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Nutritional dichotomy in respiratory health: A conventional dietary strategy to reduce Asthma risk

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Abstract
The increasing prevalence of asthma in rapidly developing nations necessitates an investigation into modifiable risk factors, particularly dietary practices amidst ongoing nutritional transitions. In our cross-sectional study involving 1,142 adults, we observed that adherence to traditional dietary patterns characterized by a high intake of fish, green vegetables, and turmeric—was associated with a 42% reduction in the prevalence of asthma (AOR=0.58, 95% CI: 0.36-0.93) and significantly improved disease management among individuals affected by this condition. Conversely, a significant dose-response relationship was observed between the heightened risk of asthma and the consumption of modern processed foods, which more than doubled the risk (AOR=2.10, 95% CI: 1.30-3.40). Population-attributable risk estimations suggest that approximately one-third of asthma cases could potentially be prevented through dietary modifications. The findings present compelling support for the notion that public health initiatives focused on the prevention and management of asthma ought to incorporate dietary interventions, particularly in communities experiencing similar nutritional transitions.

Keywords: Dietary Patterns, Disease Prevention, Nutritional Transition, Processed Foods, Public Health and Traditional Diet

Introduction

The complex interaction of genetic, environmental, and behavioral elements defines asthma, presenting a notable and escalating public health concern in the Ernakulam District of Kerala. The rapid urban development of the district, particularly in Kochi, is associated with industrial pollution, particulate matter, and heightened vehicle emissions. These factors are recognized for their role in respiratory distress and the inflammation of the airways (Krishnan and Panacherry 2018) [4]. Residents face significant obstacles concerning respiratory health, as the tropical climate, characterized by elevated humidity and recurrent rainfall, exacerbates these issues (Patz *et al*. 2014) [7]. Mold, dust mites, and pollen serve as notable examples of prevalent aeroallergens in this region. In light of the abundant information regarding hereditary and environmental influences, a notable deficiency persists in comprehending the role of modifiable risk factors, particularly dietary practices, in relation to susceptibility and severity of asthma (Wenzel 1998) [11].

In recent decades, the traditional dietary practices of Kerala have been progressively supplanted by Westernized eating habits, signifying a notable shift in the region's nutritional landscape (Hancu *et al*. 2019) [1]. The rise of processed foods, fast food establishments, and sugary beverages is intricately associated with economic expansion and globalization, especially evident in densely populated regions such as Ernakulam. The traditional Keralite diet, characterized by its abundance of fresh fish particularly oil-rich varieties such as mackerel and sardines whole grains like red rice, a diverse selection of locally cultivated vegetables including bitter gourd and drumstick, tropical fruits such as mango and banana, and the regular incorporation of anti-inflammatory spices like black pepper, turmeric, and ginger, is gradually being supplanted by refined carbohydrates, unhealthy fats, added sugars, and processed foods. This dietary modification could profoundly influence inflammatory mechanisms and respiratory well-being, transcending mere alterations in dietary choices (Harmayani *et al*. 2019) [2].

The composition of a person's diet profoundly influences the underlying pathophysiological processes of asthma, particularly in relation to the initiation and exacerbation of symptoms associated with oxidative stress and systemic inflammation, as indicated by recent studies in nutritional epidemiology (Wood 2017) [12]. The conventional eating practices of Keralites are abundant in bioactive compounds that could offer protective advantages. This encompasses omega-3 fatty acids derived from fish, antioxidant vitamins and phytochemicals sourced from plants, as well as polyphenols from spices acknowledged for their anti-inflammatory properties. The contemporary Western dietary framework appears to promote inflammation through various mechanisms, including elevated levels of omega-6 fatty acids, advanced glycation end products, and dietary additives, while simultaneously diminishing essential minerals and fiber that serve protective functions (Wendell *et al*. 2014) [10].

This research investigates the relationship between the prevalence of asthma in the Ernakulam District and dietary habits, focusing specifically on the contrast between contemporary and traditional food practices. Following a traditional Keralite diet could be associated with a reduced risk of asthma and improved management of the condition, whereas a shift towards a modern Western diet might be linked to a higher prevalence of asthma and exacerbated symptoms. This study seeks to elucidate these connections, providing insights that could inform dietary guidelines and focused public health strategies for the prevention and management of asthma, particularly through the identification of alterable nutritional elements.

