INFORMATICS JOURNALS

Review Article

Journal of Natural Remedies
DOI: 10.18311/jnr/2026/45718

eISSN: 2320-3358 | Vol 26(4), 2026 | pp. 797-815

# Ancient *Ayurveda* Meets Modern Science: The Role of *Panchakarma* in Modulating Gut-organ Axes - A Narrative Review

**Bhavna Bhatia*, Manoj Shamkuwar and Manisha**

Department of Panchakarma, Ayurvedic and Unani Tibbia College and Hospital, Government of NCT of Delhi, New Delhi – 110005, India; bhavnakamnabhatia123@gmail.com

## Abstract

**Background:** Gut dysbiosis is associated with inflammatory and metabolic disorders, highlighting its role in multifactorial diseases. The gut microbiota regulates key physiological processes and communicates with distant organs such as the brain, liver, skin, lung, heart, and bone through gut–organ axes. In *Ayurveda*, *Agni* (digestive/metabolic factors) may correspond to gut microbiota, while *Agni dushti* (derangement of *Agni*) parallels gut dysbiosis. The systemic influence of *Agni* reflects the concept of gut–organ interactions described in modern science. **Aim:** This narrative review aims to integrate modern scientific insights on gut dysbiosis and gut-organ axes with classical *Ayurvedic* concepts. *Ayurveda*, much like contemporary science, recognises systemic interconnections through concepts like *Agni, Ama* (incompletely metabolised/toxic by-products), and *Panchakarma* (five-fold therapeutic procedures). The review explores the use of *Panchakarma* in managing systemic disorders linked to gut dysbiosis, highlighting its relevance and scope for future research. **Methods:** The literature search was conducted using Scopus, PubMed, and Google Scholar for studies published up to June 2024. Studies on gut microbiome, gut-organ interactions, and *Panchakarma* interventions in disorders related to gut dysbiosis were included, while those focusing solely on *Prakriti* (somatic constitution), diet, or *Shamana Aushadhi* (internal medications) were excluded. Findings were synthesised to align *Ayurvedic* concepts with modern perspectives on gut-mediated systemic health. **Results:** *Panchakarma* interventions can potentially improve several conditions linked to gut dysbiosis. However, only two studies have investigated their effects on gut microbiome composition using 16S rRNA next-generation sequencing, indicating a limited but emerging area of research. **Conclusion:** *Panchakarma* therapies may act as potential modulators of gut microbiota, supporting microbial balance and systemic health. Further well-designed studies are required to validate these effects and elucidate underlying mechanisms.

**Major Findings:** *Panchakarma* therapies may influence gut microbial composition and potentially affect systemic physiology through gut–organ axes. Classical *Ayurvedic* concepts emphasising digestive function show conceptual parallels with modern microbiome science. Further studies are needed to validate these microbiome-modulating effects.

**Keywords:** *Agni*, *Ayurveda*, Gut-organ Axes, Gut Microbiome, *Panchakarma*

(Article Chronicle: Article Received on: 03.09.2024; Revised on: 16.03.2026; Accepted on: 27.03.2026)

## 1. Introduction

Early in the 20th century, the term "microbiota" was coined to refer to the presence of viruses, bacteria, and yeasts in various areas of the human body like gut, skin, etc. The human microbiota contributes genetic material vastly exceeding that of the human genome. The "microbiome" encompasses all genetic material of these microorganisms[1-3]. Microbiota composition varies by body site, with the gut microbiota being crucial for health[4]. Dysbiosis (altered microbial communities) can affect distant organs through the gut-lung, gut-skin, gut-brain axes, etc., influencing diseases[5]. Dysbiosis has been linked to various

*Author for correspondence

diseases, including infectious, inflammatory, and metabolic disorders, highlighting its role in the pathogenesis of multifactorial conditions[6]. The gut microbiota regulates physiological processes and communicates with major organs like the brain, heart, liver, and skin, affecting their function. Gut-on-chip technology models these interactions, enhancing our understanding of health and disease across organ axes[7,8].

