Vitamin - mineral and other supplementation

Omega-3 fatty acids, zinc and probiotics supplements in cystic fibrosis

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Background

Polyunsaturated fatty acids (PUFA)

In humans, the polyunsaturated fatty acids (PUFA) linoleic acid (18:2 omega-6, or n-6) and alpha-linolenic (18:3 omega-3, or n-3) are 'essential' for normal growth and function; they can be introduced only with diet. Research into the omega-3 series of essential polyunsaturated fatty acids stems from the observation that the native Inuit (Eskimo) of Greenland (who consume a traditional diet rich in fish oils) have a very low incidence of some of the chronic inflammatory immune-based disorders commonly found in European and North American people.

Fish oils are the richest dietary source of the metabolically active omega-3 fatty acid derivatives eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Omega-3 fatty acids have been shown to play an important role on the integrity of cellular membranes, where they exert anti-inflammatory response. Some of the beneficial effects of the omega-3 fatty acids on inflammatory disease can be explained by a decrease in the production of pro-inflammatory metabolites derived from the omega-6 fatty acid family and an increase in the biologically less-active omega-3 and their metabolities. Several studies provide that EPA and DHA can exert anti-inflammatory effects which may benefit a range of chronic inflammatory diseases, including CF. Animal models suggest that phenotypic changes in the CF-affected organs such as lungs, pancreas and intestine may be due to a defect in essential polyunsaturated fatty acid metabolism.

Different aspects of disturbances in lipid metabolism have been seen in CF (Strandvik B et al. 2022). These include increased release of arachidonic acid (AA), which is recognized as a pro-inflammatory agent, from cell membrane phospholipids and a low status of linoleic and docosahexaenoic acids. Recent research has explored more complicated lipid associations. Disturbances in annexins and ceramides might act in concert to explain the impact on inflammation and AA release.

Endogenous specialized pro-resolving lipid mediators (SPMs) as lipoxins, resolvins, protectins, and maresins derived from polyunsaturated fatty acids are locally produced in inflammatory loci to restrain this innate response, prevent further damages to the host, and permit return to homeostasis, thus limiting excessive leukocyte infiltration and pro-inflammatory signals, stimulating innate microbial killing, and enhancing resolution. In CF non-resolving inflammation is one of the mechanism involved in morbidity and mortality. Essential fatty acid deficiency may contribute to the development of the respiratory disease, even before clinical signs become apparent. The potential role of SPMs derived from polyunsaturaed acids as protective against inflammation and infection has been recently reviewed, underlining proofs of principle for their exploitation as innovative, non-immunosuppressive drugs to address inflammation and infections in CF (Recchiuti a et al. 2019).

Zinc

Zinc (Zn) has significant anti-oxidant and anti-inflammatory activity. Zn deficiency can occur in subsets of patients with CF, especially those with malabsorption and impaired growth. Although supplemental Zn has significantly reduced infections in various disorders, its efficacy has not been thoroughly investigated in CF. Several years ago (Marquerettaz M et al. 2014) it has been postulated that CzcRS, the zinc and cadmium-specific two-component system, is not only involved in metal resistance, but also in virulence and carbapenem antibiotic resistance in Pseudomonas aeruginosa (PA) infection. As different zinc levels have been demonstrated in the sputum of CF patients a valuable strategy to modulate Zn levels may modify the increasing burden of PA infections in CF patients.

Probiotics

Probiotics are live bacteria that are administered orally and may decrease the severity and duration of childhood gastroenteritis, as well they prevent relapses of chronic inflammatory bowel diseases when given in adjunct to standard therapy. In the last years their supplementation has been suggested for pwCF.

Issues

- To determine whether there is evidence of benefit in using omega-3 polyunsaturated fatty acids supplementation in people with CF to reduce morbidity and mortality.
- To determine the effect of zinc supplementation.
- To determine the effect of probiotics supplementation on reducing morbidity in CF.
- To identify any adverse events associated to these supplementations.

