Prebiotics and ‘Biotics’ Developments: An Ongoing Work in Progress

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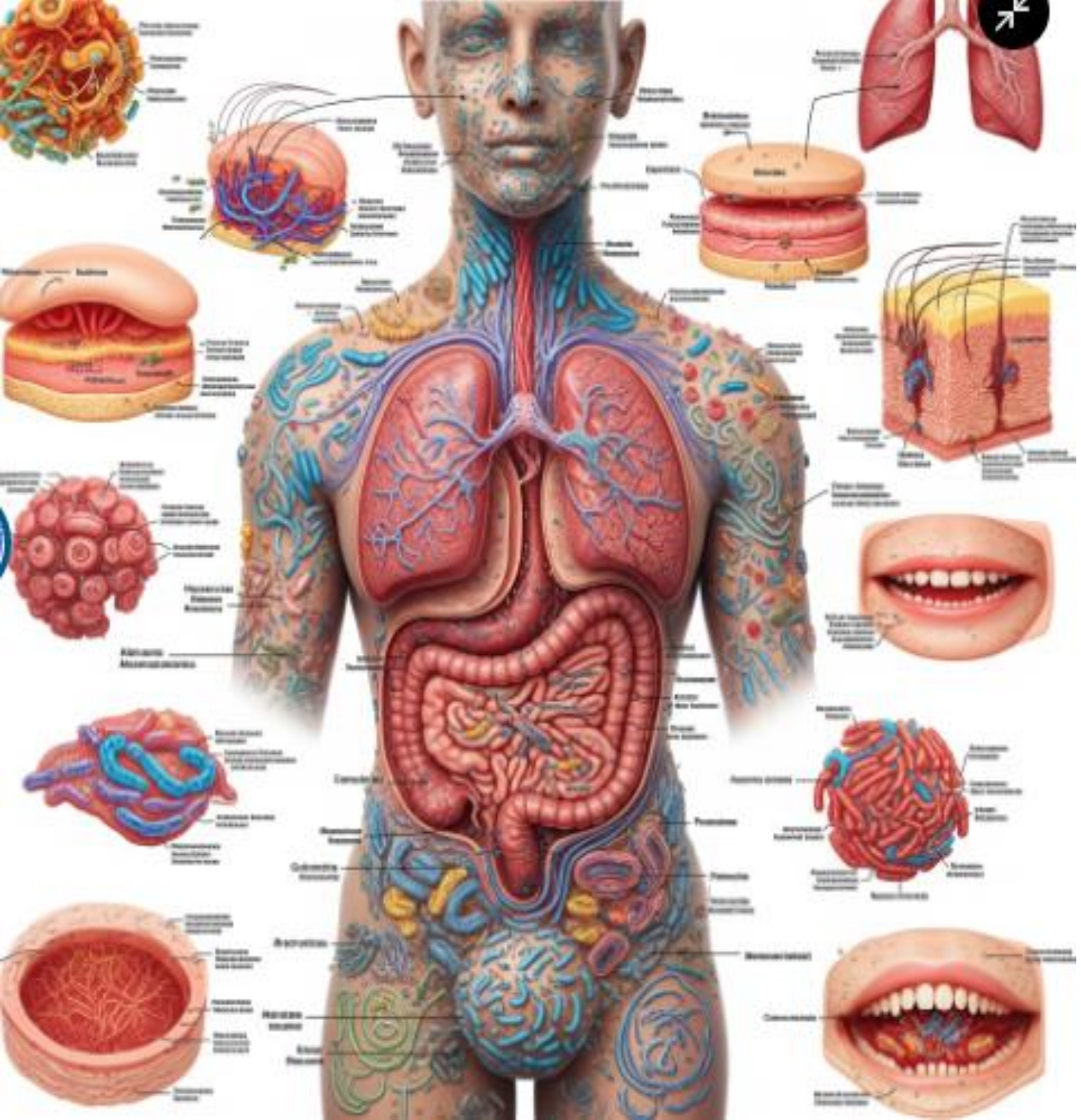
Agenda:

- The Microbiome and ‘Axes’ of Interest
- Overall Familiarity of Consumers with Biotics
- The Prebiotic Landscape
- Synbiotics
- Consumer Data on Pre and Probiotics



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The Human Microbiome:

- Microorganisms, such as bacteria, viruses, archaea, fungi, and protozoa, that live on and inside the human body.
- Different areas of the body have unique collections of microorganisms that perform important physiological functions, such as the gut microbiome, skin microbiome, and oral microbiome.
- An imbalance in the microbiome, known as dysbiosis, can lead to various diseased states and poor health.

CURRENTLY INVESTIGATED GUT-RELATED AXES:

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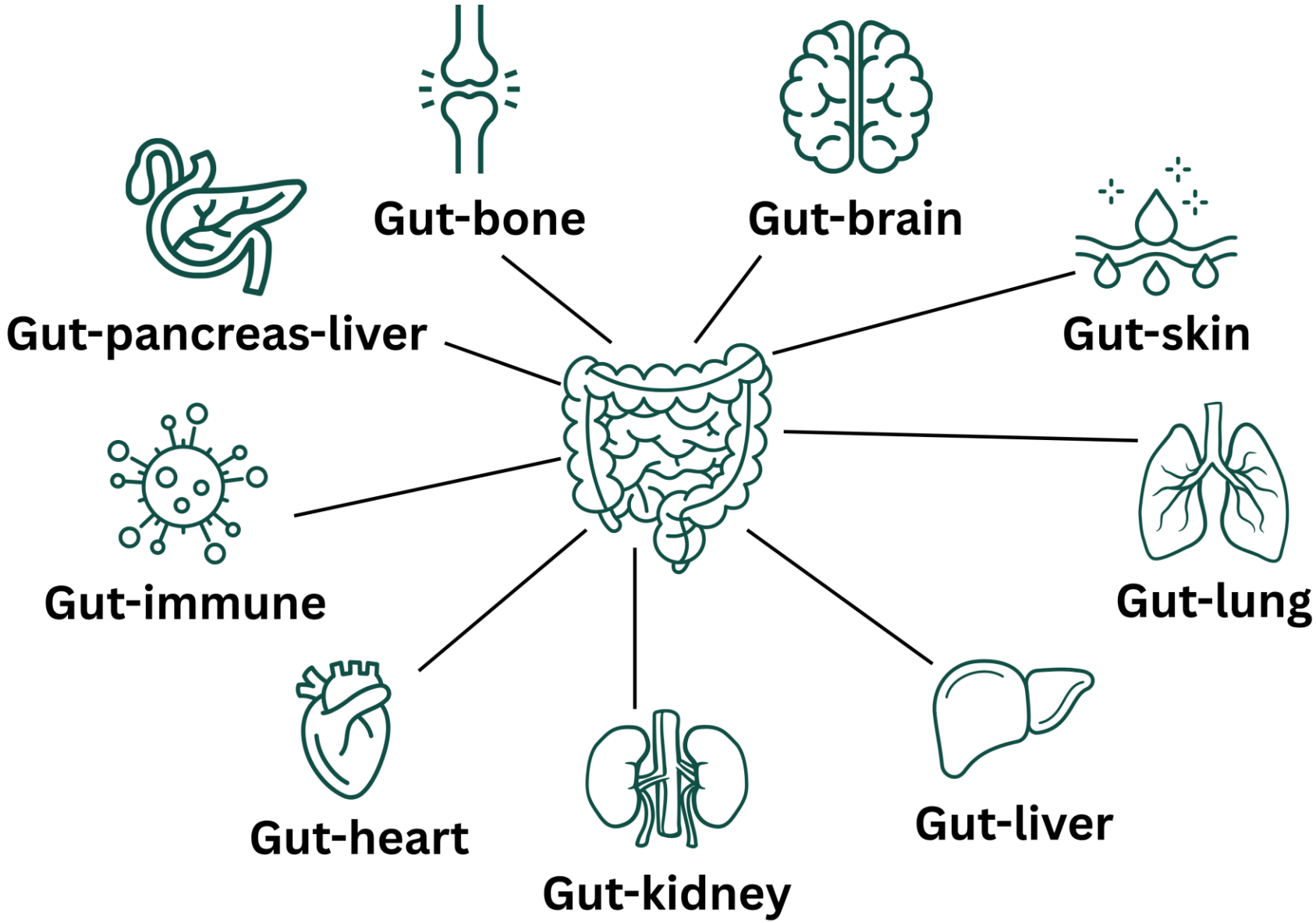


Additional proposed axes:

- Gut–muscle
- Gut–fat (adipose
- Gut–oral axes

WHAT IS A PREBIOTIC?

