

# The Status of Childrens' (Age 3–6) Probiotic Supplement Usage and Parental Perception of Supplementation Behavior in Chongqing, China

Tingting Wu<sup>1,2</sup> and Mi Jeong Kim<sup>2\*</sup>

<sup>1</sup>Ph. D. Student, Dept. of Bioscience, Silla University, Busan 46958, Republic of Korea

<sup>2</sup>Professor, Dept. of Food and Nutrition, Silla University, Busan 46958, Republic of Korea

## ABSTRACT

Numerous studies support a globally growing trend of probiotic supplement consumption. Parents may have the greatest impact on their childrens' growth. This study aims to investigate the status of Chinese childrens' (age 3–6) probiotic supplement usage, parental perception on the benefits, and risks of the supplementation behavior and childrens' adherence to the Chinese dietary guidelines. A web-based survey was conducted using the multistage stratified cluster sampling method in nine districts of Chongqing, China between June and October 2023. The parental perception scores were calculated to indicate the degree of positive perception of the usage. A total of 727 parents were found to be eligible for data analysis. Of the 727 parents, 48.75% of the them belonged to the user group and the most important reasons of usage included 'treatment of gastrointestinal disorders' (49.05%), 'appetite regulation' (48.78%), 'promotion of daily health status' (39.30%), and 'immunity boost' (36.04%). The reasons for non-usage were 'lack of necessity' (36.95%), 'lack of knowledge' (36.74%), and 'failure to recognize as food' (13.78%). Children who used probiotics exhibited better dietary behaviors than the other group (3.82 vs 3.47,  $p<0.001$ ). Parents of users showed a more positive attitude toward probiotic supplementation than parents of non-users (3.59 vs 3.43,  $p<0.001$ ). Regression analysis suggest the childrens' probiotic supplements usage ( $\beta=0.157$ ,  $p=0.002$ ), parents' experience of nutrition education ( $\beta=0.132$ ,  $p=0.020$ ), and child's ages of 5 to 6 years ( $\beta=0.152$ ,  $p=0.026$ ) tend to positively predict parents' positive perceptions of probiotic supplements, after adjusting for significant confounding variables. The findings in the study highlight the high prevalence of probiotic supplement usage among children aged 3–6 in Chongqing, China, and emphasizes the need for further investigation on the associations between probiotic supplementation, nutrient intake, and dietary behaviors of young children in a longitudinal manner and tailored nutrition education for parents.

**Key words:** probiotic supplement, parental perception, dietary behavior, Chinese children

## INTRODUCTION

Probiotics, which are live microorganisms that provide health benefits to the host when consumed in adequate amounts, have gained significant attention in recent years (Araya M *et al* 2002). They can restore balance to disrupted gut microbiomes, regulate gastrointestinal issues, enhance immunity, relieve stress, optimize metabolism, and contribute to other effects (Suez J *et al* 2019). This has led to their widespread consumption as a dietary supplement worldwide, successfully growing into a multi-billion-dollar industry (Clarke TC *et al* 2015). The probiotic dietary supplements market was valued at nearly \$6,395.5 million in 2022, with a compound annual growth rate (CAGR) of 7.7% since 2017, with the Asia-Pacific region, especially in China and Korea, is expected to be the fastest-growing market for dietary supplements,

with a CAGR of 9.3% from 2021 to 2028 [Industry Analytics Research consulting (ARC I) 2023]. Gradually, probiotic-enhanced products are moving further into the mainstream in China. The market size of probiotic supplements in China scaled to around 56.8 billion yuan in 2021. The market is expected to grow further and reach 74 billion yuan by 2025 (Ou X 2024). The South Korea probiotic supplement market was valued at US\$165.187 million in 2022 and is expected to grow at a CAGR of 11.78% during 2024 to 2029 (ARC I 2023).

Currently, numerous studies were conducted to propose probiotic supplementation as a therapy for various health issues in children, including acute gastroenteritis, antibiotic associated diarrhea, necrotizing enterocolitis (NEC), constipation, allergic disease, colic a respiratory infection (Vandenplas Y *et al* 2013, Irwin N *et al* 2020). Clinical studies indicate that probiotics can help prevent or treat a range of acute and chronic health problems while maintaining an excellent safety profile (Chen YC *et al* 2012, Wang Y *et al* 2016). Early

\* Corresponding author : Mi Jeong Kim, Tel: +82-51-999-5248, E-mail: mjkim@silla.ac.kr

childhood is a critical period for the development of gut health and immune function, making it essential to explore the use of probiotic supplements in this vulnerable population (Dogra SK *et al* 2021). Studies have shown that early-life probiotic supplementation reduced the risk of neuropsychiatric disorders developing later in childhood, possibly through mechanisms involving gut microbiota composition (Partty A *et al* 2015). Probiotic supplements were found to reduced antibiotic-associated diarrhea risk in children in Korea, as shown in a meta-analysis including Korean studies (Ambarsari A *et al* 2022). A prophylactic probiotic intervention with a carefully chosen strain combination could be a valuable tool for alleviating the health of the pediatric population, which can enhance biochemical parameters and serum concentration, as well as boost nutritional absorption capacity, which can, in turn, strengthen overall health and immunity if given for at least five weeks or more (Ballini A *et al* 2019). The report titled "Probiotic Supplements for Kids Market Forecast (2021–2026)" by Industry ARC I, indicates that probiotic supplements for kids market size is estimated at \$1.8 billion in 2020, projected to grow at a CAGR of 7.3% during the forecast period 2021–2026 (ARC I 2024).

