UNIVERSITY OF BIRMINGHAM University of Birmingham Research at Birmingham

Artificial intelligence-based personalized nutrition and prediction of irritable bowel syndrome patients

Acharjee, Animesh; Choudhury, Saptamita Paul

DOI: 10.1177/17562848221145612

License: Creative Commons: Attribution (CC BY)

Document Version Publisher's PDF, also known as Version of record

Citation for published version (Harvard):

Acharjee, A & Choudhury, SP 2022, 'Artificial intelligence-based personalized nutrition and prediction of irritable bowel syndrome patients', *Therapeutic Advances in Gastroenterology*. https://doi.org/10.1177/17562848221145612

Link to publication on Research at Birmingham portal

General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

•Users may freely distribute the URL that is used to identify this publication.

•Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.

•User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?) •Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.

Ther Adv Gastroenterol

2022, Vol. 15: 1–3

17562848221145612

© The Author(s), 2022. Article reuse guidelines: sagepub.com/journalspermissions

Animesh Acharjee 🕩 and Saptamita Paul Choudhury

syndrome patients

Artificial intelligence-based personalized

nutrition and prediction of irritable bowel

Chronic functional gastrointestinal disorder irritable bowel syndrome (IBS)1 has a detrimental effect on people's quality of life and access to healthcare. IBS is considered one of the most common intestinal discomforts and pains that pose a substantial risk to public health. IBS has complicated pathogenesis; however, the current research indicates that the gut microbiota may be crucial for the initiation, continuation and intensity of such problems.² According to one popular notion, an abnormality within gut microbiome causes stimulation of the intestinal immune response and possibly low-grade swelling.3-5 Another important information confirming this theory is an elevated probability of acquiring IBS following perturbations of the gut microbiome. Nevertheless, because of different and varying microbial patterns across individuals, identifying diagnostic biomarkers⁶ for IBS may be difficult. The other explanation for this disparity may be because the microbiome's variations hinder analysis process during intestinal bacterial research across time. As a result, a glimpse of cross-sectional study findings loses chronological precision and does not depict clinical aspects of IBS.7

With the recent development of next-generation sequencing, it has been shown that changes in the gut microbiome are linked to IBS. Observational studies have consistently demonstrated that the makeup of the gut microbiota changes in the context of IBS. Microbiomes such as *Proteobacteria* and *Streptococcus* levels in faeces and the gut mucosa were shown to be higher in abundance in several studies. Diet is becoming a more and more popular interventional strategy for treating IBS as it significantly affects the gut microbiome abundance. One effective dietary intervention for IBS is the low fermentable oligo-saccharides, disaccharides, monosaccharides and polyols diet.⁸

A very recent article by Karakan et al. (2022)9 reported an interesting study where they considered a total n = 25 baseline group of IBS patients, and the healthy controls (n=34) were compared in terms of their microbiota compositions. Out of n=25 patients, 6 weeks of a personalized nutrition diet (n=14) for group 1 and a standard IBS diet (n=11) for group 2 were followed and then compared. A schematic diagram is presented in Figure 1. The individualized nutrition model was developed by the artificial intelligence model called XGBoost (Extreme Gradient Boosting) and IBS index scores were produced. XGBoost is a technique for group learning. It might not always be enough to rely solely on a single machine learning model's output. A methodical approach to combining the prediction capacity of various learners is provided by ensemble learning. A single model that provides the combined output from multiple models is the final outcome. Due to ensemble technique, it improved speed and performance. The score distributions of IBS patients and healthy controls differ significantly (p=0.001), which suggests that the machinelearned IBS index is an important predictor of the disease. Personalized nutrition showed a statistically significant rise in the Faecalibacterium genus (p=0.04), whereas an increasing trend in Prevotella (p=0.057) was noted in the standard IBS diet group. In this analysis, researchers also found an elevation in Bacteroides within personalized nutrition cohort (p > 0.05). The elevation with in *Bacteroides* grouping may have influenced the IBS individuals' stress levels in the intervention group, improving their performance levels in the Irritable Bowel Syndrome Severity Scoring System test. Meydan et al. demonstrated that highly precise dietary therapies using prebiotics and probiotics directed by metagenomic research succeeded in clinical alleviation as well as related microbiome compositional alteration.¹⁰

