International Journal of Scientific & Engineering Research,Volume 14, Issue 9, September-2023
ISSN 2229-5518

Uncovering Essential Dietary Components for Disease Prevention

Khadijah Sajid, Ryan Jung

Abstract—In recent years, there have been notable shifts in global dietary patterns driven by the increasing awareness of the significant impact of diet on overall health. This heightened recognition has resulted in a preference for smaller, nutrient-dense meals. Diet's essential role in disease susceptibility is evident in conditions such as cancer, diabetes, asthma, obesity, and COVID-19. Promoting a plant-based diet and reducing red meat consumption emerged as effective strategies for cancer prevention. Antioxidant properties and fatty acid modulation in fruits, vegetables, fish, and the Mediterranean diet enhance asthma immunity through nutrient diversity. In the context of type 2 diabetes, adopting a healthy diet improves insulin sensitivity, reduces inflammation, and optimizes gut microbiome health, facilitating weight loss. Essential nutrients like vitamin C, vitamin D, zinc, omega-3 fatty acids, and antioxidants are crucial in bolstering immune function and potentially mitigating complications associated with COVID-19. Integrating these factors into nutritional approaches holds promise for disease prevention and management.

Index Terms—Dietary factors, human health, wellness, disease risk, cancer, diabetes, asthma.

1 Introduction

In recent years, global dietary patterns have undergone significant transformations, driven by increased recognition of diet's profound influence on health. This awareness has prompted a preference for smaller, nutrient-dense meals. An interesting study highlighted how a vegetarian diet can stave off common diseases like diabetes and cholesterol [1]. The Center for Disease Control and Prevention (CDC) underscores that adopting a healthy diet contributes to longevity and diminishes the risk of obesity, heart disease, diabetes, and specific cancer types [2].

Cancer is a complex and devastating array of diseases within the medical community, attracting intense research and investigation. Notably, lung cancer (accounting for 1.79 million deaths), liver cancer (leading to 830,000 deaths), and gastric cancer (resulting in 769,000 deaths) emerge as primary contributors to cancer-related mortality [3]. Certain dietary habits and food components exert a substantial influence on cancer risk. For example, diets high in processed foods, sugary beverages, and unhealthy fats are associated with an elevated susceptibility to colon cancer [4]. These dietary choices, lacking in essential nutrients, contribute to weight gain, obesity, and heightened vulnerability to breast, colon, and pancreatic cancer. In contrast, a plant-based diet enriched with fruits, vegetables, whole grains, and legumes offers antioxidants and fiber that significantly contribute to cancer prevention [5].

In case of type 2 diabetes, diets rich in refined carbohydrates and detrimental fats amplify risk. Nutrient selections, including vegetables, fruits, whole grains, and lean proteins, aid in stabilizing blood sugar [6]. Mitigating processed foods and added sugars could alleviate insulin resistance [7-9] Wang et al.). An anti-inflammatory diet, abundant in vegetables, fruits, whole grains, nuts, seeds, and oily fish, emerges as beneficial for individuals grappling with asthma [10].

The emergence of COVID-19, a profoundly contagious respiratory ailment caused by the novel coronavirus SARS-CoV-2, has led in an era of monumental disruption [11]. Initially identified in Wuhan, China, in late 2019, the virus rapidly disseminated globally. By September 2021, COVID-19 had triggered widespread illness, overwhelmed healthcare systems, and resulted in significant global mortality. Extensive links have been observed between nutritional factors and their effects on immune function, impacting susceptibility, severity, and the immune response to COVID-19. A well-balanced diet, abundant in vitamins and minerals, is critical for a robust immune response [12], encompassing a diverse array of vegetables, fruits, whole grains, nuts, seeds, and lean proteins can ensure an adequate intake of immune-supportive nutrients [13]. Recognizing the interplay between dietary factors, disease susceptibility, and biological mechanisms holds significant value in upholding human health and well-being. The present review aims to shed light on recent insights regarding the interconnection between dietary elements, disease risks, and their potential role in mitigating their risks.

2 Dietary factors associated with disease risk and their possible mechanisms involved

2.1 Cancer

As diet is not the sole determinant of cancer, dietary choices play a significant role in cancer prevention and overall well-being [14]. Dietary factors are a pivotal consideration as food preferences can contribute to cancer risk [14]. Recent studies suggest a potential positive correlation between western/unhealthy eating patterns and breast cancer risk, whereas an inverse link is observed between prudent eating patterns and cancer susceptibility [15, 16]. The impacts of dietary elements on cancer risk also influence the intricate biological pathways, as depicted in Figure 1. These factors can be classified into two main categories: i) dietary components that may

- *Khadijah Sajid is working as MD at The Wright Center Graduate Medical Education, Philadelphia, USA. E-mail: khadijahsajid001@gmail.com*
- *Ryan Jung is researcher at Plamica Labs, Batten Hall, 125 Western Ave, Allston, MA 02163 USA*

IJSER

elevate cancer risk and ii) dietary components that possess the potential to mitigate cancer risk.

