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Review

Lifestyle Modification in Respiratory Tract Inflammation: Persian Medicine Perspective

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Abstract

Excessive inflammation in the respiratory system could lead to life-threatening conditions. This situation is usually caused by irritants, allergens, pathogens, toxins, and pollutants, leading to airway inflammation. On the other hand, an inappropriate lifestyle can cause inflammation in different parts of the body including the respiratory tract. This study aimed to explore the recommended lifestyle modification for respiratory tract inflammation from the Persian medicine viewpoint in light of current evidence. In this review, first, we looked for lifestyle factors effective on the respiratory tract in Persian medicine sources. Then, PubMed, Web of Science, and Google Scholar were searched to find evidence about the mentioned factors, using the following keywords: psychological stress, sleep, food, exercise, gut, constipation, cold, and airway or respiratory tract. In line with Persian medicine, current literature confirms that psychological stress, intensive physical activity, allergic foods, and cold ambient trigger the beginning of the inflammation process in the respiratory system. It could happen through different pathways such as downregulation of Th1 cytokines expression, cold-inducible RNA binding protein (CIRP) synthesizing, mucin 5AC (MUC5AC) overexpression, activating transient receptor potential melastatin 8 (TRPM8) channels, inducing a neutrophilic type of inflammation and damaging the airway epithelium. Mild exercise, well-being of the gut microbiota status, and reduction of sleep duration have beneficial effects on the regression of inflammation. Lifestyle modification could play an important role in the prevention and treatment of respiratory tract inflammation. Future clinical investigations should be conducted to evaluate their effects.

Keywords: Lifestyle; Airway; Respiratory tract; Persian Medicine

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Introduction

One of the natural defense mechanisms of humans is the inflammatory process that removes harmful stimuli such as damaged cells, irritants, and pathogens initiating the healing process. In general, it is categorized as acute or chronic inflammation [1,2]. In acute inflammation, the immune process helps to immobilize the injured region and lets the rest of the immune system mobilize to initiate the healing of the injuries [2,3]. However, chronic inflammation not only fails to help, but also hinders the healing process. It usually stimulates the immune cells in the bloodstream leading to their infiltration into the inflamed tissues. The entry of these cells destroys healthy tissues during the healing process [2,4].

Usually, exposure to pathogens, toxins, pollutants, allergens, and irritants causes airway inflammation. Excessive inflammation in the respiratory system leads to life-threatening conditions because the respiratory system is vital for the necessary supply of oxygen. Accordingly, it is important to control the inflammatory processes to maintain lung homeostasis. Therefore, it is crucial to have a comprehensive knowledge of inflammatory mechanisms to treat lung inflammatory disorders [2].

Normally, the airway epithelium acts as the first defensive layer against inhaled environmental microorganisms and toxins [5]. Pseudostratified respiratory epithelium is severely damaged in lower airway diseases such as cystic fibrosis, chronic obstructive pulmonary disease (COPD), and asthma. It must be repaired to perform its normal defensive functions [6]. Some factors including disease, tissue microenvironment, energy, seasonal changes, and neighborhood affect the inflammatory response [2]. In addition, an unbalanced diet, inactivity, physiological or psychological stress, and chronic use of drugs can also trigger inflammation and consequently the development of chronic diseases [7]. Muscarinic antagonists, beta-agonists, and corticosteroids as inhaled bronchodilators could potentially target the respiratory epithelium. Novel therapeutic methods may provide new targets to restore the function of impaired epithelial barrier [6]. Knowing that the type of lifestyle affects human health from adolescence, the negative effects of an inappropriate lifestyle on health can be seen in childhood. Thus, its change may be useful for the comprehensive management of chronic diseases [8].

Nowadays, complementary and alternative medicine (CAM) is used by adults and children with respiratory disorders, especially in those with chronic diseases including cystic fibrosis and asthma. Although many healthcare centers offer CAM, most of the medical staff have little information about CAM therapies [9]. CAM encompasses a variety of treatments and practices that are not typically considered part of conventional medicine [10]. These include therapies such as acupuncture, homeopathy, and various forms of body touch therapies like massage and yoga, as well as dietary and herbal approaches [11]. The most frequently used CAM therapies in the United States are prayer (45.2%), herbalism (18.9%), breathing meditation (11.6%), meditation (7.6%), yoga (5.1%), diet-based therapy (3.5%), progressive relaxation (3.0%), and mega-vitamin therapy (2.8%) [11,12]. Complementary and traditional medicines are sources of novel therapeutic methods among which Persian medicine (PM) is one of the oldest schools [13].