GLOBAL PREBIOTIC ASSOCIATION

GPA defines a prebiotic as "*A product or ingredient that is utilized by the microbiota producing a health or performance benefit.*"

A prebiotic effect is "*A health or performance benefit that arises from alteration of the composition and/or activity of the microbiota, as a direct or indirect result of the utilization of a specific and well-defined product or ingredient by microorganisms.*"

WHAT IS A PROBIOTIC?

The Food and Agriculture Organization (FAO) and World Health Organization (WHO) define probiotics as "live microorganisms which when administered in adequate amounts confer a health benefit on the host,"

WHAT IS A POSTBIOTIC?

According to the International Scientific Association of Probiotics and Prebiotics (ISAPP), a postbiotic is defined as 'a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host'.

- excludes metabolites such as SCFAs

OVERALL FAMILIARITY INGREDIENT CATEGORIES: COUNTRY

Key Insights:

- The vast majority of supplements surveyed have an overall familiarity level of 50% or more with most seeing overall familiarity levels of 75% or more.
- Prebiotics sit at 87% overall, behind melatonin and ahead of glucosamine. The global ranking is strongly influenced by Germany, where the term is prohibited.

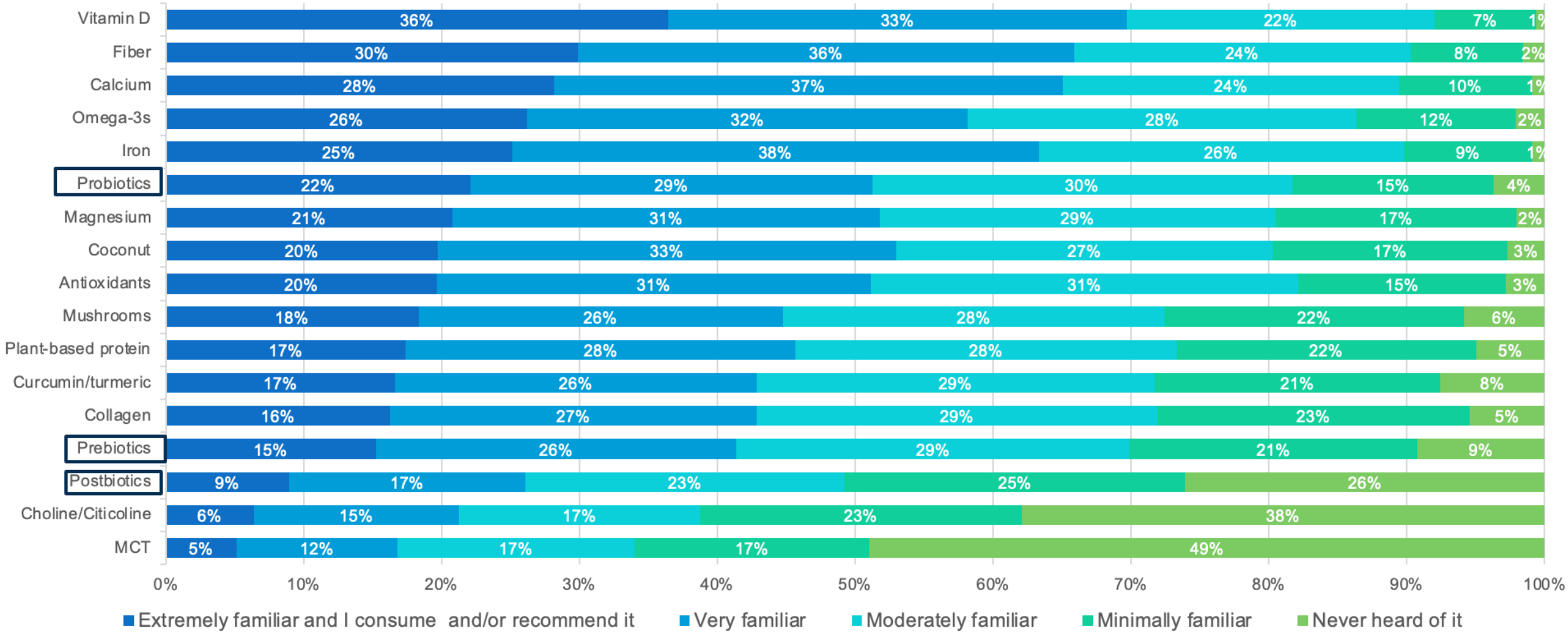
	All Respondents	US	UK	DE	IT	KR	AU	IN
Vitamin C	99%	99%	99%	99%	100%	99%	99%	100%
Multivitamin	99%	99%	99%	99%	99%	99%	99%	99%
Vitamin D	99%	99%	99%	99%	99%	98%	97%	100%
Calcium	99%	98%	98%	98%	99%	99%	98%	100%
Iron	99%	98%	99%	99%	99%	96%	98%	100%
Omega-3s	98%	97%	98%	97%	99%	98%	97%	98%
Magnesium	97%	96%	95%	99%	99%	97%	98%	97%
Probiotics	94%	96%	93%	85%	97%	96%	97%	94%
Antioxidants	94%	95%	95%	84%	97%	94%	95%	97%
Protein Powder	92%	94%	91%	89%	88%	93%	92%	99%
Collagen	91%	90%	92%	82%	94%	98%	91%	89%
Curcumin/ Turmeric	89%	87%	87%	86%	93%	85%	88%	96%
Melatonin	88%	93%	78%	88%	98%	87%	82%	85%
Prebiotics	85%	87%	80%	72%	84%	89%	85%	92%
Glucosamine	77%	82%	74%	55%	66%	94%	81%	85%
Biotin	73%	82%	55%	77%	62%	81%	54%	89%
Vitamin K2	72%	72%	63%	71%	77%	69%	59%	91%
Mushrooms	70%	76%	72%	44%	60%	66%	71%	95%
CBD	69%	88%	78%	72%	59%	40%	53%	73%
Postbiotics	61%	62%	55%	47%	55%	75%	49%	83%
Lutein	58%	57%	38%	45%	56%	94%	32%	80%
CoQ10	54%	66%	36%	55%	42%	57%	39%	67%
Glutathione	51%	45%	37%	36%	53%	80%	32%	80%
Synbiotics	50%	45%	48%	40%	45%	66%	32%	81%
Ashwagandha	49%	53%	34%	48%	29%	37%	44%	97%
Choline	48%	50%	39%	39%	46%	48%	35%	75%
MSM	47%	47%	40%	36%	40%	60%	31%	75%
Astaxanthin	43%	36%	30%	35%	36%	73%	23%	73%
Alpha-GPC	42%	41%	34%	31%	39%	47%	25%	77%
Citicoline	39%	38%	29%	32%	42%	39%	23%	74%
Nootropics	39%	39%	32%	30%	32%	44%	29%	69%

Note: All Respondents n=4198, US n=1061, UK n=526, DE n=525, IT n=526, KR n=533, AU n=508, IN n=519. Question: "How familiar would you consider yourself regarding the use of these supplements?" Sum of all responses except "Never heard of it"

FAMILIARITY

Key Insights:

- Vitamin D is the most familiar, whether measured as those extremely familiar or the combination of extremely and very familiar.
- Fiber is next up at 30% extremely familiar and an additional 36% as very familiar.
- From this list, MCT is clearly the least familiar, followed by choline/citicoline then postbiotics.



Note: US n=1001, UK n=1002, All Respondents n=2003. Question: "How familiar would you consider yourself regarding these functional ingredients in foods and/or beverages?" Sum of all responses except "never heard of it".

Most Commonly Known Prebiotics:

- Select Fiber (i.e., Acacia)
- Resistant Starch
- FOS
- GOS
- Inulin
- IMO
- HMO
- XOS
- Pectin
- Lactulose
- Whole Food Matrix
- Tagatose
- Glucan (i,e., Guar)
- Resistant Dextrin
- Polyphenols (select)*

*Select types found in both established and emerging categories

GPA is aware of new science to further validate established prebiotics as well as to support emerging and novel prebiotics.