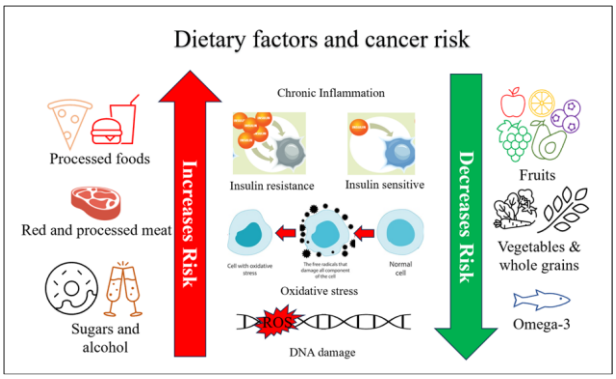

Fig 1Role of dietary factors and the mechanisms involved in cancer risk.

i)Components in the Diet that Elevate Cancer Risk

Processed Foods, Sugars, and Beverages: Cancer incidence is not solely determined by diet; dietary choices play crucial role in their prevention [17]. Diets high in processed foods, saturated fats, and sugars contribute to chronic inflammation, which fosters cancer development [17]. Sugary beverages and diets rich in added sugars are linked to an elevated risk of obesity and specific cancers, including breast and pancreatic cancer. Obesity, a recognized risk factor for various cancer types, triggers the production of hormones and growth factors within adipose tissue, perpetuating chronic inflammation and oxidative stress, thereby intensifying cancer susceptibility [18]. High-sugar and processed food diets also promote insulin resistance, which is connected to increased cancer risk [17]. Nevertheless, moderate consumption of sugary foods and drinks can assist in weight management and reduce cancer risk. Additionally, research indicates that reducing the intake of sugar-sweetened beverages and adopting healthier beverage choices could manage insulin levels and decrease the likelihood of insulin resistance, subsequently reducing the breast cancer risk [19].

Alcohol Consumption and Cancer: The development of cancer due to alcohol consumption involves multiple mechanisms, such as DNA methylation, inflammation, microbiome dysbiosis, and disruption of nutrient absorption essential for DNA synthesis and repair [18, 20]. A study conducted by Rossi et al revealed that alcohol consumption triggers alterations in various metabolic processes at the molecular level, culminating in the onset of colon cancer [21]. The oxidative and non-oxidative metabolism of alcohol, coupled with the generation of byproducts like reactive oxygen species (ROS) and metabolites, provokes a complex interplay of genetic, epigenetic, cellular signaling, and immune processes. The convergence of these diverse mechanisms has widespread effects on cancer attributes, including augmented proliferation, angiogenesis, stemness, epithelial-mesenchymal transition (EMT), oncogenic expression, and changes in immunity. These molecular modifications collectively create an environment conducive to cancer initiation and progression.

ii) Components in the Diet that Mitigate Cancer Risks

Whole Grains: The consumption of whole grains such as brown rice, whole wheat, oats, and quinoa, is associated with reduced cancer risk. Whole grains provide essential nutrients and dietary fiber, fostering digestive health and potentially lowering the risk of colorectal cancer. A study indicated that the highest intake of whole grains led to a risk reduction ranging from 5% to 12%. Dose-response analyses showed that each additional intake of 30 g of whole grains per day correlated with an approximately 7% decrease in cancer mortality risk [22]. Meta-analyses targeting site-specific cancers consistently revealed a connection between whole grain consumption and reduced cancer risk, with the most compelling evidence pointing to colorectal, gastric, pancreatic, and esophageal cancers [23].

Furthermore, research has exhibited that whole grains contain an array of unique bioactive phytochemicals with the potential to influence cellular processes and molecular pathways implicated in the development and progression of breast cancer. By modulating these signaling pathways, the bioactive compounds found in whole grains may contribute to suppressing tumor growth and decreasing breast cancer risk [23]. Another study emphasized that incorporating healthy fats, prevalent in avocados, nuts, seeds, and olive oil, into the diet can diminish cancer risk. These fats are enriched with monounsaturated and polyunsaturated fats, which are conducive to heart health and could also play a positive role in preventing cancer [24]. Diets rich in fiber and whole foods enhance insulin sensitivity and reduce the risk of cancer [17, 25]. Additionally, these foods provide antioxidants that mitigate oxidative stress and safeguard cells and DNA against damage induced by free radicals [17, 26].

Omega-3 Fatty Acids: Recognized as cancer chemopreventive agents, omega-3 fatty acids present in fish may confer protective effects against cancer by mitigating inflammation and oxidative stress, and restraining cancer cell growth [26, 27]. Conversely, diets rich in animal protein and fats can elevate estrogen levels, potentially fueling cancer growth [28, 29].

These dietary factors intricately interact with genetic and environmental factors, rendering a plant-based diet marked by decreased red meat consumption, and incorporating ample omega-3 fatty acids, antioxidants, and vitamin D, a valuable tool for cancer prevention [26]. For instance, colorectal cancer (CRC) engages shared metabolic pathways between healthy and cancerous cells. Genetic modifications in oncogenes and tumor suppressor genes steer tumorigenesis by provoking specific metabolic shifts. Mitochondrial dysfunction and heightened metabolic pathways contribute to the onset of CRC, exposing potential avenues for therapeutic intervention [20, 30]. Interventions geared toward refining metabolic function, encompassing the reduction of sugar intake and augmentation of fruit/vegetable consumption, hold promise in curbing colorectal cancer risk [31]. The strategic targeting of these pathways endows a multifaceted approach to cancer prevention and therapy, heralding the prospect of transformative changes within the field and enhancing patient well-being..

2.2 Diabetes

The correlation between type 2 diabetes and dietary

IJSER

patterns is closely intertwined, with various diets under scrutiny, including the Mediterranean diet (MedDiet), Dietary Approaches to Stop Hypertension (DASH) diet, Healthy Eating Index (HEI), and Western diet. Research findings elucidate that adopting the MedDiet, the DASH diet, and the HEI collectively reduces the risk of type 2 diabetes, while adherence to the Western diet increases the risk [32]. In a study, MedDiet reduced hemoglobin A1C (HbA1c) by 0.32 to 0.53 percentage units, indicative of effective glycemic control and a consequent decrease in type 2 diabetes risk [32]. This inverse correlation was further corroborated by the PREDIMED trial, whereas a remarkable 30% risk reduction in adverse health conditions was observed among the MedDiet groups compared to the control group [33]. This compelling evidence underscores the protective benefits of MedDiet in preventing chronic ailments and promoting overall wellness [34].