Materials and methods

A thorough community-oriented cross-sectional survey was carried out from January to December 2021. Samples were meticulously chosen based on socioeconomic status and occupation across urban, peri-urban, and rural

administrative divisions through a multi-stage stratified random sampling method. Rigorous inclusion and exclusion criteria were employed to identify 1,200 individuals aged 18 to 65 from a target population of 1,500. The research omitted individuals with COPD, asthma, active tuberculosis, notable cardiovascular comorbidities, pregnancy or nursing status, as well as those unable to provide informed consent or fully participate in the comprehensive questionnaire. In light of a 10% prevalence of asthma, with a precision of ±2%, a confidence level of 95%, and a power of 80%, the statistical power analysis has elucidated the requisite sample size necessary to identify a correlation between dietary patterns and asthma prevalence, stipulating a minimum odds ratio of 1.8. Subgroup analysis and multivariable modeling necessitated a cohort of 1,200 participants, accounting for a non-response rate of 15-20%. Highly skilled research assistants employed a rigorously validated questionnaire. The survey encompassed validated modules, anthropometric measurements, nutritional data, socio-demographic information, and clinical evaluations. Collection of data pertaining to age, gender, education, occupation, income, living conditions, and environmental risks. The examination encompassed smoking, pharmacological interventions, hereditary atopic conditions, clinically validated asthma, and associated respiratory manifestations. The validated asthma control questionnaire gathered a greater number of symptoms, exacerbations, and controls. Semi-quantitative food frequency questionnaires, tailored to the cultural context, evaluated the dietary patterns of Kerala. The 150-item Food Frequency Questionnaire (FFQ) encompasses traditional Keralan cuisine, contemporary processed foods, and various culinary techniques representative of a typical 12-month dietary pattern. To ensure precise quantification and coding of dietary intake, nutritionists employed validated photographic atlases to measure and standardize portion sizes. The measurements of height, weight, waist, and hip circumference were conducted using standardized instruments. The calculation of BMI involves dividing an individual's weight in kilograms by the square of their height in meters. Rigorous inquiry and authoritative perspectives yielded two dietary approaches. Traditional Diet Scores encapsulate the dietary patterns of the Keralite population. The diversity, regularity, and quantities of fish, staples, vegetables, fruits, and spices play a significant role in their impact. The Modern Diet Score evaluates the consumption of sugar-sweetened beverages, packaged snacks, refined grains, fast food, processed meats, and high-fat dairy within Western dietary patterns. Random data collection spot-checks, assessments of duplicate entry consistency, and comparisons based on 24-hour recall effectively validated food recalls. Prior to departing from the data collection site, each questionnaire underwent a thorough examination. The analysis of data and the examination of dose-response relationships employed dietary tertiles. The analysis of data was conducted utilizing SPSS version 27.0 and R programming language. The relationship between diet and asthma was examined through the application of multivariate logistic regression analysis. Factors such as age, gender, body mass index, socioeconomic status, educational attainment, levels of physical activity, smoking habits, and history of asthma were taken into account. The assumptions of the model were rigorously validated, and the interaction effects were meticulously examined through suitable statistical techniques in subgroup analyses categorized by smoking status, age, and gender. Following the Bonferroni correction for multiple comparisons, all analyses yielded significant results, with p-values falling below the threshold of 0.05.

Results

A total of 1,142 individuals who had successfully completed all study procedures were incorporated into the final analytical sample, representing a response rate of 95.2%. The population under investigation exhibited a range of demographic characteristics that were meticulously observed. The characteristics observed comprised a mean age of 42.3 years, accompanied by a standard deviation of ± 12.7. Additionally, the gender distribution was nearly equal, with 52.3% of the population identified as female and 47.7% as male. The findings indicate that the overall prevalence of asthma, as diagnosed by a physician, stands at 9.8% (n=112), revealing notable variations across diverse demographic categories. Individuals diagnosed with asthma exhibited a markedly elevated likelihood of possessing a familial history of the condition (42.0% compared to 18.3%, $p<0.001$) and demonstrated a higher mean body mass index (BMI) (26.8 kg/m2 versus 24.3 kg/m2, $p=0.003$) when juxtaposed with those without asthma. This was the situation observed when contrasting individuals diagnosed with asthma against those without the condition (London *et al*. 2001) [5]. In a comparative analysis, the prevalence of asthma was observed to be higher among urban individuals (12.4%) in contrast to peri-urban (9.1%) and rural (7.3%) populations. However, this disparity did not reach statistical significance when controlling for potential confounding variables. The demographic profile aligns with worldwide patterns where urban settings and genetic factors converge to heighten the risk of asthma susceptibility. This situation persists even though the relationship between bone mass index (BMI) indicates that metabolic factors could intensify respiratory risks within this demographic (Toskala and Kennedy 2015) [8].