GLOBAL PREBIOTIC ASSOCIATION

Prebiotic Verified Brands / Ingredients

OLIPOP

ASR GROUP

OLYRA

TAIYO

COMET

nexira
Innovation Inspired by Nature

ARRABINA®

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Volume 358, 15 June 2025, 123541

The mutual effect of dietary fiber and polyphenol on gut microbiota: Implications for the metabolic and microbial modulation and associated health benefits

Bo Cheng [a], Hongyan Feng [a], Cheng Li [b], Fei Jia [c], Xiaowei Zhang [a]

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https://doi.org/10.1016/j.carbpol.2025.123541

Abstract

Gut microbiota plays a critical role in maintaining human health by regulating digestion, metabolism, and immune function. Emerging research highlights the potential of dietary interventions, particularly dietary fiber (DF) and polyphenols, in modulating gut microbiota composition and function. DF serves as a fermentable substrate for beneficial gut bacteria, promoting the production of short-chain fatty acids (SCFAs). Polyphenols, a diverse group of bioactive compounds selectively modulate microbial populations and contribute to the production of bioactive metabolites with host health benefits. Importantly, the interplay between DF and polyphenols creates a synergistic effect within the gut microbiome, shaping microbial diversity, enhancing SCFAs production, and strengthening gut barrier function, which together support metabolic and immune homeostasis. This review systematically explores the synergistic effects of DF-polyphenol

Study: 20-week crossover trial with 37 adults

Intervention: Resistant starch (RS) vs. control starch

- **Findings**:
  - RS led to significant weight loss (2.81 kg)
  - Reduced fat mass and improved metabolic health
  - Altered gut microbiota, contributing to weight loss

Conclusion: RS promotes weight loss through gut microbiota changes

Limitations: Small sample size, short duration

Randomized Controlled Trial > Nat Metab. 2024 Mar;6(3):578-597.
doi: 10.1038/s42255-024-00988-y. Epub 2024 Feb 26.

Resistant starch intake facilitates weight loss in humans by reshaping the gut microbiota

Huating Li [#1,2,3], Lei Zhang [#4,5], Jun Li [#6,7], Qian Wu [#4,5], Lingling Qian [4,5], Junsheng He [6], Yueqiong Ni [4,7,8], Petia Kovatcheva-Datchary [9], Rui Yuan [10], Shuangbo Liu [10], Li Shen [11], Mingliang Zhang [4], Bin Sheng [12], Ping Li [13,14], Kang Kang [7], Liang Wu [4,5], Qichen Fang [4], Xiaoxue Long [4,5], Xiaolin Wang [15], Yanli Li [15], Yaorui Ye [15], Jianping Ye [4,16], Yuqian Bao [4], Yueliang Zhao [10,17], Guowang Xu [15], Xinyu Liu [18], Gianni Panagiotou [19,20,21,22], Aimin Xu [23,24], Weiping Jia [25]

Affiliations + expand

PMID: 38409604 PMCID: PMC10963277 DOI: 10.1038/s42255-024-00988-y

Abstract

Emerging evidence suggests that modulation of gut microbiota by dietary fibre may offer solutions for metabolic disorders. In a randomized placebo-controlled crossover design trial (ChiCTR-TTRCC-13003333) in 37 participants with overweight or obesity, we test whether resistant starch (RS) as a dietary supplement influences obesity-related outcomes. Here, we show that RS supplementation for 8 weeks can help to achieve weight loss (mean -2.8 kg) and improve insulin resistance in individuals with excess body weight. The benefits of RS are associated with changes in gut microbiota composition. Supplementation with Bifidobacterium adolescentis, a species that is markedly associated with the alleviation of obesity in the study participants, protects male mice from diet-induced obesity. Mechanistically, the RS-induced changes in the gut microbiota alter the bile acid profile, reduce inflammation by restoring the intestinal barrier and inhibit lipid absorption. We demonstrate that RS can facilitate weight loss at least partially through B. adolescentis and that the gut microbiota is essential for the action of RS.

Study: Meta-analysis of RCTs (up to May 2024)

Intervention: Prebiotics, probiotics, synbiotics

- **Key Findings**:
  - Reduced anxiety (4295 participants, p=0.0139)
  - Reduced depression (3179 participants, p=0.0335)
  - Improved cognitive function (915 participants)

Conclusion: Biotics improve mental health via gut microbiome

Limitations: Some inconsistent results, needs further research

Review > Brain Behav. 2025 Mar;15(3):e70401. doi: 10.1002/brb3.70401.

The Effect of Prebiotics and Probiotics on Levels of Depression, Anxiety, and Cognitive Function: A Meta-Analysis of Randomized Clinical Trials

Atefeh Zandifar [1 2 3], Rahim Badrfam [4 5 6], Mahdi Mohammaditabar [7 8], Bita Kargar [9], Saba Goodarzi [7], Amirhossein Hajialigol [8], Shera Ketabforoush [10], Afshin Heidari [11], Hanie Fathi [7], Arman Shafiee [7], Hadi Pourjafar [1]

Affiliations + expand

PMID: 40038860 PMCID: PMC11879892 DOI: 10.1002/brb3.70401

Abstract

Introduction: Recent studies have emphasized the relationship between mental health and the human intestine microbiota. In this study, we evaluate the effect of consuming Biotics, on levels of depression, anxiety, and cognitive function.

Methods: This meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards. We searched MEDLINE (PubMed), Cochrane Library, Scopus, Web of Science, and ClinicalTrials.gov. All full-text articles and major reviews were manually searched for additional studies.

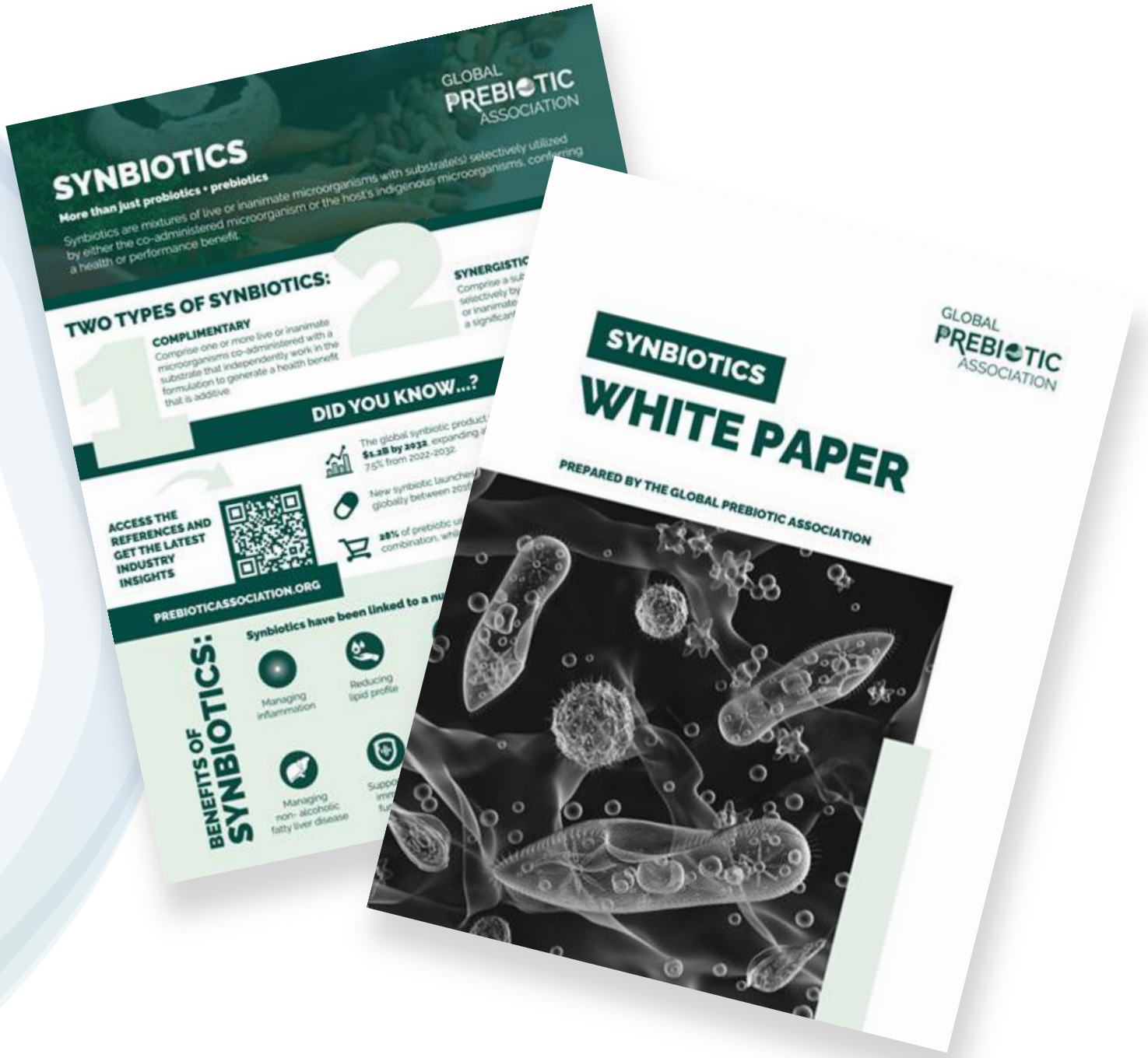
Results: The initial analysis was based on the concept that consuming Biotics causes changes in anxiety, measured using various instruments. This analysis showed that consuming Biotics significantly reduced anxiety in our study participants (SMD = 0.2894, Z = 2.46, P = 0.0139, I^2 = 92.4%). The meta-analysis included 4295 samples (2194 in the experimental group and 2101 in the control group). In terms of depression, the analysis showed that consuming Biotics significantly reduced depression in our study participants (SMD = 0.2942, Z = 2.13, P = 0.0335, I^2 = 91.7%). The meta-analysis included 3179 samples (1603 in the experimental group and 1576 in the control group). Regarding cognitive function, the analysis showed that consuming Biotics significantly improved cognitive function in our study participants (SMD = 0.4819, Z = 3.00, P = 0.0027, I^2 = 77.9%). The meta-analysis included 915 samples (470 in the experimental group and 445 in the control group).