Furthermore, Mirabelli et al. suggested that adhering to the MedDiet confers protection against insulin resistance (IR)-related diseases, such as obesity and type 2 diabetes (T2D) [25]. A study involving 4,430 women with a history of gestational diabetes unveiled a 19% lowered risk of diabetes among those demonstrating higher adherence to the MedDiet [35]. In a cohort study encompassing 13,521 Japanese residents, higher soy consumption, a fiber source, was associated with significantly lower diabetes risk among women [36].
Conversely, the Western diet rich in refined carbohydrates, processed foods, and unhealthy fats drives obesity, insulin resistance, and inflammation, elevating the susceptibility to type 2 diabetes [32]. A Canadian study revealed a 37% greater risk of diabetes among adults consuming higher proportions of highly processed foods [37]. Another research reported a 25% augmented risk of developing type 2 diabetes with a 10% increase in the consumption of highly processed foods [38]. Similarly, heightened use of ultra-processed foods was linked to a 40% greater risk of diabetes [39].

Micronutrients also play a pivotal role in diabetes prevention or development. Magnesium, zinc, and vitamin D deficiency have been associated with impaired insulin sensitivity and glucose metabolism, fostering disease development. Moreover, dietary fiber from whole grains and legumes attenuates glucose absorption, enhancing insulin sensitivity and reducing diabetes risk [40]. In a cohort study involving 13,608 adults, a high-fat diet and streptozotocin administration led to insulin resistance and glucose fluctuations [41].

Plant-based diets, rich in anti-inflammatory compounds like omega-3 fatty acids, polyphenols, and flavonoids, mitigate inflammation, enhance insulin sensitivity, and diminish type 2 diabetes risk. The composition of the gut microbiome also impacts diabetes risk, with high-fiber diets fostering beneficial gut bacteria growth and improved gut barrier function [42]. Additionally, research on mice exhibited that green tea components modulate bacterial communities, with specific groups linked to blood sugar regulation [43].

2.3 Asthma/Inflammatory Diseases

Various lifestyle and dietary strategies enhance the immune response and reduce asthma risk. Antioxidant-rich vegetables and fruits are vital in protecting the body from oxidative stress by counteracting detrimental free radicals. This oxidative stress is linked to airway inflammation in asthma, and by averting this inflammation, the potential for asthma can be diminished [44, 45]. A well-balanced diet supplies essential nutrients that bolster immune function and overall well-being [46]. Adequate hydration, regular physical activity, and sufficient sleep are vital for improving cardiovascular health and amplifying the immune system's efficacy [47].

Vitamin E, which safeguards cell membranes from oxidative damage, can counteract reactive oxygen species and alleviate airway oxidative stress associated with asthma progression. With its anti-inflammatory properties, vitamin E also curtails the production of pro-inflammatory cytokines, which, in turn, assists in immune modulation and mitigating asthma symptoms [48, 49].

Omega-3 fatty acids, renowned for their anti-inflammatory attributes, play a pivotal role in regulating immune responses by curbing inflammation in the airways [50]; this modulation is linked to improved asthma control [44]. Elevated consumption of fish, particularly oily varieties like salmon and mackerel rich in omega-3 polyunsaturated fatty acids (PUFAs), is linked to reduced allergic reactions, lowered asthma risk, and a decreased prevalence of wheezing [45, 51].

In lipid mediator pathways, Omega-3 polyunsaturated fatty acids (PUFAs) serve as precursors for specialized pro-resolving lipid mediators like resolvins and protectins, effectively reducing inflammation and promoting tissue healing. By elevating fish consumption, the production of these mediators can be heightened, aiding in limiting airway inflammation and fostering recovery [45]. Moreover, balanced ratios between omega-3 and omega-6 fatty acids are crucial to modulate immune responses and minimize airway inflammation characteristic of asthma [49].

Vitamin D, an essential immune regulator with anti-inflammatory properties, augments the production of antimicrobial peptides, natural defense molecules that safeguard against respiratory infections. Additionally, vitamin D supports a healthy gut microbiome, further bolsters immune responses and reduces airway inflammation, which is advantageous for individuals with asthma [44]. While dietary vitamin D intake is essential, its primary source is skin exposure to UVB light. Adequate sun exposure and supplementation can help maintain optimal vitamin D levels, promoting immune function and potentially mitigating asthma-related issues [52].

Zinc, a key player in immune functions, including immune cell development and activation, regulates immune responses by influencing protein modifications and intracellular signaling pathways. Moreover, zinc supports the integrity of airway epithelium, the cells lining the airways that act as a barrier against respiratory infections [49]. Maintaining low salt intake is associated with better asthma control, as higher salt intake triggers greater airway sensitivity and swelling in asthma patients. Reducing salt consumption can alleviate these effects and improve asthma conditions [44]. Table 1 summarizes the dietary factors associated with the risk of asthma and their potential impacts on human health.

IJSER

Table 1: Overview of asthma-related dietary factors, their properties, and impacts on human health.

DIETARY FACTOR	PROPERTIES	EFFECTS	POTENTIAL RISK	REFERENCE
FRUITS AND VEGETABLES	high in antioxidants and anti-inflammatory compounds	protect the body from oxidative stress by neutralizing harmful free radicals. Boost immune response	Lowered the risk	[53]
VITAMIN E	fat-soluble antioxidant, anti-inflammatory properties	protects cell membranes from oxidative damage	Lowered the risk	[49]
VITAMIN D **(PRESENT IN DAIRY AND SUN EXPOSURE UVB LIGHT)**	anti-inflammatory properties	promotes the production of antimicrobial peptides, which are natural defence molecules that help protect against respiratory infections. Supports healthy gut microbiome. Supports immune function.	Lowered the risk	[52]
OMEGA-3 FATTY ACIDS AND OMEGA-6 FATTY ACIDS (FOUND IN OILY FISH, FLAX SEEDS, AND VEGETABLE OIL)	anti-inflammatory	modulate the immune response, which may help reduce airway inflammation. reduced allergic reactions.	Lowered the risk	[51]
ZINC		regulates immune responses, suppress inflammation	Lowered the risk	[49]
SALT		high salt intake is associated with increased airway sensitivity and inflammation	High intake increased the risk	[54]

IJSER

The gut microbiome has emerged as a pivotal factor in immune regulation, with its imbalance linked to various diseases, including asthma. Dietary choices influence the composition and diversity of the gut microbiota. A fiber-rich diet, prebiotics, and probiotics foster a healthy gut microbiome, ultimately boosting immune function and curtailing asthma risk [52].