According to Persian medicine, maintaining a healthy lifestyle is necessary to prevent diseases including respiratory disorders. Based on this perspective, a great emphasis has been put on lifestyle and many diseases are primarily treated by lifestyle modification. For respiratory diseases, it includes principles such as avoiding psychological stress and harmful foods for the respiratory tract, proper physical activity, avoiding cold ambient temperature, reduction of sleep duration, and attention to gut status [14-18].

In this study, we aimed to mention some important lifestyle measures recommended by PM for respiratory diseases. Moreover, related evidence was discussed according to the recent studies.

Methods

Relevant sections about lifestyle recommendations for patients with respiratory tract inflammation (the Hifz al-Siha section of the Cannon of Medicine and Kholasa al-Hikma, and the lifestyle advice of respiratory diseases in Zakhire Kharazmshahi, Tib Akbari, and Exir Azam) were studied. Then, PubMed, Web of Science, and Google Scholar were searched without time restriction from inception up to March 2024 using the following keywords: psychological stress, sleep, food, exercise, gut, constipation, cold, and airway or respiratory tract. The selection of these words was based on the principles of Hifz al-Siha (preventive health measures) in PM. Due to the limited number of published randomized controlled trials (RCTs), all of the related studies were included.

Results

PM, a prominent school of CAM, represents an intricate and comprehensive framework encompassing a multitude of medical practices and guiding principles that have been meticulously documented in widely recognized texts [19]. According to PM sources, lifestyle factors such as sleep, exercise, food, air temperature, psychological stress, and constipation play significant roles in the development and progression of respiratory diseases. In the first step of the therapeutic approach, PM recommends lifestyle modification to patients including those with respiratory disorders

[14-18].
At first, we found 435 articles that were limited after filtration by reading their titles (125 articles) and abstracts (92 abstracts). Finally, we found 37 available full texts of the articles.
According to the current evidence, following lifestyle measures should be observed in patients with respiratory tract inflammation.

Psychological stress

It has been reported that cortisol and catecholamines (stress hormones) could change the immune response from T helper 1 (Th1) to T helper 2 (Th2) by decreasing the expression of Th1 cytokines [20]. Also, prolonged activation of the hypothalamic-pituitary-adrenal (HPA) axis and sympatho-adrenomedullary (SAM) system may result in a counter-regulatory response in stimulated lymphocytes. This would lead to downregulation of the expression and/or function of glucocorticoid receptors [21]. This in turn reduces the sensitivity to endogenous cortisol and consequently exacerbates the inflammatory responses [20].
On the other hand, upregulation of the mRNA expression and production of endogenous opioids such as dynorphins, enkephalins, and endorphins can occur due to psychological stress [20,22,23]. These endogenous opioids affect many physiological processes including respiratory control, neuroendocrine function, and analgesia through binding to three subtypes of opioid receptors: μ, δ, and κ. Binding to μ-opioid receptors (MOR) in stressful conditions, opioids modulate the function of the SAM system and HPA axis [20]. Inflammatory cells such as B cells, T cells, dendritic cells, monocytes, macrophages, and polymorphonuclear leukocytes express the MOR [20, 24]. Its activation in lymphocytes leads to the differentiation of Th2 cells and shifting immune responses from Th1 to Th2 [25-28]. The MOR on the surface of immune cells probably plays a role in chronic stress-induced inflammation [20].
It has also been reported that chronic psychological stress causes a shifting of immune responses from Th1 to Th2 in spleen cells which have been non-specifically stimulated with concanavalin A (ConA) [25]. In addition, chronic psychological stress exacerbates symptoms of asthma; this has been shown in clinical [29] and other experimental studies [30-32].
Knowing that stress may mediate the risk of developing atopy by modulating neuroimmunoregulation and the hypersensitivity response, Wright et al. argued that examining other mechanisms (intestinal dysbiosis, oxidative stress pathways, nerve–mast cell interactions, and glucocorticoid resistance) and a wider range of neuropeptides and cytokines may better define the true complexity of the underlying mechanisms linking stress to asthma and allergic sensitization [33]. Table 1 mentions the studies on the relationship between psychological stress and airway inflammation.