Conclusions: Our results indicate that most recent studies support the effectiveness of probiotics in reducing symptoms of anxiety, depression, and cognitive issues despite some discrepancies in the findings. People with mild symptoms may experience greater benefits from taking probiotics.

WHAT ARE SYNBIOTICS?

COMPLIMENTARY:
Comprise one or more live or inanimate microorganisms co-administered with a substrate that independently work in the formulation to generate a health benefit that is additive.

SYNERGISTIC:
Comprise a substrate that is utilized selectively by the co-administered live or inanimate microorganisms, yielding a significant combined benefit.



Study: Meta-analysis of 20 RCTs (1271 participants)

Population: Women with PCOS

Interventions: Prebiotics and synbiotics (8-12 weeks)

- **Findings**:
  - Reduced BMI (high-quality evidence)
  - Improved weight, waist-to-hip ratio, triglycerides (medium-quality evidence

The Effect of Prebiotics, Alone or as Part of Synbiotics, on Cardiometabolic Parameters in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Elham Razmpoosh [1], Mala S Sivanandy [2], Alan M Ehrlich [3 4]

Affiliations + expand

PMID: 39857760 PMCID: PMC11760460 DOI: 10.3390/biomedicines13010177

Abstract

Background/Objectives: This systematic review and meta-analysis aimed to investigate the effect of prebiotics, alone or as part of synbiotics, on cardiometabolic parameters in polycystic ovary syndrome (PCOS) women. **Methods**: Databases, including PubMed, Scopus, ISI Web of Science, Embase, and the Cochrane Central Register of Controlled Trials, were searched for relevant randomized-controlled trials (RCTs) until 12 December 2024. Changes in mean ± standard deviations were extracted and combined using a random-effects model. Bias was assessed using Cochrane risk of bias and evidence quality with GRADE. **Results**: Twenty RCTs with 1271 participants were included. Results showed high-quality evidence supporting prebiotics' effects, alone or as part of synbiotics, in reducing body-mass index [n = 853; weighted-mean difference (WMD): -0.510, 95%CI: -0.669, -0.351 kg/m^2] and diastolic blood pressure (WMD: -2.218, 95%CI: -4.425, -0.010 mmHg), moderate-quality evidence for weight, waist-to-hip ratio, and triglycerides improvements, and low or very-low-quality evidence for waist circumference (WC), fat mass, fasting plasma glucose, fasting insulin, low-density lipoprotein (LDL), total cholesterol (TC), high sensitive-C reactive protein, total testosterone, follicle-stimulating hormone and free androgen index improvements. Subgroup analyses revealed possible reduction in LDL with prebiotics, as well as possible decreases in WC, TC, and total testosterone with synbiotics. Dietary approaches to stop hypertension diet improved insulin sensitivity. **Conclusions**: This study suggests that prebiotics may beneficially affect several cardiometabolic parameters in PCOS women. Approximately one-third of the results were based on moderate-to-high-quality evidence. This study highlights the need for future well-designed, larger RCTs with longer treatment duration to strengthen the evidence base and guide clinical decision-making.

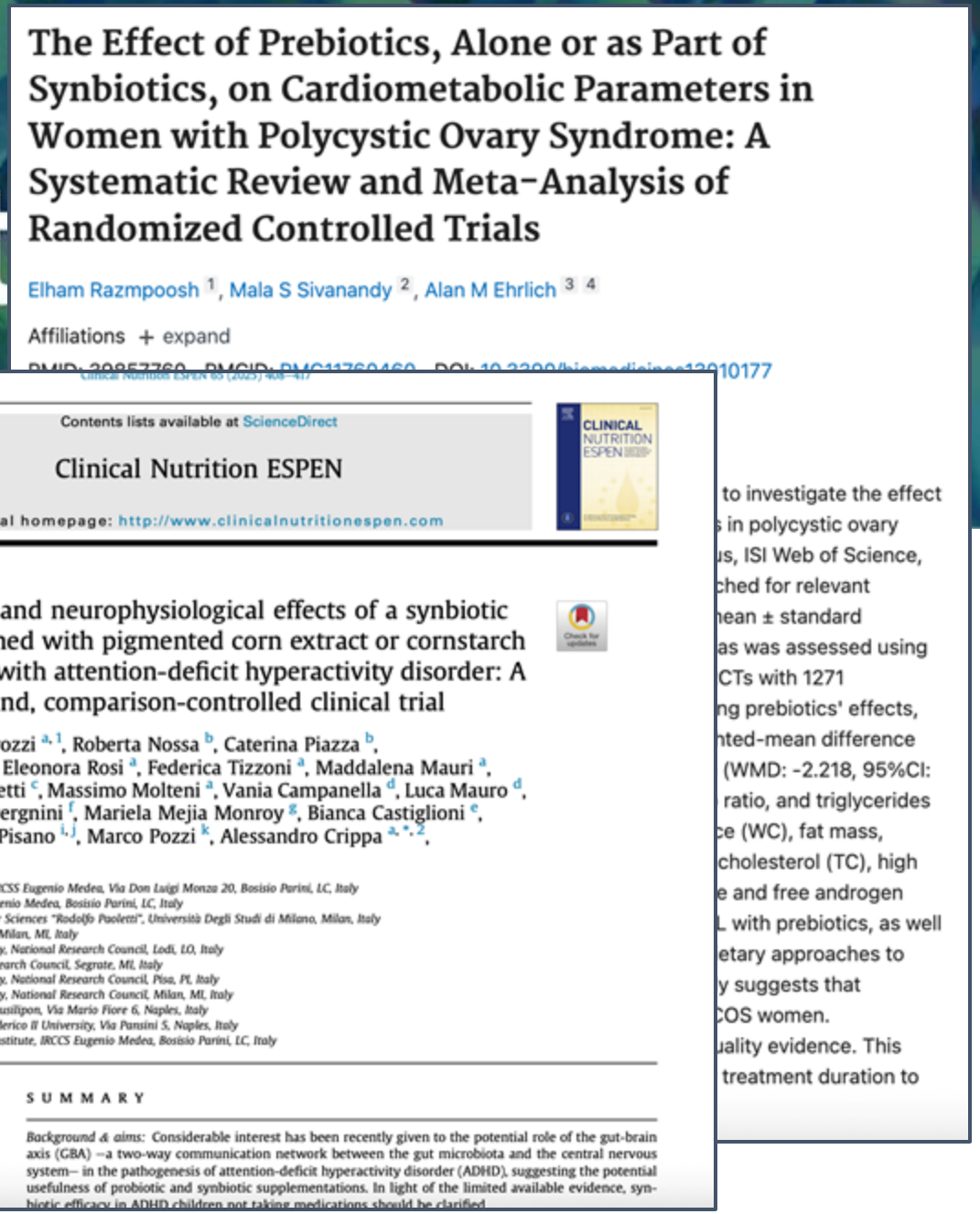
Study: 3-month randomized, double-blind trial (41 drug-naïve children, 6-16 years)

Intervention: Synbiotic mix with cornstarch vs. synbiotic with pigmented corn extract

- **Key Findings**:
  - Slight improvement in focused attention and brain response (cornstarch group)
  - No significant difference between groups
  - Synbiotics show promise for ADHD symptoms via gut-brain axis

Conclusion: Synbiotics may improve ADHD symptoms; fNIRS useful for monitoring

Limitations: Small sample size, no clear superiority of one mix



The Effect of Prebiotics, Alone or as Part of Synbiotics, on Cardiometabolic Parameters in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Elham Razmpoosh [1], Mala S Sivanandy [2], Alan M Ehrlich [3 4]

Affiliations + expand

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Randomized Controlled Trial

Behavioural, cognitive, and neurophysiological effects of a synbiotic supplementation enriched with pigmented corn extract or cornstarch in drug-naïve children with attention-deficit hyperactivity disorder: A randomised, double-blind, comparison-controlled clinical trial