Higher consumption of burgers is associated with an elevated asthma prevalence due to their high saturated fat (SFAs) and processed ingredient content, which fosters inflammation and oxidative stress. SFAs can also impact immune function and induce allergic responses, potentially contributing to asthma development and exacerbation [55].

However, adhering to the 'Mediterranean Diet,' characterized by high intake of fruits, vegetables, fish, and healthy fats, offers a practical approach to fortify immunity against asthma. This diet's comprehensive impact involves a combined effect of the aforementioned factors:

a. Synergistic Antioxidant Effects: Embracing the Mediterranean diet incorporates a wide range of fruits and vegetables, yielding a multitude of antioxidants. The synergy between these antioxidants enhances the overall antioxidant defense system, lowering oxidative stress and enhancing immune response [51].
b. Balanced Fatty Acid Profile: The Mediterranean diet advocates for healthy fats like olive oil and omega-3-rich fish. This equilibrium in fatty acid composition aids in modulating inflammation and immune responses. Omega-3 PUFAs and monounsaturated fatty acids (MUFAs) found in olive oil are linked to reduced airway inflammation and improved asthma management [56].
c. Nutrient Diversity: The Mediterranean diet encompasses an array of nutrient-dense foods, ensuring adequate intake of essential vitamins, minerals, and phytochemicals. This diverse nutrient profile bolsters overall immune function, reinforcing the body's defenses against asthma and other respiratory conditions [57].

2.4 COVID- 19

A strong association between nutritional elements and their

impact on immune function has been identified, influencing susceptibility, severity, and immune response to COVID-19. This section delves into the effects of various dietary components on COVID-19 and examines their potential mechanisms of action. Vitamin C, a potent antioxidant, plays a crucial role in supporting diverse immune functions, including the proliferation and differentiation of immune cells like T cells and B cells. It also aids the function of antioxidants such as glutathione, preserving cellular redox equilibrium and immune activity [58]. Additionally, vitamin C is a coenzyme for enzymes involved in collagen synthesis, vital for the structural integrity of skin and mucosal barriers - the first line of defense against pathogens [59]. Vitamin D, a fat-soluble vitamin, maintains immune homeostasis through receptors on various immune cells, including T cells, B cells, and antigen-presenting cells, implying its role in immune regulation [60, 61]. It stimulates the production of antimicrobial peptides that directly neutralize viruses, including respiratory viruses.

Moreover, vitamin D exhibits anti-inflammatory attributes, regulating immune responses and mitigating excessive inflammation [60-62]. Zinc, a vital micronutrient, crucially supports immune functionality, especially the development and activity of immune cells like natural killer cells, neutrophils, and T cells. Deficiency compromises the immune system's integrity [61]. Research indicates a potential connection between zinc status and COVID-19 outcomes, as it inhibits the replication of coronaviruses in vitro, including the SARS-CoV-2 virus responsible for COVID-19. Hence, zinc supplementation has been linked to reduced severity and duration of respiratory infections [63]. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), essential omega-3 fatty acids with robust anti-inflammatory characteristics, suppress the production of pro-inflammatory molecules like cytokines and prostaglandins, thus modulating the immune response [64]. They also enhance the generation of specialized lipid mediators that alleviate inflammation and promote tissue healing [64]. Numerous studies highlight omega-3 fatty acids' positive impact on treating respiratory infections. A randomized controlled trial in elderly patients demonstrated that omega-3 supplementation reduced the frequency and severity of such infections (Calder et al., 2020).

Furthermore, antioxidants are pivotal in reducing oxidative stress linked to immune deficiency and inflammation. Elevated oxidative stress characterizes COVID-19 infection, stemming from an imbalance between the body's antioxidant defense system and reactive oxygen species (ROS) production [62]. Antioxidants like vitamins C and E in fruits, vegetables, and nuts neutralize free radicals and safeguard immune cells against oxidative harm (Biesalski, 2020). Therefore, dietary factors significantly modulate immune function and potentially impact COVID-19 susceptibility, severity, and immune response. Adequate intake of immune-boosting nutrients such as vitamin C, zinc, omega-3 fatty acids, vitamin D, and antioxidants contributes to enhancing immune system resilience and potentially lowered COVID-19-associated risks [59, 62, 65].

2.4.1 Biological Mechanisms and Pathways for Strengthening Immunity against COVID-19

Gaining insights into the biological mechanisms and signaling pathways that can be positively influenced to enhance immune function and mitigate COVID-19 risks is essential for effective pandemic management. This segment examines these pivotal mechanisms and pathways, evaluating potential nutritional strategies to boost immune function and offer solutions in the battle against COVID-19.