What is known

PUFA

1 CDSR (Oliver C et al, 2016) determined whether omega-3 polyunsaturated fatty acid supplementation reduces morbidity and mortality in CF and to identify any adverse event associated with their supplementation. RCTs that compared omega-3 fatty acid supplements with placebo in subjects with CF were evaluated. 15 studies were identified: four studies with 91 participants (children and adults) were included; duration of studies ranged from six weeks to six months. Five studies were judged to have a risk of bias.Two studies compared the effect of omega-3 fatty acids to olive oil for six weeks. One study compared a liquid dietary supplement containing omega-3 fatty acids to one without for six months. One study compared omega-3 fatty acids and omega-6 fatty acids to a control group (capsules with customised fatty acid blends) for three months. One short-term study (19 participants) comparing omega-3 to placebo reported a significant improvement in lung function and Schwachman score and a reduction in sputum volume in the treated group. Another study (43 participants) showed a significant increase in serum phospholipid essential fatty acid content and a significant drop in the n-6/n-3 fatty acid ratio following omega-3 fatty acid supplementation compared to control. The longer-term study (17 participants) demonstrated a significant increase in essential fatty acid content in neutrophil membranes and a significant decrease in the leukotriene B4 to leukotriene B5 ratio in participants taking omega-3 supplements compared to placebo.

A systematic review (Sohouli MH, 2023) evaluated the impact of omega-3 supplementation in children and adolescents with CF. A meta-analysis of 12 of the eligible studies showed that omega-3 supplementation significantly increased the levels of docosahexaenoic acid (weighted mean [WMD]: 2.06%, 95% confidence interval [CI]: 1.29, 2.82, p?<?0.001) and eicosapentaenoic acid (WMD: 0.32%, 95% CI: 0.15, 0.48, p?<?0.001) as well as decreased arachidonic acid (WMD: -0.78%, 95% CI: -1.50, -0.05, p?=?0.035) and C-receptive protein (CRP) (WMD: -3.76?mg/L, 95% CI: -7.42, -0.10, p?=?0.044), especially when used in higher doses and for a longer period of time compared to the control group. However, no significant effect was observed on other factors including FEV1, FVC as well as anthropometric parameters. In addition, high heterogeneity was reported for all fatty acids, but heterogeneity was low and not significant for other variables. In pediatric patients with CF, omega-3 supplementation showed benefits only in plasma fatty acid profile and serum CRP.

One CDSR (Oliver C, 2020) investigated omega?3 fatty acid supplementation in people with CF, of any age and severity. 5 RCTs were included. This review found that regular omega?3 supplements may provide some limited benefits for pwCF with relatively few adverse effects; however, the quality of the evidence across all outcomes was very low.

1 RCT (López-Neyra A, 2020) investigated a long-term docosahexaenoic acid (DHA) supplementation in pwCF (96 CF patients (age >2 months) 44 female, age 14.6±11.9 years (48 DHA and 48 placebo)). Patients were randomized to receive a seaweed DHA oil solution (50 mg/Kg/day) or matching placebo for 48 weeks. There were no differences in all primary outcomes [serum-IL-8 (p=0.909), respiratory-IL-8 (p=0.384) or fecal calprotectin (p=0.948)], all secondary inflammatory biomarkers, or in any of the clinical outcomes evaluated. There were few adverse events, with similar incidence in both study groups. In conclusion in this study, long-term DHA supplementation in CF patients was safe, but did not offer any benefit on inflammatory biomarkers, or in clinical outcomes compared with placebo.

One Italian multicentre trial performed in thirty-four patients with CF did not show any improvement of respiratory function, nutritional status and inflammatory cytokines (Alicandro G et al, 2013) over a one year DHA supplementation.

1 clinical trial has been completed (Hanssens L et al, 2016). Clinical status, exercise tolerance, inflammatory parameters, and erythrocyte fatty acid profile were evaluated in fiftheen ?F508-homozygous patients with CF undergoing chronic azithromycin randomized to receive 1 year of oral omega-3 supplementation at a dose of 60mg/Kg/day or placebo. The number of pulmonary exacerbations decreased at 12 months (1.7 vs. 3.0, p<0.01), as did the duration of antibiotic therapy (26.5 days vs. 60.0 days, p<0.025), in comparison with the previous year, in the supplemented group. Supplementation significantly increased the levels of EPA and DHA as early as <3 months of administration, with concomitant decreases in AA levels.

One Phase II clinical trial (NCT00221546) has been completed in order to evaluate the influence of DHA-rich supplement vs placebo on DHA-status and health evolution of patients with CF (17 patients enrolled in Belgium). No data are published.

A randomized double-blind study (NCT02518672)(PREMDIC project) has been terminated in 2017 with the aim to evaluate whether daily supplementation monoglyceride of DHA may reduce lung inflammation and improve pulmonary function. No published data are available.