Sara Trezzi [a,1], Gaia Scaccabarozzi [a,1], Roberta Nossa [b], Caterina Piazza [b], Alessandro Rodolfo Bianchi [a], Eleonora Rosi [a], Federica Tizzoni [a], Maddalena Mauri [a], Laura Camillo [a], Andrea Baragetti [c], Massimo Molteni [a], Vania Campanella [d], Luca Mauro [d], Paola Cremonesi [e], Marco Severgnini [f], Mariela Mejia Monroy [g], Bianca Castiglioni [e], Francesca Sparvoli [h], Simone Pisano [i,j], Marco Pozzi [k], Alessandro Crippa [a,*,2], Maria Nobile [a,2]

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Keywords:

SUMMARY

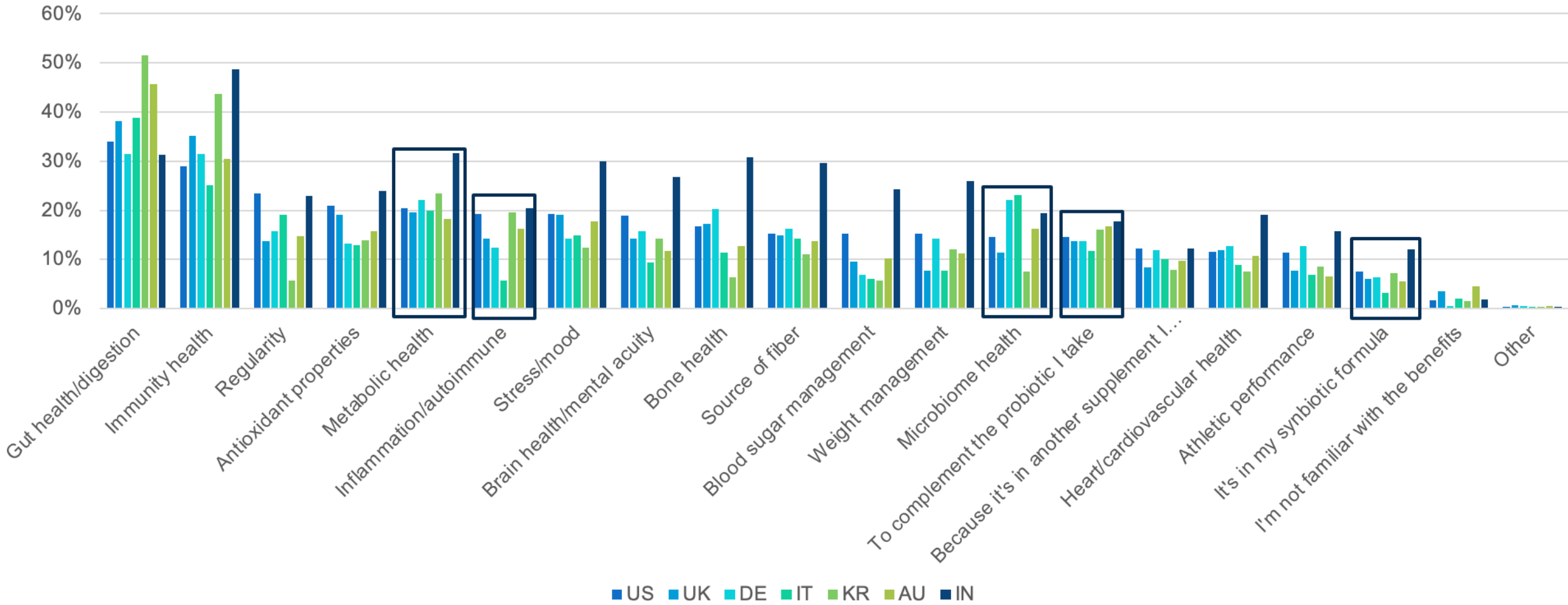
Background & aims: Considerable interest has been recently given to the potential role of the gut-brain axis (GBA) –a two-way communication network between the gut microbiota and the central nervous system– in the pathogenesis of attention-deficit hyperactivity disorder (ADHD), suggesting the potential usefulness of probiotic and synbiotic supplementations. In light of the limited available evidence, syn-biotic efficacy in ADHD children not taking medications should be clarified

PREBIOTIC: DEEP DIVE - SUPPLEMENTS

WHY DO THEY TAKE PREBIOTICS?

Key Insights:

- Gut health/digestion and immunity health are the top two responses by a decent margin, the former being the top response from all but Indian respondents who instead mark immunity number one.
- Indian respondents, as seen with most survey questions, tend to have some of the highest response rates.

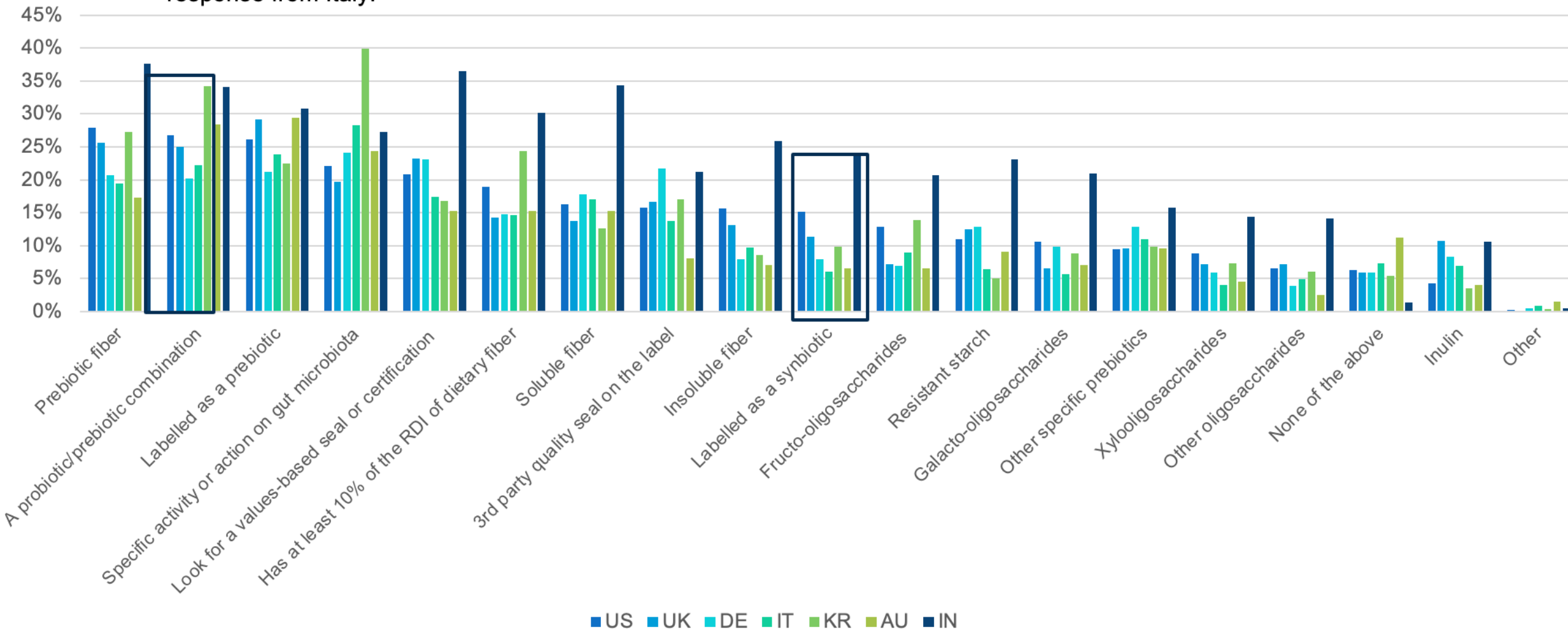


Note: US n=474, UK n=168, DE n=203, IT n=247, KR n=316, AU n=197, IN n=367. Question: "Why do you take a prebiotic supplement?"

IMPORTANT LABEL CHARACTERISTICS

Key Insights

- Responses are varied with a noticeable top 4 or 5 and as usual, Indian respondents over-indexing across the board.
- The top response is from Korean respondents for specific activity or action on gut microbiota at 40%; that is also the top response from Italy.