Despite the growing body of research on the probiotics in children, there is limited literature reporting on the prevalence of probiotic supplementation in healthy children (Irwin N *et al* 2020). A scoping review revealed the prevalence of probiotic supplement usage ranged from 4% to 51% across various countries (Irwin N *et al* 2020). Kim HS *et al* (2013) found that 25.6% of Korean mothers of preschoolers reported the use of probiotic supplements for their children. On the contrary, studies in China have primarily focused on intervention trials assessing the impact of probiotic supplements on digestibility and immunity in infants (Xiao L *et al* 2017), or have targeted infants aged 18 months (Chen YC *et al* 2012), clinical pediatric population (An Y & Cheng Q 2013), cancer patients (Yao D *et al* 2023) or young adults (Ma T *et al* 2021). Limited information exists regarding the status of probiotic supplementation focusing on preschool-aged children in China.

Parents play a crucial role in the decision to use probiotic supplements for their children, the probiotic supplements use in a child's diet was positively correlated with parents' consumption and level of knowledge about the term probiotic (Bezek K *et al* 2023). Andersen SS *et al* (2018) demonstrated

that parents were receptive to probiotics based on healthcare professionals' recommendations or potential child benefits, yet they exhibited skepticism toward preventive applications. In the Australian Capital Territory, 47.4% of preschool-aged children have been exposed to probiotics, with 14.9% consuming them within the last month (Irwin N *et al* 2022). A quantitative study conducted in Alberta, Canada, revealed that while mothers possess a strong understanding of probiotics, more than a third expressed uncertainty regarding the health risks associated with probiotic supplement use (Bridgman SL *et al* 2014). Moreover, parent-related perception were most focused on clinical pediatric population (An Y & Cheng Q 2013). Therefore, the present study aims to explore the status of probiotic supplements usage of preschool-aged children in Chongqing, China, and to investigate parental perceptions of the benefits and risks associated with the probiotic supplements usage.

## MATERIALS AND METHODS

### 1. Study Design and Participants

A cross-sectional survey was conducted in Chongqing, China between June and October 2023. A multistage stratified cluster sampling method was used to collect data from the nine urban districts of Chongqing. These districts were categorized into three levels based on population density, economic level, and geographical location. From each level, three kindergartens were randomly selected and the parents voluntarily participated in the survey. The web-based questionnaires were sent via WeChat chatrooms where teachers and parents regularly communicated. Parents were asked to answer an online questionnaire, which took approximately 10–15 minutes to complete. A pilot study was conducted with 15 participants through the survey link prior to the main survey in May 2023.

According to the sample size formula (Majid U 2018) ( $N = \frac{Z_{1-\alpha/2}^2 * P(1-P)}{\delta^2}$ ) of cross-sectional survey, the  $p$  was set at 50% based on the estimated probiotic use prevalence in China in 2019. The statistical power was set at 0.95 ( $1-\beta$ ), with tolerance of 0.04 ( $\delta$ ) and a significance level of 0.05 ( $\alpha$ ) at the two-tailed. The calculated target sample size was  $N=600$ . Additionally, we set a 20% non-response, and a minimum of 750 cases were required. This study was approved by Silla University's Institutional Review Board (IRB 1041449-

202206-HR-003). No monetary compensation or tangible prizes were offered for participation in the study. A total of 727 parents were included in the data analysis after excluding participants with missing information on probiotic supplement usage and perception-related variables ( $n=24$ ).

## 2. Questionnaire

The questionnaire developed in the present study was based on adoption of the Dietary Guidelines for Chinese preschool children (2016) [Chinese Dietary Guidelines (CNS) 2017], a comprehensive literature review on probiotic supplement usage among children (Mollakhalili N & Am M 2017; Andersen SS *et al* 2018), and semi-structured interviews of parents with children in the form of several focus group interviews.

In the demographic section, parents were asked to provide details regarding their age, gender, residential area, education level, work status, household income, and nutrition education experience. Education level was categorized into three levels: low (junior high school or below), medium (senior high school), and high (college or above). Monthly household was also categorized into three level low (less than ¥5000), medium (¥5000–¥10000), and high (more than ¥10000). Additionally, parents were asked to share demographic information about their children, including gender, age, and family size.