The concept of *Agni* (digestive/metabolic factors) is central to *Ayurveda*. One of the most important elements in determining optimum health is *Agni*. On the contrary, *Ama* (anything that exists in a state of incomplete transformation) is responsible for the aetiology of various diseases. It is seen as a morbid substance that arises from faulty digestion and impaired metabolism. This intermediate or byproduct of metabolism tends to cause blockages within the body's microchannels, or '*Srotasa*,' i.e., *Srotorodha,* leading to systemic illnesses. The primary cause of *Ama* formation is *Agni* impairment, which ultimately leads to *Agni* destruction. As a result, a vicious cycle of reduced *Agni* and *Ama* production is established[9,10]. *Ama* can be produced at the level of *Jatharagni* (digestive/metabolic fire responsible for primary digestion), *Bhutagni* (elemental metabolic factors acting on the five basic elements), and *Dhatvagni* (tissue-level metabolic factors responsible for metabolism within body tissues)[11].

The concept of *Agni* in *Ayurveda* can be hypothesised to relate to the gut microbiota of the present era. Similarly, *Agni Dushti* (faulty metabolic fire) can be compared to modern gut dysbiosis. The bidirectional relationship of *Agni* with the functioning of various organs throughout the body underscores the concept of gut-organ axes, where the health of the digestive system profoundly impacts the well-being of other organs.

While research on the gut microbiota and its systemic influence has expanded significantly, the role of *Panchakarma* (five-fold therapeutic procedures) in modulating gut dysbiosis remains largely unexplored. Limited research exists to determine whether *Panchakarma* therapies can restore the balance of the gut microbiome.

By integrating *Ayurvedic* perspectives with contemporary microbiome science, this review seeks to highlight the interconnectedness of gut health with various organ systems and how *Panchakarma* therapies have been traditionally used to manage disorders associated with gut dysbiosis. Specifically, this review aims to:

i. Explore modern research on the existence of gut-organ axes (e.g., gut-brain, gut-skin, gut-liver, etc.) alongside classical *Ayurvedic* concepts that indicate similar interconnectedness between the gut and systemic health. It validates the relevance of *Ayurveda* in the context of modern gut health research and opens avenues for integrative approaches that combine ancient wisdom with contemporary science.
ii. Compile evidence on the traditional use of *Panchakarma* therapies in managing disorders now linked to gut dysbiosis, emphasising their potential relevance in modulating gut-organ interactions.

By achieving the above-mentioned objectives, it seeks to identify research gaps and propose future directions for interdisciplinary studies integrating *Panchakarma* with modern microbiome science.

## 2. Materials and Methods

### 2.1 Eligibility Criteria

#### 2.1.1 Studies that Met the Following Criteria were Included

Original research articles, observational studies, case reports, clinical trials, and review articles on gut-organ axes and *Panchakarma* therapies. Studies focusing on the impact of *Panchakarma* therapies on the gut microbiome, gut-organ axes, changes in gut microbiota composition, metabolomic profiles, inflammatory markers, and clinical outcomes. Articles that reported microbiome analyses. Only articles published in English were considered.

#### 2.1.2 Studies that were Excluded

Studies that did not provide detailed information on the *Panchakarma* interventions or outcomes.

Microbiome Studies related to *Prakriti* (individual constitution), diet, or medication effects were excluded.

### 2.2 Information Sources

Several databases, including Scopus, PubMed, and Google Scholar, were thoroughly searched. The search

covered literature published up to June 2024. Additional sources included classical *Ayurveda* texts.

### 2.3 Search Strategy

Search terms included Medical Subject Headings (MeSH) and keywords related to "*Ayurveda*", "*Panchakarma*", "gut microbiome", and selected gut-organ axes (gut-heart, gut-liver, gut-brain, gut-bone, gut-lung, and gut-skin). Additional free-text keyword combinations included: "Gut microbiome *Panchakarma*", "heart *Panchakarma*", "liver *Panchakarma*", "brain *Panchakarma*", "lung *Panchakarma*", "skin *Panchakarma*", and "bone *Panchakarma*".

