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From Diagnosis to Diet: Nutritional Management of Cystic Fibrosis in the Indian Context

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ABSTRACT

Nutritional management plays a pivotal role in addressing the challenges of cystic fibrosis (CF) among Indian patients. Despite historical underdiagnosis, recent attention has illuminated the prevalence and complexities of CF in India. This paper examines the journey from diagnosis to dietary intervention, highlighting the unique considerations within the Indian context. While CF in Indian patients mirrors Western clinical presentations, the presence of diverse CFTR mutations complicates diagnosis and genetic counseling. Limited access to specialized care, compounded by socioeconomic disparities, poses significant barriers to effective treatment. Malnutrition and poor weight gain are prevalent among Indian CF patients, necessitating culturally sensitive nutritional strategies. Despite notable advancements, research gaps persist, urging further exploration into epidemiology, genotype-phenotype correlations, and longitudinal outcomes. Addressing socioeconomic and cultural barriers remains paramount to enhancing access to care and improving outcomes for Indian CF patients.

Keyword- Cystic fibrosis , Nutritional management , Indian context, Diagnosis , Genetic mutations, Access to care, Malnutrition, Socioeconomic disparities Cultural sensitivity

1. INTRODUCTION

Cystic fibrosis (CF) is a complex genetic disorder characterized by dysfunction of the cystic fibrosis transmembrane conductance regulator (CFTR) protein, leading to thickened mucus secretions and multi-organ complications [1]. While CF is relatively well-studied in Western populations, research on CF in India has gained increasing attention over the past decade due to growing awareness, improved diagnostic capabilities, and emerging challenges associated with the disease in this region.

1.1 Epidemiology of Cystic Fibrosis in India

Historically, cystic fibrosis was considered rare in India, primarily due to underdiagnosis and limited awareness among healthcare providers. However, recent studies have suggested a higher prevalence of CF in India than previously recognized, with estimates ranging from 1 in 10,000 to 1 in 100,000 live births [2, 3]. The true prevalence of CF in India remains uncertain, partly due to variations in diagnostic practices, regional differences in disease awareness, and challenges in accessing specialized care for affected individuals.

1.2 Clinical Presentation and Diagnostic Challenges

The clinical presentation of CF in Indian patients often mirrors that of Western populations, with respiratory symptoms such as chronic cough, recurrent infections, and bronchiectasis being predominant features [4]. However, there are notable differences in the spectrum of CFTR mutations observed in Indian patients compared to those of European descent. Studies have identified a diverse range of CFTR mutations in Indian CF patients, including novel and rare variants not commonly seen in Western populations [5, 6]. This genetic heterogeneity presents challenges for diagnostic testing and genetic counseling in Indian CF

populations.

1.3 Barriers to Care and Access to Treatment

Access to specialized CF care and treatment remains a significant challenge for many Indian patients due to socioeconomic factors, limited availability of healthcare resources, and disparities in healthcare infrastructure across different regions of the country. Diagnostic facilities capable of performing sweat chloride testing, genetic testing, and multidisciplinary CF care are often concentrated in urban centers, posing barriers to timely diagnosis and management for patients residing in rural or underserved areas. Additionally, the high cost of CF medications [6], including enzyme replacement therapy[7] and CFTR modulator drugs, presents financial challenges for many Indian families, further exacerbating disparities in access to care.

2 LITERATURE SURVEY : SOCIO-ECONOMIC DISPARITIES

Socioeconomic disparities refer to the unequal distribution of resources, opportunities, and access to healthcare based on socioeconomic factors such as income, education, and occupation. In the context of cystic fibrosis (CF) in India, socioeconomic disparities significantly impact the diagnosis, management, and outcomes of CF patients[8][9][10].

2.1 Access to Healthcare:

Socioeconomic status influences access to specialized CF care facilities, diagnostic services, and medications. Patients from lower socioeconomic backgrounds may face financial barriers, travel distance, and lack of health insurance, resulting in delayed diagnosis and suboptimal treatment [11].

2.2 Treatment Adherence:

Financial constraints may hinder adherence to treatment regimens, including medications, nutritional supplements, and physiotherapy sessions. Patients from lower socioeconomic strata may struggle to afford the costs associated with CF care, leading to inconsistent treatment adherence and poorer health outcomes [6].

2.3 Nutritional Support:

Socioeconomic disparities affect access to adequate nutrition, exacerbating malnutrition and poor weight gain among CF patients [12] [13]. Affordability of specialized CF diets, nutritional supplements, and enzyme replacement therapy can pose challenges for economically disadvantaged families.

