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ORIGINAL ARTICLE

Multistrain Probiotics and their Role in Presentation of Severity and Frequency of Upper Respiratory Tract Infection

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ABSTRACT

Background: Upper respiratory tract infections (URTIs) are a leading cause of morbidity and unnecessary antibiotic use globally.

Objective: To evaluate the effect of multistrain probiotic supplementation on the frequency, severity, and duration of URTIs in a cohort of individuals with a history of recurrent respiratory infections.

Methods: This descriptive, observational study was conducted at Lahore General Hospital, Lahore from 5 Jan 2023 to 10 July 2023. A total of 135 patients were enrolled using non-probability consecutive sampling. Baseline demographic information, medical history, nutritional status, and previous URTI frequency over the past 12 months were recorded using a standardized questionnaire. During the 12-week intervention period, participants were instructed to record any new URTI episodes, symptom duration, and severity using a daily symptom diary.

Results: The mean number of URTI episodes declined from 4.2 ± 1.1 to 1.3 ± 0.9 ($p < 0.001$). Symptom severity scores decreased from 7.6 ± 1.9 to 3.4 ± 1.2, and the average duration of illness per episode dropped from 6.1 ± 2.3 days to 3.0 ± 1.5 days ($p < 0.001$). Antibiotic usage reduced from 47.4% to 13.3%, and the number of missed work or school days fell from 3.8 ± 1.7 to 1.4 ± 0.8 per episode ($p < 0.001$). The intervention was well tolerated, with no serious adverse events and a compliance rate of 89.6%.

Conclusion: It is concluded that multistrain probiotics reduce the frequency, severity, and duration of upper respiratory tract infections and may decrease the need for antibiotics and associated absenteeism. These findings support the inclusion of probiotics in preventive strategies for respiratory health. Further randomized trials are recommended to validate these outcomes and refine optimal probiotic combinations.

Keywords: Multistrain probiotics, upper respiratory tract infection, severity, immune modulation, antibiotic use.

INTRODUCTION

Upper respiratory tract infections (URTIs), which include common colds, pharyngitis, sinusitis, and laryngitis, are among the most widespread infectious conditions affecting both children and adults globally. They account for the majority of outpatient antibiotic prescriptions despite their predominantly viral etiology[1]. The recurrent and often disruptive nature of these infections imposes a considerable socioeconomic burden in terms of healthcare costs, work absenteeism, and reduced quality of life. While symptomatic treatment remains the cornerstone of management, emerging interest in preventive strategies has led to increased focus on modulating host immunity through nutritional and microbiome-based interventions[2]. Among these, probiotics defined as live microorganisms which, when administered in adequate amounts, confer a health benefit on the host have gained significant attention[3]. The mucosal surfaces of the respiratory tract, like the gastrointestinal tract, harbor a diverse microbial ecosystem that interacts closely with the immune system. Probiotics are known to influence mucosal immunity by enhancing the production of secretory IgA, promoting the activity of natural killer (NK) cells, and modulating inflammatory cytokines such as interleukin-10 and interferon-gamma[4]. These mechanisms suggest a potential role for probiotics in both the prevention and mitigation of URTIs. While initial studies often focused on gastrointestinal benefits, more recent investigations have begun exploring the gut-lung axis, a bidirectional communication pathway through which gut microbiota can influence pulmonary immune responses[5].

