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Laura Oliver  
*HELP/PSI, Inc., New York*

Heather Rasmussen  
*Rush University Medical Center, [heather.rasmussen@unl.edu](mailto:heather.rasmussen@unl.edu)*

Mary B. Gregoire  
*Rush University Medical Center*

Yimin Chen  
*Rush University Medical Center*

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## Health Care Providers' Knowledge, Perceptions, and Use of Probiotics and Prebiotics

Laura Oliver, MS, RD;<sup>1</sup> Heather Rasmussen, PhD, RD;<sup>2</sup>

Mary B. Gregoire, PhD, RD, FADA;<sup>3</sup> and Yimin Chen, MS, RD, CNSC<sup>2</sup>

1. HELP/PSI, Inc., New York, USA
2. Department of Clinical Nutrition, Rush University Medical Center, Chicago, Illinois, USA
3. Food and Nutrition Services, Rush University Medical Center, Chicago, Illinois, USA

*Corresponding author* – Heather Rasmussen, Department of Clinical Nutrition, Rush University Medical Center, 1700 W. Van Buren St., Suite 425, Chicago, IL 60612, email [heather\\_rasmussen@rush.edu](mailto:heather_rasmussen@rush.edu)

### Abstract

Health care providers (N = 256) completed an online questionnaire to assess their knowledge, perceptions, and use of probiotics and prebiotics. Participants were familiar with probiotics (88%) but not with prebiotics (22%). Probiotics (62%) and prebiotics (55%) were perceived as being “somewhat” to “quite a bit” beneficial to health ( $\mu = 3.6 \pm 1.0$  and  $3.6 \pm 1.2$ , respectively). Health care providers were “quite a bit” to “very much” willing to recommend probiotics (77%) and prebiotics (83%) if substantiated with literature. Despite this belief, they did not recommend probiotics (45%) or prebiotics (26%) to patients or read current research (75% and 76%, respectively).

**Keywords:** health care providers, prebiotics, probiotics

The gastrointestinal tract contains up to 100 trillion bacteria that are collectively known as the gut microbiota. Because of the potential benefits of the microbiota to host health, studies are being conducted on the effects of compounds that may beneficially alter gut microbiota, such as probiotics and prebiotics. Both probiotics and prebiotics may impact specific

functions of the gut microbiota, including immune function, nutrient absorption and metabolism, and bile acid metabolism.<sup>1-3</sup>

According to the World Health Organization, probiotics are live microbes that can benefit the host when consumed in sufficient amounts.<sup>4</sup> Probiotic function and benefit depend on the specific strain used and its ability to survive transit through, and be established in, the gastrointestinal tract. Current research suggests that probiotic use may be effective for certain conditions such as ulcerative colitis (UC), irritable bowel syndrome (IBS), antibiotic-associated diarrhea, and necrotizing enterocolitis.<sup>5-8</sup> A prebiotic is a selectively fermented ingredient that results in specific changes, in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health.<sup>9</sup> Evidence for the benefit of prebiotics for these conditions is more limited, and of these conditions, prebiotics may benefit those with IBS the most.<sup>10-14</sup> While some research supports the use of probiotics and prebiotics for these conditions, not all data support use of these dietary supplements.<sup>15</sup> More randomized controlled trials should be conducted to determine optimal dosage, strain (probiotics), and composition (prebiotics) for each condition, as well as determine the effectiveness of these dietary compounds on additional conditions such as metabolic diseases including cardiovascular disease and diabetes. In addition, while probiotics and prebiotics are thought to be largely safe for consumption, additional measures to ensure a positive safety profile, such as in vitro and in vivo experimentation, are necessary.

Probiotic and prebiotic market availability has been increasing over the past decade. One of the primary concerns with probiotic and prebiotic use is a knowledge deficit on the part of both consumers and health care providers. On the basis of data looking at the knowledge, use, and perceptions of probiotics and prebiotics in hospitalized patients, patients use probiotics (56%) and prebiotics (33%) for health but are not knowledgeable about the products and their appropriate use.<sup>16</sup> This prevalent and uninformed use, coupled with the growing body of evidence supporting probiotic and prebiotic effectiveness, emphasizes the importance of the health care provider to become well informed about this topic and to provide the most appropriate recommendations for use. Despite this importance, limited research has been conducted on the knowledge, perceptions, and use of probiotics and prebiotics among health care providers. In the present study, registered dietitians, nurses, nurse practitioners, physicians, pharmacists, and physician assistants were surveyed to assess these parameters in health care providers working at an urban medical center.