A crucial aspect of COVID-19 involves a perturbed immune response that can result in excessive inflammation and tissue damage. Dietary factors can modulate this inflammatory response, fostering a balanced and controlled immune reaction. Notably, omega-3 fatty acids, particularly EPA and DHA, possess anti-inflammatory attributes by inhibiting the formation of pro-inflammatory molecules such as prostaglandins and cytokines [62, 64]. These fatty acids may play a role in limiting the likelihood of an exaggerated immune response, often termed a cytokine storm, prevalent in severe COVID-19 cases. Moreover, bioactive compounds like curcumin, resveratrol, and quercetin, present in fruits, vegetables, and spices, exhibit anti-inflammatory effects by targeting specific inflammatory pathways [61]. These compounds potentially regulate the production of pro-inflammatory mediators, curbing excessive inflammation and fostering a harmonized immune response.

A study involving 100 patients examined the potential link between gut microbiome composition and COVID-19 severity. Remarkably, significant changes in the gut microbiome were observed in COVID-19 patients, even post-recovery, with a reduction in beneficial bacteria. The dysbiotic gut microbiome correlated with disease severity and increased inflammatory markers, indicating its influence on COVID-19 severity and ongoing symptoms [66]. Dietary factors, such as prebiotics (fiber-rich foods) and probiotics (beneficial live bacteria), can positively impact the gut microbiota and fortify the immune system. Prebiotics nourish healthy gut bacteria, enhancing their growth, activity, and modulation of immune function, including reinforcing the gut barrier [29, 61]. Probiotics, in contrast, introduce beneficial bacteria directly to the gut, enhancing immune function through the stimulation of immune-regulating substances and competition with harmful bacteria [61, 67].

The immune system necessitates a delicate balance between activation and regulation. Excessive activation can trigger detrimental inflammatory responses, while insufficient activation impairs infection defense. Dietary components can help maintain this equilibrium and support immune regulation. Plant-derived polyphenols harbor immune-modulating attributes [58, 65]. These polyphenols can potentially prevent respiratory viral infections, possibly through multiple mechanisms, including enhancing the body's anti-inflammatory and antioxidant defenses against viral infections. Targeting viral proteins or blocking cellular receptors presents additional antiviral strategies to impede virus entry and replication in host cells [68].

3 Limitations and Future Outlooksections

The existing literature concerning nutrition and its impact on disease risk primarily relies on self-reported data, under-

IJSER

scoring the necessity for broader diversity and enhanced reliability in investigating the connection between plant-based diets and insulin resistance for the purpose of advancing health equity. Key considerations, such as age, ethnicity, socioeconomic status, and geographical location, warrant specific attention to enhance the applicability of research findings. Delving into the role of factors like fiber content, gut microbiota, antioxidants, and bioactive compounds in mediating the positive effects of plant-based diets on insulin resistance is vital. These studies are helpful in identifying the most efficacious dietary strategies for enhancing insulin sensitivity and mitigating the risk of type 2 diabetes [42].

In the realm of cancer prevention, a prioritization of mechanistic inquiries is recommended to comprehend the intricate interactions between the Mediterranean diet and cancer development. To corroborate the efficacy of dietary components in lowering mortality rates and cancer incidence, it is imperative to conduct long-term intervention studies across diverse population groups. The quest for biomarkers indicative of individual responses to dietary interventions can augment tailored approaches to cancer prevention. Incorporating advanced technologies like artificial intelligence and omics analysis can propel nutrigenomics research, facilitating the creation of personalized nutritional recommendations. Collaborating with researchers, clinicians, nutritionists, and policymakers is vital for translating scientific knowledge into practical guidelines and interventions for cancer prevention through dietary adjustments [61].

For adult asthma, a priority should be assigned to longitudinal studies that deepen comprehension of the role of diet in its emergence. Overcoming the limitations of self-reported data, objective measures like biomarkers or metabolomics can yield more precise assessments of the correlation between diet and asthma. An inclusive evaluation of non-dietary factors, including physical activity, smoking, socioeconomic status, and stress, is necessary to comprehend their collective impact on adult asthma. Comparative studies encompassing diverse population groups can illuminate the cultural and regional influences shaping the relationship between diet and asthma [69]. The immune system relies on essential nutrients, including vitamins (A, B6, B12, folic acid, C, D, and E) and trace elements (zinc, copper, selenium, and iron) to uphold its function, thus diminishing infection risk. An equitable diet blending plant and animal sources is advised to fortify immune function. Nonetheless, certain micronutrients may necessitate supplementation for optimal reinforcement [65].

In conclusion, forthcoming research endeavors should accord precedence to longitudinal studies, encompass representative populations, delve into mechanistic aspects, and undertake comparative investigations. Such efforts will enhance our comprehension of the correlations between dietary elements and disease risk, ultimately leading to more effective strategies for promoting overall well-being [42, 61, 65, 69].

ACKNOWLEDGMENT

The authors wish to thank A, B, C. This work was supported in part by a grant from XYZ.

