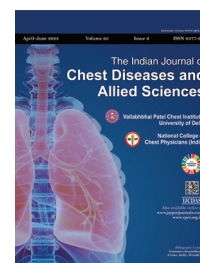


Diets and Chronic Lung Diseases: A Narrative Review

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ABSTRACT

Chronic respiratory diseases like chronic obstructive pulmonary disease (COPD), tuberculosis, obstructive sleep apnea (OSA), and asthma contribute significantly to the mortality of the human population. Many advances exist in treating chronic lung disease, but clinicians and researchers must address dietary intervention better. Malnutrition has a bidirectional link with tuberculosis (TB). Calorie-rich and protein-rich diets are to be advised to the TB patient. Cachexia is detrimental as well as obesity increases the risk of cardiovascular mortality. So optimal weight management is very much crucial in COPD management. A vitamin D-rich diet rich in fiber and polyunsaturated fatty acid (PUFA) is to be included in the diet of COPD patients. Oily, salt food is to be avoided by asthma patients. Junk and oily food increase the risk of asthma exacerbation. Milk consumption does not affect asthma symptoms to be included in an asthma patient's diet. Weight reduction will improve the apnea-hypopnea index in OSA patients. Low carbohydrate food is to be advised for OSA patients. India is culturally diverse. So diet chart will be provided to all chronic lung disease patients based on individual, social, and cultural needs.

Keywords: Body mass index, Chronic lung diseases, Diet, Malnutrition, Tuberculosis, Vitamin D.

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ABBREVIATIONS USED IN THIS ARTICLE

BMI = Body mass index; COPD = Chronic obstructive pulmonary disease; OSA = Obstructive sleep apnea; PUFA = Polyunsaturated fatty acid; TB = Tuberculosis.

INTRODUCTION

In the words of Hippocrates, often regarded as the father of medicine, the idea is expressed as, "Allow your food to be your medicine and let your medicine be your food". This is also very much applied to modern medicine. Much more has been described regarding the medicinal value of food. Less known about food can be used as medicine. Chronic lung diseases like chronic obstructive pulmonary disease (COPD), asthma, obstructive sleep apnea (OSA), and tuberculosis (TB) are the leading cause of death. It is estimated that the global prevalence of COPD is 10.3%.¹ Chronic obstructive pulmonary disease is the third leading cause of death UK. India contributes significantly to the global TB burden. In India, in 2020, 4.93 lakhs of people died due to Tuberculosis.²

Less-known diet modification and nutrition are essential approaches to improving various chronic lung conditions. These methods are gaining recognition as factors that can be modified and contribute to the development and progression of chronic diseases. The customized diet plan is a part of the management protocol for chronic lung diseases. This review intends to know the role of diet in various lung diseases and what diet to take from patients with chronic lung diseases.

TUBERCULOSIS

As per the World Health Organization (WHO), approximately 10 million individuals worldwide were projected to contract TB in

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the year 2020, with an estimated 1.5 million succumbing to the disease.³ India shares the fourth global burden of TB. Most TB cases are due to the reactivation of TB. Malnutrition is a recognized risk factor for the advancement of latent TB infection to active TB. Undernutrition leads to more reactivation of TB cases than human immunodeficiency virus (HIV) globally.⁴ Without treating malnutrition, it is impossible to eliminate TB. Malnutrition has a bidirectional link with TB. Malnutrition leads to the reactivation of TB and relapse, mortality, and late smear conversion. One-quarter of TB in the world result from malnutrition.⁵ Tuberculosis predisposes individuals to malnutrition, significantly elevating the risk of progressing from latent TB to active TB by 6–10 times.⁵ The host's protective immune mechanism against Mycobacteria like monocyte-macrophages phagocytosis, T-lymphocytes, and their

cytokines function are impaired in malnutrition. So nutritional support plays a significant role in tuberculosis treatment.

Diets for TB Patients

According to the Government of India Health and Family Welfare guidelines, the calorie requirement for a TB patient will be 40 calories/kg/day.⁶ This requirement is based on the lifestyle and the workplace of the patient. The lower acceptable range of body mass index (BMI) in our country, as per the National TB Elimination Programme India, is 18.5kg/m², whereas the desirable BMI corresponds to 21kg/m².⁶ The recommended dietary intake suggests that carbohydrates should constitute 55–75% of the total energy consumed.⁶ Proteins should comprise around 10–15% of the total energy intake, which is 1.2–1.5 gm/kg ideal body weight per day.⁶ Fat intake is recommended to constitute 15–30% of the total daily energy intake.⁶ The diet can be modified according to the associated comorbidities associated with TB.