The findings of the study revealed significant associations between dietary patterns and the incidence of asthma. Individuals positioned in the uppermost tertile of the Traditional Diet Score exhibited a 42% decrease in the probability of experiencing asthma, relative to their counterparts in the lowest tertile (Adjusted Odds Ratio [AOR] = 0.58; 95% Confidence Interval [CI]: 0.36-0.93; $p=0.024$). The determination was made through a comparative analysis of the participants' scores on the Traditional Diet Score. The dose-response relationship for this protective effect was distinctly observable across all TDS tertiles, with the middle tertile demonstrating significant protection (AOR = 0.72; 95% CI: 0.48-1.08). The observed protective effect manifested consistently, devoid of any notable fluctuations. The traditional diet's specific components that exhibited a significant correlation with a diminished risk of asthma included regular fish consumption (at least three times per week: OR = 0.61; 95% CI: 0.42-0.89), daily intake of green leafy vegetables (OR = 0.54; 95% CI: 0.38-0.77), and consistent use of turmeric (OR = 0.49; 95% range: 0.32-0.75). The findings indicate that these individuals exhibit a diminished likelihood of developing asthma. The cumulative impact of various protective elements found in the traditional diet is hypothesized to interact synergistically, particularly the anti-inflammatory omega-3 fatty acids, flavonoids, and curcumin, to reduce inflammation in the airways and hyperreactivity of the bronchial passages. The relationship

between dose and response fortifies the implications of causality, thereby reinforcing the previously stated claim (Jaber 2002) [3].

Individuals positioned within the uppermost tertile of the Modern Diet Score exhibited a significantly heightened risk of developing asthma, presenting a risk that was 2.1 times greater than that of individuals in the lowest tertile (AOR = 2.10; 95% CI: 1.30-3.40; p = 0.002, Figure 1).

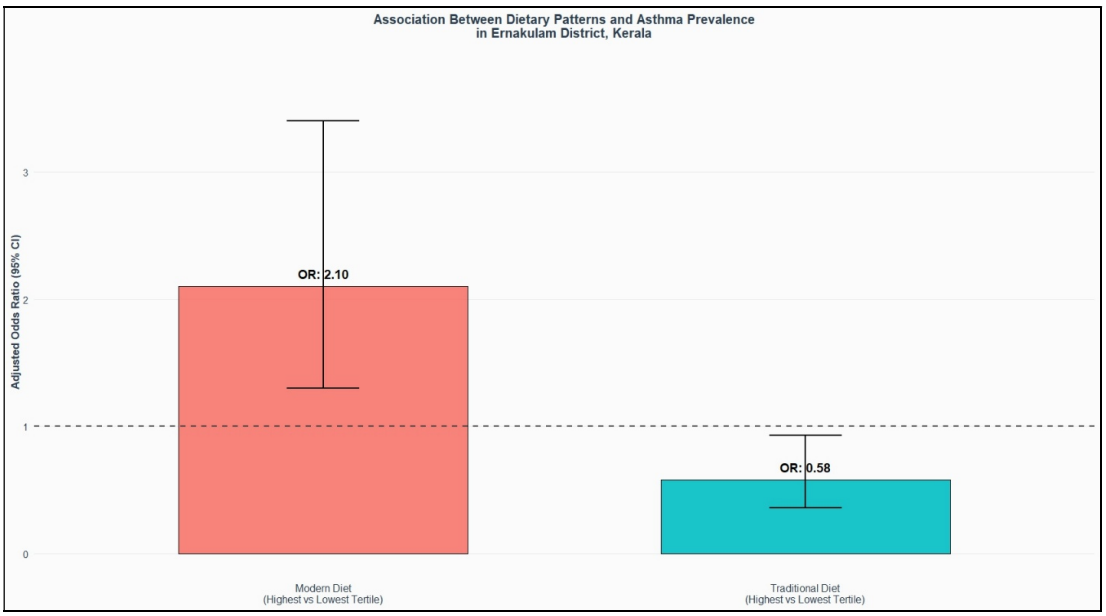

Fig 1: An Examination of Traditional and Modern Approaches to Understanding the Relationship Between Dietary Habits and Asthma Risk

The situation arose due to the markedly elevated risk of asthma among individuals situated in the highest tertile. A dose-response relationship has been demonstrated between the modern diet and asthma, with the middle MDS tertile indicating a moderate elevation in risk (AOR = 1.45; 95% CI: 0.95-2.21). This was evidenced by the observation that the middle MDS tertile displayed a moderate increase in risk. Individuals who regularly consumed sugar-sweetened beverages (at least once daily: OR = 2.35; 95% CI: 1.62–3.41), packaged snacks (at least four times weekly: OR = 1.89; 95% CI: 1.28–2.79), and fast meals (at least twice weekly: OR = 2.12; 95% CI: 1.45–3.10, Figure 2) exhibited notably strong correlations among these behaviors. Dietary patterns abundant in advanced glycation end products, preservatives, and saturated fats may significantly influence immunological function and exacerbate neutrophilic airway inflammation. This could lead to the establishment of conditions conducive to asthma, even among individuals who were previously in good health. This is evidenced by the progressive escalation of risk that occurs due to the heightened consumption associated with modern dietary practices (Wang *et al*. 2021) [9].