## **Methods**

### ***Study design***

A cross-sectional survey design using an online questionnaire through SurveyMonkey (Portland, Oregon) was used for this study. The questionnaire included questions about the knowledge, perceptions, and use of probiotics and prebiotics in medical center health care providers and was designed to obtain both quantitative and qualitative data. The target population for this study was health care providers currently employed at a large urban medical center in Chicago, Illinois. The sample included registered dietitians, nurses, nurse practitioners, physicians, pharmacists, and physician assistants who were employed

at the time of questionnaire administration. The research sample was extracted from the institution email list and telephone directory.

### *Questionnaire design*

The questionnaire was modeled after a previously developed questionnaire conducted by the same medical center researchers and was originally designed to assess hospitalized patients' knowledge, perceptions, and use of probiotics and prebiotics.<sup>16</sup> For this, questions were developed on the basis of the research objectives and consisted of 3 sections that included demographic information, probiotic questions, and prebiotic questions, all designed to assess these factors in health care providers. The probiotic and prebiotic sections were designed to measure health care provider knowledge, perceptions, and use of probiotics or prebiotics.

### *Data collection*

Approval from the institutional review board was received before beginning the study. Before the administration of the survey, 20 pilot questionnaires were emailed to medical center health care providers to gain feedback on questionnaire methodology and clarity. Description of the study purpose and a link to the questionnaire on the SurveyMonkey website were emailed to the health care providers. A modified Dillman method was used to increase response rate; 2 follow-up emails were sent, each 1 week after the previous email. An evaluation was also completed by the pilot study participants, which included questions concerning the amount of time required to complete the survey, the clarity of scales and questions, and any technical errors while completing the questionnaire. The respondents did not express any concerns with the pilot questionnaire or the survey process, so no changes were made to the instrument and associated administration methods.

The study questionnaire was administered in August 2011 in the same manner as the pilot, using a modified Dillman method with the same initial email and 2 proceeding follow-up emails 1 week apart. The initial email was sent to the potential subjects with a description of the questionnaire and a link to access it through the SurveyMonkey website; all responses were anonymous. As an incentive for participation, health care providers who completed the questionnaire were invited to an informational session on probiotics and prebiotics held after study completion. Current literature and products on the market were discussed, and participants were able to sample probiotic and prebiotic products.

### *Data analysis*

SPSS PASW (version 18, 2009, SPSS, Inc., an IBM Company, Chicago, Illinois) was used for all data analyses. Descriptive statistics were run for all items, and means, standard deviations, and frequencies were calculated to describe distributions and differences in knowledge, perceptions, and use of probiotics and prebiotics. Differences between demographic and employment characteristics (gender, age, race, education level, and occupation) and probiotic and prebiotic consumption, reading of current peer-reviewed literature, beneficial beliefs, harmful beliefs, willingness to recommend if substantiated by literature and familiarity were analyzed through  $\chi^2$  analysis.

## Findings and Discussion

A total of 3004 questionnaires were emailed to medical center health care providers. Overall, 309 were deemed undeliverable because of a change of employment status resulting in invalid emails. Of the 2695 individuals who received the questionnaire, 273 participants began the questionnaire, and 245 were considered valid as determined by completing at least 2 of the 3 questionnaire sections. The data from the pilot study ( $n = 11$ ) were combined with the data from the proceeding questionnaire to give usable responses from 256 participants because no changes were made to the study questionnaire on the basis of the pilot study of health care provider input.

The response rate for the combined pilot study and questionnaire was 9%. When stratified by profession, response rate was 32% for registered dietitians, 13% for nurses, 7% for physicians, and 30% for other (pharmacists and physician assistants). Of the 245 respondents, 4% were registered dietitians, 49% nurses, 39% physicians, and 9% other. Most of the participants were female (74%) and white (77%), with 10% Asian/Pacific Islander and 13% categorized as other (Table 1).

