



# Prebiotics: The foundation of preventive health care

## Prebiotyki – fundament profilaktyki zdrowotnej

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### ABSTRACT

**INTRODUCTION:** Prebiotics are substances that support the development and activity of the gut microbiota by stimulating the growth and function of the bacteria inhabiting the large intestine. These compounds are not digested in the human gastrointestinal tract. They include, among others, starches and dietary fiber.

**MATERIAL AND METHODS:** The research material consisted of a group of 140 individuals: 99 women and 41 men aged between 30 and 50 years. The research method used in the study was a diagnostic survey, with a proprietary questionnaire being the research tool.

**RESULTS:** The correct definition of the term “prebiotic” was selected by 57.1% of the respondents, while 25% confused it with probiotics. The terms “probiotic” and “prebiotic” were considered synonymous by 20% of respondents, whereas 12.1% were unable to answer the question. More than half of the respondents (57.6%) knew that probiotics can be combined with prebiotics, but only 48.6% could identify a range of products that contain them. According to 65% of respondents, prebiotics undergo fermentation in the digestive tract, which is the correct answer, whereas 35% provided an incorrect response.

**CONCLUSIONS:** Some respondents were aware of the positive effects of prebiotics on gut health. However, specific health benefits and prebiotic-rich products remain unclear to many. The results indicate a need for further public education, including a detailed explanation of the differences between prebiotics and probiotics and their role in human nutrition.

### KEYWORDS

prebiotics, digestive system, bacteria, dietary fiber, gut microbiota

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## STRESZCZENIE

**WPROWADZENIE:** Prebiotyki to substancje, które wspierają rozwój i aktywność mikrobioty jelitowej poprzez stymulację wzrostu i funkcjonowania bakterii zasiedlających jelito grube. Składniki te nie ulegają trawieniu w przewodzie pokarmowym człowieka. Należą do nich m.in. skrobia i błonnik pokarmowy.

**MATERIAŁ I METODY:** Materiał badawczy stanowiła grupa 140 osób – 99 kobiet i 41 mężczyzn w wieku od 30 do 50 lat. Metodą badawczą zastosowaną w analizie była ankieta diagnostyczna, a techniką badawczą autorski kwestionariusz.

**WYNIKI:** Poprawną definicję terminu „prebiotyk” wybrało 57,1% uczestników, podczas gdy 25% pomyliło go z probiotykiem. Określenia „probiotyk” i „prebiotyk” uznano za synonimiczne 20% respondentów, natomiast 12,1% nie potrafiło udzielić odpowiedzi na to pytanie. Ponad połowa uczestników badania (57,6%) wie, że prebiotyki można łączyć z probiotykami, ale jedynie 48,6% potrafi wskazać produkty, które je zawierają. Według 65% badanych prebiotyki ulegają fermentacji w przewodzie pokarmowym, co stanowi poprawną odpowiedź, podczas gdy 35% udzieliło błędnej odpowiedzi.

**WNIOSKI:** Niektórzy respondenci są świadomi pozytywnego wpływu prebiotyków na zdrowie jelit. Jednak dla wielu z nich konkretne korzyści zdrowotne oraz produkty bogate w prebiotyki pozostają niejasne. Wyniki wskazują na potrzebę dalszej edukacji społeczeństwa, w tym szczegółowego wyjaśnienia różnic między probiotykami a prebiotykami oraz ich roli w żywieniu człowieka.

## SŁOWA KLUCZOWE

prebiotyki, układ trawienny, bakterie, błonnik pokarmowy, mikrobiota jelitowa

## INTRODUCTION

The term “prebiotic” was introduced in 1995, defined as “an indigestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon” [1]. More than 20 years later, the International Scientific Association for Probiotics and Prebiotics (ISAPP) published a new definition that also includes low-carbohydrate substances with beneficial effects beyond the digestive tract. The positive health effects of individual substances must be supported by reliable research for them to be classified under this term [2]. Prebiotics can increase the population of probiotics, which most commonly are bacteria residing in the human gut; they have a positive impact on overall bodily function. Probiotic bacteria are part of the normal intestinal microbiota and they play a crucial role in inhibiting the growth of harmful bacteria as well as regulating the immune system. Probiotics cannot grow or conduct their own metabolic processes without a carbon source, which they obtain from carbohydrates [3].