The dietary behavior section of the questionnaire consists of seven inquiries addressing various aspects of children's eating habits, including food diversity, intake of vegetables and fruits, milk and water consumption, as well as behaviors such as picky eating, breakfast skipping, and parental supervision during meals. Each participant's response was assessed for adherence to dietary guidelines, and these individual scores were cumulated to generate a total score. Higher scores indicated a greater adherence to the Chinese Dietary Guidelines for children aged 3–6 years (2016) (CNS 2017).

Additionally, the questionnaire included a section querying parents about their children's usage of probiotic supplements in the past year. Parents whose children used probiotics were asked to explain their motivations for supplementation, while parents of non-users were asked of their reason of refrainment.

Finally, the questionnaire encompasses 12 items aimed at capturing parental perceptions of the benefits and risks associated with probiotic supplements. Responses were evaluated using a 5-point Likert scale ranging from 1 (strongly disagree)

to 5 (strongly agree). The average score serves as an indicator of overall perceptions regarding the functions of probiotic supplements, with risk-related questions were reversely-coded. A higher average score indicates a more positive attitude of probiotic supplementation. The scale's reliability in assessing parental views on probiotic supplementation was confirmed by a Cronbach's alpha value of 0.90, underscoring its internal consistency and suitability for parents.

## 3. Data Analysis

All statistical data were analyzed using Stata statistical software (version 18.1; Stata Co., Cary, NC, USA). Descriptive statistics including numbers and percentages for categorical variables, and means with standard deviations (S.D.) for continuous variables, were grouped by users and non-users. Statistical comparisons were performed using chi-square ( $\chi^2$ ) tests for categorical variables and *t*-tests for continuous variables. Multiple linear regression was employed to identify factors associated with parents' perception scores. Significance levels for statistical tests were set at  $p<0.05$ , and all tests were two-tailed.

## RESULTS AND DISCUSSION

Table 1 presents the characteristics of the survey participants and prevalence of probiotic supplements usage. In this study, 48.75% of parents reported their 3–6-year-old children using supplements in the past year, which is lower than the prevalence of probiotic supplementation among infants (<3 years old) in Chongqing (85.43%) in 2013 (An Y & Cheng Q 2013). The usage of probiotic supplements varies significantly across studies due to differences in study populations and time of probiotic use (e.g., current, recent, or lifetime exposure) (Bezek K *et al* 2023). This study targeted the usage of probiotic supplements among preschool children in China, particularly in Chongqing city. Previous studies that associated probiotic supplementation behavior in China primarily focused on clinical intervention trials, such as testing probiotic effects on infants (Xiao L *et al* 2017), probiotic supplements usage for infants aged 18 months (Chen YC *et al* 2012), clinical pediatric population (An Y & Cheng Q 2013), cancer patients (Yao D *et al* 2023) or young adults. Differences (Ma T *et al* 2021) be attributed to biases across studies involving hospital clinic pediatric populations, which could influence probiotic

**Table 1. General characteristics of parents and children**

Variables	Categories	Total (n=727)	Probiotic supplements usage		p-value <sup>1)</sup>
			Yes (n=369)	No (n=358)	
Age of parent	18–25	18 ( 2.48)	10 ( 2.71)	8 ( 2.23)	0.093
	26–30	127 (17.47)	75 (20.33)	52 (14.53)	
	31–40	447 (61.49)	225 (60.98)	222 (62.01)	
	Over 41	135 (18.57)	59 (15.99)	76 (21.23)	
Role of parent	Father	125 (17.19)	65 (17.62)	60 (16.76)	0.760
	Mother	602 (82.81)	304 (82.38)	298 (83.24)	
Education level of mother/father <sup>2)</sup>	Low	124 (17.06)	42 (11.38)	82 (22.91)	<0.001
	Medium	144 (19.81)	64 (17.34)	80 (22.35)	
	High	459 (63.14)	263 (71.27)	196 (54.75)	
Monthly household income <sup>3)</sup>	Low	215 (29.57)	102 (27.64)	113 (31.56)	0.220
	Medium	330 (45.39)	165 (44.72)	165 (46.09)	
	High	182 (25.03)	102 (27.64)	80 (22.35)	
Nutrition education	No	544 (74.83)	261 (70.73)	283 (79.05)	0.010
	Yes	183 (25.17)	108 (29.27)	75 (20.95)	
Residential area	Urban	508 (69.88)	272 (73.71)	236 (65.92)	0.022
	Rural	219 (30.12)	97 (26.29)	122 (34.08)	
Gender of child	Boy	378 (51.99)	196 (53.12)	182 (50.84)	0.540
	Girl	349 (48.01)	173 (46.88)	176 (49.16)	
Age of child	3–4 Years	246 (33.84)	160 (43.36)	86 (24.02)	<0.001
	4–5 Years	287 (39.48)	143 (38.75)	144 (40.22)	
	5–6year	194 (26.69)	66 (17.89)	128 (35.75)	
Number of child	Only one	328 (45.12)	144 (40.22)	184 (49.86)	0.009
	Two and above	399 (54.88)	214 (59.78)	185 (50.14)	
Work status of parents	Yes	585 (80.47)	278 (77.65)	307 (83.20)	0.059
	No	142 (19.53)	80 (22.35)	62 (16.80)	

Values are presented as number (%).