The participant specialty areas were collapsed into 5 categories and included internal medicine (33%), family medicine (18%), general (11%), neurology (9%), and other (29%). The patient population served included inpatient (42%) and outpatient (20%), with 38% of the sample working in both settings. Half of the participants (50%) had been in practice for 0 to 4 years compared with 5 to 9 years (16%), 10 to 19 years (12%), and 20 or more years (22%).

### *Probiotic and prebiotic knowledge*

When asked whether familiar with the term “probiotic” or “prebiotic,” health care providers appeared more familiar with the term “probiotic” (88%) than “prebiotic” (22%); however, this difference was not statistically significant ( $P = .054$ ). The percent difference in perceived familiarity could be due to marketing advertisements of probiotic-fortified products available to consumers, such as Dannon Activia and Yoplait YoPlus, but this is not clear. In addition, products containing prebiotics are generally being marketed as “containing fiber” rather than using the term “prebiotic”; this is likely to contribute to the unfamiliarity of the health care providers with the term.

**Table 1.** Demographic Characteristics of Medical Center Health Care Providers

	<i>n</i> (%) <sup>a</sup>
Gender	
Male	66 (26)
Female	188 (74)
Race	
White	197 (77)
Asian/Pacific Islander	26 (10)
Other (blacks, Hispanics)	33 (13)
Position	
Nurse <sup>b</sup>	125 (49)
Physician <sup>c</sup>	100 (39)
Registered dietitian	9 (3)
Other <sup>d</sup>	22 (9)
Area of specialty	
Internal medicine	85 (33)
Family medicine	45 (18)
General	28 (11)
Neurology	24 (9)
Other	74 (29)
Patient population	
Inpatient	105 (41)
Outpatient	50 (20)
Inpatient and outpatient	98 (39)
Years in practice	
0–4	127 (50)
5–9	42 (16)
10–19	31 (12)
≥ 20	55 (22)

a. Based on the total subjects who responded (*n* = 249–256).

b. Includes nurses, nurse practitioners, registered nurses, and clinical nurse specialists.

c. Includes residents, fellows, and attendings.

d. Includes pharmacists and physician assistants.

Only those who stated they were familiar with the “probiotic” or “prebiotic” term were able to complete the remainder of the respective section. Of those familiar with the terms, a majority were able to select the correct definition from a list of 4 definitions, with 91% choosing the correct definition of probiotics and 78% choosing the correct definition of prebiotics (Table 2).

**Table 2.** Definitions of Probiotics and Prebiotics Selected by Medical Center Health Care Providers

Definition <sup>a</sup>	n (% <sup>b</sup> )
<b>Probiotics</b>	
Probiotics are live bacteria that are helpful to your health when you eat them <sup>c</sup>	222 (91)
Probiotics are fibers that help feed the good bacteria in your body	18 (7)
Probiotics are natural antibiotics	5 (2)
Probiotics are cleaning products to help kill bacteria on fruit and vegetables	0 (0)
Probiotics are substances that make food taste sweeter	0 (0)
<b>Prebiotics</b>	
Prebiotics are food that you eat that can help the good bacteria in your body <sup>c</sup>	54 (78)
Prebiotics are live bacteria that are helpful to your health when you eat them	12 (17)
Prebiotics are a type of vitamin to help health	2 (3)
Prebiotics are drugs to help lower blood pressure	1 (1)
Prebiotics are harmful chemicals	0 (0)

a. Listed from greatest to least selected definition for both probiotics and prebiotics from the list of 5 definitions.

b. Based on the total number of subjects who responded as being familiar with probiotics ( $n = 245$ ) and prebiotics ( $n = 69$ ).

c. Correct definition.

Both the correct probiotic and prebiotic definitions were an option in each of the questions pertaining to familiarity. The second most common response to the probiotic question was the prebiotic definition (7%), and the second most common response to the prebiotic question was the probiotic definition (17%). This indicates that health care providers may be familiar with the terms but, in certain cases, may not fully understand the difference between probiotics and prebiotics. Familiarity with the terms did not differ by demographics. When specifically examining registered dietitian response, 100% were familiar with probiotics and prebiotics, and 100% answered the correct definition for both. Only results from those who stated they were familiar with the terms “probiotic” (88%) and “prebiotic” (22%) and able to correctly define the term from the list of 4 definitions were included in the subsequent analyses.