2.4 Disease Management:

Limited access to healthcare resources and educational opportunities may contribute to a lack of awareness about CF among lower socioeconomic groups. This can lead to delayed diagnosis, mismanagement of symptoms, and increased disease burden among underserved populations [14].

2.5 Impact on Quality of Life:

Socioeconomic disparities compound the psychosocial impact of CF, affecting patients' and families' emotional well-being, social support networks, and overall quality of life. Financial stress, social stigma, and reduced opportunities for education and employment further exacerbate the challenges faced by CF patients and their families[6][14].

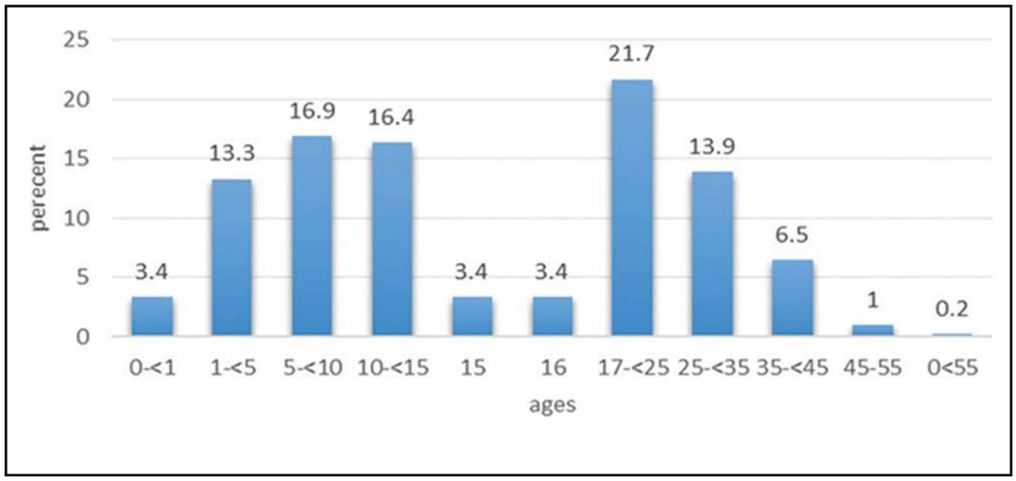

Figure 1: Distribution of patients with age- related cystic fibrosis (1938-2022) of patients

3. LITERATURE SURVEY: NUTRITIONAL CONSIDERATIONS AND DISEASE MANAGEMENT

Nutritional management is crucial in the comprehensive care of cystic fibrosis (CF) patients, playing a pivotal role in their overall health and quality of life. However, in the Indian context, addressing the nutritional needs of CF patients presents unique challenges stemming from dietary differences, cultural practices, and varying nutritional statuses.

3.1 Dietary Differences and Cultural Practices:

Indian cuisine is diverse and rich in spices, flavors, and ingredients, which may differ significantly from the typical Western diet often referenced in CF nutritional guidelines. Cultural practices surrounding food preparation, meal timing, and dietary preferences can influence the dietary intake and adherence of CF patients [14]. For instance, traditional Indian diets may include high-carbohydrate foods like rice and wheat-based products, which can pose challenges in meeting the high-calorie and high-fat requirements recommended for CF patients.

3.2 Malnutrition and Poor Weight Gain:

Malnutrition and poor weight gain are prevalent among Indian CF patients, largely attributed to factors such as pancreatic insufficiency, malabsorption of nutrients, and increased energy expenditure due to chronic illness. These challenges are exacerbated by limited access to nutritional resources and specialized dietary support in certain regions of India [15].

3.3 Multidisciplinary Approach to Nutritional Management:

Optimal nutritional management in CF necessitates a multidisciplinary approach involving healthcare professionals such as dietitians, gastroenterologists, pulmonologists, and nurses [16]. This approach aims to address various aspects of nutrition, including dietary counseling, monitoring of growth and nutritional status, management of pancreatic insufficiency through enzyme replacement therapy, and supplementation of fat-soluble vitamins [17].

3.4 Cultural Sensitivity and Adaptation of Dietary Recommendations:

Implementing nutritional strategies for CF patients in India requires cultural sensitivity and adaptation of dietary recommendations to align with cultural norms and preferences. Healthcare providers must work

closely with patients and their families to develop dietary plans that are both nutritionally adequate and culturally acceptable [18]. This may involve modifying traditional recipes, incorporating locally available ingredients, and accommodating religious or cultural dietary restrictions.