<sup>1)</sup> Pearson chi-square test was used.

<sup>2)</sup> Low: junior high school or below, Medium: senior high school, High: college or above.

<sup>3)</sup> Low: less than ¥5,000, Medium: ¥5,000~¥10,000, High: more than ¥10,000.

usage for disease improvement or treatment. Additionally, differences in determining the probiotic supplement usage over an infant's lifespan may contribute to varying prevalence rates.

Nevertheless, probiotic supplement usage among preschool children in Chongqing appears higher compared to other

regions over the past year. In Slovenia, 28.4% of children consume a combination of probiotic foods and supplements, while 12.8% consume only probiotic supplements (Bezek K *et al* 2023). In the Australian Capital Territory, 47.4% of preschool-aged children have been exposed to probiotics, and 14.9% have taken probiotic supplements in the previous month

(Irwin N *et al* 2022). The prevalence of probiotic supplement usage among preschoolers in three Korean cities was 25.6% (Kim HS *et al* 2013). A scoping review spanning from studies in the United States to Finland reported prevalence rates of probiotic supplement usage ranging from 4% to 11% for current or recent usage and 16% to 51% for lifetime exposure (Irwin N *et al* 2020).

The majority of respondents were mothers (82.81%), with over 60% being over 30 years old, well-educated, and residing in urban areas. More than 48% of parents reported that they were currently using probiotic supplements for children. Those using probiotics for their children had higher education level (71.27% vs. 54.75%,  $p<0.001$ ), nutrition education experience (29.27% vs. 20.95%,  $p=0.01$ ), and indicated higher dietary behavior scores of their children (3.82 vs. 3.47,  $p<0.001$ ) compared to non-users. Additionally, there were fewer parents from rural areas and with children aged 5–6 years or having only one child in the user group ( $p<0.05$ ). Differences in education level of parents, nutrition education experience of parents, and dietary behavior scores of children between probiotic supplement users and non-users might reflect the supplement usage of children is closely related to the educa-

tion received by their parents. A previous study demonstrated associations between parental probiotic supplement usage, higher maternal education, and income with probiotic usage for children (Irwin N *et al* 2020).

The purposes of probiotic supplements usage for children are presented in Fig. 1(A). The top five reasons reported by users' parents were "treating gastrointestinal disorders" (49.05%), "regulating child's appetite" (48.78%), "promoting daily health" (39.30%), "immunity enhancement" (36.04%), and "gastrointestinal disease prevention" (34.42%). These findings align with previous research indicating that most individuals or parents use probiotic products for general digestive or overall health reasons (O'Connor LE *et al* 2021; Irwin N *et al* 2023). Parental willingness to provide their children with probiotics might depend on whether they interpret the purpose of the probiotics as preventive or therapeutic, on their interpretation of the product itself, or on their health beliefs in general (Mansour ME *et al* 2000). Also, reasons why parents do not provide probiotic supplements for children were present in Fig. 1 (B). The most common reason is that 36.95% of parents believe their children do not need them, while over 30% think they lack sufficient knowledge about