Overall, most of the participants had not read any recent peer-reviewed publications on probiotics (75%) or prebiotics (76%). Chi-square analysis indicated a difference between the number of health care providers who recently read peer-reviewed probiotic (25%) and prebiotic (24%) publications ( $P = .001$ ). Of the health care providers who had recently read publications, only 21% had read about both probiotics and prebiotics. The low percentage of health care providers who have read about these topics suggests that their sources of knowledge may not be based on peer-reviewed literature but rather on media advertisements or word of mouth. There was a difference in the frequency of reading the probiotic

peer-reviewed literature based on gender, with 35% of males and 20% of females having read these publications ( $P = .024$ ). Also, a difference was found in the reading of probiotic literature based on position, with 89% of registered dietitians, 15% of nurses, 29% of physicians, and 24% of other having read these publications ( $P < .001$ ).

### ***Probiotic and prebiotic perceptions***

Participants were asked perceived impact of probiotics and prebiotics on health and willingness to recommend either to patients. On a scale of 1 to 5, with 1 being “not at all” and 5 being “very much,” probiotics (62%) and prebiotics (57%) were mostly perceived as being “somewhat” (score = 3) to “quite a bit” (score = 4) beneficial to overall health ( $\mu = 3.6 \pm 1.0$  and  $3.5 \pm 1.2$ , respectively), and probiotics (97%) and prebiotics (90%) were perceived as “not at all” (score = 1) to “a little” (score = 2) harmful to health ( $\mu = 1.2 \pm 0.5$  and  $1.3 \pm 0.8$ , respectively) (Table 3). This is similar to a study asking gastroenterologists about the safety of probiotics; all ( $n = 56$ ) believed probiotics to be safe for consumption.<sup>17</sup>

**Table 3.** Health Care Provider Perceptions of Probiotics and Prebiotics

Question	<i>n</i>	Not at All	A Little	Some- what	Quite a Bit	Very Much	Mean $\pm$ SD <sup>a</sup>
<b>Probiotics</b>							
Do you believe probiotics are beneficial for health?	222	0 (0)	31 (14)	74 (33)	64 (29)	53 (24)	3.6 $\pm$ 1.0
Do you think that probiotics are harmful for health?	222	177 (80)	38 (17)	5 (2)	0 (0)	1 (1)	1.2 $\pm$ 0.5
If substantiated by peer-reviewed literature, would you be willing to recommend probiotics to your patients?	220	2 (1)	3 (1)	45 (21)	77 (35)	93 (42)	4.2 $\pm$ 0.9
<b>Prebiotics</b>							
Do you believe prebiotics are beneficial for health?	51	3 (6)	7 (14)	13 (26)	16 (31)	12 (24)	3.6 $\pm$ 1.2
Do you think that prebiotics are harmful for health?	51	41 (80)	5 (10)	4 (8)	0 (0)	1 (2)	1.4 $\pm$ 0.8
If substantiated by peer-reviewed literature, would you be willing to recommend prebiotics to your patients?	52	1 (2)	0 (0)	8 (15)	14 (27)	29 (56)	4.2 $\pm$ 1.0

a. Scale: 1 = not at all; 2 = a little; 3 = somewhat; 4 = quite a bit; 5 = very much

b. Based on the total number of responses for each question ( $n = 51$ – $222$ ).

Registered dietitians believed that probiotics (89%) and prebiotics (78%) were beneficial to overall health and not harmful to health (100% and 89%, respectively); there were no statistically significant differences in these perceptions based on position. Despite a majority not reading peer-reviewed literature on probiotics and prebiotics, health care providers



would be “quite a bit” to “very much” willing to recommend probiotics (77%) and prebiotics (83%) if substantiated by peer-reviewed literature. In addition, registered dietitians would be “quite a bit” to “very much” willing to recommend probiotics (100%) and prebiotics (89%) if substantiated by peer-reviewed literature.