3.5 Innovative Approaches to Address Adherence and Compliance:

Ensuring adherence to nutritional interventions can be challenging, particularly in a diverse country like India with varying socioeconomic backgrounds and healthcare access. Innovative approaches such as telemedicine, mobile health applications, and community-based nutritional support programs can help overcome barriers to adherence and improve compliance with dietary recommendations [19].

In conclusion, addressing the nutritional needs of CF patients in India requires a tailored approach that takes into account dietary differences, cultural practices, and socioeconomic factors. By adopting a multidisciplinary approach, promoting cultural sensitivity, and embracing innovative strategies, healthcare providers can optimize nutritional management and enhance the overall well-being of Indian CF patients considering Diet Plan for Cystic Fibrosis Patients [20].

4 Key Considerations:

A well-balanced and nutritious diet is essential for individuals with cystic fibrosis (CF) to maintain optimal health, support growth and development, and manage the unique nutritional challenges associated with the condition. The primary goals of a CF-specific diet plan are to meet increased energy and nutrient requirements, optimize digestion and absorption of nutrients, prevent malnutrition, and support overall well-being.

4.1 High-Calorie, High-Protein Foods:

- CF patients often have increased energy needs due to the energy expended during breathing and the metabolic demands of chronic inflammation and infection. Therefore, the diet should be rich in high-calorie, high-protein foods to meet these increased energy requirements and support growth and weight maintenance [21].
- Include protein-rich foods such as lean meats, poultry, fish, eggs, dairy products, legumes, nuts, and seeds in the diet to support muscle growth and repair, immune function, and enzyme production [26].

4.2 Pancreatic Enzyme Replacement Therapy (PERT):

- Many individuals with CF have pancreatic insufficiency, leading to impaired digestion and absorption of fats, proteins, and fat-soluble vitamins. Pancreatic enzyme replacement therapy (PERT) is essential to aid in the digestion of fats and improve nutrient absorption [22].
- Take PERT with meals and snacks as prescribed by a healthcare provider to optimize digestion and prevent malabsorption-related complications [25].

4.3 Balanced Macronutrient Intake:

- Aim for a balanced intake of macronutrients, including carbohydrates, proteins, and fats, to provide sustained energy and support various metabolic functions.
- Choose complex carbohydrates such as whole grains, fruits, vegetables, and legumes to provide fiber, vitamins, and minerals while regulating blood sugar levels.
- Include healthy fats from sources such as olive oil, avocados, nuts, seeds, and fatty fish to support cardiovascular health, inflammation modulation, and nutrient absorption [23].

4.4 Micronutrient-Rich Foods:

- Ensure adequate intake of micronutrients, including vitamins and minerals, to support immune function, bone health, and overall well-being.
- Focus on nutrient-dense foods such as fruits, vegetables, whole grains, lean meats, and dairy products to obtain essential vitamins and minerals, including vitamin D, calcium, iron, zinc, and antioxidants [24].

- Consider supplementation with fat-soluble vitamins (A, D, E, and K) and other micronutrients as recommended by a healthcare provider based on individual needs and deficiencies [26].

4.5 Hydration:

- Stay adequately hydrated by consuming plenty of fluids throughout the day, especially during periods of increased respiratory secretions, sweating, or physical activity.
- Opt for water, herbal teas, electrolyte-rich beverages, and low-sugar fluids to maintain hydration status and support optimal respiratory function and mucous clearance [21].

Table: 1. 7-day sample meal plan for individuals with Cystic Fibrosis (CF)

Day	Meal	Food Items	Calories
1	Breakfast	Vegetable oats upma, boiled egg, fortified milk	570
	MidMorning Snack	Greek yogurt with berries and honey	150
	Lunch	Dal tadka with brown rice, mixed vegetable salad	550
	Afternoon Snack	Roasted chickpeas, carrot sticks with hummus	300
	Dinner	Grilled chicken with spinach and roti, raita	550
	Evening Snack	Mixed nuts, herbal tea	200
	Total Calories for Day 1	**Approximately 2320 calories**	
2	Breakfast	Masala omelette with whole wheat toast, fresh orange juice	550
	MidMorning Snack	Cottage cheese with pineapple	200
	Lunch	Chana masala with quinoa, cucumber and tomato salad	500
	Afternoon Snack	Apple slices with almond butter	200
	Dinner	Fish curry with brown rice, mixed vegetable stirfry	550
	Evening Snack	Homemade energy bar, buttermilk	200
	Total Calories for Day 2	**Approximately 2400 calories**	
3	Breakfast	Vegetable poha, fortified soy milk	450
	MidMorning Snack	Greek yogurt with berries and granola	200
	Lunch	Palak paneer with roti, cucumber and mint salad	500
	Afternoon Snack	Mixed nuts and dried fruits trail mix	250
	Dinner	Tandoori chicken with roasted sweet potatoes, spinach salad	500
	Evening Snack	Roasted chickpeas, herbal tea	200
	Total Calories for Day 3	**Approximately 2100 calories**	