Prebiotics primarily serve as a food source for beneficial bacteria present in the digestive tract. Their mechanisms of action can be classified into two types: direct mechanisms, which modulate the immune system by stimulating probiotic microorganisms, which in turn strengthens chemical, mechanical, biological, and immunological barriers, and indirect mechanisms, in which compounds such as short-chain fatty acids (SCFAs) and secondary metabolites of probiotics are produced and pathogens are eliminated. The metabolic by-products of probiotic bacteria can result in a lower pH in the colon, which is part of the large intestine. Proper acidity levels are essential for

maintaining the viability of probiotics, especially *Lactobacillus* and *Bifidobacteria*, allowing them to remain on the intestinal epithelium – where prebiotics exert their primary effects. SCFAs help maintain a balance in the gut microbiota, enhancing nutrient absorption, strengthening intestinal barrier function, and alleviating digestive disorders such as irritable bowel syndrome, Crohn’s disease, or ulcerative colitis [4,5,6,7].

Examples of prebiotics include plant fibers, which are edible parts of plants, or carbohydrate analogs resistant to digestion and absorption. These include inulin, gentiooligosaccharides, and fructooligosaccharides and are found in garlic, onions, nuts, and soy; resistant starches in legumes and cereals; lactulose, a synthetic form of lactose; stachyose, a complex sugar found in legumes such as beans and fava beans, as well as cruciferous vegetables like cabbage. These compounds undergo fermentation only in the large intestine because humans lack the necessary enzymes to hydrolyze complex polymer bonds – unlike gut microbiota – which leads to an increase in beneficial gut bacteria [8,9].

Prebiotic dietary fibers also influence mineral absorption, including calcium. The intake of lactulose, galactooligosaccharides, or inulin combined with oligofructose in doses ranging from 5 to 20 g/day significantly enhances calcium absorption [10]. During immunosenescence – the gradual aging of the immune system – the gut microbiota composition does not remain constant, but changes with age, leading to a decline in immunity. Maintaining a healthy microbiome can help delay aging-related processes, which contributes to longer global life expectancy [11,12]. Changes in the human microbiome occur in metabolic disorders such as obesity and diabetes, as well as neuropsychiatric conditions, including anxiety



and depression. A characteristic symptom is altered eating behaviors due to the strong connection between the gut–brain axis, which influences food preferences and intake quantity, thereby affecting calorie metabolism and various metabolic processes [13,14]. The gut–brain axis is a bidirectional communication system between the central nervous system and the gastrointestinal tract, in which the gut microbiota, the immune system, and neurotransmitters play key roles. In the absence of prebiotics – which are considered a food source for probiotics – the number of probiotics decreases, causing dysfunction in both the digestive and immune systems [15,16]. The use of an appropriate diet and dietary supplements containing probiotics and prebiotics improves mood and helps maintain or enhance cognitive functions during stressful situations, among other things [17,18]. Proper homeostasis is crucial for quality of life. A well-balanced gut microbiota is essential for protecting and supporting the intestinal mucosa, which undergoes continuous evolution due to changing environmental conditions. Ongoing research will lead to the discovery of additional benefits and new sources of prebiotics, as well as improved methods for supporting gut microbiota, ultimately contributing to disease prevention [19].

The aim of the study was to analyze the awareness and knowledge of survey participants regarding prebiotics, their role in maintaining health, and disease prevention.

## MATERIAL AND METHODS

The study was conducted using a proprietary questionnaire consisting of 25 questions: 3 demographic questions and 22 substantive questions. The method used was computer-assisted web interviews (CAWI), which involves respondents completing the survey themselves via the internet. This method makes it possible to reach a wide range of participants quickly and conveniently, ensuring their anonymity and comfort when answering. The survey was carried out online via Google Forms from January 13 to February 19, 2025. Respondents were recruited through a direct link to the survey shared among the authors' acquaintances. Additionally, the link, along with a request to complete the survey, was posted on social media platforms such as Messenger and Instagram. Furthermore, via Facebook, the link was shared on numerous pages where users exchange information, advice, and news.