One randomized double blind, cross-over clinical trial (NCT02690857) has been completed in 2019 for evaluation of daily administration of DHA (Pro-Mind) to 10 patients, 5mg/kg for 2 weeks, then 10mg/kg for the next 2 weeks compared to placebo (sunflower oil) capsules. Biomarkers of lipid peroxidation and vitamin E levels have been measured. Plasma and platelet lipid compositions have been determined. No published data are available.

A controlled study (Ayats-Vidal R et al, 2023) was performed in order to characterize the fatty acid profiles in the erythrocyte membrane of pediatric pwCF eceiving highly concentrated docosahexaenoic acid (DHA) supplementation (Tridocosahexanoin-AOX® 70%) at 50 mg/kg/day (*n* = 11) or matching placebo (*n* = 11) for 12 months. The mean age was 11.7 years. The DHA group showed a statistically significant improvement in n-3 polyunsaturated fatty acids (PUFAs), which was observed as early as 6 months and further increased at 12 months. Among the n-3 PUFAs, there was a significant increase in DHA and eicosapentaenoic acid (EPA). Additionally, a statistically significant decrease in n-6 PUFAs was found, primarily due to a decrease in arachidonic acid (AA) levels and elongase 5 activity. No change in linoleic acid levels was observed. The administration of DHA over one year was safe and well tolerated. The administration of a high-rich DHA supplement at a dose of 50 mg/kg/day for one year can correct erythrocyte AA/DHA imbalance and reduce fatty acid inflammatory markers, although this treatment did not fully normalized PUFA concentration.

One RCT (Ayats-Vidal R, 2024) investigated the impact of 1-year supplementation with high-rich Docosahexaenoic acid (DHA) (Tridocosahexanoin-AOX(®) 70%) at 50 mg/kg/day on clinical variables and inflammatory biomarkers in pediatric cystic fibrosis patients (n=22; 11 in the treatment group and 11 in the placebo group; mean age=11.7 years). In the DHA group, there was a significant increase in FVC (p = 0.004) and FVE(1) expressed in liters (p = 0.044) as compared with placebo, and a lower median number of exacerbations (1 vs 2). Differences in sputum cellularity (predominantly neutrophilic), neutrophilic elastase, and sputum and serum concentrations of resolvin D1 (RvD1), interleukin (IL)-8 (IL-8), and tumor necrosis factor alpha (TNF-?) between the study groups were not found. Significant increases in weight and height were also observed among DHA-supplemented patients. In conclusion, the use of

a highly concentrated DHA supplement for 1 year as compared with placebo improved pulmonary function and reduced exacerbations in pediatric CF.

Zinc

No CDSR is available on the potential role of zinc in CF.

A Turkish observational study (Turk J et al, 2014) was performed to evaluate the effect of supplementary zinc on BMI, FEV1 and the number of hospitalizations in 30 children with CF. Supplementary zinc of 2mg/kg/day was administered to all patients. Serum level of zinc, alkaline phosphatase, and albumin as well as BMI, FEV1, and number of hospitalizations were compared before and after zinc administration. Height (p<0.001), weight (p<0.001) and BMI (p=0.001) were significantly increased after zinc, while the number of hospitalizations was significantly decreased (p=0.023). In contrast to patients with normal pulmonary function tests who received supplement therapy, BMI was not increased in those with abnormal pulmonary function after supplementary zinc.

An Indian double-blind randomized placebo-controlled trial (Sharma G et al, 2016) was conducted among children with CF to assess the effect of zinc supplementation administered daily for 12 months in reducing the need for antibiotics by 50%. Any significant difference in the need for antibiotics, pulmonary function tests, hospitalization, colonization with *Pseudomonas*, was found for children with CF receiving zinc supplementation of 30mg/day.

Recently (Bauer SE, 2021) a longitudinal study has been performed in order to determine the prevalence of low serum Zn (sZn) and its relationship with growth in the first 3 years of life in children with CF. A total of 106 sZn measurements from 53 infants were evaluated. Seventeen infants (32%) had intermittent Zn insufficiency, defined as at least one sZn <70 mcg/dl in their first 3 years of life. Cross-sectional and longitudinal analyses revealed discrepant associations between sZn and growth. Therefore, prospective studies are needed to understand the role of Zn in growth in CF.