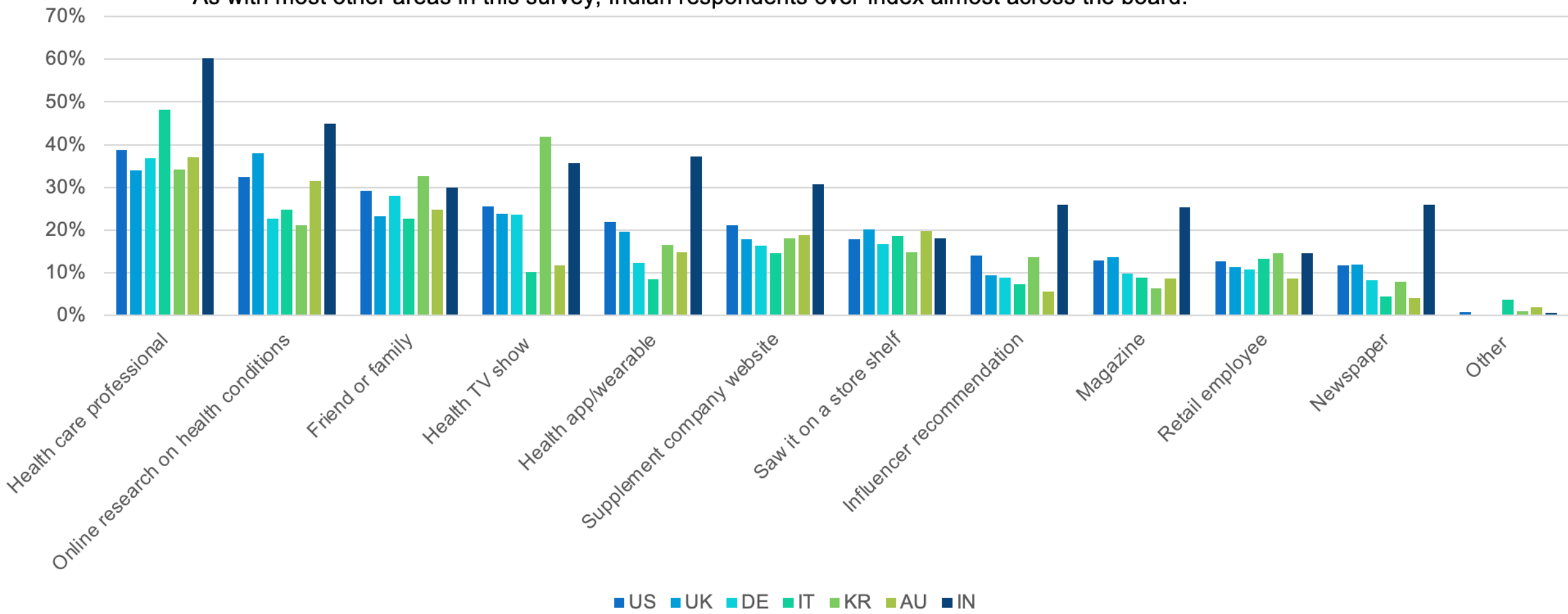


Note: US n=474, UK n=168, DE n=203, IT n=247, KR n=316, AU n=197, IN n=367. Question: "When you select what prebiotic to purchase, what characteristics do you look for on the label?"

SOURCE OF PREBIOTIC KNOWLEDGE

Key Insights:

- A health care professional is the number one response for all but the UK (online research on health conditions) and South Korea (health TV show).
- As with most other areas in this survey, Indian respondents over-index almost across the board.



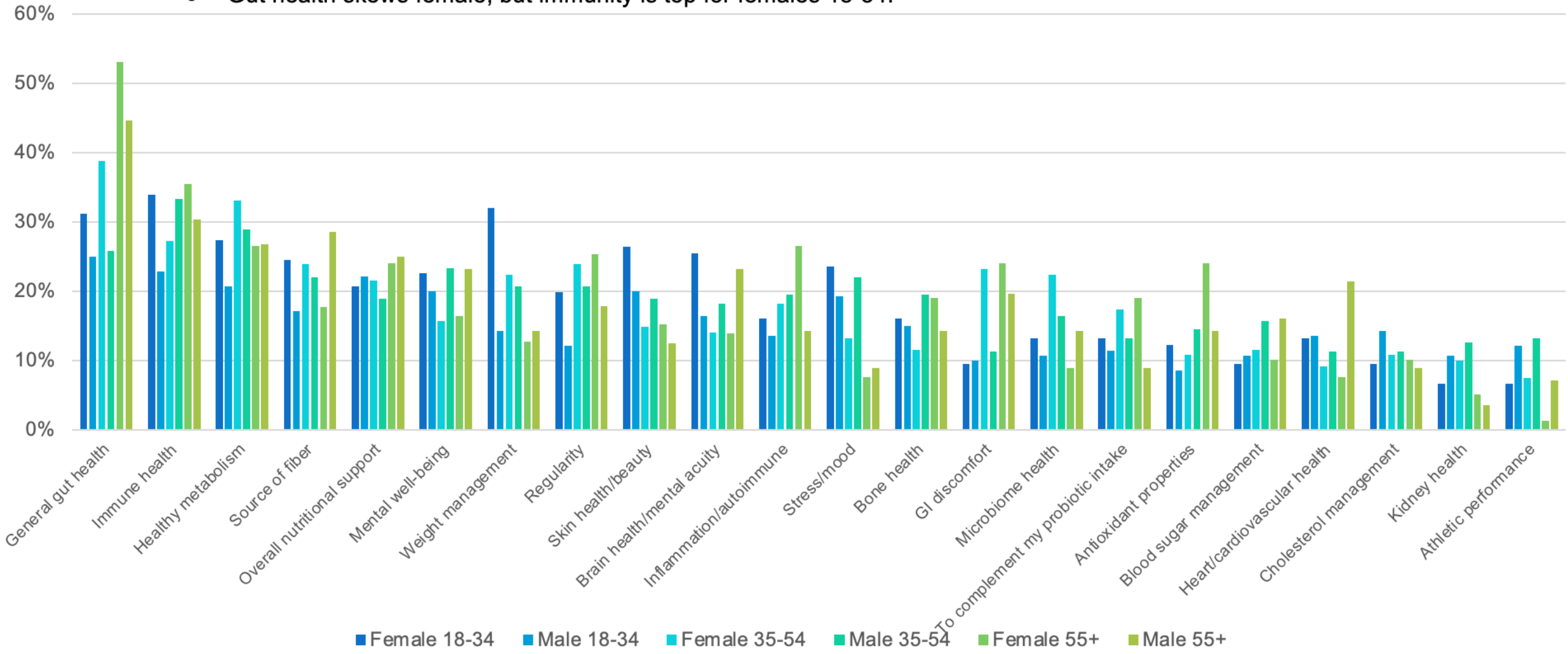
Note: US n=474, UK n=168, DE n=203, IT n=247, KR n=316, AU n=197, IN n=367. Question: "How did you learn about prebiotics?"

PREBIOTIC: DEEP DIVE – FUNCTIONAL FOODS & BEVERAGES

PREBIOTICS BENEFIT: US: AGE & GENDER

Key Insights:

- While general gut health is the primary benefit sought by most groups of functional food and beverage consumers, as in supplements, we see a diffusions of the benefits, into immunity, and then very quickly - metabolism.
- Source of fiber is fourth.
- Gut health skews female, but immunity is top for females 18-34.