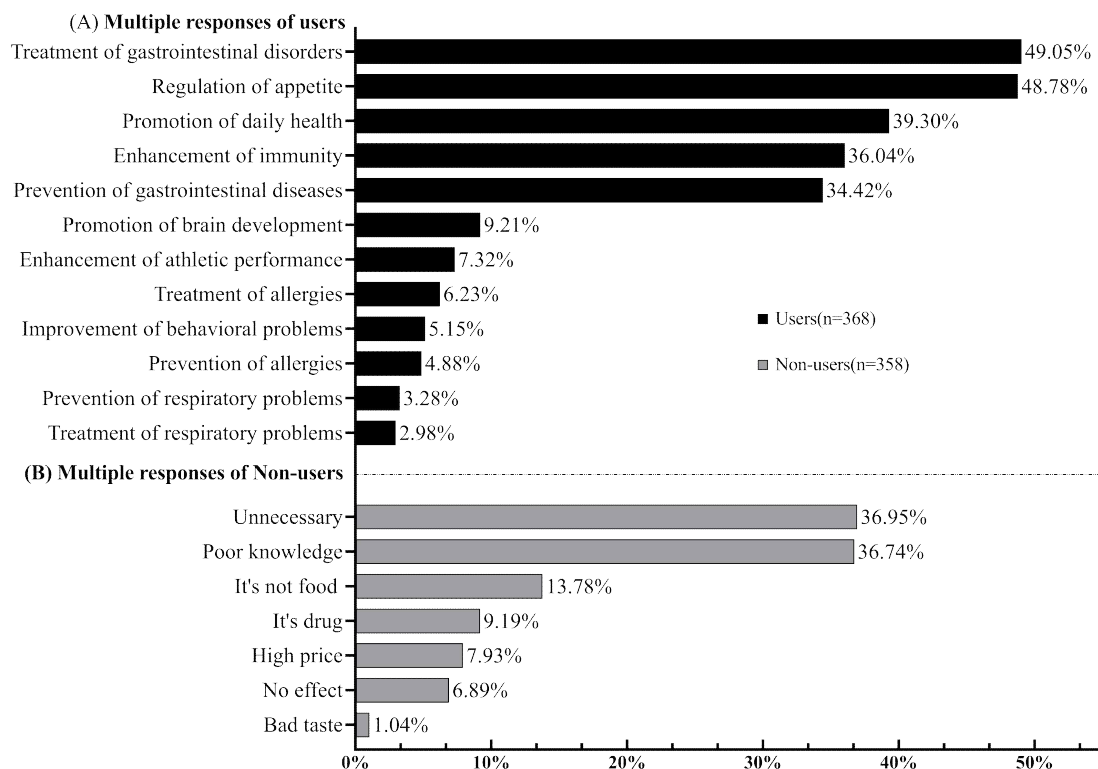


Fig. 1. Rationale behind parents providing or withholding probiotic supplements to their children.

probiotic supplements. Additional factors include perceptions that probiotic supplements are not food, but rather medication, and concerns about the cost and effectiveness of these supplements. It's crucial to underscore that these findings align with previous studies reporting barriers to probiotic usage among parents, such as lack of knowledge and concerns about safety and effectiveness (Partty A *et al* 2015; Kothari D *et al* 2019). This highlights the importance of addressing these barriers through targeted education and awareness campaigns to promote informed decision-making regarding probiotic supplementation for children.

Table 2 showed the difference between dietary behavior of users and non-users. Over 40% of parents reported picky eating habits of their children, which can have significant detrimental impacts on growth, nutritional status, development, physical activity, and health status (Chao HC 2018; Cole NC 2018). Additionally, more than 60% of parents stated that their children require adult supervision during meals, suggesting potential challenges in mealtime behaviors. Only one-third (24.62%) of parents reported that their children

consume more than 12 different types in a day. However, most children (86.24%) meet the recommendations for vegetable and fruit intake and water consumption. Moreover, probiotic supplement users exhibit higher dietary behavior scores, characterized by fewer breakfast skipping, greater food diversity, and more appropriate intake of milk, vegetables, and fruits. This finding may suggest that the better the children's dietary habits, the more likely their parents are to provide probiotic supplements to their children as parents have higher aspirations for their children's overall health (Liu L *et al* 2018).

Table 3 displays the perception scores regarding the benefits and risks of probiotic supplements. Parents of probiotic supplement users showed a more positive attitude compared to the non-users' parents, as evidenced by higher scores for benefits but lower scores for risks of probiotic supplementation. Parents of users scored an average of 3.59 for those 12 items by combining perceived benefits and reversely-coded risks of probiotic supplements, and this is comparable to the average score of 3.43 for non-users ( $p < 0.001$ ). The average

**Table 2. Dietary behaviors of children based on the Chinese dietary guidelines (2016) for 3-6 aged children**

Variables		Total	Probiotic supplements usage		<i>p</i> -value <sup>1)</sup>
			Yes (n=369)	No (n=358)	
Overall dietary behavior score		3.65±1.35	3.82±1.39	3.47±1.28	<0.001
Picky eating	Yes	402 (55.30)	202 (54.74)	200 (55.87)	0.760
	No	325 (44.70)	167 (45.26)	158 (44.13)	
Eating without adults' supervision	Yes	288 (39.61)	137 (37.13)	151 (42.18)	0.160
	No	439 (60.39)	232 (62.87)	207 (57.82)	
Breakfast skipping	Yes	143 (19.67)	62 (16.80)	81 (22.63)	0.048
	No	584 (80.33)	307 (83.20)	277 (77.30)	
Food diversity (≥12 types/day)	Yes	179 (24.62)	106 (28.73)	73 (20.39)	0.009
	No	548 (75.38)	263 (71.27)	285 (79.61)	
Milk intake (300–400 mL/day)	Yes	461 (63.41)	209 (56.64)	252 (70.39)	<0.001
	No	266 (36.59)	160 (43.36)	106 (29.61)	
Vegetable and fruit intake (300–500 g/day)	Yes	627 (86.24)	331 (89.70)	296 (82.68)	0.006
	No	100 (13.76)	38 (10.30)	62 (17.32)	
Water intake (600–800 mL/day)	Yes	525 (72.21)	269 (72.90)	256 (71.51)	0.680
	No	202 (27.79)	100 (27.10)	102 (28.49)	

Values are presented as mean±S.D. or number (%).