Multistrain probiotic formulations combine two or more strains of beneficial bacteria, often from different genera such as *Lactobacillus*, *Bifidobacterium*, and *Streptococcus*. The rationale behind using multistrain preparations lies in the possibility of synergistic effects: different strains may target distinct components of the host immune system, enhance colonization resistance, or work through complementary pathways to produce a broader and more consistent health outcome[6]. For instance, while *Lactobacillus rhamnosus GG* is known for its epithelial adherence and barrier function enhancement, *Bifidobacterium animalis subsp. lactis* has been shown to modulate systemic cytokine responses[7]. Thus, combining such strains may offer additive or even multiplicative effects on immune modulation. Several clinical trials and meta-analyses have reported that probiotic supplementation, particularly with multistrain products, can reduce the incidence, severity, and duration of URTIs in various populations, including children attending daycare, athletes, healthcare workers, and the elderly[8]. Furthermore, much of the current literature lacks a clear distinction between monostrain and multistrain effects, and very few studies have directly compared the efficacy of multistrain probiotics against monostrain products in the context of URTIs[9]. Additionally, most existing research does not comprehensively address the severity of symptoms using validated clinical scoring systems, nor does it examine frequency trends longitudinally across multiple infection seasons or varying environmental exposures[10]. Therefore, the potential of multistrain probiotics as an adjunct or alternative to traditional approaches in the prevention and management of URTIs remains underexplored in real-world, diverse populations. Beyond clinical efficacy, the safety profile of probiotics is also of great importance[11]. Generally considered safe for healthy individuals, certain populations, such as immunocompromised patients or those with central venous catheters, may be at risk for probiotic-related complications, including bacteremia or fungemia. However, such instances are rare and often associated with inappropriate strain selection or compromised host barriers[12].

Objective: To evaluate the effect of multistrain probiotic supplementation on the frequency, severity, and duration of URTIs in a cohort of individuals with a history of recurrent respiratory infections.

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METHODOLOGY

This descriptive, observational study was conducted at Lahore General Hospital, Lahore from 5 Jan 2023 to 10 July 2023. A total of 135 patients were enrolled using non-probability consecutive sampling.

Inclusion Criteria:

- Age between 5 to 65 years.
- History of recurrent URTIs or high-risk exposure.
- Willingness to comply with daily probiotic intake and follow-up schedule.
- No recent use (past 30 days) of antibiotics or probiotic supplements.

Exclusion Criteria:

- Immunocompromised patients or those with autoimmune diseases.
- Individuals on immunosuppressive therapy or chronic steroid use.
- Pregnant or lactating women.
- Known allergy to any component of the probiotic formulation.

Data collection: Baseline demographic information, medical history, nutritional status, and previous URTI frequency over the past 12 months were recorded using a standardized questionnaire. During the 12-week intervention period, participants were instructed to record any new URTI episodes, symptom duration, and severity using a daily symptom diary. Severity was assessed using a validated clinical scoring system that included parameters such as fever, sore throat, nasal congestion, cough, fatigue, and days of work/school missed. All participants received a commercially available multistrain probiotic supplement once daily for a duration of 12 weeks. The formulation contained a combination of *Lactobacillus rhamnosus*, *Lactobacillus casei*, *Bifidobacterium lactis*, and *Streptococcus thermophilus*, delivering a total viable count of $\geq 10^9$ CFU per dose. Follow-up assessments were conducted at baseline, week 4, week 8, and week 12 either in-person or via telehealth. Compliance with probiotic intake was monitored through diary logs and follow-up interviews. Participants received a daily dose of a multistrain probiotic supplement for 12 consecutive weeks. The formulation included a combination of *Lactobacillus rhamnosus*, *Lactobacillus casei*, *Bifidobacterium lactis*, and *Streptococcus thermophilus*, with a total viable count of not less than 10^9 colony-forming units (CFU) per dose. The supplement was administered orally and participants were instructed to take it at the same time each day to ensure consistency.

