PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title page, p. 1 — systematic review identified.
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract, p. 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction, pp. 2–3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introduction, final paragraph, pp. 2–3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Study Selection and Data Extraction, pp. 4-5; Table 1 (PICOS). Imaging modalities synthesised in Results.
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Literature Search Strategy, p. 3; last search 1 November 2026; PubMed, Scopus, Ovid MEDLINE.
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Literature Search Strategy, p. 3; supplied search-strategy document (Supplementary Table S1).
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Study Selection and Data Extraction, pp. 4-5 (two independent reviewers; third reviewer if needed).
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Study Selection and Data Extraction, pp. 4-5 (two independent extractors).
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Study Selection and Data Extraction, pp. 4-5; imaging outcomes in Results, pp. 16–20.
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Study Selection and Data Extraction, pp. 4-5; Tables 2–3.
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Risk-of-Bias Assessment, p. 6; Supplementary Table S2 (SYRCLE); two independent reviewers.
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Data Preparation and Synthesis, p. 5; Qualitative synthesis based on reported between-group differences, direction of effects, statistical significance, and nonsignificant findings. No pooled or standardised effect estimates were calculated.
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	PICOS eligibility (Table 1, p. 5); grouped narrative findings by modality in Results, pp. 16–20.
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Data Preparation and Synthesis, p. 5; Extracted outcomes were organised by neuroimaging modality, brain region, and intervention characteristics. Original measurement units and reported statistical findings were retained; no data conversions or imputations of missing summary statistics were performed.
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Table 2 (pp. 8-11); Table 3 (pp. 14-15); Figure 2 (p. 7); Figure 3 (pp. 17-18); Results, pp. 16–20 (qualitative tabulation and narrative presentation).



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	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Methods: Data Preparation and Synthesis, p. 5; Results: modality-specific narrative synthesis (pp. 16–20). A structured narrative synthesis was conducted according to neuroimaging modality, HMO intervention characteristics, and reported outcomes. Meta-analysis was not performed because of substantial clinical and methodological heterogeneity across studies.
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Methodological difference of HMO intervened neuroimaging studies, pp. 12–13; descriptive comparison.
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Methods: Data Preparation and Synthesis, p. 5. No sensitivity analyses were conducted because of the limited number of eligible studies and substantial methodological and outcome heterogeneity.
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	No separate assessment of risk of bias due to missing synthesis results reported.
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	No formal certainty-of-evidence framework (e.g. GRADE) reported;
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Study selection, p. 6; Figure 1 cited: 797 identified, 322 duplicates, 475 screened, 82 full texts, 74 excluded, 8 included.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Study selection, p. 6. 74 studies were excluded because they lacked neuroimaging data (n = 41), did not involve an HMO-based intervention (n = 29), or use non-HMO prebiotics (n = 4).
Study characteristics	17	Cite each included study and present its characteristics.	Results, pp. 16–20; Table 2 (eight studies) and Table 3 (imaging methods).
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Risk-of-Bias Assessment, p. 7; Supplementary Table S2 (eight study-by-domain SYRCLE ratings).
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Results: Modality-specific neuroimaging findings (pp. 16–20); Table 2 (pp. 8-11). Principal statistically significant and nonsignificant neuroimaging outcomes are summarised descriptively. Comprehensive group-level statistics, effect estimates, and measures of precision are not consistently reported.
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Risk-of-Bias Assessment, p. 7; methodological characteristics, pp. 12–13; modality-specific Results, pp. 16–20.
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable to pooled statistical synthesis: no meta-analysis undertaken; narrative findings in Results, pp. 16–20.
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Methodological heterogeneity discussed descriptively, pp. 12–13.
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable. No sensitivity analyses were conducted; therefore, no sensitivity-analysis results are available to report.



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Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable; no synthesis-level assessment of reporting bias due to missing results was conducted. Study-level selective outcome reporting was assessed using SYRCLE's risk-of-bias tool (Supplementary Table S2), and the absence of a separate synthesis-level assessment is acknowledged in the Discussion.
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not assessed. No formal certainty-of-evidence ratings were performed. The limitations and consistency of the available preclinical neuroimaging evidence are discussed qualitatively in the Discussion (Methodological Limitations and Quality of Evidence).
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Interpretation of MRI/DTI/MWF/MRS findings and biological mechanisms, pp. 16–25.
	23b	Discuss any limitations of the evidence included in the review.	Risk-of-Bias Assessment (p. 7) and Methodological Limitations and Quality of Evidence (p. 12); Limitations of neuroimaging-based HMO research, pp. 26–27.
	23c	Discuss any limitations of the review processes used.	Limitations of review process, p. 27.
	23d	Discuss implications of the results for practice, policy, and future research.	Future Directions, pp. 27-28 (study design, imaging harmonisation and clinical translation).
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	The systematic review was not registered in a systematic review registry, p. 6.
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	No formal review protocol was prepared prior to conducting the review, p. 6.
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	No registered or published protocol amendments to report.
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding statement, p. 28;
Competing interests	26	Declare any competing interests of review authors.	Conflict of interest statement, p. 28.
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Data Availability Statement, p.28; Tables 2–3; Supplementary Tables S1–S2. Extracted study characteristics, neuroimaging findings, methodological details, database search strategies, and study-level risk-of-bias assessments are provided in the manuscript and supplementary materials. No meta-analysis or associated statistical code was generated.

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