The survey included one open-ended question regarding age, while the remaining questions were closed-ended with single-choice answers, except for two questions allowing multiple-choice answers. The majority of the respondents (40 individuals) declared

their age to be within the range of 30–35 years (48.6%). The substantive questions focused on prebiotics – their definition, sources, impact on the human body, and interaction with probiotics. A total of 140 people participated in the study. The inclusion criterion for the study was an age in the range of 30–50 years.

The sampling was purposive and was conducted using a non-probabilistic method. Respondents were invited to participate in the study by sharing a link to the survey via social media and the authors' personal contacts. This recruitment strategy allowed for the rapid capture of data from participants fitting the profile of the study, but comes with limitations regarding the generalizability of the results to the population at large. The sample was not nationally representative, which needs to be taken into account when interpreting the survey results and formulating conclusions.

## RESULTS

After the responses to the survey questions were analyzed and processed, the results were compiled in the form of pie charts generated using Google Forms. The study confirms the existence of a correlation between the results and the level of knowledge necessary to consciously care for one's health and to understand the significance of these important substances for the human body. This study verified the knowledge declared by respondents on the broad topic of prebiotics and identified areas where knowledge is insufficient.

The first standard question asked respondents to indicate the gender they identify with. The vast majority of the participants were women (70.7%,  $n = 99$ ), while men accounted for 41 respondents, which corresponds to 29.3% ( $n = 41$ ) of the total (Figure 1).

### Sex

140 respondents

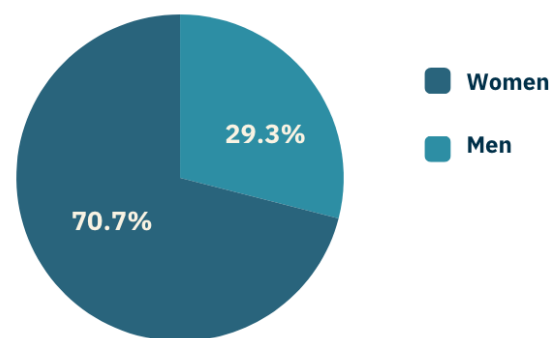


Fig. 1. Gender of the respondents



The only open-ended question in the survey concerned age. The largest numbers of respondents declared themselves to be 31 and 34 years old – each representing 10% ( $n = 14$ ) of all participants. The oldest individuals taking part in the survey were 50

years old ( $n = 7$ ), while the youngest group consisted of eight participants at the age of 30, making up 5.7% ( $n = 8$ ) of the total. In terms of age distribution, the majority of the respondents (48.6%,  $n = 68$ ) belonged to the 30–35 age group (Figure 2).