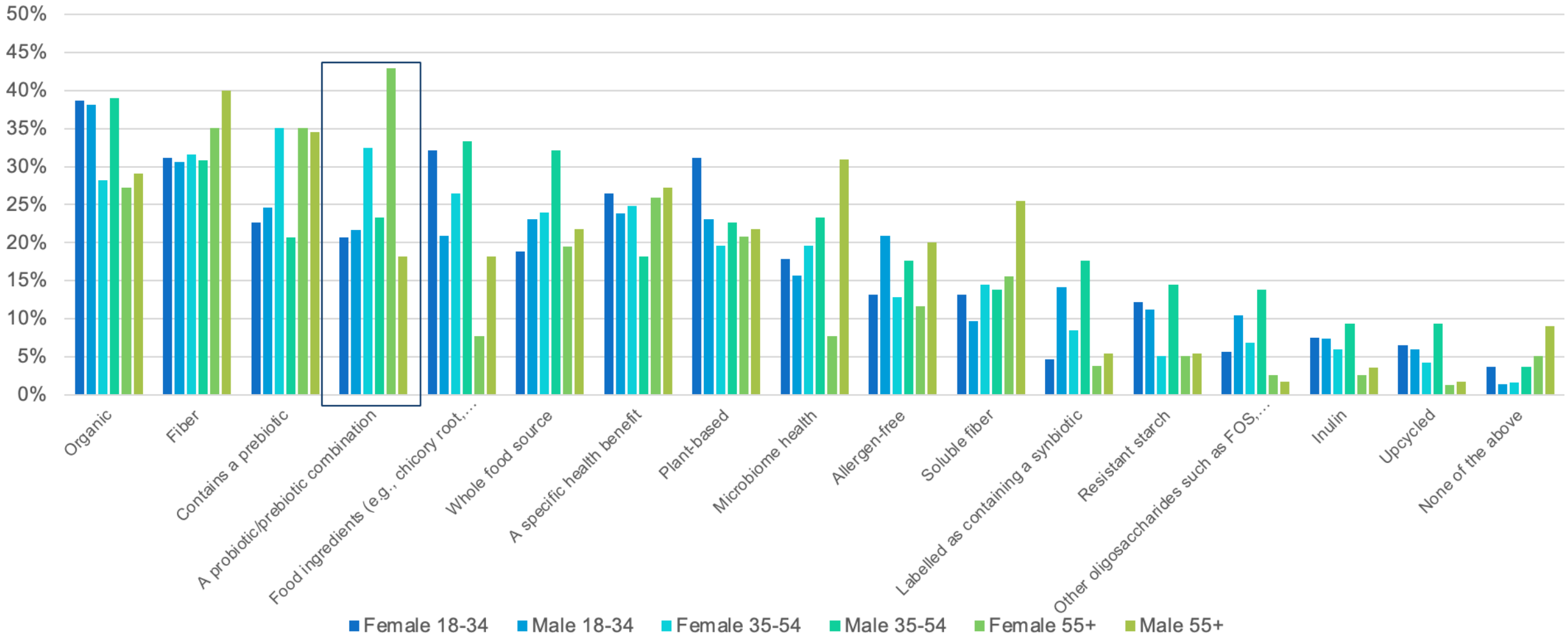


Note: All US Respondents n=661. Female 18-34 n=106, Male 18-34 n=140, Female 35-54 n=121, Male 35-54 n=159, Female 55+ n=79, Male 55+ n=56. Question: "What benefits are you looking for when you choose to consume foods/beverages that contain prebiotics?"

LABEL CHARACTERISTICS: US: AGE & GENDER

Key Insights:

- Organic as a label feature ranks high, especially among younger consumers. Fiber skews older.
- A combination ranks quite high, skewing female.



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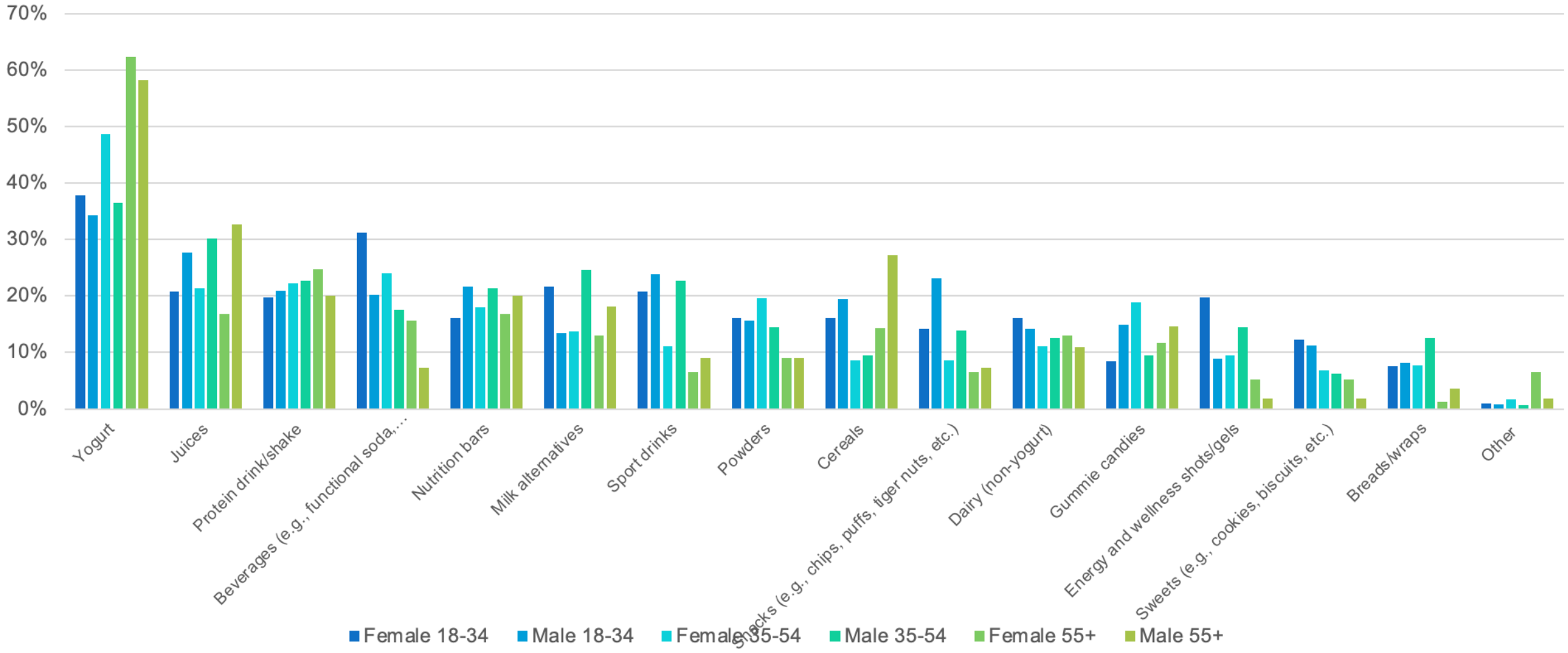
PREFERRED TYPES: US: AGE & GENDER

Key Insights:

- For food and beverage formats, the top response form all groups was yogurt, followed by juices for males.
- Females, especially younger ones, went with beverages as their second choice.



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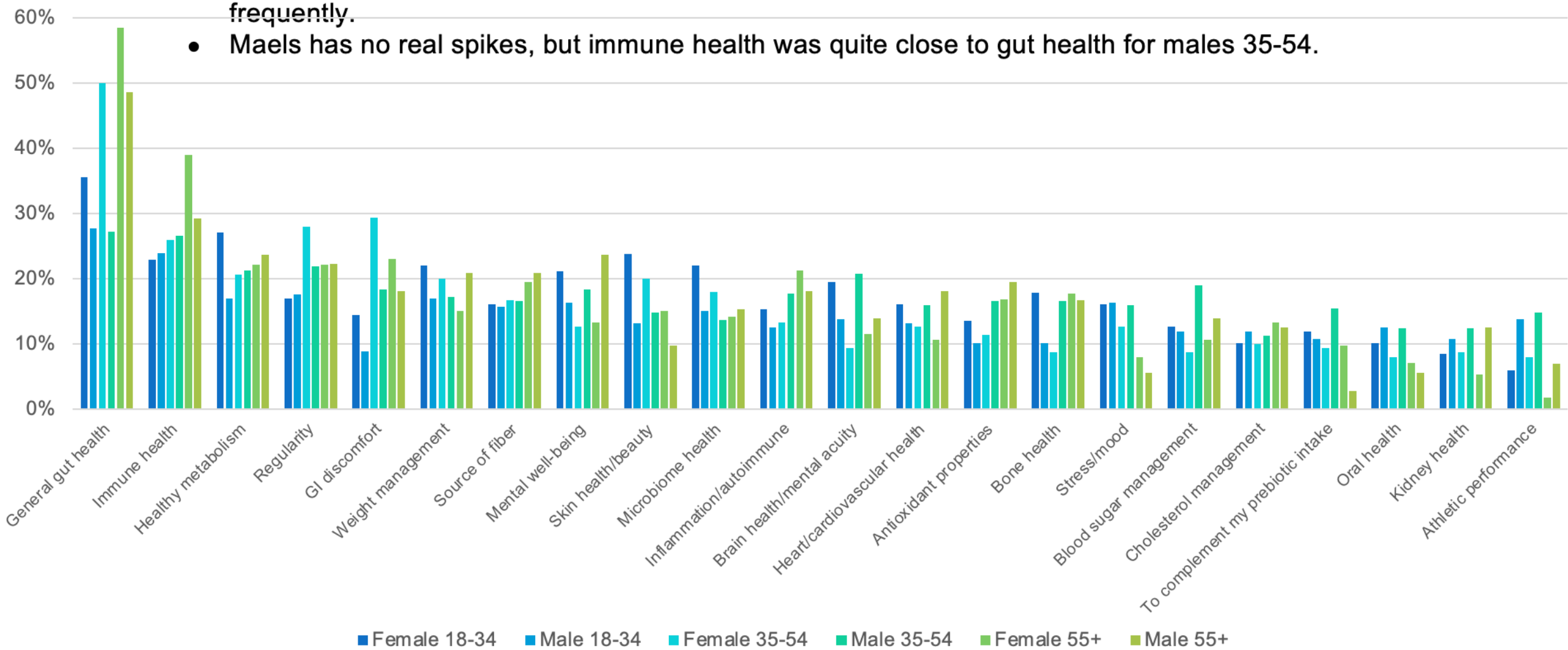
PROBIOTIC: DEEP DIVE – FUNCTIONAL FOODS & BEVERAGES

PROBIOTICS BENEFIT: AGE & GENDER, US

Key Insights:

- The main benefit sought for all groups but especially for females and males 55+ was general gut health.
- Females 55+ also ranked immune health highly, while females 35-54 chose regularity and GI discomfort frequently.
- Maels has no real spikes, but immune health was quite close to gut health for males 35-54.