REFERENCES

1. Leitzmann, C., Vegetarian nutrition: past, present, future. *The American Journal of Clinical Nutrition* **2014,** 100, 496S-502S.
2. Pflipsen, M.; Zenchenko, Y., Nutrition for oral health and oral manifestations of poor nutrition and unhealthy habits. *Gen. Dent.* **2017,** 65, (6), 36-43.
3. Ferlay, J.; Colombet, M.; Soerjomataram, I.; Parkin, D. M.; Piñeros, M.; Znaor, A.; Bray, F., Cancer statistics for the year 2020: An overview. *Int. J. Cancer* **2021,** 149, (4), 778-789.
4. Joh, H.-K.; Lee, D. H.; Hur, J.; Nimptsch, K.; Chang, Y.; Joung, H.; Zhang, X.; Rezende, L. F.; Lee, J. E.; Ng, K., Simple sugar and sugar-sweetened beverage intake during adolescence and risk of colorectal cancer precursors. *Gastroenterology* **2021,** 161, (1), 128-142. e20.
5. Naylor Metoyer, B.; Chuang, R.-J.; Lee, M.; Markham, C.; Brown, E. L.; Almohamad, M.; Dave, J. M.; Sharma, S. V., Fruit and Vegetable Intake and Home Nutrition Environment among Low-Income Minority Households with Elementary-Aged Children. *Nutrients* **2023,** 15, (8), 1819.
6. Hu, Y.; Ding, M.; Sampson, L.; Willett, W. C.; Manson, J. E.; Wang, M.; Rosner, B.; Hu, F. B.; Sun, Q., Intake of whole grain foods and risk of type 2 diabetes: results from three prospective cohort studies. *BMJ* **2020,** 370.
7. Juul, F.; Vaidean, G.; Parekh, N., Ultra-processed foods and cardiovascular diseases: potential mechanisms of action. *Adv. Nutr.* **2021,** 12, (5), 1673-1680.
8. Vally, H.; Thompson, P. J., Role of sulfite additives in wine induced asthma: single dose and cumulative dose studies. *Thorax* **2001,** 56, (10), 763-769.
9. Wang, J.; Liu, A. H., Food allergies and asthma. *Curr. Opin. Allergy Clin. Immunol.* **2011,** 11, (3), 249-254.
10. Guilleminault, L.; Williams, E. J.; Scott, H. A.; Berthon, B. S.; Jensen, M.; Wood, L. G., Diet and asthma: is it time to adapt our message? *Nutrients* **2017,** 9, (11), 1227.
11. Wise, J., Covid-19: WHO declares end of global health emergency. In British Medical Journal Publishing Group: 2023.
12. Aman, F.; Masood, S., How Nutrition can help to fight against COVID-19 Pandemic: COVID-19 and Diet. *Pakistan Journal of Medical Sciences* **2020,** 36, (COVID19-S4).
13. Iddir, M.; Brito, A.; Dingeo, G.; Fernandez Del Campo, S. S.; Samouda, H.; La Frano, M. R.; Bohn, T., Strengthening the Immune System and Reducing Inflammation and Oxidative Stress through Diet and Nutrition: Considerations during the COVID-19 Crisis. *Nutrients* **2020,** 12, (6), 1562.
14. Zhang, F. F.; Cudhea, F.; Shan, Z.; Michaud, D. S.; Imamura, F.; Eom, H.; Ruan, M.; Rehm, C. D.; Liu, J.; Du, M.; Kim, D.; Lizewski, L.; Wilde, P.; Mozaffarian, D., Preventable Cancer Burden Associated With Poor Diet in the United States. *JNCI Cancer Spectrum* **2019,** 3, (2).
15. Bessaoud, F.; Tretarre, B.; Daurès, J.-P.; Gerber, M., Identification of Dietary Patterns Using Two Statistical Approaches and Their Association With Breast Cancer