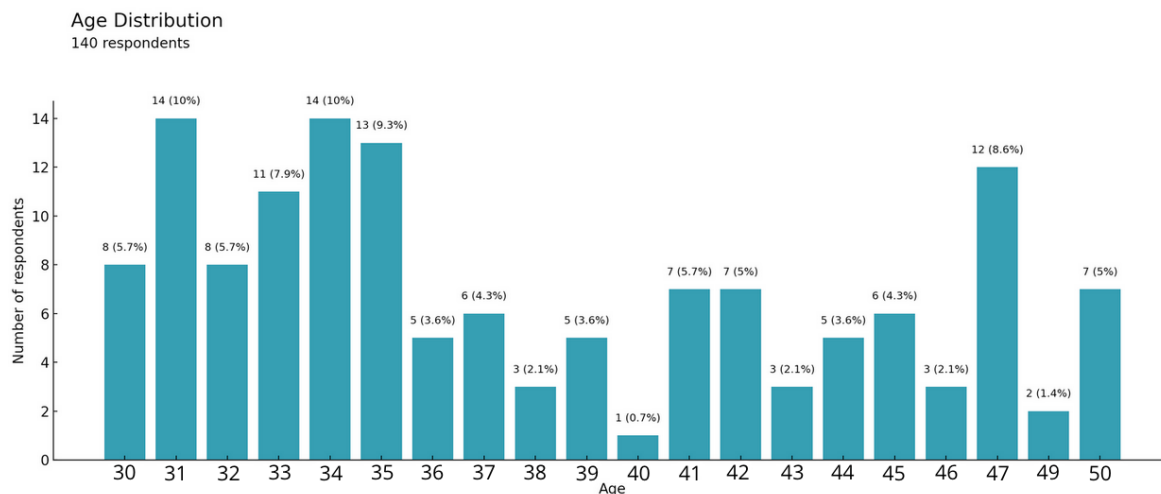


Fig. 2. Age of respondents

A correct definition of the term “prebiotic” was selected by 57.1% ( $n = 80$ ), while 25% ( $n = 35$ ) confused it with probiotics. Another 12.1% ( $n = 17$ ) selected the definition of symbiotics, while the remaining group was unable to provide an answer to this question (Figure 3).

The terms “probiotic” and “prebiotic” were considered synonymous by 20% ( $n = 28$ ) of the respondents, whereas 12.1% ( $n = 17$ ) were unable to answer the question. These substances are not the same, though this was the response given by nearly three quarters of the respondents (Figure 4).

The next question was related to using probiotics concomitantly with prebiotics. The correct answer, yes, was marked by 57.9% ( $n = 81$ ) of the respondents. A similar percentage (20.7%,  $n = 29$  and 21.4%,  $n = 30$ ) of them were unable to provide the correct answer (Figure 5).

In the question about which products contain prebiotics, nearly half of the respondents (48.6%,  $n = 68$ ) provided the correct answer. A significant group (17.8%,  $n = 25$ ) was unable to identify which products are rich in prebiotics. The smallest number of respondents (5%,  $n = 7$ ) selected honey, which also contains probiotics (Figure 6).

Probiotics offer a range of health benefits for humans,

yet only 42.1% ( $n = 59$ ) of the respondents are aware of all the listed advantages. Meanwhile, 12.1% – equivalent to 17 respondents – do not consume any probiotic-containing products and are therefore unable to identify their positive effects (Figure 7).

More than 40% ( $n = 58$ ) of the respondents indicated that all the listed substances are prebiotics. Another 17.9% ( $n = 25$ ) believed that only dietary fiber falls into this category and 10% ( $n = 14$ ) that only linoleic acid isomers qualify, while 6.4% ( $n = 9$ ) considered polyunsaturated fatty acids to be the correct answer. The remaining respondents (24.4%,  $n = 34$ ) were unable to provide an answer to this question (Figure 8).

For the only true-or-false question – whether prebiotics undergo fermentation in the digestive tract – 91 respondents, accounting for 65%, selected the correct answer, while 35% ( $n = 49$ ) provided an incorrect response (Figure 9).

When asked which prebiotics support the growth of specific probiotic bacteria, 37.8% ( $n = 53$ ) of the respondents selected an incorrect answer, while 20% ( $n = 28$ ) answered “I don’t know.” The correct answer – that prebiotics influence each listed group of probiotic bacteria – was selected by 59 participants, accounting for 42.2% of the total (Figure 10).