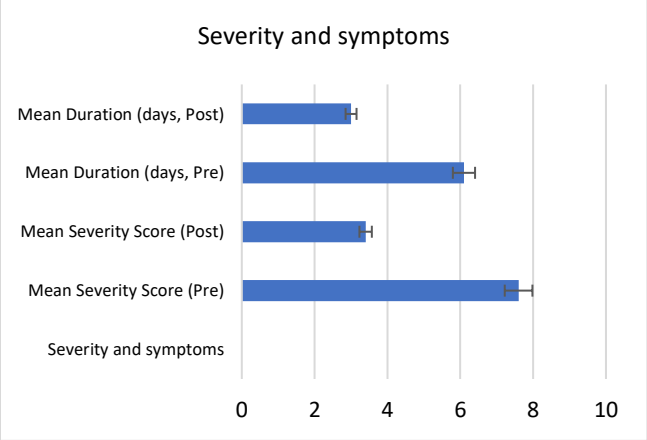
Statistical Analysis: Data were analyzed using SPSS version 26. Descriptive statistics such as mean and standard deviation were calculated for continuous variables, while categorical variables were expressed as frequencies and percentages. Paired t-tests were employed to compare the pre-and post-intervention differences in URTI frequency and severity. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 135 patients were added to the study with a mean age of 29.8 ± 11.4 years. The majority were female (58.5%), and most had experienced 3 to 5 upper respiratory tract infections (URTIs) in the previous year. A large portion of the cohort (80%) had no significant comorbidities, and 68.9% had not used antibiotics recently. Following 12 weeks of multistrain probiotic supplementation, the mean frequency of URTIs significantly declined from 4.2 ± 1.1 to 1.3 ± 0.9 episodes ($p < 0.001$). Post-intervention, 71.1% of participants experienced fewer than two episodes, while only 8.9% had three or more. There was also a marked reduction in symptom severity and illness duration. The mean symptom severity score decreased from 7.6 ± 1.9 to 3.4 ± 1.2, and the average duration of symptoms dropped from 6.1 ± 2.3 days to 3.0 ± 1.5 days ($p < 0.001$), indicating improved clinical outcomes with probiotic use.

Table 1: Demographic and Baseline Characteristics

Variable	Value
Total Patients	135
Mean Age (years)	29.8 ± 11.4
Gender - Female	79 (58.5%)
Gender - Male	56 (41.5%)
URTI Episodes Last Year (3-5)	90 (66.7%)
URTI Episodes Last Year (>5)	45 (33.3%)
No Significant Comorbidities	108 (80.0%)
No Recent Antibiotic Use	93 (68.9%)
Change in UTRI	
Mean URTI Frequency (Pre)	4.2 ± 1.1
Mean URTI Frequency (Post)	1.3 ± 0.9
p-value	< 0.001
Patients with <2 Episodes Post	96 (71.1%)
Patients with ≥3 Episodes Post	12 (8.9%)
Severity and symptoms	
Mean Severity Score (Pre)	7.6 ± 1.9
Mean Severity Score (Post)	3.4 ± 1.2
Mean Duration (days, Pre)	6.1 ± 2.3
Mean Duration (days, Post)	3.0 ± 1.5
p-value	< 0.001



Before supplementation, 64 patients (47.4%) reported using antibiotics for URTI episodes, which decreased to just 18 patients (13.3%) after the 12-week course. Additionally, the average number of days missed from work or school due to illness dropped from 3.8 ± 1.7 days to 1.4 ± 0.8 days.

Table 2: Antibiotic Use and Work Absenteeism

Parameter	Value
Patients Using Antibiotics (Pre)	64 (47.4%)
Patients Using Antibiotics (Post)	18 (13.3%)
Mean Days Missed (Pre)	3.8 ± 1.7
Mean Days Missed (Post)	1.4 ± 0.8
p-value	< 0.001

The study demonstrated high treatment adherence, with 121 participants (89.6%) maintaining at least 90% compliance with the probiotic regimen. Mild gastrointestinal symptoms such as bloating or discomfort were reported by 9 participants (6.7%), but these were transient and did not require discontinuation.

Table 3: Compliance and Safety

Parameter	Value
High Compliance (≥ 90%)	121 (89.6%)
Mild GI Symptoms	9 (6.7%)
Serious Adverse Events	0

The mean fever score reduced from 1.8 ± 0.5 to 0.6 ± 0.3, and sore throat scores dropped from 1.6 ± 0.6 to 0.8 ± 0.4. Similarly, nasal congestion improved from 2.0 ± 0.7 to 1.0 ± 0.5, while cough and fatigue scores decreased from 1.9 ± 0.6 to 0.9 ± 0.4 and 2.1 ± 0.5 to 1.1 ± 0.3, respectively. All changes were statistically significant ($p < 0.001$), reflecting a substantial reduction in symptom intensity across multiple domains.