Vitamin A

According to the study by Brendan K Podell, TB Patients have 3.59 times (95% CI, 2.05–6.29) more likely to have been vitamin A deficient than matched control.⁷ The simultaneous supplementation of zinc and vitamin A demonstrated a significant association with heightened sputum smear conversion at 2 months (RR: 1.16, 95% CI: 1.03–1.32). However, no impact on treatment success was observed.⁸ So vitamin-rich diet should be provided to the TB patient.

Selenium and Zinc

Cellular killing by macrophages was found to be reduced during zinc deficiency.⁹ Zinc and selenium concentrations were significantly lower in patients of TB.¹⁰

Vitamin D

A deficiency in vitamin D is linked to an increased risk of contracting TB. Vitamin D-deficient individuals are more susceptible to developing TB and worse disease outcomes.¹¹ The average vitamin D level was notably lower in TB patients when compared to a group of healthy, age-matched control adults.¹² Females, individuals aged 21–40 years, and patients with elevated bacillary levels or those infected with the rifampicin-resistant strain exhibit markedly lower vitamin D levels.¹² Vitamin D supplementation among children leads to faster resolution of fever, and cough 2022.¹³

Dietary Advice for Tuberculosis Patients

Nutritional status assessment should be conducted for every patient diagnosed with tuberculosis. If a BMI less than 18.5 kg/m² is observed, then the patient should be given nutrition advice. The patient should provide an individualized diet chart for adequate weight gain. Patients should supplement with vitamin-rich as well as an s calorie-rich diets.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chronic obstructive pulmonary disease is a multifactorial inflammatory disease causing a significant burden worldwide and in India also. It is the second leading cause of death in India.¹⁴ The current prevalence of COPD is 11.4% in urban areas and 6% in rural area.¹⁴ Growing awareness acknowledges that diet and nutrition play significant roles as factors that can be modified to influence the onset and progression of chronic diseases. Multiple studies

provide substantial evidence highlighting the crucial role of dietary habits during early life in the development and management of obstructive lung diseases.

Nutrition and Chronic Obstructive Pulmonary Disease

Obesity

According to findings from the PLATINO study, the occurrence of obesity among individuals with COPD stood at 23%, while it was higher at 32% among those without COPD.¹⁵ There are controversial results across the world regarding COPD and obesity. There are reports indicating that being overweight or having mild obesity in the context of COPD is linked to enhanced survival rates.¹⁶ It has been a well-established observation that obese individuals tend to experience greater symptoms of breathlessness and encounter more limitations during exercise, irrespective of whether they have airflow limitations or not.¹⁷ Obesity increases the other complications of COPD like heart failure and diabetes.¹⁸ Due to the existence of the 'obesity paradox,' the optimal therapeutic approach for addressing obesity in COPD remains uncertain. Clinicians encounter a dilemma when advising weight loss for obese COPD patients, as while it may enhance cardiovascular outcomes, it could potentially exacerbate respiratory effects and elevate the risk of mortality. Advising weight loss to older people may be problematic because weight loss doesn't only involve the reduction of fat but may also entail the loss of skeletal muscle mass. Loss of skeletal muscle mass among COPD patients will be detrimental. So how much weight loss is required and how an older COPD patient will lose weight without losing muscle mass requires research.

Low Body Mass Index

The primary contributors to pulmonary cachexia in COPD include factors such as tissue hypoxia, disuse atrophy, alterations in metabolism and caloric intake, oxidative stress, aging, inflammation, the use of glucocorticoids, and malnutrition.¹⁹ Individuals with COPD who start with a BMI below 20 kg/m² or experience weight loss over a one-year follow-up period face an elevated risk of acute exacerbations, coupled with a heightened mortality rate. In contrast, those with a BMI equal to or exceeding 20 kg/m² or those without weight loss exhibit a comparatively lower risk of acute exacerbations and mortality among COPD patients.²⁰ Cachectic patients had a greater than three-fold increase in mortality.²¹ So maintaining optimal weight is required for COPD patient.