Health care providers were asked how they perceived probiotics and prebiotics would impact specific health conditions and provided their response on the same scale of 1 to 5 (1, “not at all”; 5, “very much”). A majority of providers stated that probiotics were “somewhat” (score = 3), “quite a bit” (score = 4), or “very much” (score = 5) beneficial for gut health (general digestion/gut health [91%;  $\mu = 3.9 \pm 1.0$ ], IBS [88%;  $\mu = 3.5 \pm 1.0$ ], Crohn’s disease [CD] [75%;  $\mu = 3.1 \pm 1.2$ ], UC [74%;  $\mu = 3.1 \pm 1.2$ ]), and immune health (76%;  $\mu = 3.3 \pm 1.2$ ) (Table 4). In another study, more health care providers (98%) believed that probiotics were beneficial for gastrointestinal illnesses; however, these participants were gastroenterologists and therefore may have a different perspective regarding the benefits of probiotic use.<sup>17</sup> Despite this belief, literature to support the use of probiotics for many health conditions, including CD, is lacking.

Prebiotics were perceived as the most beneficial for the same health conditions, with health care providers believing that prebiotics were “somewhat,” “quite a bit,” or “very much” beneficial for gut health (general digestion/gut health [84%;  $\mu = 3.7 \pm 1.1$ ], IBS [84%;  $\mu = 3.5 \pm 1.1$ ], CD [71%;  $\mu = 3.1 \pm 1.2$ ], UC [68%;  $\mu = 3.1 \pm 1.2$ ]), and immune health (62%;  $\mu = 3.0 \pm 1.3$ ). While probiotics and prebiotics were perceived as most beneficial for digestion/gut health, the knowledge of health care providers specializing in gastroenterology was not able to be determined because of lack of an adequate number of participants in this specialty area ( $n = 4$ ).

Differences in perceptions of probiotics on various health conditions were assessed by demographics. For all conditions, perceptions differed by position, with more registered dietitians and nurses believing in the benefits of probiotics on these health conditions than did physicians or other ( $P < .05$ ). Differences in perception of probiotic benefit existed by gender with the following conditions: general digestion/gut health ( $P = .001$ ), IBS ( $P = .001$ ), CD ( $P = .019$ ), immune health ( $P = .001$ ), mental health/stress ( $P = .01$ ), and heart health ( $P = .001$ ); females appeared more likely to believe that probiotics were beneficial for these conditions than were males. Additional differences were seen on the basis of the patient population, race, and area of specialty as listed in Table 4. No significance was found on the basis of years in practice.

**Table 4.** Health Conditions for Which Health Care Providers Perceive Probiotics and Prebiotics to Be Beneficial

Health Condition	<i>n</i>	Not at All	A Little	Some-what	Quite a Bit	Very Much	Mean ± SD <sup>f</sup>
Question	<i>n</i> (% <sup>b</sup> )						
<b>Probiotics</b>							
General digestion/gut health <sup>c,d,e</sup>	222	3 (2)	16 (7)	61 (28)	70 (32)	72 (32)	3.9 ± 1.0
Irritable bowel syndrome <sup>d,e,f</sup>	222	7 (3)	20 (9)	86 (39)	68 (31)	41 (19)	3.5 ± 1.0
Immune health <sup>d,e</sup>	222	23 (10)	30 (14)	67 (30)	54 (24)	48 (22)	3.3 ± 1.2
Crohn disease <sup>d,e</sup>	221	26 (12)	38 (13)	89 (40)	45 (20)	33 (15)	3.2 ± 1.2
Ulcerative colitis <sup>e,f</sup>	222	29 (13)	27 (12)	84 (38)	50 (23)	30 (14)	3.1 ± 1.2
Allergies <sup>e</sup>	222	40 (18)	39 (18)	73 (33)	37 (17)	33 (15)	2.9 ± 1.3
Overweight/obesity <sup>e,f</sup>	220	72 (33)	48 (22)	50 (23)	29 (13)	21 (10)	2.5 ± 1.3
Mental health/stress <sup>d,e,f</sup>	222	75 (34)	53 (24)	52 (24)	23 (10)	18 (8)	2.4 ± 1.3
Heart health <sup>d,e,g</sup>	222	75 (34)	46 (21)	54 (24)	26 (12)	20 (9)	2.4 ± 1.3
<b>Prebiotics</b>							
General digestion/gut health <sup>d,e</sup>	54	2 (4)	6 (12)	12 (24)	17 (33)	14 (28)	3.7 ± 1.2
Irritable bowel syndrome <sup>c,e</sup>	54	2 (4)	6 (12)	16 (32)	16 (32)	10 (20)	3.5 ± 1.1
Ulcerative colitis <sup>d,e,f,g</sup>	54	6 (12)	10 (20)	14 (28)	13 (26)	7 (14)	3.2 ± 1.3
Crohn disease <sup>d,e,g</sup>	54	5 (10)	19 (18)	16 (33)	13 (27)	6 (12)	3.2 ± 1.2
Immune health <sup>d,e</sup>	50	8 (16)	11 (22)	12 (24)	10 (20)	9 (18)	3.1 ± 1.4
Allergies <sup>d,e</sup>	50	12 (42)	10 (20)	14 (28)	7 (14)	7 (14)	2.8 ± 1.4
Heart health <sup>d</sup>	49	18 (37)	5 (10)	13 (27)	7 (14)	6 (12)	2.7 ± 1.5
Overweight/obesity <sup>e</sup>	50	17 (34)	9 (18)	11 (22)	6 (12)	7 (14)	2.6 ± 1.4
Mental health/stress <sup>e</sup>	50	23 (46)	6 (12)	10 (20)	6 (12)	5 (10)	2.4 ± 1.5

