TITLE: Breath test results in IBS-D subjects are associated with differing bowel movement morphology detected by artificial intelligence

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ABSTRACT BODY:
Background: Irritable bowel syndrome (IBS) with diarrhea is characterized by diarrhea, abdominal pain and bloating. Breath testing appears to be abnormal in a significant subset with IBS-D and helps define the microbiome microtype. A recent study suggests that real time image capture of stool in IBS is more accurate than patient self-reporting of stool consistency. However, there has been no study examining the relationship between real time stool imaging and breath testing results in IBS. In this study, we aim to compare stool imaging results with finding on a three-gas breath test.

Methods: Subjects with IBS-D (Rome IV criteria) were recruited for a RCT and breath levels of hydrogen (H_2), methane (CH_4) and hydrogen sulfide (H_2S) were measured (Gemelli Biotech, Raleigh, NC). Positive testing for each gas was based on the North American Consensus and hydrogen sulfide was positive if any reading was ≥3ppm. Subjects were asked to capture an image of every stool for 14-day run in phase (baseline) using the Dieta app that is able to characterize, using artificial intelligence, five different stool variables, including consistency, Bristol stool score (BSS), edge fuzziness, fragmentation and volume. The statistical analysis was performed based on the repeated mixed model, as patients took a picture every time they had a bowel movement for 14 days.

Results: 41 subjects with IBS-D were included in the study (Female=39.0%, Age=44.7±14.4yrs, BMI=23.5±4.6kg/m^2). 10 subjects were negative for all three gases, 6 were positive only for H_2S (>3 ppm), 14 only positive for H_2, 4 positives for both H_2 and H_2S, and 7 of the total 41 subjects were CH_4 positive. Participants were grouped based on their breath test result. Subjects with CH_4+ had a significantly lower BSS (P=0.005) (Fig. 1A), edge fuzziness (P=0.018) (Fig. 1B) and fragmentation (P=0.031) (Fig. 1C) than CH_4- subjects. When subjects only positive for H_2 (n=14) and those only positive for H_2S (n=6) were compared, those H_2S+ had a higher stool volume than those that were positive for only H_2 (P=0.001) (Fig. 2A). Those individuals who were positive for H_2S (n=6) were also compared with those individuals who were negative for all three gases (n=10) and again a higher stool volume was observed in H_2S+ subjects (P=0.0002)

(Fig. 2B). Moreover, when subjects were separated in different H_2S levels, we observed that as H_2S levels increase the stool volume becomes more and more irregular (Fig. 2C).