### What is the definition of the term 'prebiotic'?

140 respondents

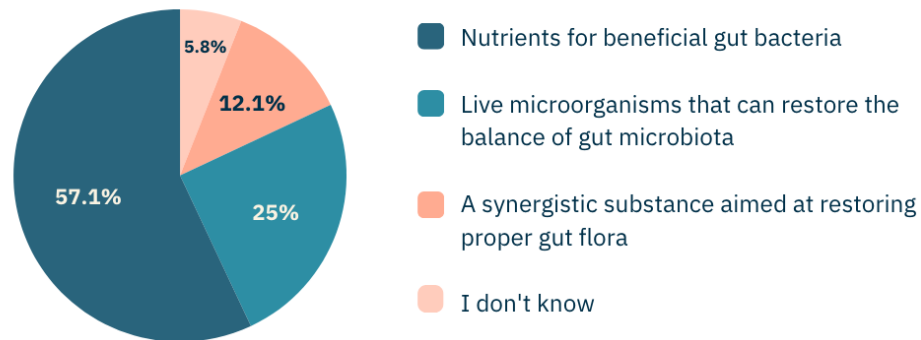


Fig. 3. Definition of the term "prebiotic" according to the respondents

### Do you believe that the terms 'probiotic' and 'prebiotic' mean the same thing?

140 respondents

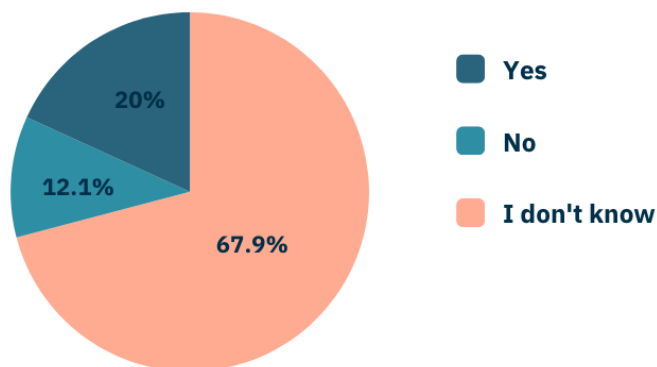


Fig. 4. Identify of concepts according to the respondents

### Do you believe that probiotics and prebiotics can be combined?

140 respondents

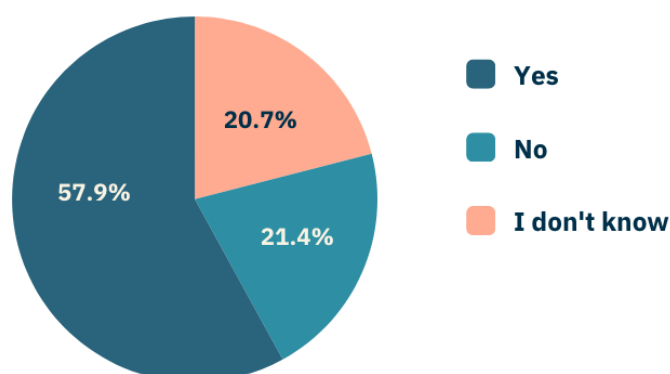


Fig. 5. Simultaneous use of prebiotics and probiotics according to the respondents