<sup>1)</sup> *t*-test or Pearson chi-square test were used.

**Table 3. Parents' perception of probiotic supplement usage for their children**

Variables	Probiotic supplements usage		p-value <sup>1)</sup>
	Yes (n=369)	No (n=358)	
Overall positive perceptions on probiotic supplements <sup>2)</sup>	3.59±0.59	3.43±0.62	<0.001
A. Strengthen for overall health	3.89±0.75	3.61±0.78	<0.001
B. Strengthen immune system	3.86±0.79	3.65±0.79	<0.001
C. Adjustment of digestive system	3.98±0.72	3.70±0.79	<0.001
D. Alleviate behavioral problems	3.56±0.87	3.35±0.86	<0.001
E. Alleviate memory	3.45±0.87	3.35±0.85	0.110
F. Alleviate concentration	3.41±0.86	3.28±0.87	0.035
G. Mitigate the emotional problems	3.40±0.86	3.32±0.85	0.190
H. Lose weight	2.98±0.93	3.02±0.86	0.510
I. Promote appetite	3.75±0.75	3.54±0.79	<0.001
J. Alleviate food allergies	3.36±0.87	3.23±0.83	0.046
K. Cause diarrhea	2.95±1.03	3.15±0.90	<0.001
L. Resistance to antibiotics	2.96±0.94	3.18±0.84	0.002

Values were presented as mean±S.D.

<sup>1)</sup> t-test was used.

<sup>2)</sup> The mean score of 12 items (items A to L). Items K and L were reversely coded from the original scales.

perception scores of the parents of users were significantly higher than parents of non-user for six items out of the ten benefit associated items about probiotic supplements ( $p < 0.05$ ). The highest score among these benefits was for 'adjustment of the digestive system', with users' parents scoring 3.98 points compared to non-users' parents scoring 3.70, suggesting widespread recognition of probiotic supplements for digestive health (Slykerman RF *et al* 2018). Taken together, the disparity in the perceptions of parents of users and non-users might be attributed to some parents' concerns about potential risks associated with probiotic supplements, leading them to refrain from using supplements for their children. Alternatively, parents of probiotic supplements users might have insufficient understanding of the risks associated with probiotic supplementation, which could contribute to their overly optimistic attitude towards probiotic usage. This finding is consistent with the study in Alberta, Canada, most mothers (73.1%) think probiotics were beneficial but none thought they were harmful (Bridgman SL *et al* 2014). On one hand, the limited availability and accessibility of high-quality, evidence-based

information on probiotics could contribute to parents' uncertainty and confusion regarding their usage (Jeon HJ *et al* 2022). On the other hand the diverse range of probiotic products available in the market, each with varying strains and dosages, may contribute to the inconsistencies in parents' perceptions (ARC I 2024). The lack of standardized guidelines for probiotic supplements usage in children may also play a role in this variability (Forster CS *et al* 2021). This emphasizes the need for healthcare professionals and researchers to provide tailored guidance and education on the potential benefits and risks of probiotics for children.

Multiple linear regression results (Table 4) suggest that children's probiotic supplements usage ( $\beta = 0.157$ ,  $p = 0.002$ ), parents' experience of nutrition education ( $\beta = 0.132$ ,  $p = 0.020$ ), and child's ages of 5 to 6 years ( $\beta = 0.152$ ,  $p = 0.026$ ) tend to positively predict parents' positive perceptions of probiotic supplements, after adjusting for significant confounding variables. This may indicate that parents are familiar with these several possible benefits of probiotic supplements and expect the corresponding benefits for their children using probiotics

**Table 4. Factors associated with parents' perception scores of providing probiotic supplements for their children**

Independent variables <sup>1)</sup>		B	S.E.	$\beta$ coefficient	<i>p</i> -value	VIF
Probiotic supplements usage	Yes	0.121	0.05	0.157	0.002	1.09
Parental experience of nutrition education	Yes	0.09	0.06	0.132	0.020	1.04
Age of children (years)	4–5	0.06	0.06	0.079	0.121	1.36
	5–6	0.10	0.07	0.152	0.026	1.55
$R^2=0.21$ , adjusted $R^2=0.14$ , $F=7.32$ , $p<0.001$						

<sup>1)</sup> A multiple linear regression was performed: probiotic supplements usage, dietary behavior score, education level of parents, parental experience of nutrition education, residential area, age of child (with 3-4year as the reference), number of child were examined for initial investigation of regression model.

(Andersen SS *et al* 2018). This finding was similar to maternal perspectives on the usage of probiotics in infants, which pointed out parents play a crucial role in the decision to use probiotic supplements for their children, and their perceptions of the benefits and risks associated with these products may influence their choices (Bridgman SL *et al* 2014). Future studies should continue to explore the relationship between probiotic supplements usage, perceptions, and individual characteristics to provide a more comprehensive understanding of the topic.