Diet

The skin and gastrointestinal tract responses are two common clinical manifestations of food-related allergic reactions. In addition, food allergy leads to allergic symptoms in the upper and lower respiratory tract [34]. Borisova et al. showed that respiratory forms of food allergy are caused by cow milk, hen eggs, nutritive cereals, fruit, and vegetables as the most frequent allergens [35]. These symptoms are not common and usually are associated with gastrointestinal or skin symptoms. Respiratory symptoms, particularly asthmatic reactions, secondary to food allergy reactions are of concern, as they have often been observed in fatal and near-fatal reactions after food consumption. A wide range of respiratory symptoms including coughing, wheezing, sneezing, itching of the nose and throat, rhinorrhea, and nasal congestion have been attributed to food allergy. About 6% of pediatrics with asthma were less marked with food-induced lower airway symptoms than with sinusitis, allergic rhinitis, and viral infections of the upper respiratory tract.

Table 1. Studies on the relationship between psychological stress and airway inflammation.

First author	Type of the study	Year	Results	Ref
Buske-Kirschbaum A	Clinical trial	2003	Decreased HPA axis reactivity (a weak adrenal cortex response) to stress in asthmatic children may be a typical hallmark of chronic allergic inflammatory processes in atopy.	[51]
Okuyama K	Animal study	2007	MOR plays a role in the stress-induced exacerbation of allergic airway inflammation.	[20]
Okuyama K	Animal study	2010	MOR in the CNS is involved in the stress-induced exacerbation of allergic airway inflammation.	[52]
Miyasaka T	Animal study	2016	Histamine receptors H1R, but not H3/4R, may play a role in asthma exacerbations caused by stress in the CNS.	[53]

HPA: hypothalamic-pituitary-adrenal, MOR: μ-opioid receptors, CNS: central nervous system, HR: Histamine receptors

Also, chronic asthma results from occupational exposure to airborne food allergens. For example, bakers with asthma experience shortness of breath and cough due to airborne cereal grain dust exposure [34]. The relationship between foods and airway inflammation according to the most recent studies is shown in table 2.

Physical activity

A decrease in Th2 immune response and lymphocytic and eosinophilic inflammation has been demonstrated in the murine model of allergic asthma induced by regular aerobic exercise with low or moderate intensity. Previous studies have also shown the effect of exercise on the reduction of activity and expression of transcription nuclear factor kB (NF-kB), RANTES (CCL2), glucocorticoid receptors, insulin-like growth factor 1 (IGF-1), as well as the increased expression of the receptor antagonist of IL-1 (IL-1ra) and interleukin 10 (IL-10). In addition to the mentioned anti-inflammatory effects of aerobic exercise, airway remodeling was reduced by decreasing the deposition of elastic fiber, collagen, airway smooth muscles, hypertrophy, and hyperplasia of epithelial cells. In addition to airways, also the vessels and lung parenchyma benefit from the anti-inflammatory effects of aerobic exercise [5]. Regarding exercise intensity, there is exercise-induced hyperpnea due to the increase in the rate and depth of respiration and airway dilation. Consequently, the increased airflow due to hyperventilation causes mechanical stresses on the epithelium, which leads to changes in epithelial ion channel conductance. The inhibition or activation of mechanical stress-sensitive ion channels is likely due to tension changes in the cytoskeleton, changes in lipid bilayer curvature local to the ion channel, and/or signaling events including protein phosphorylation/dephosphorylation or lipid metabolism [36].

Although exercise-induced airway epithelial injury was first demonstrated in animal models, recent studies have also confirmed it in humans. Environmental factors and exercise intensity have been identified as moderators of airway epithelial damage during exercise [37].

The most characteristic response is the acute phase, also known as exercise-induced asthma, in which patients experience bronchoconstriction that is self-limiting and transient soon after cessation of hyperventilation. Also, airway inflammation due to the eosinophilic and neutrophilic response is believed to occur in a late-phase response [38]. The increased prevalence of asthma among cross-country skiers may be due to increased ventilation during exercise. Also, athletes who are exposed to cold weather have a higher prevalence of airway hyperreactivity and asthma. A high amount of neutrophils has also been reported in the bronchial biopsy samples of these people [39]. The effects of physical activity on airway inflammation are shown in table 3.