Probiotics

1 CDSR (Coffey MJ, 2020) was performed to evaluate the effect of probiotics in CF, including 12 RCTs (11 completed and one trial protocol ? this trial was terminated early) (464 children and adult CF patients). Probiotics significantly reduce faecal calprotectin (a marker of intestinal inflammation) in children and adults with CF, however the clinical implications of this require further investigation. Probiotics may make little or no difference to pulmonary exacerbation rates, however, further evidence is required before firm conclusions can be made.

A systematic review (Anderson JL, 2017) conducted by an electronic search with the aim to evaluate the effect of probiotics on respiratory, gastrointestinal and nutritional outcomes detected five databases and three trial databases. Results suggest that probiotics may improve respiratory and gastrointestinal outcomes in a stable CF clinic population, but there is inadequate evidence to recommend a specific species, strain or dose of probiotic as likely to be of significant benefit.

Other 2 systematic reviews (Nikniaz Z, 2017; Van Biervliet S, 2017) and one double-blind cross-over study (Van Biervliet S, 2018) showed that there is insufficient evidence to support the use of probiotics for treatment of CF pulmonary exacerbations and intestinal inflammation, although no side effects are reported and some beneficial effects are described (improvement of gut permability). Primary outcomes were pulmonary exacerbations, duration of hospitalization and antibiotics, and all-cause mortality. Secondary outcomes included gastrointestinal symptoms, markers of gut inflammation, and intestinal microbial balance. Nine studies (RCTs, 6, non-RCTs, 3; N=275) were included in the review. The pooled estimate showed significant reduction in the rate of pulmonary exacerbation (fixed effects model, two parallel group RCTs and one cross-over trial: relative risk (RR) 0.25 (95% CI 0.15; 0.41); p < 0.00001; level of evidence: low) and decrease in fecal calprotectin (FCLP) levels (fixed effect model, three RCTs: mean difference (MD) -16.71, 95% CI -27.30; -6.13); p = 0.002; level of evidence: low) after probiotic supplementation. Probiotic supplementation significantly improved gastrointestinal symptoms (one RCT, one non-RCT) and gut microbial balance (decreased Proteobacteria, increased Firmicutes, and Bacteroides in one RCT, one non-RCT). Details of some studies included in the analysis are reported below.

A systematic review (Neri LCL et al, 2019) aimed to categorize current evidence regarding the effects of probiotics supplements in CF patients on gastrointestinal and respiratory outcomes according to the type of intervention, as reported by Cochrane Collaboration recommendations. Studies were categorized by probiotic strain (Lactobacillus reuteri; Lactobacillus rhamnosus GG or a mix of strains); dosage (low dosage if <10 CFU or high dosage if >10 CFU); and duration of intervention (1, 3, 6, or 12 months). Among a total of 205 identified studies only 9 met the criteria for meta-analysis inclusion. 4 of 5 studies reported a positive result for intestinal inflammation, and other 4 studies reported a positive result for pulmonary exacerbation frequency, regardless of the treatment approach. Despite data indicated as useful probiotic use in CF, studies of standardized therapeutic interventions are needed to confirm these data.

A prospective cross-over randomized study showed that probiotics reduce incidence of pulmonary exacerbations and hospital admissions in CF (Bruzzese E et al, 2007). The same group (Bruzzese E et al, 2014) investigated both the composition of intestinal microbiota in children with CF and analyzed its relationship with intestinal inflammation and the microflora structure before and after *Lactobacillus* GG (LGG) administration in children with CF with and without antibiotic treatment. The main results demonstrated that the levels of *Eubacterium rectale*, *Bacteroides uniformis*, *Bacteroides vulgatus*, *Bifidobacterium adolescentis*, *Bifidobacterium catenulatum*, and *Faecalibacterium prausnitzii* were reduced in children with CF. A similar but more extreme pattern was observed in children with CF who were taking antibiotics. LGG administration reduced fecal calprotectin and partially restored intestinal microbiota. There was a significant correlation between reduced microbial richness and intestinal inflammation. These data suggested that qualitative and quantitative changes in intestinal microbiota of subjects with CF may be restored by probiotics, supporting the efficacy of probiotics in reducing intestinal inflammation and pulmonary exacerbations. In a phase III randomised double-blind clinical trial in children with CF (Lactobacillus GG 6x109CFU/day vs placebo) for 12 months no significant difference was found for body mass index and FEV1 (Bruzzese E et al, 2017).