Vitamin D

A deficiency in vitamin D has been associated with the advancement of COPD. Randomized control has shown vitamin D supplementation has a significant effect number of acute exacerbations in COPD if given for prolonged periods.²² Randomized control trials have demonstrated that the supplementation of vitamin D effectively and safely decreased the frequency of moderate to severe exacerbations in COPD patients with initial 25-hydroxyvitamin D levels below 25 nmol/L. However, there was no significant reduction in exacerbation rates observed in individuals with higher baseline vitamin D levels.²³ Vitamin D deficiency is highly prevalent throughout the Indian subcontinent, affecting a significant proportion of the general population, with estimates ranging from 70 to 100%.²⁴ So food rich in vitamin D is to be added to the food of COPD patients.

Dietary Fibers

High dietary fiber decreases the risk of COPD in current and ex-smokers.²⁵ So dietary fiber has a role in the prevention of COPD. Greater intake of dietary fiber has a role in better lung function in COPD by improving gut immunity and reducing systemic inflammation.²⁶ Food-rich dietary fiber will be added to smokers' and COPD patients' diets.

Polyunsaturated Fatty Acid

The favorable impacts of polyunsaturated fatty acids (PUFA) on exercise capacity in patients cannot be solely attributed to a reduction in systemic levels of C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-alpha). However, these findings suggest that PUFA still exhibits beneficial effects on exercise capacity in individuals.²⁷

Dietary Advice for COPD

Maintenance of adequate weight is quite crucial in COPD patients. Obesity and low BMI are both harmful to the patient. So diet plan and weight maintenance plan should be individualized. Patients with COPD should be provided with a high-fiber, vitamin D-rich diet.

ASTHMA

Obesity and Asthma

In 2019, an estimated 262 million people worldwide were affected by asthma, and it was responsible for approximately 455,000 deaths. Asthma is a significant public health concern due to its prevalence and potential to cause severe respiratory symptoms and even fatalities. Obesity is a known risk factor for the development and exacerbation of asthma. British Thoracic Society Difficult Asthma Registry suggests a higher prevalence of obesity among adults with severe asthma compared to the general population. According to the British Thoracic Society Difficult Asthma Registry, the prevalence of asthma among obese patients was 48% whereas in the general population it is 26%.²⁸ Asthma may, on occasion, predispose to obesity; both may co-exist. obese children are more likely to experience increased asthma severity, poorer disease control, lower quality of life, and more frequent exacerbations compared to their non-obese counterparts. The relationship between obesity and asthma is complex and involves various mechanisms. Comparison between obese, overweight, and normal-weight asthmatics showed that obese group exhibited more requirement of drugs; significant more gastroesophageal reflux disease, decreases FVC and increased in carbon monoxide transfer coefficient.²⁸ Obesity with asthma increases hospitalization by 4–6 fold in comparison to lean adults with asthma.²⁹ Weight reduction in asthma patients is associated with a remarkable reduction of mean values of IL6, TNF- α , and IL8.³⁰ Using a structured weight management program over 16 weeks results in clinically significant improvements in asthma control and quality of life in comparison to standard care.³¹

Asthma and Junk Food

According to the randomized control trial by Wood et al., Asthma patients who used to take low antioxidant-rich food had more exacerbation and lesser forced expiratory volume (FEV)1 in spirometry.³² Processed foods, and added sugars, have been associated with several health concerns. Research suggests that a Western dietary pattern may contribute to asthma in children.³³

Excess intake of fast food and processed salty food among children correlates with asthma, wheezing, and airway hyper-responsiveness.³⁴ In adults, a Western diet pattern has also been associated with frequent asthma exacerbation.³⁴ Among specific diets, fruit and cooked green vegetable intake was associated with a low prevalence of wheezing and asthma in school children.³⁵ A systematic review and meta-analysis has shown that less intake of fruit and vegetables may lead to the development of asthma and allergies. Fruit and green leafy vegetable are to be added to the food of the patient with asthma.³⁶

Dairy Product and Asthma

In India, common misconception is that milk consumption may aggravate asthma symptoms. According to a NHANES analysis of 2007–2012, there was no association between milk consumption and lung function.³⁷ Milk consumption has a protective effect on hay fever and asthma.³⁸ It has a negative impact on lung function.³⁸ Drinking milk was associated with a lower risk of hay fever: OR = 0.791 (95% CI: 0.636, 0.982, and asthma: OR = 0.587 (95% CI: 0.442, 0.779, $p = 0.001$).³⁸