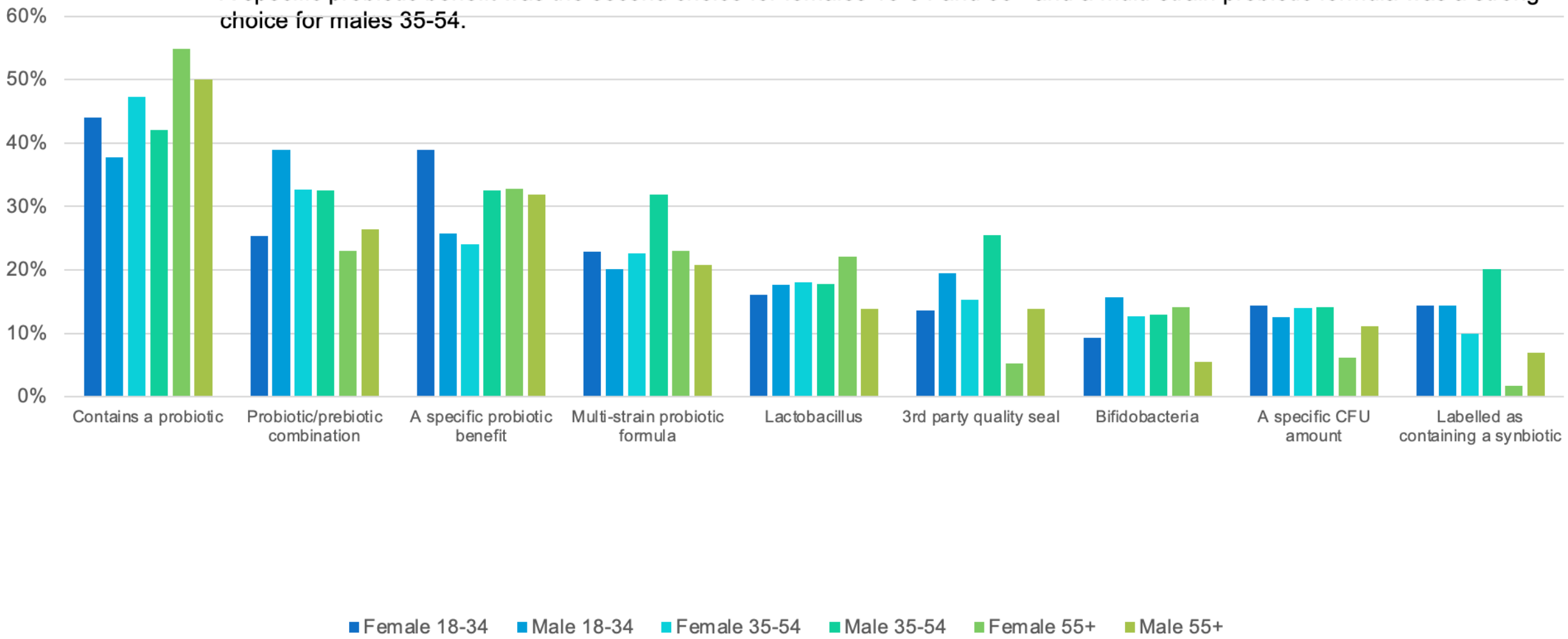


Note: All US Respondents n=781. Female 18-34 n=118, Male 18-34 n=159, Female 35-54 n=150, Male 35-54 n=169, Female 55+ n=113, Male 55+ n=72. Question: "What benefits are you looking for when you choose to consume foods/beverages that contain probiotics?"

LABEL CHARACTERISTICS: AGE & GENDER, US

Key Insights:

- For all groups except males 18-34, contains a probiotic was the top choice. For those males, the top selection was a probiotic/prebiotic combination.
- A specific probiotic benefit was the second choice for females 18-34 and 55+ and a multi-strain probiotic formula was a strong choice for males 35-54.

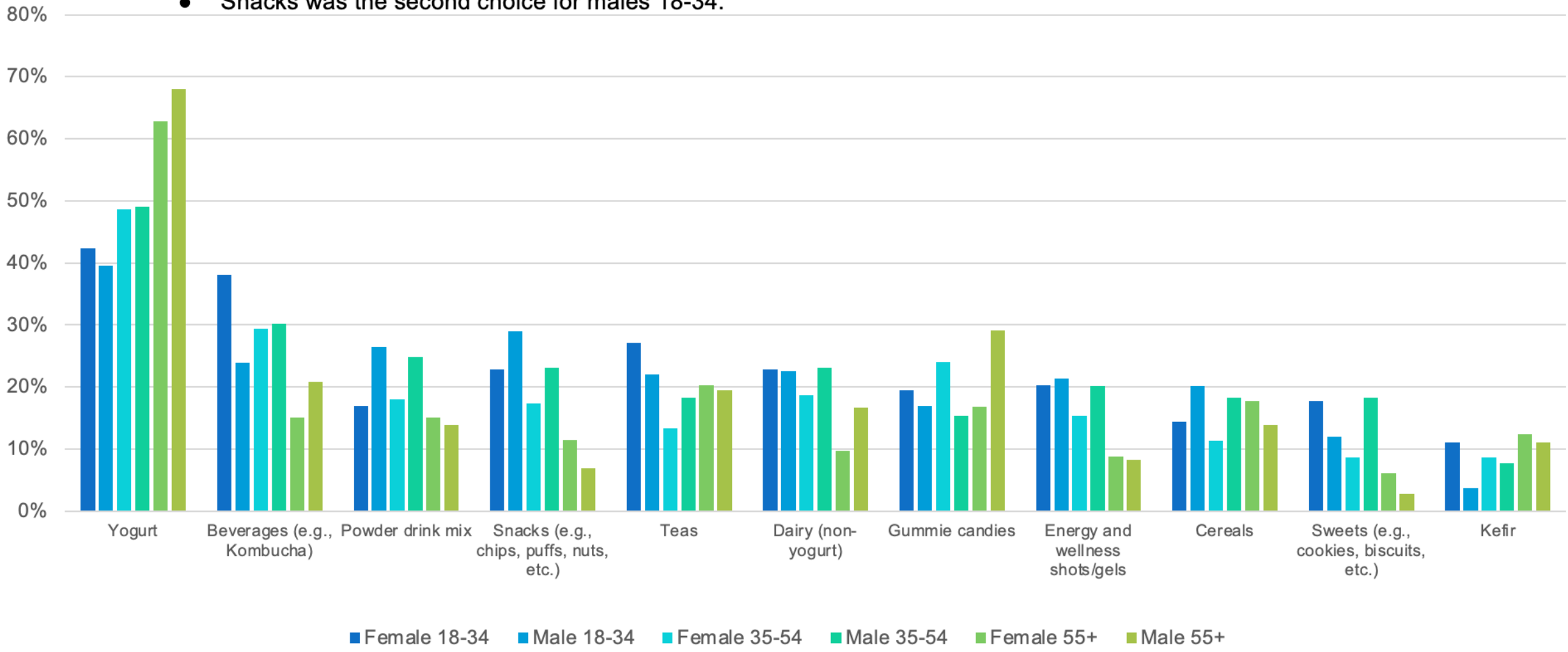


Note: All US Respondents n=781. Female 18-34 n=118, Male 18-34 n=159, Female 35-54 n=150, Male 35-54 n=169, Female 55+ n=113, Male 55+ n=72. Question: "What do you look for on the label when choosing a food or beverage containing probiotics?"

PREFERRED TYPES: AGE & GENDER, US

Key Insights:

- When it comes to food and beverage formats, yogurt was the top choice among all groups, with beverages second, especially for females 18-34 and 35-54 and males 35-54.
- Snacks was the second choice for males 18-34.



Note: All US Respondents n=781. Female 18-34 n=118, Male 18-34 n=159, Female 35-54 n=150, Male 35-54 n=169, Female 55+ n=113, Male 55+ n=72. Question: "What are your preferred types of functional foods/beverages with probiotics?"

GLOBAL PREBIOTIC ASSOCIATION

QUESTIONS?

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