a. Scale: 1 = not at all; 2 = a little; 3 = somewhat; 4 = quite a bit; 5 = very much

b. Based on the total number of responses for each condition ( $n = 49-222$ ).

c. Differences based on race,  $\chi^2$  analysis ( $P < .05$ ).

d. Differences based on gender,  $\chi^2$  analysis ( $P < .05$ ).

e. Differences based on position,  $\chi^2$  analysis ( $P < .05$ ).

f. Differences based on the area of specialty,  $\chi^2$  analysis ( $P < .05$ ).

g. Differences based on the patient population,  $\chi^2$  analysis ( $P < .05$ ).

When comparing prebiotic beliefs with demographics, significance was found on the basis of the position for the following conditions: general digestion/gut health ( $P = .006$ ), CD ( $P = .021$ ), UC ( $P = .011$ ), allergies ( $P = .003$ ), immune health ( $P = .006$ ), overweight/obesity ( $P = .037$ ), and mental health/stress ( $P = .001$ ), with more nurses believing prebiotics to be beneficial when compared with registered dietitians, physicians, or other. Similar to probiotics, differences in beliefs that prebiotics are beneficial for general digestion/gut health ( $P < .001$ ), IBS ( $P = .010$ ), CD ( $P < .001$ ), UC ( $P < .001$ ), allergies ( $P = .007$ ), immune health ( $P < .001$ ), and heart health ( $P = .019$ ) were found on the basis of gender, with more females than males believing prebiotics were beneficial. Chi-square analysis showed that believing prebiotics are beneficial for CD and UC is based on the patient population

served, with the inpatient-only group believing they were most beneficial when compared with the outpatient-only group or the inpatient/outpatient group. When examining differences in beliefs based on race, IBS ( $P = .044$ ) and UC ( $P = .025$ ) were significant, with whites being more believing than Asians/Pacific Islanders and others. No significant difference was found between beliefs that prebiotics are beneficial, based on specialty or years in practice.

### *Probiotic and prebiotic use*

Despite believing that probiotics and prebiotics are beneficial, the majority of the health care providers had never recommended probiotics (55%) or prebiotics (74%). This may be because of lack of knowledge about recent peer-reviewed literature and an understanding that their belief may not be based on this literature. However, the majority of registered dietitians had recommended probiotics and prebiotics (78% and 67%, respectively). Recommendation practices may be influenced by knowledge, with 59% not recommending probiotics or reading current literature and 65% not recommending prebiotics or reading literature.