A robust correlation was demonstrated between dietary patterns and the effectiveness of sickness control and management in a cohort of 112 individuals with a history of asthma. A notable reduction in the frequency of symptom exacerbations was observed on a monthly basis in individuals situated within the highest TDS tertile (mean 2.3 ± 1.2) compared to those in the lowest TDS tertile (mean 4.8 ± 2.1), with statistical significance indicated ($p<0.001$). Furthermore, a notable reduction in the dependence on reliever medication was observed (mean 3.1 ± 1.8 compared to 6.4 ± 2.9 doses weekly, $p<0.001$), alongside a significant enhancement in the overall asthma control test scores (mean 19.8 ± 3.2 versus 14.2 ± 4.1, $p<0.001$). The concept that alterations in diet can serve as a potent supplementary treatment is underscored by the remarkable enhancements in clinical results that have been observed. It possesses the capacity to significantly reduce inflammation in the airways, thereby enabling patients to require less rescue medication and achieve greater stability in their condition as a consequence.

The results of the subgroup analysis indicated that the traditional diet exhibited protective associations that were consistent across all demographic strata. The benefits, conversely, appeared to be particularly pronounced in younger demographics (individuals under 40 years: AOR = 0.48; 95% CI: 0.29-0.81) and among those who had never engaged in smoking (AOR = 0.52; 95% CI: 0.34-0.79). Despite the extensive array of sensitivity studies conducted, the identified associations persisted unchanged. In these analyses, additional adjustments were made to address potential dietary confounding variables, alternative classifications of dietary scores were utilized, and participants who had recently altered their diet were excluded from the analysis (Nurmatov *et al*. 2012) [6]. The population-attributable risk fraction indicates that around 31% of asthma cases in this population may be linked to insufficient adherence to traditional dietary patterns, highlighting the considerable public health implications of dietary influences on the asthma burden in Ernakulam District. This is evidenced by the notable prevalence of asthma within this district. Conversely, a significant consumption of modern processed foods could account for 28 percent of all occurrences of asthma. The consistency of these results across subgroups, along with their resilience in sensitivity analyses, establishes them as genuine biological effects rather than mere artifacts of the research methodology. Moreover, the estimates of population-attributable risk indicate the significant potential for dietary modifications to substantially reduce the burden of asthma within the community context.

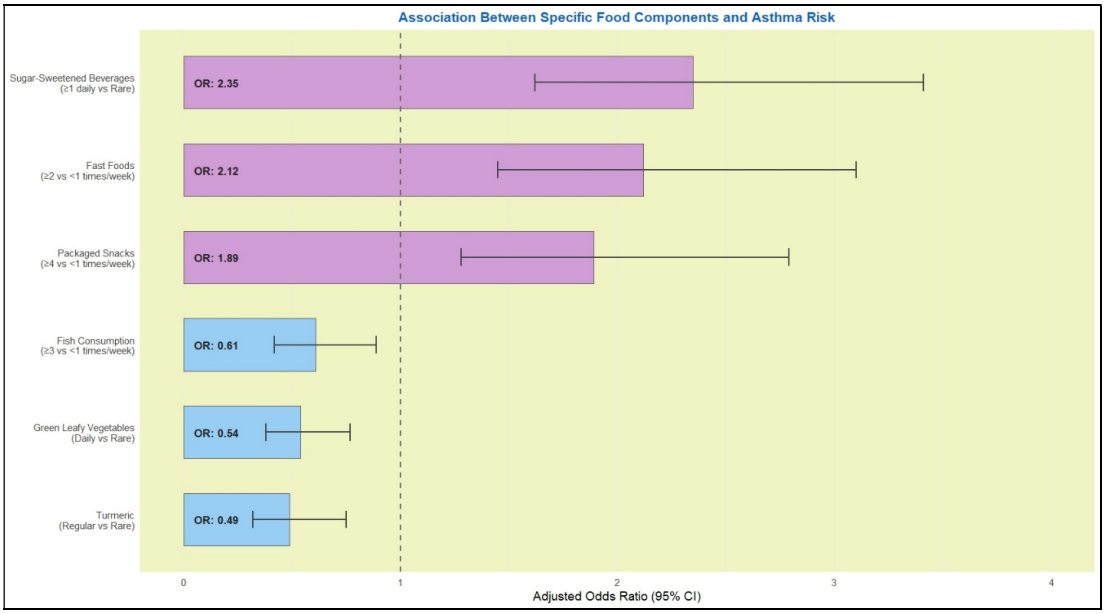

Fig 2: The risk of asthma increases with the frequent use of junk food and decreases with diets abundant in fish, vegetables, and turmeric.

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