Cold ambient temperature

Especially in the higher latitudes, winter is a difficult time for patients with chronic respiratory diseases. Cold air inhalation has negative effects on the lungs, particularly in asthmatic patients. The increasing use of air conditioning in homes, cars, hotels, and shopping malls, especially in developed countries, has highlighted emerging public health problems arising from exposure to cool air. This is part of a broader problem related to indoor air quality, whether in offices or homes, where people spend their time more than 90% [40]. Cold air inhalation without adequate temperature alteration causes severe respiratory autonomic responses including coughing, mucosal secretion, and airway constriction [41]. Even short-time exposure to low ambient temperatures is known to exacerbate asthma or chronic obstructive pulmonary disease (COPD) [42].

Cold-inducible RNA-binding protein (CIRP) is one of the members of the cold shock proteins family which is a key component of the cellular response to moderate hypothermia. Induction of CIRP expression by cold in humans and mice has been shown in previous studies. Based on its increased expression in cold-treated mice

Table 2. Studies on the relationship between foods and airway inflammation.

First author	Type of the study	Year	Results	Ref
Wallaert B	Clinical trial	2002	Patients with food allergy without clinical respiratory symptoms have a subclinical neutrophil airway inflammation.	[54]
Kulkarni N	Clinical trial	2012	Food allergy increases airway eosinophilic inflammation in pediatrics with asthma.	[55]
Borisova IV	Clinical trial	2013	Respiratory forms of food allergy caused by cow milk, hen eggs, nutritive cereals, fruit and vegetables as the most frequent allergens.	[35]
Krogulska A	DBPCFC study	2016	Food allergens could increase bronchial reactivity.	[56]

Table 3. Studies on the relationship between physical activity and airway inflammation.

First author	Type of the study	Year	Results	Ref
Davis MS	Animal study	2002	Peripheral airway mucosal damage due to exposure to unventilated air occurs in horses exercising in cold climates.	[38]
Hallstrand TS	Clinical trial	2005	Injury to the airway epithelium, overexpression of Cysteinyl leukotrienes, relative underproduction of PGE2, and higher airway eosinophilia are various immunopathologic aspects of bronchial asthma with exercise-prompted bronchoconstriction.	[57]
Vieira RP	Animal study	2011	Aerobic exercise reduces oxidative stress, nitrosative stress, growth factors, adhesion molecules, the epithelial expression of Th2 cytokines, chemokines, and NF-kB and P2X7 receptors. In addition, increased the epithelial expression of IL-10.	[5]
Jones CU	Clinical trial	2013	Breathing exercises with a device that includes vibration and humidification of inspired air in patients dependent on mechanical ventilation were effective in increasing the clearance of secretions without any side effects.	[58]
Simpson AJ	Clinical trial	2017	Mild exercise-induced dehydration does not increase airway responsiveness to dry air in athletes with mild exercise-induced asthma bronchoconstriction, however may also affect small airway function.	[59]
Prossegger J	Clinical trial	2019	Recreational winter exercise at relatively cold temperatures reduces allergic airway inflammation by reducing nasal eosinophilic cell counts and FeNO leading to sustained improvement in allergic symptoms.	[60]
Vendrusculo FM	Clinical trial	2019	Chest physiotherapy for airway clearance before the exercise may cause ventilatory dynamics during exercise in cystic fibrosis patients.	[61]
Davidson WJ	Clinical trial	2012	Exercise leads to the reduction of IL-6 and IL-8 in sputum and serum eosinophils of steroid-naïve patients with COPD.	[62]
Evaristo KB	Clinical trial	2017	Aerobic exercise leads to the reduction of eosinophils of sputum in patients with persistent asthma.	[63]
Scott HA	Clinical trial	2012	The exercise leads to a significant reduction in sputum eosinophils.	[64]

PGE2: prostaglandin E2, Th: T helper, IL: interleukin, FeNO: fractional oral exhaled nitric oxide, COPD: chronic obstructive pulmonary disease

and COPD patients, CIRP overexpression by mucin 5AC (MUC5AC) may have a potential pathological effect on cold-induced COPD exacerbation [42]. A large number of studies have identified CIRP as a novel inflammatory mediator that induces Toll-like receptors 4 (TLR4) involving *nuclear transcription factor* B (TLR41NF-κB) activation. This in turn regulates IL-1 expression in cultured fibroblasts. Moreover, TLR4/NF-B is an important signaling pathway in the MUC5AC synthesis. It is one of the predominant airway mucins involved in mucus-overproducing lung diseases. These results indicate that CIRP may mediate cold air-induced MUC5AC production by acting directly on the TLR4/NF-B pathway [42]. The molecular basis of cold perception is primarily represented by specific ion channels called transient receptor potential melastatin 8 channels (TRPM8). The temperature threshold for TRPM8 activation is typically 28°C and is influenced by various factors such as lipids, pH, Ca^{2+}, and other factors including ambient temperature. TRPM8 is expressed in various tissues and organs in the human body including the respiratory system. Its expression is in the upper airways, airway epithelium, and nerve endings [43].