4	Breakfast	Vegetable dosa with sambar, fresh pineapple juice	550
	MidMorning Snack	Cottage cheese with guava	200
	Lunch	Chicken curry with brown rice, kachumber salad	500
	Afternoon Snack	Banana smoothie	250
	Dinner	Mixed dal with roti, stir fried vegetables	450
	Evening Snack	Mixed nuts, buttermilk	200
	Total Calories for Day 4	**Approximately 2150 calories**	
5	Breakfast	Masala omelette with whole wheat toast, fortified milk	500
	MidMorning Snack	Greek yogurt with berries and honey	200
	Lunch	Rajma with quinoa, cucumber and tomato salad	500
	Afternoon Snack	Mango slices	150
	Dinner	Tandoori fish with quinoa pulao, spinach salad	500
	Evening Snack	Roasted chickpeas, herbal tea	150
	Total Calories for Day 5	**Approximately 2000 calories**	
6	Breakfast	Vegetable upma with fortified milk	450
	MidMorning Snack	Greek yogurt with mixed berries and granola	200
	Lunch	Paneer tikka with roti, mixed vegetable salad	500
	Afternoon Snack	Roasted chickpeas, carrot sticks with hummus	300
	Dinner	Chicken biryani with cucumber raita	650
	Evening Snack	Mixed nuts, herbal tea	200
	Total Calories for Day 6	**Approximately 2300 calories**	
7	Breakfast	Masala omelette with whole wheat toast, fortified soy milk	500
	MidMorning Snack	Greek yogurt with berries and honey	200
	Lunch	Chole with brown rice, mixed vegetable salad	500
	Afternoon Snack	Apple slices with almond butter	200
	Dinner	Tandoori fish with quinoa pulao, spinach salad	500
	Evening Snack	Roasted chickpeas, herbal tea	150
	Total Calories for Day 7	**Approximately 2050 calories**	

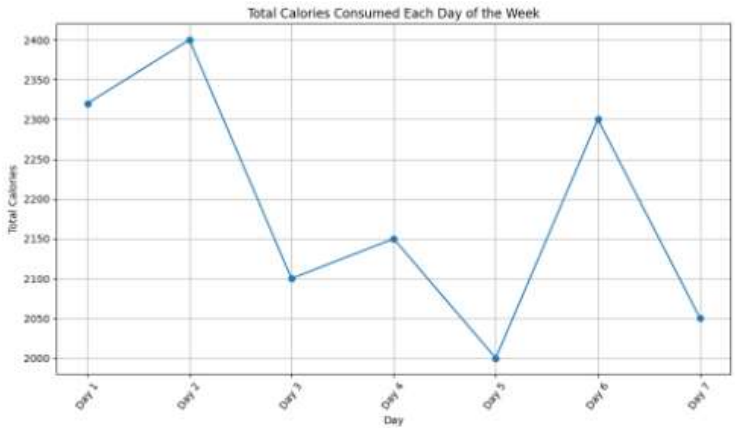

Figure 2: Analysis of calories consumption

4. Future Scope

Despite advancements, significant research gaps persist in understanding the epidemiology, genotype-phenotype correlations, and long-term outcomes of CF in India [27]. Prospective studies and longitudinal research are imperative to elucidate the disease's trajectory and inform evidence-based clinical practices. Addressing socioeconomic and cultural barriers is paramount for improving access to care and outcomes for Indian CF patients. By fostering an integrated approach that combines medical, nutritional, and social support, we can enhance the quality of life and health outcomes for individuals affected by this debilitating genetic disorder.