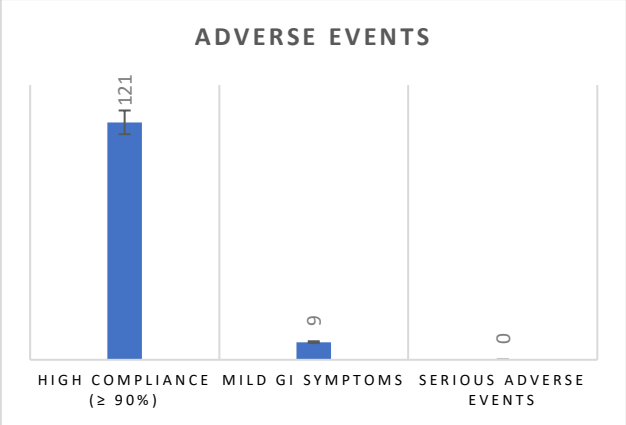


Table 4: Change in Individual Symptom Scores (Pre vs. Post)

Symptom	Mean Score (Pre)	Mean Score (Post)	p-value
Fever	1.8 ± 0.5	0.6 ± 0.3	< 0.001
Sore Throat	1.6 ± 0.6	0.8 ± 0.4	< 0.001
Nasal Congestion	2.0 ± 0.7	1.0 ± 0.5	< 0.001
Cough	1.9 ± 0.6	0.9 ± 0.4	< 0.001
Fatigue	2.1 ± 0.5	1.1 ± 0.3	< 0.001

DISCUSSION

The findings of this prospective cohort study demonstrate a significant reduction in both the frequency and severity of upper respiratory tract infections (URTIs) following a 12-week course of multistrain probiotic supplementation. With a sample size of 135 participants, this study supports the growing evidence that modulation of the gut-respiratory axis via probiotics may serve as an effective preventive strategy in reducing the burden of respiratory infections. The observed reduction in mean URTI episodes from 4.2 episodes in the prior year to 1.3 during the intervention was both statistically and clinically significant. Importantly, our study noted not only a reduction in frequency but also a marked decline in symptom severity and duration. The mean symptom score fell from 7.6 to 3.4, and duration reduced from an average of 6.1 to 3.0 days. This suggests that multistrain probiotics may enhance mucosal immunity and reduce inflammatory response severity, which aligns with the mechanisms proposed in previous studies[13]. A particularly noteworthy finding was the reduction in antibiotic usage, which fell from 47.4% of participants at baseline to just 13.3% during the study. This supports the hypothesis that probiotics may play a key role in antimicrobial stewardship by lowering the clinical threshold for antibiotic needs, thus reducing the risk of resistance[14]. The reduction in missed work or school days (from 3.8 to 1.4 per episode) further highlights the socio-economic implications of probiotic use, particularly in high-exposure populations such as school children, factory workers, or healthcare professionals. In terms of safety and adherence, the probiotic formulation was well-tolerated[15]. No serious adverse events were reported, and the few cases of mild gastrointestinal discomfort resolved spontaneously. The high compliance rate (89.6%) underscores the acceptability of probiotic supplementation in everyday use, making it a feasible public health strategy[16].

Despite the promising results, this study has limitations. First, it lacked a placebo-controlled group, which may have introduced bias related to participant expectation or natural seasonal variation in URTI incidence. Second, the study relied on self-reported symptom diaries, which, while practical, may be subject to recall bias[17]. Future randomized controlled trials (RCTs) with larger, more diverse populations and biochemical immune markers would provide stronger causal evidence. Moreover, strain-specific effects were not isolated in this multistrain formulation, leaving room for further mechanistic exploration to determine optimal strain combinations[8]. Nonetheless, our findings strengthen the argument that multistrain probiotics are a safe, affordable, and effective adjunct for reducing the frequency and severity of URTIs. In light of rising concerns over antimicrobial resistance and the limitations of current preventive measures (e.g., seasonal vaccines for specific pathogens), probiotics represent a promising non-pharmacological tool that enhances host resilience against a broad spectrum of respiratory pathogens.

CONCLUSION

It is concluded that multistrain probiotic supplementation significantly reduces the frequency, severity, and duration of upper respiratory tract infections (URTIs) in individuals at risk of recurrent episodes. The use of a probiotic blend containing *Lactobacillus* and *Bifidobacterium* species was associated with improved clinical outcomes, including fewer symptomatic days, decreased antibiotic usage, and reduced work or school absenteeism.

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