While this study has provided valuable insights into probiotic supplement usage among 3-6-year-old Chinese children and their parents' perceptions of the associated benefits and risks, several limitations warrant consideration for future research. Firstly, the study utilizes a cross-sectional design, precluding the establishment of causality. Future studies should employ longitudinal or randomized controlled trial designs to better assess the relationship between probiotic supplement usage and parental perceptions. Secondly, this study focused exclusively on probiotic supplements and did not consider probiotics derived from food sources. To provide a more comprehensive assessment of children's probiotic intake, future research should include both food and supplement sources. Additionally, the study's sample was limited to healthy children aged 3 to 6 from the Chongqing region, potentially limiting the generalizability of the findings. Future studies should include diverse regions and children of varying age groups to yield more representative results. Furthermore, dietary behavior scores were based on the 2016 Chinese dietary guidelines for children aged 3-6 years, which may not reflect the latest recommendations. Given that the 2020 edition of these guidelines was not available during the questionnaire

administration, future studies should use the latest version for more accurate dietary behavior assessments. Lastly, the questionnaire survey may introduce recall bias, potentially leading to overreporting or underreporting of probiotic usage and healthy behaviors. Future research should employ objective methods such as observation in home or kindergartens to validate parental-reported data.

## CONCLUSION

The present cross-sectional study indicates that high prevalence of probiotic supplementation among children aged 3–6 in Chongqing, China and emphasizes the association between parental perception and probiotic supplements usage in children. Parents of users demonstrate a positive attitude towards probiotic supplement usage compared to non-users' parents, which reflected in the higher scores regarding the perceived benefits and risks (reversely coded) of probiotic supplementation. These findings revealed a need of further investigation on the associations between probiotic supplementation, nutrient intake and dietary behaviors of young children in a longitudinal manner and tailored nutrition education for parents.

## CONFLICT OF INTEREST

The authors declare no competing interests.

## ACKNOWLEDGEMENT

The authors are grateful to the parents who participated in the study. All authors contributed to the design and read and



approved the final manuscript.

## REFERENCES

- Ambarsari A, Murti B, Rahardjo SS (2022) Probiotics and its effects on the cognitive development in children: A meta-analysis. *Indonesian Journal of Medicine* 7(2): 232-241.
- An Y, Cheng Q (2013) Parents' perception and use behavior of probiotics in child health clinics in China. *Proceedings of the 18th National Paediatrics Conference of the Chinese Medical Association*. Chang Sha, China.
- Andersen SS, Michaelsen KF, Laursen RP, Holm L (2018) Why parents are skeptical about using probiotics preventively for small children: A Danish qualitative study. *BMC Complement Altern Med* 18: 336.
- Araya M, Morelli L, Reid G, Sanders M, Stanton C, Pineiro M, Embarek P (2002) *Guidelines for the Evaluation of Probiotics in Food*. Food and Agricultural Organization of the United Nations/WHO, London, Ontario. pp 1-11.
- Ballini A, Gnoni A, De Vito D, Dipalma G, Cantore S, Gargiulo Isacco C, Saini R, Santacroce L, Topi S, Scarano A, Scacco S, Inchingolo F (2019) Effect of probiotics on the occurrence of nutrition absorption capacities in healthy children: A randomized double-blinded placebo-controlled pilot study. *Eur Rev Med Pharmacol Sci* 23(19): 8645-8657.
- Bezdek K, Fajkovic E, Stubelj M (2023) Parents' perspective on probiotics in preschool children: A cross-sectional survey. *Zdr Varst* 62(1): 5-12.
- Bridgman SL, Azad MB, Field CJ, Letourneau N, Johnston DW, Kaplan BJ, Kozyrskyj AL (2014) Maternal perspectives on the use of probiotics in infants: A cross-sectional survey. *BMC Complement Altern Med* 14: 366.
- Chao HC (2018) Association of picky eating with growth, nutritional status, development, physical activity, and health in preschool children. *Front Pediatr* 6: 22.
- Chen YC, Chien YW, Chang PJ, Hsieh WS, Chen PC (2012) Probiotic supplement use among young children in Taiwan: A prospective cohort study. *PLoS One* 7(9): e43885.
- Clarke TC, Black LI, Stussman BJ, Barnes PM, Nahin RL (2015) Trends in the use of complementary health approaches among adults: United States, 2002-2012. *Natl Health Stat Report* (79): 1-16.
- Chinese Dietary Guidelines (2017) *Supplementary Guidelines for Specific Populations*. In *Chinese Dietary Guidelines (2016)*, 4th ed. Chinese Nutrition Society, Beijing, China. p 6.
- Cole NC (2018) *Nature and nurture on picky eating behavior in early childhood*. Ph D Dissertation University of Illinois Urbana-Champaign, Urbana-Champaign. p 9.
- Dogra SK, Kwong Chung C, Wang D, Sakwinska O, Colombo Mottaz S (2021) Nurturing the early life gut microbiome and immune maturation for long term health. *Microorganisms* 9(10): e2110.
- Forster CS, Hsieh MH, Cabana MD (2021) Perspectives from the society for pediatric research: Probiotic use in urinary tract infections, atopic dermatitis, and antibiotic-associated diarrhea: an overview. *Pediatr Res* 90(2): 315-327.
- Industry Analytics Research Consulting (2023) *Probiotics Dietary Supplements Market Overview*. <https://www.industryarc.com> (accessed on 4. 3. 2024).
- Industry Analytics Research Consulting (2024) *Probiotic Supplements for Kids Market Forecast*. <https://www.industryarc.com> (accessed on 4. 3. 2024).
- Irwin N, Currie MJ, Davis D (2022) Probiotic supplementation in healthy pre-school-aged children: Prevalence and predictors. *J Pediatr Child Health* 58(4): 604-610.
- Irwin N, Currie MJ, Davis D (2023) Probiotic supplementation in healthy pre-school-aged children: What, why, how and when? *J Pediatr Child Health* 59(1): 58-63.
- Irwin N, Davis D, Currie MJ (2020) Probiotic supplementation in well children: A scoping review. *J Child Health Care* 24(3): 386-401.
- Jeon HJ, Ban OH, Bang WY, Yang J, Jung YH (2022) Trends, functionalities, and prospects of probiotic. *Microbiol Biotechnol Lett* 50(4): 465-476.
- Kim HS, Lee HY, Kim MK (2013) Dietary supplements use and related factors of preschoolers in 3 Korean cities. *Pediatr Gastroenterol Hepatol Nutr* 16(2): 104-115.
- Kothari D, Patel S, Kim SK (2019) Probiotic supplements might not be universally-effective and safe: A review. *Biomed Pharmacother* 111: 537-547.
- Liu L, Lliu F, He XY, Wang CA (2018) Family childcare types and conduct problem behaviors in young children: The mediation role of caregiver-child interaction. *Front Pediatr* 6: e217.
- Ma T, Jin H, Kwok LY, Sun Z, Liang MT, Zhang H (2021) Probiotic consumption relieved human stress and anxiety

