially edentulous subjects [32].

It appears that this might be due to altered masticatory function, considering that masticatory function is connected to inflammation and infection of gastric mucosa. Accordingly, patients with severely impaired dental statuses correlate with increased inflammation and infection markers of gastric mucosa [33].

Evenmore, Carretero and his team is advocating that comminution capacity has a bigger influence in causing GI problems such as dyspepsia compared to lack of occlusal pairs [34]. Regardless, Esmailzadeh and co-authors demonstrates that losing 1-2 teeth correlates with IBS-C in men, while the presence of dentures associated positively with IBS-C diagnosis in women [35]. Although we did not register dental situation of our volunteers, as this represented a preliminary study, it will most certainly be part of our future recordings.

Mechanisms of the association between tooth loss and IBS are impaired masticatory function, psychological stress induced by tooth loss which comes with greater IBS risk, severe periodontitis is accompanied by active inflammatory response with highly possible risk to be sensitive or allergic to agents and have IBS [35].

Another factor that connects IBS with oral cavity is the reduced autonomic nervous activity in patients who are unable to masticate or swallow food, adverse effects being registered on gastric motor function and excretion function [36].

Patients with GI problems have increased levels of anxiety even if they do not fulfil criteria of any psychiatric diagnosis. For instance, IBS-D has increased prevalence of anxiety, but it is important to interpret with caution these results because they encompass small sample sizes [37].

## 5. Conclusions

As has been presented in this manuscript, the VAS-IBS questionnaire is a reliable tool for estimating gastrointestinal symptoms along with the degree of severity in individuals. Thus, we have noted differences between sexes in terms of physical symptoms reflected by their scores for abdominal pain and diarrhoea. Since correlation not always implies a causative substrate, how dental anxiety shapes a patient's perception as a potential trigger of IBS is not fully understood. This probably has to do with the degree of education, awareness and experience of the dentist.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved Ethics Committee of Matsumoto Dental University, Shiojiri, Japan, with the approval number 0278 from 28 February 2019.

**Informed Consent Statement:**  
Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The datasets used and analyzed during the current

study are available from the corresponding author upon reasonable request.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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