### 2.4 Study Selection

The process for selecting studies involved several steps:

i. Screening: Relevance was assessed by screening the titles and abstracts of the identified articles.
ii. Eligibility: According to the inclusion criteria, full-text articles of possibly pertinent research were evaluated for eligibility.
iii. Inclusion: Studies meeting all criteria were included in the review.

### 2.5 Data Collection Process

The data was extracted independently. Discrepancies were resolved through discussion with co-authors.

### 2.6 Data Items

For the 16S rRNA-based microbiome studies included in the review, the following data items were extracted: Authors (Year), Patients (Number), Race (Country of the Study), Treatment Given, Analysed sample type, Method, Total Reads, Findings, and *Firmicutes* to *Bacteroidetes* Ratio.

### 2.7 Data Synthesis

The data were synthesised by integrating findings from contemporary scientific studies, classical *Ayurvedic* literature, and clinical research articles/case studies. *Ayurvedic* principles were correlated with modern scientific insights to provide a comprehensive understanding of the gut-organ axes and the potential therapeutic role of *Panchakarma* in modulating gut health and systemic well-being.

### 2.8 Synthesis Strategy

To explore the potential of *Panchakarma* therapies in the context of gut-organ axes, literature was systematically grouped under three thematic domains for each axis (e.g., gut-brain, gut-skin, gut-bone, gut-lung, gut-liver, and gut-heart).

#### *2.8.1 Contemporary Scientific Findings*

This sub-section compiles modern scientific studies on gut dysbiosis and its modulation through interventions such as probiotics, prebiotics, dietary modifications, Faecal Microbiota Transplant, etc. These studies provide insights into established mechanisms of gut-organ interactions.

#### *2.8.2 Ayurvedic Perspective*

It compiles classical *Ayurvedic* references that conceptually support the interconnectedness between gut health and systemic functions. This includes core *Ayurvedic* concepts such as *Agni, Ama, Aharaja Nidana* (diet-related etiological factors), and *Panchakarma* to show how traditional texts indirectly reflect gut-organ relationships. Thus, offering an indigenous framework that aligns with modern findings.

#### *2.8.3 Panchakarma-based Clinical Evidence*

Experimental studies, case reports, and research articles documenting the use of *Panchakarma* therapies for disorders related to specific gut-organ interactions are cited in this sub-section. The cited evidence highlights the potential role of *Panchakarma* in modulating gut dysbiosis and managing systemic disorders.

## 3. Integrative Analysis

### 3.1 Gut-brain Axis

#### *3.1.1 Contemporary Scientific Findings*

Recent research highlights the gut-brain axis (GBA), a system linking gastrointestinal balance with emotional and cognitive functions. Gut microbes interact with the enteric nervous system (ENS) and influence the central nervous system (CNS) via neuroendocrine and metabolic pathways, involving components like the CNS, autonomic nervous system (ANS), and hypothalamic-pituitary-adrenal (HPA) axis[12,13]. Dysbiosis is linked to conditions such as autism, anxiety,

depression, and irritable bowel syndrome (IBS), with probiotic treatments showing potential in modulating neurochemistry and alleviating symptoms[14-21]. Additionally, a pilot study identified alterations in the gut microbiome of patients with erectile dysfunction[22]. This highlights the broader impact of gut microbiota on immune activation and neurotransmitter release[23-25].

### 3.1.2 Ayurvedic Perspective

*Ayurveda* clearly emphasises the interdependence of gut health and mental well-being, mirroring the modern understanding of the gut-brain axis. Classical *Ayurvedic* concepts illustrate this connection in the following ways:

*Ayurveda* describes a close relationship between *Pittadhara Kala* (Mucous membrane of the small intestine/duodenum) and *Majjadhara Kala* (nervous system tissue), suggesting that disturbances in digestion can influence the nervous system. This aligns with modern observations where gut microbiota (GM) imbalances are linked with neuropsychiatric disorders such as depression, anxiety, and autism. Similarly, disorders like *Unmada* (psychiatric illness) and *Apasmara* (epilepsy) are associated with faulty food habits like *Ahita* (unwholesome), *Viruddha* (incompatible), *Dushta* (vitiated/contaminated), and *Ashuchi Bhojana* (impure food), highlighting how improper dietary practices and digestive imbalances can lead to mental disturbances[26]. Emotions such as *Krodha* (anger), *Lobha* (greed), *Shoka* (grief), and *Manodvega* (mental agitation) impair *Agni* (digestive capacity), pointing to a bidirectional relationship between digestion and the mind[27].