Notably, a sub-population of airway vagal afferents expresses TRPM8 receptors. Stimulation and activation of TRPM8 receptors of airway autonomic nerves by cold can induce an autonomic nerve reflex to increase airway resistance. This hypothetical autonomic response may be related to exacerbation of cold-induced asthma and other lung diseases making TRPM8 receptors a potential target for the prevention of cold-related respiratory diseases [41].

Activation of the short TRPM8 isoform causes an inflammatory response with the expression and secretion of various cytokines including IL-1, 1β, 4, 6, 8, 13, and TNF-α in the bronchial epithelium [43]. Therefore, the cold stimulus is thought to be a trigger point that exacerbates respiratory diseases characterized by increased respiratory tract infections, infiltration of inflammatory factors, and mucin production [42].

Cold whether combined with exercise or not, can also adversely affect lung function and cause neutrophilic inflammation. It is distinct from the eosinophil-

ic/Th2-driven inflammation that classically occurs in patients with asthma [39]. Liu et al. showed that cold air can induce inflammatory responses via the TRPM8-mediated phosphorylated protein kinase C/ nuclear factor kappa B (PKC/NF-B) signaling pathway in primary airway epithelial cells of mice with asthma [44]. Inflammatory cytokines mRNAs expression of IL-1, IL-4, IL-6, IL-8, IL-10, IL-13, tumor necrosis factor 14 (TNF-14), and granulocyte-macrophage colony-stimulating factor (GM-CSF) was significantly increased under cold conditions and after TRPM8 overexpression, and further enhanced in the presence of the PKC inhibitor calfostin C. However, the down-regulation of TRPM8 and NF-B impaired the transcription of these cytokine genes. Furthermore, phosphorylated PKC and phosphorylated nuclear factor kappa B (IB) inhibitors were activated by cold stimuli [44]. Table 4 lists the studies on the association between cold and airway inflammation.

Sleep Duration

Sleep deprivation has both beneficial and adverse effects on the body [45]. It has been shown that persistent sleep deprivation in rats is harmful and can be fatal; however, long-term sleep deprivation in rats appears to produce cytokines that may contribute to tumor regression. Thus, sleep deprivation can be either beneficial or harmful in various circumstances [45]. Table 5 shows the studies on the relationship between sleep duration and airway inflammation**.**

Gut Status

It is well-known that constipation alters the intestinal microbiota [46]. Gut microbiota have an important role in maintaining intestinal homeostasis in healthy people. It maintains the energy balance of the colon and directly interacts with gut immunity through different immune-modulating pathways. However, the gut microbiome immune-modulating is not limited to the gut microbiota, and consequent alterations in immune function have been associated with different lung diseases [47]. Imbalances in the composition of the gut microbiota, referred to as dysbiosis, are caused by many factors such as host genetics, exposure to microorganisms, lifestyle, or various medical procedures [48]. For example, disrupting the commensal bacterial community in the gut through the use of antibiotics increased susceptibility to pneumonia and supported a Th2 response associated with allergic airway disease. Similarly, germ-free mice have shown reduced immunological tolerance and increased susceptibility to developing allergic respiratory tract diseases [47].

Table 4. Studies on the relationship between coldness and airway inflammation.