Correspondence to: Animesh Acharjee

Institute of Cancer and Genomic Sciences and Centre for Computational Biology, College of Medical and Dental Sciences, University of Birmingham, Birmingham B15 2TT, UK

Institute of Translational Medicine, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK NIHR Surgical Reconstruction and Microbiology Research Centre, University Hospitals Birmingham, Birmingham, UK MRC Health Data Research UK (HDR UK), London, UK a.acharjee@bham.ac.uk

Saptamita Paul Choudhury

Department of Human Genetics, National Institute of Mental Health and Neurosciences, Bengaluru, India

journals.sagepub.com/home/tag



Creative Commons CC BY: This article is distributed under the terms of the Creative Commons Attribution 4.0 License (https://creativecommons.org/licenses/by/4.0/) which permits any use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).



Figure 1. The overall workflow of the entire process is represented as a schematic diagram.

There is currently no ideal or limited diet for treating IBS patients as IBS is a heterogeneous set of diseases and hence might reflect the changes in gut microbiome. The optimum diet likely to be specific for each individual patients. According to majority estimations, diets are a stronger predictor of individual differences in the makeup of the intestinal microbiome than genetics. This study could be the initial effort to achieve these treatment objectives in IBS patients based on diet intervention. This research also highlights the diagnostics⁶ and therapeutic impact of a customized diet on each person's gut flora and diseasespecific symptoms promoting personalized and translational research in IBS.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Author contribution(s)

Animesh Acharjee: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Writing – original draft; Writing – review & editing.

Saptamita Paul Choudhury: Data curation; Writing – original draft; Writing – review & editing.

Acknowledgements

None.

Funding

The authors disclosed receipt of the following financial support for the research, authorship and/ or publication of this article: The authors acknowledge support from the NIHR Birmingham SRMRC and the MRC Health Data Research UK (HDRUK/CFC/01), an initiative funded by UK Research and Innovation. The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research, the Medical Research Council or the Department of Health.

Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials Not applicable.

ORCID iD

Animesh Acharjee 0003-2735-7010

https://orcid.org/0000-

References

- 1. Ford AC, Sperber A, Corsetti M, *et al.* Irritable bowel syndrome. *Lancet* 2020; 396: 1675–1688.
- 2. Leshem AE, Segal E and Elinav E. The gut microbiome and individual-specific responses to diet. *mSystems* 2020; 5: e00665-20.
- 3. VanWagner LB, Serper M, Kang R, *et al.* Factors associated with major adverse cardiovascular events after liver transplantation among a national sample. *Am J Transplant* 2016; 16:2684–2694.
- Casén C, Vebø HC, Sekelja M, et al. Deviations in human gut microbiota: a novel diagnostic test for determining dysbiosis in patients with IBS or IBD. Aliment Pharmacol Ther 2015; 42: 71–83.
- Bennet SMP, Ohman L and Simren M. Gut microbiota as potential orchestrators of irritable bowel syndrome. *Gut Liver* 2015; 9: 318–331.
- 6. Acharjee A, Singh U, Choudhury SP, *et al.* The diagnostic potential and barriers of microbiome

based therapeutics. *Diagnosis (Berl)* 2022; 9: 411–420.

- Halvorson HA, Schlett CD and Riddle MS. Postinfectious irritable bowel syndrome-a metaanalysis. *Am J Gastroenterol* 2006; 101: 1894– 1899.
- Kim MY and Choi SW. Dietary modulation of gut microbiota for the relief of irritable bowel syndrome. *Nutr Res Pract* 2021; 15: 411–430.
- 9. Karakan T, Gundogdu A, Alagözlü H, *et al.* Artificial intelligence-based personalized diet: a pilot clinical study for irritable bowel syndrome. *Gut Microbes* 2022; 14: 2138672.
- Meydan C, Afshinnekoo E, Rickard N, et al. Improved gastrointestinal health for irritable bowel syndrome with metagenome-guided interventions. *Precis Clin Med* 2020; 3: 136–146.

Visit SAGE journals online journals.sagepub.com/ home/tag

SAGE journals