### Please provide information on which products contain prebiotics:

140 respondents

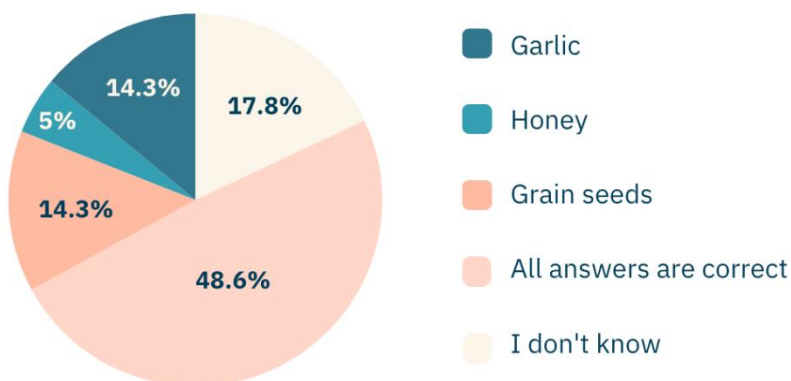


Fig. 6. Food sources of prebiotics according to the respondents

### What health benefits result from consuming prebiotics?

140 respondents

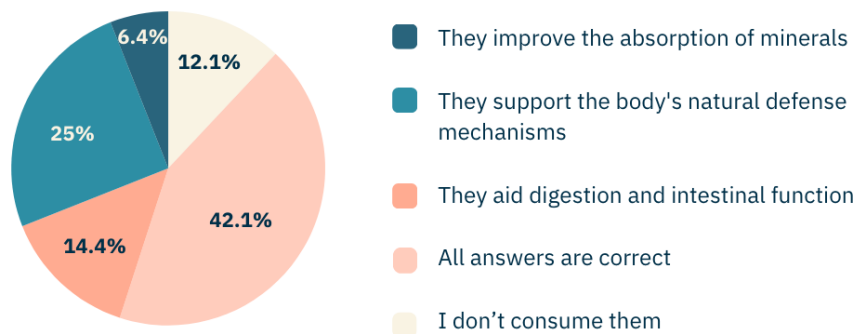


Fig. 7. Health benefits of prebiotics according to the respondents

### Prebiotics include:

140 respondents

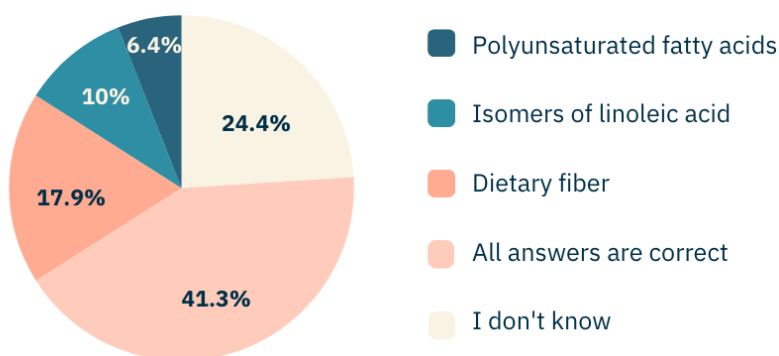
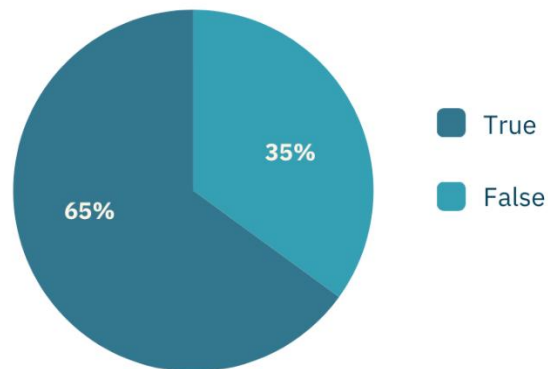


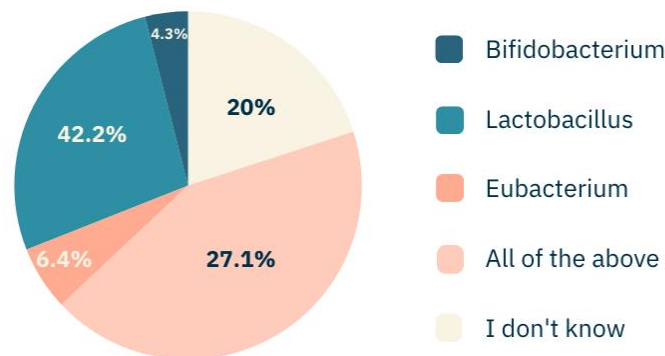
Fig. 8. Examples of prebiotics according to the respondents

**Prebiotics undergo fermentation in the digestive tract.**

140 respondents

**Fig. 9.** Fermentation of prebiotics in the digestive tract according to the respondents**Prebiotics support the growth of bacteria from the genus:**

140 respondents

**Fig. 10.** Prebiotics and the growth of probiotic bacteria according to the respondents**DISCUSSION**

Most respondents provided correct answers to the survey questions. However, an analysis of the overall study group reveals that their knowledge remains insufficient in certain areas. This indicates that some individuals within the 30–50 age range have gaps in their understanding that need to be addressed. It is assumed that some participants dedicated considerable time to exploring this topic due to the recent public discussion of gut microbiota. The findings of this study align with those of other researchers assessing knowledge on this subject.

The population of Saudi Arabia has been extensively studied across all age groups, making it relevant to cite a study that examined the knowledge of 50 doctors and dietitians there. In research conducted by King Abdulaziz University, 48.6% of the respondents were over 30 years old [1]. Among the surveyed doctors, 61.9% correctly identified the definition of “prebiotic,” as did 57.1% of hospital-

-employed dietitians, totaling 59.5% of all respondents. In this study, the reported percentage was very similar (57.1%). Another study on Saudi Arabian women found that nearly three quarters of the participants could correctly define prebiotics, with 51.4% recognizing their positive impact on the digestive system [20].