First author	Type of the study	Year	Results	Ref
Davis MS	Animal study	2002	Cooling and drying of the airways may be a factor in airway inflammation commonly found in equine athletes.	[38]
Sabnis AS	In vivo study	2008	Expression of several chemokine and cytokine genes, including IL-1α, IL-1β, IL-4, IL-6, IL-8 and IL-13, TNF-α, and GM-CSF were increased by the activation of the TRPM8 variant in lung epithelial cells of human.	[65]
Mäkinen TM	Clinical trial	2009	Cold temperatures and low humidity were associated with an increased incidence of respiratory tract infections, and a decrease in temperature and humidity preceded the onset of infections.	[66]
Seys SF	Clinical trial	2013	Exposure to high-altitude environmental conditions (cold, hypoxia, and exercise) was associated with a moderate loss of asthma control, neutrophilic airway inflammation, and increased airway obstruction.	[39]
Naumov DE	Clinical trial	2015	TRPM8 has a potential role in CAH development.	[43]
Chen L	Animal study	2016	Expression of CIRP protein was significantly increased in mice treated with cold air and COPD patients.	[42]
Juan Y	Animal study	2016	Airway inflammatory response and mucus overproduction are induced by cold temperature through increased CIRP-mediated mRNA stability and protein translation.	[67]
Liu H	Animal study	2018	Activation of TRPM8 by cold temperature and toluene diisocyanate induces enhanced transcription of inflammatory cytokines in mice bronchial epithelial cell lines.	[44]
Stjernbrandt A	Clinical trial	2021	Occupational exposure to cold was associated with wheezing and chronic and productive cough, but leisure exposure to cold was not significantly associated with reporting respiratory symptoms.	[68]

IL: interleukin, CIRP: cold-inducible RNA binding protein, COPD: chronic obstructive pulmonary disease, TRPM8: transient receptor potential melastatin 8, CAH: cold-induced airway hyperresponsiveness, TNF: tumor necrosis factor, GM-CSF: granulocyte-macrophage colony-stimulating factor

In allergic respiratory diseases, an interaction between dysbiotic states of the microbiota and allergic reactions in response to allergen exposure plays an important role. A recent longitudinal analysis has shown an association between the gut microbial environment and the development of asthma in children. The gut microbiota co-evolves with the infant's immune system, and several studies have shown that the change of microbiome diversity in early childhood is the cause of allergic rhinitis and asthma at school age [49]. Also, an evolved symbiotic relationship has been established between hosts and their microbiomes which plays a role in regulating mucosal immunity and inflammation [49].

Serum immunoglobulin E (IgE) is an antibody produced in response to allergens that is essential in the pathogenesis of allergic diseases. In the gut, IgE is produced locally due to the stimulation of food allergens and acts as an indicator of food sensitivity. Furthermore, an early altered pattern of gut microbiota is associated with the risk of IgE-mediated food allergy in children [49]. Studies on the effects of constipation and gut microbiota on airway inflammation are listed in table 6.

Discussion

According to the PM, mental states such as anger, fear, joy, sadness, and even embarrassment should be kept in moderation to maintain health [50]. In this regard, psychological stress leads to increased secretion of cortisol and catecholamines through the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic and adrenomedullary (SAM) system, respectively [20]. The stress hormones can alter the immune response by reducing the expression of Th1 cytokines and promoting the differentiation of Th2 cells. Chronic stress may also reduce the sensitivity to endogenous cortisol, exacerbating inflammatory responses. Inflammatory cells express MOR, which likely plays a role in stress-induced inflammation.

PM suggests limiting the consumption of cold-natured and flatulent foods to improve the symptoms of patients with chronic lung diseases [50]. For the treatment of patients with chronic lung diseases, PM sug-

Table 5. Studies on the relationship between sleep duration and airway inflammation.

First author	Type of the study	Year	Results	Ref
Renegar KB	Animal study	2000	Sleep deprivation may exert its beneficial effects on the airways through increased production of antiviral cytokines.	[45]
Sazak Kundi FC	Animal study	2021	Chronic sleep deprivation resulted in a significant increase in mucociliary clearance rate and ciliary cell number.	[69]

Table 6. Studies on the relationship between constipation, gut microbiota, and airway inflammation.