IJSER

Risk: A Case-Control Study in Southern France. *Ann. Epidemiol.* **2012,** 22, (7), 499-510.
16. Xiao, Y.; Xia, J.; Li, L.; Ke, Y.; Cheng, J.; Xie, Y.; Chu, W.; Cheung, P.; Kim, J. H.; Colditz, G. A., Associations between dietary patterns and the risk of breast cancer: a systematic review and meta-analysis of observational studies. *Breast Cancer Res.* **2019,** 21, (1), 1-22.
17. Hagland, H. R.; Søreide, K., Cellular metabolism in colorectal carcinogenesis: Influence of lifestyle, gut microbiome and metabolic pathways. *Cancer Lett.* **2015,** 356, (2, Part A), 273-280.
18. Van Puyvelde, H.; Dimou, N.; Katsikari, A.; Ruiz, B. I. I.; Godderis, L.; Huybrechts, I.; De Bacquer, D., The association between dietary intakes of methionine, choline and betaine and breast cancer risk: A systematic review and meta-analysis. *Cancer Epidemiol.* **2023,** 83, 102322.
19. Fiolet, T.; Srour, B.; Sellem, L.; Kesse-Guyot, E.; Allès, B.; Méjean, C.; Deschasaux, M.; Fassier, P.; Latino-Martel, P.; Beslay, M., Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. *BMJ* **2018,** 360.
20. Sedlak, J. C.; Yilmaz, Ö. H.; Roper, J., Metabolism and colorectal cancer. *Annual Review of Pathology: Mechanisms of Disease* **2023,** 18, 467-492.
21. Rossi, M.; Jahanzaib Anwar, M.; Usman, A.; Keshavarzian, A.; Bishehsari, F., Colorectal cancer and alcohol consumption—populations to molecules. *Cancers (Basel)* **2018,** 10, (2), 38.
22. Clinton, S. K.; Giovannucci, E. L.; Hursting, S. D., The world cancer research fund/American institute for cancer research third expert report on diet, nutrition, physical activity, and cancer: impact and future directions. *The Journal of nutrition* **2020,** 150, (4), 663-671.
23. Xie, M.; Liu, J.; Tsao, R.; Wang, Z.; Sun, B.; Wang, J., Whole grain consumption for the prevention and treatment of breast cancer. *Nutrients* **2019,** 11, (8), 1769.
24. Weber, D. D.; Aminzadeh-Gohari, S.; Tulipan, J.; Catalano, L.; Feichtinger, R. G.; Kofler, B., Ketogenic diet in the treatment of cancer–where do we stand? *Molecular metabolism* **2020,** 33, 102-121.
25. Mirabelli, M.; Chiefari, E.; Arcidiacono, B.; Corigliano, D. M.; Brunetti, F. S.; Maggisano, V.; Russo, D.; Foti, D. P.; Brunetti, A., Mediterranean diet nutrients to turn the tide against insulin resistance and related diseases. *Nutrients* **2020,** 12, (4), 1066.
26. Qin, X.; Chen, J.; Jia, G.; Yang, Z., Dietary factors and pancreatic cancer risk: an umbrella review of meta-analyses of prospective observational studies. *Adv. Nutr.* **2023**.
27. Rose, D. P.; Connolly, J. M., Omega-3 fatty acids as cancer chemopreventive agents. *Pharmacol. Ther.* **1999,** 83, (3), 217-244.
28. Hill, M. J., Cereals, cereal fibre and colorectal cancer risk: a review of the epidemiological literature. *Eur. J. Cancer Prev.* **1998,** 7, (2).
29. Chen, S.; Chen, Y.; Ma, S.; Zheng, R.; Zhao, P.; Zhang, L.; Liu, Y.; Yu, Q.; Deng, Q.; Zhang, K., Dietary fibre intake and risk of breast cancer: a systematic review and meta-analysis of epidemiological studies. *Oncotarget* **2016,** 7, (49), 80980.
30. La Vecchia, S.; Sebastián, C. In *Metabolic pathways regulating colorectal cancer initiation and progression*, Semin. Cell Dev. Biol., 2020; Elsevier: 2020; pp 63-70.
31. Aune, D.; Lau, R.; Chan, D. S. M.; Vieira, R.; Greenwood, D. C.; Kampman, E.; Norat, T., Nonlinear Reduction in Risk for Colorectal Cancer by Fruit and Vegetable Intake Based on Meta-analysis of Prospective Studies. *Gastroenterology* **2011,** 141, (1), 106-118.
32. Papamichou, D.; Panagiotakos, D.; Itsiopoulos, C., Dietary patterns and management of type 2 diabetes: A systematic review of randomised clinical trials. *Nutrition, Metabolism and Cardiovascular Diseases* **2019,** 29, (6), 531-543.
33. Martín-Peláez, S.; Fito, M.; Castaner, O., Mediterranean Diet Effects on Type 2 Diabetes Prevention, Disease Progression, and Related Mechanisms. A Review. *Nutrients* **2020,** 12, (8), 2236.
34. Guasch-Ferré, M.; Willett, W. C., The Mediterranean diet and health: a comprehensive overview. *J. Intern. Med.* **2021,** 290, (3), 549-566.
35. Schwingshackl, L.; Hoffmann, G.; Lampousi, A.-M.; Knüppel, S.; Iqbal, K.; Schwedhelm, C.; Bechthold, A.; Schlesinger, S.; Boeing, H., Food groups and risk of type 2 diabetes mellitus: a systematic review and meta-analysis of prospective studies. *Eur. J. Epidemiol.* **2017,** 32, 363-375.
36. Konishi, K.; Wada, K.; Yamakawa, M.; Goto, Y.; Mizuta, F.; Koda, S.; Uji, T.; Tsuji, M.; Nagata, C., Dietary soy intake is inversely associated with risk of type 2 diabetes in Japanese women but not in men. *The Journal of Nutrition* **2019,** 149, (7), 1208-1214.
37. Nardocci, M.; Polsky, J. Y.; Moubarac, J.-C., Consumption of ultra-processed foods is associated with obesity, diabetes and hypertension in Canadian adults. *Can. J. Public Health* **2021,** 112, 421-429.
38. Duan, M.-J.; Vinke, P. C.; Navis, G.; Corpeleijn, E.; Dekker, L. H., Ultra-processed food and incident type 2 diabetes: studying the underlying consumption patterns to unravel the health effects of this heterogeneous food category in the prospective Lifelines cohort. *BMC Med.* **2022,** 20, (1), 1-11.
39. Li, M.; Shi, Z., Association between Ultra-Processed Food Consumption and Diabetes in Chinese Adults—Results from the China Health and Nutrition Survey. *Nutrients* **2022,** 14, (20), 4241.
40. Odoh, U. E.; Egbuna, C.; Chukwube, V. O.; Diovu, E. O.; Stephen, A. B.; Onyegbulam, C. M.; Udodeme, O. H.; Okonta, E. O.; Onyekere, P. F.; Ugwu, P. N., Nutrigenomics of type 2 diabetes: Gene–diet interactions. In *Role of Nutrigenomics in Modern-Day Healthcare and Drug Discovery*, Elsevier: 2023; pp 85-113.
41. Magalhães, D. A.; Kume, W. T.; Correia, F. S.; Queiroz, T. S.; Allebrandt, E. W.; Santos, M. P.; Kawashita, N. H.; França, S. A., High-fat diet and streptozotocin in the induction of type 2 diabetes mellitus: a new proposal. *An Acad Bras Cienc* **2019,** 91.