One multi-center, double-blind, randomized placebo-controlled trial (Ray KJ, 2022) investigated the association of gut Bifidobacteria enrichment following oral Lactobacillus-supplementation (daily Lactobacillus rhamnosus strain GG (LGG) probiotic supplementation over a 12-month period) with clinical improvements in children with CF. Resilts showed that Bifidobacteria-dominated fecal microbiota were more likely to arise in LGG-treated children with CF (P?=?0.04). Children with Bifidobacteria-dominated gut microbiota had a

reduced rate of pulmonary exacerbations (IRR?=?0.55; 95% CI 0.25 to 0.82; P?=?0.01), improved pulmonary function (+?20.00% of predicted value FEV(1); 95% CI 8.05 to 31.92; P?=?0.001), lower intestinal inflammation (Calprotectin; Coef?=??-?16.53 ?g g(-1) feces; 95% CI?-?26.80 to?-?6.26; P?=?0.002) and required fewer antibiotics (IRR?=?0.43; 95% CI 0.22 to 0.69; P?=?0.04) compared to children with Bacteroides-dominated microbiota who were less likely to have received LGG. In conclusion the majority of pediatric CF patients in this study possessed a Bacteroides- or Bifidobacteria-dominated gut microbiota. Bifidobacteria-dominated gut microbiota were more likely to be associated with LGG-supplementation and with better clinical outcomes.

One RCT (Tabatabaii SA, 2024) evaluated the effect of Lactobacillus reuteri on pulmonary function test and growth of 40 children with CF aged from 6 to 20?years. Participants were designated to receive either L. reuteri or placebo daily for 4?months. The median baseline BMI of the patients was 16.28?kg?m(-2). A significant change in the probiotic group's BMI z-score after the study period was observed (P?=?0.034) but not for weight and height z-scores (P?>?0.05). After treatment, Pseudomonas aeruginosa grew in sputum cultures of seven in the placebo and one patient in the intervention group (P?=?0.03) while at baseline it grew in the sputum of four patients in each group. There was no significant difference in forced expiratory volume in the first second, forced expiratory flow at 25-75% or forced vital capacity change between the two groups after the treatment period (P?>?0.05). Additionally, no significant differences were found in pulmonary exacerbations, hospitalization frequencies or COVID-19 infection between the two groups during the study (P?>?0.05). The results suggest that L. reuteri supplementation may impact the growth of severely malnourished CF patients. Furthermore, it may be concluded that this strain might reduce P. aeruginosa in the sputum culture of CF patients.

Recently (Cruz Mosquera FE et al, 2025) a systematic review and meta-analysis of randomized controlled trials (RCTs) published between 2000 and 2024 were conducted in Cochrane, ScienceDirect, Web of Science, LILAC, BMC, PubMed, and SCOPUS following PRISMA guidelines. Methodological quality was assessed using the Jadad scale, and RevMan 5.4® evaluated the effects on FEV_1, pulmonary exacerbations, hospitalizations, quality of life, and inflammatory markers. Thirteen RCTs (n = 552), mostly in pediatric populations, were included. Most examined probiotics (e.g., *Lactobacillus rhamnosus GG*, *L. reuteri*), while four used synbiotics. Several studies reported reduced fecal calprotectin and proinflammatory interleukins (e.g., IL-6, IL-8), suggesting an anti-inflammatory effect. However, no significant differences were observed regarding hospitalizations or quality of life. None of the studies documented serious adverse events associated with the intervention. The meta-analysis showed no significant decrease in exacerbations (RR = 0.81; 95% CI = 0.48-1.37; p = 0.43) or improvements in FEV_1 (MD = 4.7; 95% CI = -5.4 to 14.8; p = 0.37), even in subgroup analyses. Sensitivity analyses did not modify the effect of the intervention on pulmonary function or exacerbation frequency. These data suggest that supplements should be considered experimental adjuncts rather than standard interventions in CF.

One recent double-blind randomized clinical trial (Rahamani P et al, 2025) included 110 CF patients that were divided into two equal groups of 55 subjects. In the probiotic group patients consumed Lactobacillus reuteri at the rate of 10^8 CFU/d for one month, while the control group received a placebo. Pulmonary, gastrointestinal, and growth-related outcomes as well as quality of life were evaluated after one month of intervention as well as at three-month follow-up. Main results of the study showed that in both groups weight increases significantly after 12 weeks (P = 0.01), while no difference was reported between the two groups after 12 weeks (P = 0.09), as well as regarding BMI and FEV1. CFQ questionnaire score increased significantly in the intervention group in the 4th and 12th week. No significant differences were observed between the two groups in terms of factors related to lung function or exacerbations after 12 weeks.