Vitamin D in Asthma

Consumption of vitamin D during pregnancy decreases the risk of asthma and wheezing in childhood.³⁹ Vitamin D supplementation during pregnancy was associated with a reduction in childhood wheeze (OR ranged from 0.58; 95% CI 0.38–0.88 to 0.81; 95% CI, 0.67–0.98) in meta-analyses.⁴⁰ Vitamin D insufficiency is also linked to asthma severity. According to a meta-analysis done by Mingming Wang, vitamin D supplementation decreases asthma exacerbation significantly, also, there was an improvement of FEV1% among asthma patients who had baseline vitamin D deficiency.⁴¹

Dietary Advice for Asthma

Obesity increases asthma exacerbation and poor asthma control, so patients with asthma and obesity should be provided with a low-carbohydrate diet plan. Fast food and processed salty food should be avoided as it increases the risk of asthma. Dairy product has no role in asthma exacerbation and can be taken by asthma patients. A vitamin D-deficient person has more asthma exacerbation and more severe asthma symptoms. So asthma patients should be advised vitamin D-rich diet.

OBSTRUCTIVE SLEEP APNEA

Obstructive sleep apnea (OSA) typically occurs when the muscles in the throat and tongue relax excessively during sleep, causing a narrowing or closure of the airway. According to the Wisconsin Sleep Study Cohort, the prevalence of moderate OSA was reported to be 17% among men and 9% among women.⁴² Obesity was one of the risk factors for the development and progression of obstructive sleep apnea. It is estimated that obese individuals are more than twice as likely to develop OSA compared to individuals of normal weight.⁴³ Additionally, the severity of OSA is often severely obese individuals.⁴³ Obesity may worsen preexisting OSA. Dietary modification plays a key role in the treatment of OSA. Among the mild OSA cases, a dietary intervention for two years leads to significant improvement of the apnea-hypopnea index (AHI) and sustained improvement in OSA symptom.⁴⁴ According to a meta-analysis done by Thomasouli et al. comparing standard care vs standard care with intensive lifestyle modification among the

patients of OSA, a significant reduction in the AHI was identified in those subjects receiving an compared intensive lifestyle modification with the control groups.⁴⁵

Lower Carbohydrate Diets

Carbohydrate diets can indeed be categorized into different types based on the amount of carbohydrates they allow. Two common types first moderate carbohydrate intake type: Carbohydrate intake typically ranges from 26 to 45% of total energy from carbohydrates. Very low-carbohydrate ketogenic diet: Carbohydrate intake is restricted to a very low level, usually around 20–50 gm per day. According to a meta-analysis by Nassib Bezerra Bueno et al., the ketogenic diet is more effective in losing weight. Compared to a low-fat diet, very-low-carbohydrate ketogenic diet causes more weight loss.⁴⁶ Decrease in upper airway neuromuscular tone is one of the pathogenic mechanisms of the development of OSA. Upper airway neuromuscular tone increases in OSA patients to the most significant degree in very low-carbohydrate diets compared to low-fat diets.⁴⁷ So low carbohydrate ketogenic diet is recommended for the management of OSA. Diabetes is one of the comorbidities associated with OSA. Low carbohydrate has a role in the management of comorbidities associated with OSA. The keto diet is challenging to follow for vegetarians. A low-fat diet is a surrogate for the keto diet.

CONCLUSION

Malnutrition has a bidirectional link with TB. Tuberculosis causes malnutrition due to suppression of appetite, and malnutrition predisposes to tuberculosis. The lower acceptable range of BMI is 18.5 kg/m². The patient should be assessed and treated for malnutrition. Protein requirement in TB is more than usual. So they should encourage a calorie-rich and protein-rich diet. Pulmonary cachexia in COPD is detrimental. So maintenance of adequate lean body mass is essential. Vitamin D has a role in the prevention of recurrent exacerbation. In India, 75% of people have vitamin D deficiency. So a diet rich in vitamin D should be adequately provided to the patient with COPD. Junk food is to be avoided by the asthma patient. Fruit and cooked green vegetable intake was associated with a low prevalence of wheezing and asthma. A diet low in fatty acids and carbohydrates allows a reduction in body weight and leads to the improvement of OSA symptoms. India is a culturally diverse country. The food habit and pattern of the southern part of India and northern India is different. So personalized diet charts to provided to the patient based on their socioeconomic and cultural practice.

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