Cystic fibrosis represents a significant health challenge for Indian patients, with increasing recognition of the disease burden and associated complexities over the past decade. While progress has been made in diagnosis, management, and research efforts, considerable work remains to be done to address the unique needs of Indian CF patients and improve their outcomes. By advancing our understanding of cystic fibrosis in the Indian context and implementing evidence-based strategies for care delivery, we can strive towards better health outcomes and quality of life for all individuals affected by this debilitating genetic disorder.

5. Conclusion

The journey from diagnosis to dietary intervention in managing cystic fibrosis (CF) among Indian patients underscores the critical role of nutritional management in improving health outcomes. Historically underdiagnosed, CF in India has gained increasing recognition, revealing a higher prevalence and complex challenges that necessitate tailored strategies. The clinical presentation of CF in Indian patients often parallels that of Western populations; however, the presence of diverse CFTR mutations introduces significant diagnostic and genetic counseling complexities. These genetic variations require robust diagnostic frameworks and enhanced genetic counseling capabilities to ensure accurate identification and management of the disease. Socioeconomic disparities exacerbate the challenges faced by CF patients in India. Limited access to specialized care, diagnostic facilities, and essential medications, compounded by financial constraints, geographical barriers, and inequities in healthcare infrastructure, impedes effective disease management. These disparities highlight the need for targeted interventions that enhance access to care, particularly for patients in rural and underserved regions. Financial support mechanisms, improved healthcare policies, and the establishment of specialized CF centers are crucial steps toward mitigating these barriers.

Malnutrition and poor weight gain are prevalent among Indian CF patients, emphasizing the necessity for culturally sensitive nutritional management strategies. Dietary interventions should account for local dietary practices, availability of food resources, and cultural preferences to ensure adherence and

effectiveness. Multidisciplinary approaches involving dietitians, healthcare providers, and community support systems are essential to address the nutritional needs of CF patients comprehensively.

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REFERENCES

[1] S. K. Kabra, M. Kabra, R. Lodha, and S. Shastri, "Cystic fibrosis in India," *Pediatric Pulmonology*, vol. 42, no. 12, pp. 1087–

1094, doi: 10.1002/ppul.20677.

[2] S. K. Kabra, "Cystic fibrosis in India: past, present and future," *HSOA Journal of Pulmonary Medicine & Respiratory Research*,

vol. 1, no. 1, pp. 1–8, Dec. 2015, doi: 10.24966/pmrr-0177/100002.

[3] A. L. Quittner *et al.*, "Prevalence of depression and anxiety in patients with cystic fibrosis and parent caregivers: results of The

International Depression Epidemiological Study across nine countries," *Thorax*, vol. 69, no. 12, pp. 1090–1097, Sep. 2014, doi:

10.1136/thoraxjnl-2014-205983.

[4] S. S. Shastri, M. Kabra, S. K. Kabra, R. M. Pandey, and P. S. N. Menon, "Characterisation of mutations and genotype–phenotype

correlation in cystic fibrosis: Experience from India," *Journal of Cystic Fibrosis*, vol. 7, no. 2, pp. 110–115, Mar. 2008, doi:

10.1016/j.jcf.2007.06.004.

[5] M. Di Rocco, R. Biancheri, A. Rossi, M. Filocamo, and P. Tortori-Donati, "Genetic disorders affecting white matter in the

pediatric age," *American Journal of Medical Genetics. Part B, Neuropsychiatric Genetics*, vol. 129B, no. 1, pp. 85–93, May

2004, doi: 10.1002/ajmg.b.30029.

[6] C. Daly, P. Ruane, K. O'Reilly, L. Longworth, and G. Vega-Hernandez, "Caregiver burden in cystic fibrosis: a systematic

literature review," *Therapeutic Advances in Respiratory Disease*, vol. 16, p. 175346662210864, Jan. 2022, doi:

10.1177/17534666221086416.

[7] M. D. Amaral, "Novel personalized therapies for cystic fibrosis: treating the basic defect in all patients," Journal of Internal Medicine, vol. 277, no. 2, pp. 155–166, Jan. 2015, doi: 10.1111/joim.12314.