Of the participants who had recommended probiotics, they recommended them “never/rarely” to “a few times a year” for general health/gut digestion (57%), IBS (70%), CD (86%), UC (84%), allergies (79%), immune health (75%), overweight/obesity (89%), mental health/stress (89%), and heart health (90%) (Table 5). This pattern existed for prebiotic recommendations as well, with a majority of the health care providers recommending prebiotics “never/rarely” for most conditions. Some health care providers (10%) recommend “frequent use” of prebiotics for certain conditions such as general digestion/gut health and IBS, and 16% recommended “a few times a week” or “daily” for these 2 conditions.

If participants recommended probiotics or prebiotics, they were asked about the specific products that they recommend. Participants were asked to free-text their responses rather than selecting from a list, and all of these responses were included independent of their accuracy. The most common probiotic products recommended were yogurt (15%), *Lactobacillus* (13%), and other (16%), which included *Bifidobacteria* (1%), unspecified over-the-counter products, Kefir, Bio-K Plus, and Florajen. It is unknown whether participants were referring to standard yogurt or yogurt-containing probiotics, such as Activia or Yoplait YoPlus when answering “yogurt.” Activia was recommended 8% of the time. As *Lactobacillus* was recommended 13% of the time by the health care providers who recommended probiotics, it suggests that it is more well known to health care providers than *Bifidobacteria* (1%). Specific probiotic supplements, such as Florastor (9%), Align, (7%), Culturelle (5%), and VSL#3 (4%) were recommended, suggesting that some health care providers are aware of the current probiotic market.

**Table 5.** Health Conditions for Which Health Care Providers Have Recommended Probiotics and Prebiotics<sup>a</sup>

Health Condition	A Few Times a Year		A Few Times a Month		A Few Times a Week		Daily	Mean $\pm$ SD <sup>b</sup>
	Never/Rarely	Year	Monthly	Month	Weekl y	Week		
<i>n</i> (%) <sup>c</sup>								
<b>Probiotics</b>								
General digestion/gut health	21 (22)	33 (35)	7 (7)	11 (12)	7 (7)	8 (8)	8 (8)	3.1 $\pm$ 1.9
Irritable bowel syndrome	44 (49)	19 (21)	7 (8)	6 (7)	5 (6)	5 (6)	4 (4)	2.3 $\pm$ 1.8
Crohn disease	57 (68)	15 (18)	4 (5)	3 (4)	1 (1)	3 (4)	1 (1)	1.7 $\pm$ 1.3
Ulcerative colitis	57 (66)	15 (17)	4 (5)	5 (6)	1 (1)	3 (4)	1 (1)	1.7 $\pm$ 1.4
Allergies	66 (73)	5 (6)	3 (3)	6 (7)	3 (3)	4 (4)	3 (3)	1.9 $\pm$ 1.7
Immune health	59 (66)	8 (9)	3 (3)	6 (7)	3 (3)	8 (9)	2 (2)	2.1 $\pm$ 1.8
Overweight/obesity	76 (86)	2 (2)	1 (1)	6 (7)	1 (1)	1 (1)	1 (1)	1.4 $\pm$ 1.2
Mental health/stress	75 (86)	2 (2)	1 (1)	3 (3)	1 (1)	4 (5)	1 (1)	1.5 $\pm$ 1.4
Heart health	76 (87)	2 (2)	2 (2)	3 (3)	3 (3)	0 (0)	1 (1)	1.4 $\pm$ 1.1
<b>Prebiotics</b>								
General digestion/gut health	0 (0)	1 (8)	2 (17)	1 (8)	3 (25)	4 (33)	1 (8)	4.8 $\pm$ 1.7
Irritable bowel syndrome	3 (25)	3 (25)	2 (17)	0 (0)	0 (0)	3 (25)	1 (8)	3.6 $\pm$ 2.3
Crohn disease	5 (42)	2 (17)	1 (8)	0 (0)	0 (0)	3 (25)	1 (8)	3.4 $\pm$ 2.6
Ulcerative colitis	4 (33)	3 (25)	1 (8)	0 (0)	0 (0)	3 (25)	1 (8)	3.5 $\pm$ 2.5
Allergies	6 (11)	1 (8)	0 (0)	2 (17)	0 (0)	2 (17)	1 (8)	3.2 $\pm$ 2.5
Immune health	6 (43)	2 (14)	0 (0)	2 (14)	0 (0)	2 (14)	2 (14)	3.2 $\pm$ 2.5
Overweight/obesity	4 (33)	2 (17)	0 (0)	2 (17)	1 (8)	2 (17)	1 (8)	3.6 $\pm$ 2.4
Mental health/stress	7 (64)	0 (0)	0 (0)	2 (18)	0 (0)	2 (18)	0 (0)	2.8 $\pm$ 2.4
Heart health	5 (42)	2 (17)	0 (0)	1 (8)	1 (8)	2 (17)	1 (8)	3.4 $\pm$ 2.5