A recent observational prospetive study was performed with the aim to characterize the changes in the intestinal microbiota in 31 pediatric patients with CF aged 6-18 years after 6 months of treatment with ETI. Microbiota analysis was performed in stool sample susing 16S rRNA gene amplicon sequencing before and after 6 monthe of treatment Statistical analyses were employed to evaluate changes in alpha and beta diversity and variations in the relative abundance of different bacterial taxa. Clinical variables such as concomitant use of azithromycin and probiotics were considered. No significant changes in the alpha diversity were observed, while alterations in bacterial composition were detected. A decrease in the abundance of potentially pathogenic bacteria, such as Enterobacteriaceae members (Escherichia/Shigella) was observed, as well as the abundance of genus Blautia Differential analysis according to antibiotic and probiotic consumption revealed specific changes in microbiota profile. These data suggest a modulation of ETI towards a healthier intestinal microbiota composition (Gutierrez-Diaz I et al, 2025).

SYNBIOTICS

An RCT (de Freitas MB et al, 2017) explored the effect of synbiotic supplementation versus placebo in children and adolescents with CF. Markers evaluated before and after 90-day of supplementation with a synbiotic were: FEV1, nutritional status, IL-12, TNF-alpha, IL-10, IL-6, IL-1beta, IL-8, myeloperoxidase (MPO), nitric oxide metabolites (NOx). Results showed that NOx diminished significantly after supplementation in the synbiotic CF group (p = 0.030). In the synbiotic CF group with positive bacteriology, reductions were found in IL-6 (p = 0.033) and IL-8 (p = 0.009) after supplementation.

1 RCT (N Bilan, et al., 2020) investigated the effects of synbiotic supplementation on the pulmonary manifestations and anthropometric measurements in 40 children with CF. Children were assigned to receive either two synbiotic supplements or placebo each day for 6 months. Results showed that there were no significant differences in the number of pulmonary exacerbation (P?=?0.92), duration and number of hospitalization (P?=?0.91 and P?=?0.98, respectively) between groups during the intervention. The synbiotic also did not have a significant effect on forced expiratory volume in one second (FEV1, P?=?0.22) and BMI z-score (P?=?0.77). Authors cocnluded that the synbiotic had no significant effect on pulmonary and anthropometric outcomes in children with CF. Further studies are necessary to confirm these findings.

Unresolved questions

Regular omega-3 supplements may provide some benefits for people with CF with relatively few adverse effects, but there is little evidence to recommend dietary intake of fish oil. The current evidence is insufficient to draw firm conclusions or recommend routine use of omega-3 acids supplements in people with CF. A large, long?term, multicentre, randomised controlled study is needed to determine any significant therapeutic effect and to assess the influence of disease severity, dosage and duration of treatment. Future

researchers should note the need for additional pancreatic enzymes when providing omega?3 supplementation or olive oil placebo capsules.

An ongoing double blind randomized parallel trial vs placebo (IRCT20251004067497N1) will evaluate the effect of probiotic onsumption on improving the quality of life in children aged 6 to 13 Years with CF and PI. Intervention group will assume a daily dose of 1X108 CFU/day. Lactobacillus reuteri for a period of two months. The control group will assume a daily placebo sachet containing maltodextrin and 1% magnesium stearate for two months, and free of any live bacteria. Change in total quality of life score after two months of probiotic (Lactobacillus reuteri) consumption compared with placebo, based on the standardized Cystic Fibrosis Quality of Life Questionnaire (CF-QoL) will be the primary endpoint after two months of treatment.

Probiotics are associated with a small number of adverse events including vomiting, diarrhoea and allergic reactions. In children and adults with CF, probiotics may be considered as a therapy by patients and their healthcare providers. Given the variability of probiotic composition and dosage, further adequately?powered multicentre RCTs of at least 12 months duration are required to best assess the efficacy and safety of probiotics for children and adults with CF.

No conclusive data are available to define the role of synbiotics in CF.

Keywords

Minerals; Omega-3; Omega-6; Supplementation;