[8] T. F. Ashavaid, R. Raghavan, P. Dhairyawan, and S. Bhawalkar, "Cystic fibrosis in India: a systematic review.," PubMed, vol. 60, pp. 39–41, Aug. 2012, [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/23405520
[9] M. C. Goodchild, "Nutritional management of cystic fibrosis," Digestion, vol. 37, no. 1, pp. 61–67, Jan. 1987, doi: 10.1159/000199543.
[10] M. E. McGarry, W. A. Williams, and S. A. McColley, "The demographics of adverse outcomes in cystic fibrosis," Pediatric Pulmonology, vol. 54, no. S3, Nov. 2019, doi: 10.1002/ppul.24434.
[11] M. Zampoli, B. M. Morrow, and G. Paul, "Real-world disparities and ethical considerations with access to CFTR modulator drugs: Mind the gap!," Frontiers in Pharmacology, vol. 14, Mar. 2023, doi: 10.3389/fphar.2023.1163391.
[12] E. M. Zani et al., "Nutritional Care in Children with Cystic Fibrosis," Nutrients, vol. 15, no. 3, p. 479, Jan. 2023, doi: 10.3390/nu15030479.
[13] M. Sharma and M. Singh, "Nutritional management of children with cystic fibrosis.," PubMed, vol. 40, no. 11, pp. 1055–62, Nov. 2003, [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/14660836
[14] L. Thomas et al., "Effect of malnutrition in infants with cystic fibrosis in India: An underestimated danger," Journal of Family Medicine and Primary Care, vol. 10, no. 5, p. 1994, Jan. 2021, doi: 10.4103/jfmpc.jfmpc_2421_20.
[15] M. D. Amaral, "Novel personalized therapies for cystic fibrosis: treating the basic defect in all patients," Journal of Internal Medicine, vol. 277, no. 2, pp. 155–166, Jan. 2015, doi: 10.1111/joim.12314.
[16] D. Patel, A. Shan, S. Mathews, and M. Sathe, "Understanding cystic fibrosis comorbidities and their impact on nutritional management," Nutrients, vol. 14, no. 5, p. 1028, Feb. 2022, doi: 10.3390/nu14051028.
[17] S. S. Shastri, M. Kabra, S. K. Kabra, R. M. Pandey, and P. S. N. Menon, "Characterisation of mutations and genotype–phenotype correlation in cystic fibrosis: Experience from India," Journal of Cystic Fibrosis, vol. 7, no. 2, pp. 110–115, Mar. 2008, doi: 10.1016/j.jcf.2007.06.004.
[18] C.-M. Lăcătușu, E.-D. Grigorescu, M. Floria, A. Onofriescu, and B.-M. Mihai, "The Mediterranean Diet: From an Environment-Driven food culture to an emerging medical prescription," International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health, vol. 16, no. 6, p. 942, Mar. 2019, doi: 10.3390/ijerph16060942.
[19] A. MacDonald, "Nutritional management of cystic fibrosis.," Archives of Disease in Childhood, vol. 74, no. 1, pp. 81–87, Jan. 1996, doi: 10.1136/adc.74.1.81.
[20] C. M. McDonald et al., "Academy of Nutrition and Dietetics: 2020 Cystic Fibrosis Evidence Analysis Center Evidence-Based Nutrition Practice Guideline," Journal of the Academy of Nutrition and Dietetics, vol. 121, no. 8, pp. 1591-1636.e3, Aug. 2021, doi: 10.1016/j.jand.2020.03.015. [24] N. Stylos and J. Zwiegelaar, *Big Data as a Game Changer: How Does It Shape Business Intelligence Within a Tourism and Hospitality Industry Context?* 2019.
[21] https://www.cff.org/managing-cf/healthy-high-calorie-eating

[22] https://cystic-fibrosis.com/treatment/pancreatic-enzymes-supplements

[23] https://www.medicalnewstoday.com/articles/326138

[24] https://kidshealth.org/en/teens/cf-dietary.html
[25] P. N. Freswick, E. K. Reid, and M. R. Mascarenhas, "Pancreatic enzyme replacement therapy in cystic fibrosis," Nutrients, vol. 14, no. 7, p. 1341, Mar. 2022, doi: 10.3390/nu14071341.
[26] M. P. K. J. Engelen, G. Com, and N. E. P. Deutz, "Protein is an important but undervalued macronutrient in the nutritional care of patients with cystic fibrosis," Current Opinion in Clinical Nutrition and Metabolic Care, vol. 17, no. 6, pp. 515–520, Nov. 2014, doi: 10.1097/mco.0000000000000100.
[27] B. O. V. Shum, G. Bennett, A. Navilebasappa, and R. K. Kumar, "Racially equitable diagnosis of cystic fibrosis using next-generation DNA sequencing: a case report," BMC Pediatrics, vol. 21, no. 1,

Mar. 2021, doi: 10.1186/s12887-021-02609-z.

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