Conclusions: Despite the enrollment of only IBS-D subjects, the presence of CH_4 is associated with less severe diarrhea than those without CH_4. Interestingly, in the CH_4 negative group (with more diarrhea severity), the presence of H_2S meant a greater volume of diarrhea was seen starting at levels ≥2ppm. This study adds to a growing literature regarding the role of breath testing and gut microtypes in IBS.
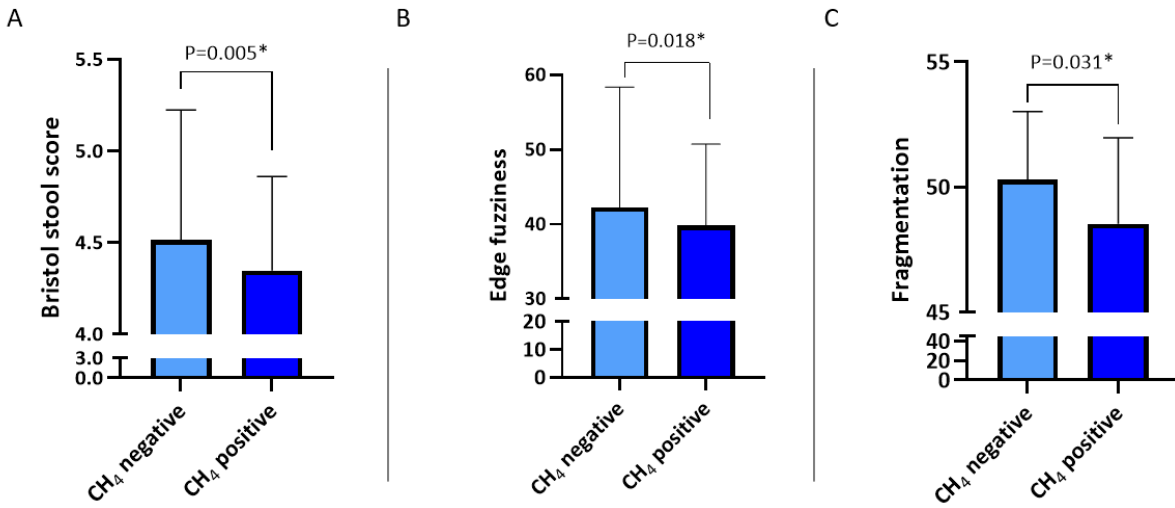
Figure 1. Comparison of different stool variables between CH4 negative and CH4 positive subjects. (A) Bristol stool score, (B) edge fuzziness and (C) stool fragmentation. * The statistical analysis was performed based on the repeated mixed model.
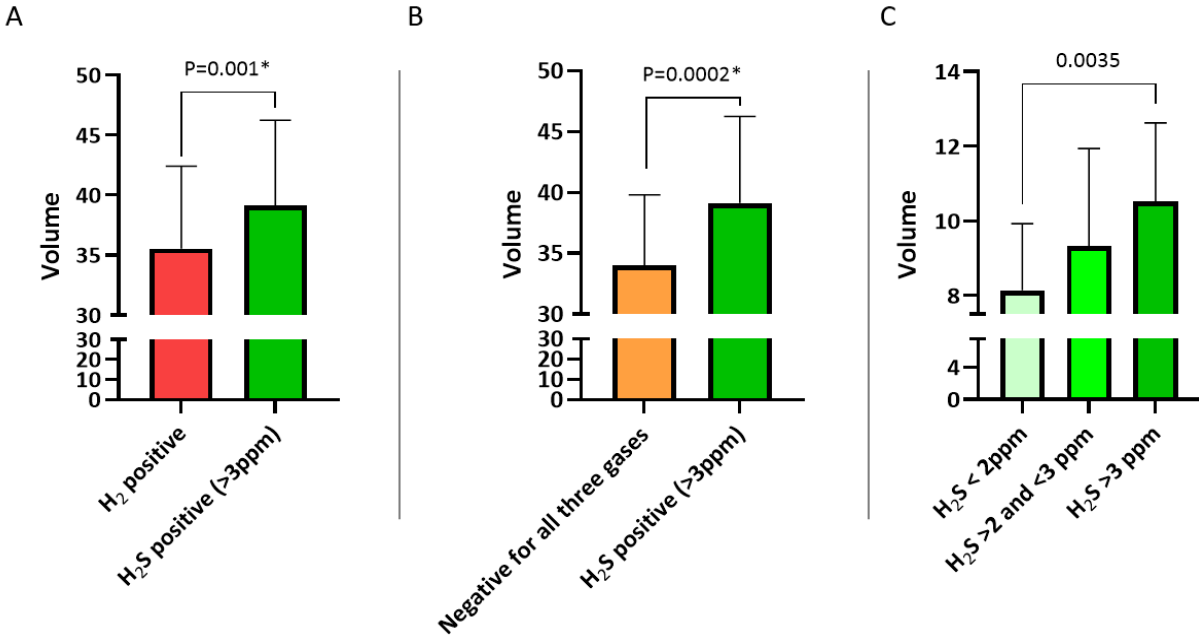
Figure 2. (A) Comparison of stool volume between subjects that are positive only for H_2 and those subjects who are positive only for H_2S (>3 ppm). (B) Comparison of stool volume between subjects that are negative for H2, H2S and CH4 and those who are positive for H_2S (>3 ppm). * The statistical analysis was performed based on the repeated mixed model. (C) Stool volume (standard deviation) was compared between subjects considering H_2S levels.