Moreover, the symptom of *Manah Sadana* (psychosomatic disturbance) in *Vataja Grahani* (*Vata*-predominant malabsorption syndrome) and the causes of *Atisara* (diarrhoea) linked to emotional triggers like *Krodha* (anger), *Irshya* (jealousy), *Bhaya* (fear), and *Chittotvega* (mental agitation) further strengthen the *Ayurvedic* perspective that gut and mental health are deeply interconnected[28,29]. These references collectively indicate that *Ayurveda*, much like modern science, recognises the gut-brain axis, offering its own unique framework to understand and address this intricate relationship.

### 3.1.3 Panchakarma-based Clinical Evidence

Various clinical studies highlight the effectiveness of *Panchakarma* therapies like *Shirodhara* (therapeutic pouring of medicated liquids over the forehead), *Virechana* (therapeutic purgation), and *Basti* (medicated enema therapy) in treating conditions such as IBS, Parkinson's Disease (PD), Premature Ejaculation (PME), Major Depressive Disorder (MDD), and Anxiety[30-34].

## 3.2 Gut-skin Axis

### 3.2.1 Contemporary Scientific Findings

Recent studies have explored the gut–skin axis, linking gut microbiome alterations with skin diseases such as psoriasis, rosacea, and atopic dermatitis. Significant findings include protective effects of probiotics like *Lactobacilli* and *Bifidobacteria*, with unidirectional causal relationships between gut microbiota and conditions like psoriasis, rosacea, and acne, while bidirectional effects were noted for atopic dermatitis and vitiligo[35,36]. Gut dysbiosis is known to increase gut permeability and inflammatory responses, potentially worsening conditions like psoriasis by promoting proinflammatory states and elevating biomarkers for intestinal permeability[37-41]. Probiotics have shown promise in alleviating psoriasis symptoms and reducing proinflammatory cytokines in animal studies[42-45].

### 3.2.2 Ayurvedic Perspective

The bidirectional relationship between *Agni* and *Twacha* (skin) in *Ayurveda* mirrors the interdependency observed between the gut microbiota (GM) and the skin. Also, *Ayurvedic* texts state that inappropriate dietary and lifestyle factors (*Aharaja-Viharaja Nidana*) are one of the root causes of skin disorders (*Kushtha*). These factors include - consuming too much dairy and sweets, eating in an incorrect order or pattern, excessive intake of *lavana rasa* (salt taste) and *amla rasa* (sour taste), *diwashayana* (sleeping during daytime), and experiencing psychological disturbances during meals, etc[46]. These factors may affect the gut microbiota and cause various skin disorders.

Also, *Agni* (digestive fire) is essential for nutrient breakdown and absorption. When *Agni* functions optimally, it contributes to clear skin (*Varna*) and a radiant complexion (*Prabha*)[47]. Also, the importance of *Shodhana* (detoxification) therapy in the treatment of *Kushtha* (skin disorders) has been highlighted by all *Ayurvedic Acharyas*. It has been suggested that patients with skin disorders (*Kushtha*) undergo repeated

*Shodhana* karma at regular intervals[48,49]. *Shodhana* procedures, i.e. *Vamana* (therapeutic emesis) and *Virechana* (therapeutic purgation), have a significant role in improving the function of *Agni*[50]. *Asthapana* (Decoction-based enema) and *Anuvasana* (Oil-based enema), *Basti* also have the property to enhance *Agni*[51,52]. Therefore, this may suggest a link between the gut and the skin in *Ayurveda*.

### 3.2.3 Panchakarma-based Clinical Evidence

Various studies provide evidence of the efficacy of *Panchakarma* therapies like *Vamana*, *Virechana*, and *Basti* in treating various skin disorders like Psoriasis, Chronic dermatitis, Vitiligo, and *Acne vulgaris*[53-57].