- a. Based on the total number of health care providers who have recommended probiotics ( $n = 100$ ; 46%) and prebiotics ( $n = 14$ ; 26%).
- b. Scale: 1 = never/rarely; 2 = a few times a year; 3 = monthly; 4 = a few times a month; 5 = weekly; 6 = a few times a week; 7 = daily
- c. Based on the total number of responses for each condition ( $n = 11-95$ ).

As stated by the participants, prebiotic products recommended were whole grains (13%), fruit (13%), vegetables (13%), Metamucil (13%), and other (23%). The other category included flax, Nutraflora, and natural foods. Activia (6%) and yogurt (6%) were listed, suggesting confusion between the probiotic and prebiotic definitions despite the correct answer to these definitions in the questionnaire. As whole foods such as fruit and vegetables were recommended, this suggests that health care providers may be discussing overall nutrition with their patients but may incorrectly perceive the potential role of these foods in modification of gut microbiota. Correct sources of prebiotics including fermented foods (4%) and inulin (4%) were infrequently recommended to patients by health care providers,

suggesting that only a small percentage of health care providers are recommending appropriate prebiotics.

In addition to patient recommendation, personal consumption was assessed for both probiotics and prebiotics. Personal consumption (past or current) was 64% for probiotics and 34% for prebiotics. Of the registered dietitians, the majority had consumed probiotics (89%) and prebiotics (78%). A range of consumption was evident for all participants, with “weekly” to “daily” consumption of probiotics at 40% and prebiotics at 48% and “never/rarely” to “monthly” consumption of probiotics at 41% and prebiotics at 34%. On the basis of personal consumption, a significant difference existed in recommendation practices; of those who had suggested probiotics to their patients, 75% had personally consumed probiotics whereas 25% had not ( $P = .000$ ). Differences in prebiotic recommendations based on personal consumption could not be assessed because of inadequate sample numbers for  $\chi^2$  analysis. Personal consumption practices for both probiotics and prebiotics were also influenced by reading publications ( $P < .05$ ). A total of 44% of health care providers had consumed but not read publications on probiotics, whereas 17% had consumed but not read publications on prebiotics. This suggests that despite a lack of knowledge on probiotics, health care providers may still consume them, but this applies less so to prebiotics.

### ***Strengths***

A strength of the study was the sample population ( $N = 256$ ) that captured various health care providers, including registered dietitians, nurses, and physicians. The pilot study allowed the questionnaire to be assessed for clarity, amount of time to complete, and technical errors. The survey took a short duration of time to complete (~10–15 minutes), and the informational session gave the respondents an incentive to complete the questionnaire. Also, an attempt to maximize the number of respondents by sending the questionnaire 3 different times was made.

### ***Limitations***

Locating health care provider email addresses was done manually, but some of the health care providers were likely missed and therefore did not receive the questionnaire. Despite the attempt to encourage participation, the response rate was only 9%. Since the sample was from a teaching hospital, the results may not be representative of community hospitals or clinics.

### **Conclusions**

Health care providers are familiar with probiotics but not prebiotics; in contrast, registered dietitians were familiar with both probiotics and prebiotics. While health care providers believe that both probiotics and prebiotics are beneficial to overall health, they frequently do not recommend them to patients nor read the research related to these dietary substances. Health care providers believe that probiotics and prebiotics are most beneficial to general digestion/gut health, IBS, CD, and UC. The results of this study provide registered dietitians and other health care providers with information about knowledge, perceptions,

and use of probiotics and prebiotics, and emphasize the importance of education to best provide recommendations to patients.

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