The Queensland Centre for Population Research carried out a social survey in Australia in 2017. Only one third (35.3%) of the participants were able to identify what prebiotics are, while more than half (58.6%) either did not know or had never heard of the term, suggesting that prebiotics are often overlooked in daily life [21]. Completely different results were obtained in Romania, where the participants were divided into two groups – adolescents and adults – over a three-month study period. Assessing respondents’ awareness of the concept of prebiotics, 74% stated they were familiar with it, whereas one quarter had never heard of it before. More than half of those surveyed did not know that the foods they consume could stimulate the growth of probiotic



bacteria, potentially improving their health. Additionally, nearly 30% of the respondents believed that the primary benefits of consuming prebiotic compounds were improved digestion, immune system support, enhanced nutrient absorption, and body detoxification. In a questionnaire designed by the authors, 42.1% of the respondents correctly answered a similar question, indicating that Polish society possesses slightly greater knowledge in this area. It is also worth mentioning opinions on who should be responsible for communicating such important information. The most common response pointed to healthcare professionals, due to their expertise and qualifications. The second most cited source was social media, which is understandable given its vast reach, though it carries the risk of spreading misinformation [22].

In the Indian state of Maharashtra, a study was conducted with 104 dental postgraduate students. When asked to distinguish between probiotics and prebiotics, 45.1% provided the correct answer. It was noted that the respondents had varying perspectives on simultaneous supplementation with these compounds which play a crucial role in gut health. Most believed that this approach constituted microbiome therapy aimed at restoring microbiota balance. Some preferred multibiome therapy, a newer and broader concept that considers not only gut microbiota, but also the skin, oral, and lung microbiomes. The smallest group of respondents considered both options [23].

It is well recognized how important health education is, especially among older adults. At a university hospital in Canada, 122 patients over the age of 50 completed a questionnaire assessing their knowledge of prebiotics, probiotics, and symbiotics. They were then taught about these topics, and the survey was repeated two weeks later. When asked whether prebiotics provide essential energy to probiotics for proper functioning, 64.75% were initially unable to answer, while 32.79% agreed with the statement. After explaining these concepts, a significant increase in correct responses was observed, with 79.51% affirming the statement and only 17.21% remaining uncertain. When asked whether foods such as bananas, onions, and oats contain prebiotics, the most common response was “I don’t know” (72.95%). Following the educational intervention, this percentage dropped to 18.85%. This study was the first to illustrate the importance of explaining key concepts to older adults, contributing to their expanded knowledge through well-structured education [24].

The studies cited from various parts of the world indicate that a portion of society lacks fundamental knowledge about prebiotics. The lack of awareness regarding their beneficial effects on the body may lead to health issues in the future. Few people can distinguish between the more commonly known probiotics and prebiotics, highlighting the need to continue educational efforts on this topic across different age groups.

## CONCLUSIONS

This study provides valuable insights into the current level of awareness, knowledge, and beliefs regarding prebiotics among the Polish population aged 30–50 years. The results indicate a sufficient level of knowledge about prebiotics among the participants. However, despite this, it is essential to continue promoting awareness on this topic through various preventive and educational initiatives accessible to all Polish residents. The findings of this brief study may serve as a foundation for further research by other scientists in this field, as the subject is broad and increasingly significant due to the growing number of recent scientific reports.

Based on an analysis of the results and all relevant aspects of the topic, the following conclusions were drawn:

1. Most Poles in the 30–50 age group are knowledgeable about prebiotics; however, some still confuse them with probiotics and are unaware of their positive effects on the body.
2. Research has shown that, despite widely available information, knowledge remains insufficient. To effectively address this issue, various initiatives should be implemented for all age groups, with a special emphasis on individuals who do not use the internet.
3. It is necessary to both increase the number of information campaigns and expand their reach. Education should take place in schools by integrating topics related to probiotics, prebiotics, symbiotics, and postbiotics into the curriculum of elementary and secondary schools. Additionally, healthcare facilities such as clinics, hospitals, and pharmacies should provide access to information about the effects of these substances on the proper functioning of the digestive system, with particular attention to gut microbiota.





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**Author's contribution**

Study design – W. Ficoń, M. Dobosz

Data collection – W. Ficoń, M. Dobosz

Data interpretation – W. Ficoń, M. Dobosz

Manuscript preparation – W. Ficoń, M. Dobosz, B. Całyniuk

Literature research – W. Ficoń, M. Dobosz

Final approval of the version to be published – W. Ficoń, M. Dobosz, B. Całyniuk

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