## 3.3 Gut-bone Axis

### 3.3.1 Contemporary Scientific Findings

Bacterial metabolites impact the gut-bone axis by regulating inflammation, immune responses, and nutrient absorption, crucial for bone health. While short-chain fatty acids and other metabolites impact bone health by controlling hormones like estrogen and preserving gut barrier function, dysbiosis can cause chronic inflammation and impact bone metabolism[58]. Diet significantly affects gut microbiota and bone health; high-fat diets reduce microbiota diversity, whereas fibre-rich diets, such as the Mediterranean diet, enhance SCFA levels and support bone health[59-65]. Studies show differences in microbiota diversity between individuals with osteoporosis and those with normal bone mass, with specific strains like *Prevotella* showing potential in preventing bone loss[66].

### 3.3.2 Ayurvedic Perspective

According to *Ayurveda*, *Agni* is in charge of digesting food and turning it into essential nutrients. It highlights the sequential nourishment of *Dhatus* (body tissues) from *Rasa* (plasma/nutrient fluid) to *Rakta* (blood), *Mamsa* (muscle), *Meda* (adipose tissue), *Asthi* (bone), *Majja* (bone marrow), and *Shukra* (reproductive tissue). Proper functioning of *Agni* (digestive and metabolic fire) ensures that each *dhatu* receives adequate nourishment, with the bones receiving structural support from the preceding *Dhatus*. Any disruption in this chain, particularly due to impaired *Agni*, can compromise bone health[67].

Optimal *Agni* contributes to *Bala* (strength), which is further explained in the commentary by *Acharya Chakrapani* as "physical strength inferred through an individual's capacity for *Vyayama* (exercise)"[67]. This concept corresponds with findings in contemporary research demonstrating that performance in physical tests correlates with Bone Mineral Density (BMD), and that reduced physical performance, along with low BMD, is associated with an increased risk of falls and fractures[68]. Therefore, optimal *Agni* plays a crucial role in nutrient assimilation, maintenance of bone density and physical strength, and prevention of bone-related disorders.

*Shodhana* (purificatory) therapies such as *Vamana* (therapeutic emesis), *Virechana* (therapeutic purgation), and *Niruha Basti* (decoction-based medicated enema) are described to enhance strength (*Bala vriddhi*) and improve the function of *Agni* (*Agni vardhana*)[50,69]. Additionally, *Anuvasana Basti* (oil-based medicated enema) has the potential to increase strength and promote *Raktadi samprasada* (proper purification and nourishment of *Rakta* and subsequent *Dhatus*), as indicated in its *Samyaka Yoga Lakshana* (signs of proper therapeutic action). Although *Agnivriddhi* is not explicitly mentioned for *Anuvasana Basti*, *Raktadi samprasada* is described. *Acharya Chakrapani* explains this as the optimal functioning and nourishment of *Raktadi Dhatus* (*Rakta, Mamsa, Meda, Asthi, Majja,* etc.) through *Anuvasana Basti*, suggesting its potential to nourish *Asthi dhatu*[70].

Additionally, weak or impaired *Agni* leads to the formation of *Ama*. *Ama* accumulates in the body and blocks the channels (*Srotorodha*), including those that nourish the *Asthi* (bone tissues)[71]. This blockage can lead to poor bone density and the presence of *Sama-Vata Lakshana*, such as *Agnisada* (impairment of digestive fire), *Vedana* (pain), *Nistoda* (pain), *Angapeeda* (body ache), *Sthamba* (stiffness), and *Shopha* (swelling)[72]. According to *Ayurvedic* principles, these points suggest a connection between gut and bone health.

### 3.3.3 Panchakarma-Based Clinical Evidence

Various studies provide evidence on the efficacy of *Panchakarma* treatments such as *Snehana* (oleation therapies), *Virechana*, and *Basti* in treating osteoporosis and osteopenia[73-77].