- symptoms possibly via modulating the neuroactive potential of the gut microbiota. *Neurobiol Stress* 14: 100294.
- Majid U (2018) Research fundamentals: Study design, population, and sample size. *URNCSST J* 2(1): 1-7.
- Mansour ME, Lanphear BP, DeWitt TG (2000) Barriers to asthma care in urban children: Parent perspectives. *Pediatrics* 106(3): 512-519.
- Mollakhalili N, Am M (2017) Probiotic supplements and food products: A comparative approach. *Biochem Pharmacol* 6(2): 227.
- O'Connor LE, Gahche JJ, Herrick KA, Davis CD, Potischman N, Vargas AJ (2021) Nonfood prebiotic, probiotic, and synbiotic use has increased in US adults and children from 1999 to 2018. *Gastroenterology* 161(2): 476-486.
- Ou X (2024) Forecasted Market Size of Probiotic Supplements in China 2021-2025. Statista. <https://www.statista.com> (accessed on 4. 3. 2024).
- Partty A, Kalliomaki M, Wacklin P, Salminen S, Isolauri E (2015) A possible link between early probiotic intervention and the risk of neuropsychiatric disorders later in childhood: A randomized trial. *Pediatr Res* 77(6): 823-828.
- Slykerman RF, Kang J, Van Zyl N, Barthow C (2018) Effect of early probiotic supplementation on childhood cognition, behaviour and mood a randomised, placebo-controlled trial. *Acta Paediatr* 107(12): 2172-2178.
- Suez J, Zmora N, Segal E, Elinav E (2019) The pros, cons, and many unknowns of probiotics. *Nat Med* 25(5): 716-729.
- Vandenplas Y, De Greef E, Devreker T, Veereman-Wauters G, Hauser B (2013) Probiotics and prebiotics in infants and children. *Curr Infect Dis Rep* 15(3): 251-262.
- Wang Y, Li X, Ge T, Xiao Y (2016) Probiotics for prevention and treatment of respiratory tract infections in children: A systematic review and meta-analysis of randomized controlled trials. *Medicine (Baltimore)* 95(31): e4509.
- Xiao L, Ding G, Ding Y, Deng C (2017) Effect of probiotics on digestibility and immunity in infants: A study protocol for a randomized controlled trial. *Medicine (Baltimore)* 96(14): e5953.
- Yao D, He W, Hu Y, Yuan Y, Xu H, Wang J, Dai H (2023) Prevalence and influencing factors of probiotic usage among colorectal cancer patients in China: A national database study. *PLoS One* 18(9): e0291864.

---

Date Received	Mar. 25, 2024
Date Revised	May 1, 2024
Date Accepted	May 2, 2024