IJSER

42. McMacken, M.; Shah, S., A plant-based diet for the prevention and treatment of type 2 diabetes. *Journal of geriatric cardiology: JGC* **2017,** 14, (5), 342.
43. Wu, G.; Liu, A. B.; Xu, Y.; Wang, Y.; Zhao, L.; Hara, Y.; Lam, Y. Y.; Yang, C. S., The effects of green tea on diabetes and gut microbiome in db/db mice: studies with tea extracts vs. Tea powder. *Nutrients* **2021,** 13, (9), 3155.
44. Verstegen, R. E.; Kostadinova, A. I.; Merenciana, Z.; Garssen, J.; Folkerts, G.; Hendriks, R. W.; Willemsen, L. E., Dietary fibers: effects, underlying mechanisms and possible role in allergic asthma Management. *Nutrients* **2021,** 13, (11), 4153.
45. Nagel, G.; Weinmayr, G.; Kleiner, A.; Garcia-Marcos, L.; Strachan, D. P.; Group, t. I. P. T. S., Effect of diet on asthma and allergic sensitisation in the International Study on Allergies and Asthma in Childhood (ISAAC) Phase Two. *Thorax* **2010,** 65, (6), 516-522.
46. Price, S., Understanding the importance to health of a balanced diet. *Nurs. Times* **2005,** 101, (1), 30-1.
47. Ptomey, L. T.; Montgomery, R. N.; Gorczyca, A. M.; Szabo-Reed, A. N.; Sullivan, D. K.; Hastert, M.; Foster, R. N.; Washburn, R. A.; Donnelly, J. E., The impact of exercise and cumulative physical activity on energy intake and diet quality in adults enrolled in the Midwest Exercise Trial for the Prevention of Weight Regain. *Br J Nutr* **2022,** 128, (12), 2498-2509.
48. Fogarty, A.; Lewis, S.; Weiss, S.; Britton, J., Dietary vitamin E, IgE concentrations, and atopy. *The Lancet* **2000,** 356, (9241), 1573-1574.
49. Takkinsatian, P.; Mairiang, D.; Sangkanjanavanich, S.; Chiewchalermsri, C.; Tripipitsiriwat, A.; Sompornrattanaphan, M., Dietary Factors Associated with Asthma Development: A Narrative Review and Summary of Current Guidelines and Recommendations. *J. Asthma Allergy* **2022**, 1125-1141.
50. Simopoulos, A. P., Omega-3 Fatty Acids in Inflammation and Autoimmune Diseases. *J. Am. Coll. Nutr.* **2002,** 21, (6), 495-505.
51. Black, P.; Sharpe, S., Dietary fat and asthma: is there a connection? *Eur. Respir. J.* **1997,** 10, (1), 6-12.
52. Varraso, R.; Camargo, C. A., Novel dietary risk factors for asthma. *Expert Rev. Respir. Med.* **2019,** 13, (8), 695-698.
53. Ellwood, P.; Asher, M. I.; Björkstén, B.; Burr, M.; Pearce, N.; Robertson, C. F., Diet and asthma, allergic rhinoconjunctivitis and atopic eczema symptom prevalence: an ecological analysis of the International Study of Asthma and Allergies in Childhood (ISAAC) data. *Eur. Respir. J.* **2001,** 17, (3), 436-443.
54. Lieberman, D.; Heimer, D., Effect of dietary sodium on the severity of bronchial asthma. *Thorax* **1992,** 47, (5), 360-362.
55. Wickens, K.; Barry, D.; Friezema, A.; Rhodius, R.; Bone, N.; Purdie, G.; Crane, J., Fast foods – are they a risk factor for asthma? *Allergy* **2005,** 60, (12), 1537-1541.
56. Cazzoletti, L.; Zanolin, M. E.; Spelta, F.; Bono, R.; Chamitava, L.; Cerveri, I.; Garcia-Larsen, V.; Grosso, A.; Mattioli, V.; Pirina, P., Dietary fats, olive oil and respiratory diseases in Italian adults: A population-based study. *Clin. Exp. Allergy* **2019,** 49, (6), 799-807.
57. Chatzi, L.; Apostolaki, G.; Bibakis, I.; Skypala, I.; Bibaki-Liakou, V.; Tzanakis, N.; Kogevinas, M.; Cullinan, P., Protective effect of fruits, vegetables and the Mediterranean diet on asthma and allergies among children in Crete. *Thorax* **2007,** 62, (8), 677-683.
58. Calder, P. C., Nutrition, immunity and COVID-19. *BMJ Nutrition, Prevention & Health* **2020,** 3, (1), 74-92.
59. Carr, A. C.; Maggini, S., Vitamin C and Immune Function. *Nutrients* **2017,** 9, (11), 1211.
60. Munteanu, C.; Schwartz, B., The relationship between nutrition and the immune system. *Front Nutr* **2022,** 9, 1082500.
61. Gombart, A. F.; Pierre, A.; Maggini, S., A Review of Micronutrients and the Immune System–Working in Harmony to Reduce the Risk of Infection. *Nutrients* **2020,** 12, (1), 236.
62. Conte, L.; Toraldo, D. M., Targeting the gut–lung microbiota axis by means of a high-fibre diet and probiotics may have anti-inflammatory effects in COVID-19 infection. *Ther. Adv. Respir. Dis.* **2020,** 14, 1753466620937170.
63. Mrityunjaya, M.; Pavithra, V.; Neelam, R.; Janhavi, P.; Halami, P.; Ravindra, P., Immune-boosting, antioxidant and anti-inflammatory food supplements targeting pathogenesis of COVID-19. *Front. Immunol.* **2020,** 11, 2337.
64. Galanakis, C. M.; Aldawoud, T. M.; Rizou, M.; Rowan, N. J.; Ibrahim, S. A., Food ingredients and active compounds against the coronavirus disease (COVID-19) pandemic: A comprehensive review. *Foods* **2020,** 9, (11), 1701.
65. Calder, P. C., Nutrition, immunity and COVID-19. *BMJ Nutrition, Prevention & Health* **2020,** 3, (1), 74.
66. Yeoh, Y. K.; Zuo, T.; Lui, G. C.-Y.; Zhang, F.; Liu, Q.; Li, A. Y.; Chung, A. C.; Cheung, C. P.; Tso, E. Y.; Fung, K. S., Gut microbiota composition reflects disease severity and dysfunctional immune responses in patients with COVID-19. *Gut* **2021,** 70, (4), 698-706.
67. Şahin, M., The role of probiotics in COVID-19 treatment: Gut microbiota can help physicians in the outbreak. *The Turkish Journal of Gastroenterology* **2020,** 31, (10), 724.
68. El-Missiry, M. A.; Fekri, A.; Kesar, L. A.; Othman, A. I., Polyphenols are potential nutritional adjuvants for targeting COVID-19. *Phytother. Res.* **2021,** 35, (6), 2879-2889.
69. Visser, E.; De Jong, K.; Pepels, J.; Kerstjens, H.; Ten Brinke, A.; Van Zutphen, T., Diet quality, food intake and incident adult-onset asthma. In Eur Respiratory Soc: 2022.

IJSER