First author	Type of the study	Year	Results	Ref
Trompette A	Animal study	2014	Fermentable fiber and SCFAs can shape the immunological environment in the lungs and influence the severity of allergic inflammation.	[70]
Kim YG	Animal study	2014	Antibiotic treatment-induced gut dysbiosis increases allergic airway inflammation by shifting pulmonary macrophage polarization towards the alternatively activated M2 phenotype.	[48]
Vital M	Animal study	2015	The composition of the gut microbiota changes in lung allergy, suggesting bidirectional gut-lung communication.	[47]
Kepert I	In vivo and Animal study	2017	Feeding mice with D-tryptophan before experimental asthma induction increased the number of regulatory T cells in the lungs and intestines, decreased lung Th2 responses, and alleviated allergic airway inflammation and hyperreactivity so that allergic airway inflammation increased microbiological diversity in the gut, which was increased by D-tryptophan.	[71]
Zhang Y	Clinical trial	2018	Inflammatory components in asthmatic children's blood are correlated to intestinal flora and GI function.	[72]
Zhang J	Animal study	2018	Treatment with LGG contributes to protection against OVA-induced allergic airway inflammation by expanding mesenteric CD103+DCs and accumulating mucosal regulatory T cells. Furthermore, the protective effect induced by LGG is associated with the gut microbiota rather than the lung flora.	[73]
Wu MC	Cohort study	2020	Constipated patients had twice as much AR than non-constipated patients regardless of sex and comorbidities.	[74]
Chiu CY	Clinical trial	2020	Airway microbial dysbiosis in response to house dust mites and their interaction with the gut microbial community is associated with allergic airway disease in early childhood.	[75]

SCFAs: Short-chain fatty acids, LGG: *Lactobacillus rhamnosus* GG, Th: T helper, OVA: ovalbumin.

gests consuming a variety of nourishing sustenance. These include fermented bread, which is enriched with nutritious additives such as hyssop and thyme, both renowned for their therapeutic properties. Furthermore, the intake of small freshwater fish and the consumption of small birds are also recommended [13]. Respiratory manifestations of food allergy are caused by common allergens such as cow milk, eggs, cereals, fruits, and vegetables. However, respiratory symptoms, particularly asthmatic reactions, have been observed in fatal and near-fatal reactions after food consumption, making them a concern.

From the PM's point of view, physical activity is one of the most important factors affecting human health. PM's recommendations on the characteristics of appropriate physical activity for patients with respiratory disorders include doing exercises that involve the respiratory muscles, such as archery, doing exercises from slow to fast speed/intensity, and breath holding and then blowing slowly and strongly in special containers [50]. To dilute and eliminate thick mucus in patients with respiratory disorders, chest massage with or without oil is also recommended. Moreover, mild exercise is very useful according to the ability of the patients [13]. Previous research has demonstrated that exercise can reduce inflammation by decreasing the activity and expression of certain factors and increasing the expression of others, as well as reducing airway remodeling and benefiting the vessels and lung parenchyma.

PM has proposed that inhalation of very cold air is a trigger for dyspnea and other respiratory diseases. Accordingly, avoiding cold air exposure is one of the important recommendations of PM physicians to maintain lung health [50]. Inadequate modification of temperature during cold air inhalation can result in significant respiratory autonomic reactions such as airway constriction, mucosal secretion, and coughing. PM has inhibited prolonged sleep, especially immediately after meals as well as daytime sleep in patients with respiratory disorders [13]. Sleep deprivation may have both beneficial and detrimental impacts on the physical well-being of an individual. This phenomenon has been exemplified by the potential danger of prolonged sleeplessness in rats and the potential for cytokine generation to assist in tumor regression in rats subjected to persistent sleep deprivation.

From the viewpoint of PM, not only the treatment of the respiratory system itself, but also paying attention to the absence of constipation in patients with respiratory disorders is very important to improve their symptoms [13]. It is widely recognized that constipation impacts the intestinal microbiota, which is crucial for maintaining intestinal homeostasis and energy balance in healthy individuals. Dysbiosis, or the imbalance in gut microbiota composition, can result from various factors and has been linked to immune dysfunction in lung diseases.

Conclusion

In line with Persian medicine recommendations for lifestyle modification in respiratory diseases, recent studies are also confirmative regarding these considerations. It has been shown that psychological stress could lead to shifts in the immune response from Th1 to Th2. Light physical activity leads to reducing the expression of some mediators such as NF-κB, IGF-1, oxidative stress, and the production of Th2 cytokines, and induces the expression of IL-10 and IL-1 receptor antagonists. On the other hand, intense exercise and training in a cold environment could result in damage to airway epithelial cells, leukotriene overexpression, and greater airway eosinophilia. Also, the well-being of the intestinal microbiota [and avoiding constipation] and decreasing the sleep duration have a positive effect on the regression of inflammation. All in all, lifestyle modification can be used as a complementary therapy to prevent exacerbations and the occurrence of airway inflammation. Further clinical investigations should be conducted to confirm the efficacy of lifestyle modification tips.

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Declaration of competing interest

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