## 3.4 Gut-lung Axis

### 3.4.1 Contemporary Scientific Findings

The gut-lung axis illustrates how gut microbiota influences lung health and vice versa, with imbalances linked to Chronic Obstructive Pulmonary Disease (COPD) and potential asthma risks. For example, specific gut microbiota in breast-fed infants may prevent childhood asthma and allergies, while a decrease in *Bifidobacterium, Akkermansia, Faecalibacterium*, and an increase in fungi like *Candida* and *Rhodotorula*, raise the risk of asthma in children[78-84]. Air pollution affects the gut microbiome and can enter the gastrointestinal system through inhalation, leading to systemic inflammation[85]. Probiotics, helminth therapy, and faecal microbiota transplantation (FMT) are under exploration for managing COPD, aiming to regulate inflammation and restore microbiota balance[78,79].

### 3.4.2 Ayurvedic Perspective

In *Ayurveda*, respiratory health is closely linked to the balance of *Doshas* (bodily humours) and the proper functioning of *Agni* (digestive fire). *Prana*, often used synonymously with *Vayu* (air), encompasses five types: *Prana, Udana, Samana, Vyana*, and *Apana*. *Agni* is crucial for *Ayu* (life), *Bala* (strength), *Swastha* (health), *Utsaha* (enthusiasm), and *Prana*. *Acharya Chakrapani* clarifies that *Prana* includes all its five forms. To maintain health, *Agni* should be in its normal state (*Samagni*), ensuring the proper digestion, absorption, and assimilation of food[47]. *Shwasa roga* (respiratory diseases) are considered disorders of the *Pranavaha Srotas* (respiratory channels). *Hridaya* (heart) and *Mahasrotasa* (the primary channel of nourishment) are the *moola* (root sites) of *Pranavaha Srotasa*. When these channels are vitiated due to *Kshaya* (depletion), *Vegadharana* (suppression of natural urges), and *Ruksha Ahara-Vihara* (dry predominant diet and lifestyle), etc., it leads to symptoms such as prolonged, obstructed, agitated, and noisy respiration[86,87].

According to *Ayurveda*, certain dietary habits such as consuming heavy (*guru*), dry (*ruksha*), and highly acidic (*vidahi*) foods can contribute to the onset of *Tamaka Shvasa*. It can be correlated with bronchial asthma in modern literature and is caused by the obstruction of channels and vitiation of *Vata dosha* in the *Pranavaha Srotasa* due to *Ama* formation from *Agnimandya*[88]. Intake of heavy foods that increase *Kapha* can lead to increased *Ama* and *Malabhuta Shleshma* (mucus), which obstructs the path of *Vata*, causing its improper movement (*vimarga gamana*) and inflammation (*Shotha*) in the respiratory tract. *Chakrapani* explains that *Vata* and *Kapha doshas* get vitiated, accumulate in their respective sites, and further aggravate each other, disrupting the digestive fire (*Jatharagni*) and leading to *Ama* formation. This process impairs the formation of proper tissues and increases *Rasa mala Kapha* (mucus derived from the metabolic waste of *Rasa dhatu*), exacerbating the symptoms[72].

*Ayurvedic* texts describe the relationship between *Prana Vayu* and *Apana Vayu* within the *Mahasrotasa*. *Prana Vayu* resides in the uppermost part, while *Apana Vayu* is situated in the lower part[89]. *Udavarta* (upward or reverse movement of *Vata dosha*) is a multifaceted concept in *Ayurveda*. It can manifest as an independent disease or serve as a *Lakshana* (symptom) in various conditions where *Vata* function is impaired, such as *Arsha* (piles). Additionally, *Udavarta* can act as a *Nidana* (causative factor) for different diseases like *Hikka* (hiccups) and *Shvasa* (dyspnoea). Furthermore, it may also be considered an *Upadrava* (complication) associated with other diseases, like *Arsha*[90]. In cases of *Udavarta*, there is *Pratiloma Gati* (upward movement) of *Apana Vayu* within the *Pakwashaya* (large intestine)[91]. *Tamaka shwasa* also involves *Pratiloma Gati* of *Vayu*[92]. Also, *Acharya Chakrapani* explains that *Shwasa* originates from the *Pitta-sthana*, specifically referring to the *Amashaya* (stomach)[93].

These points can also establish the gut-lung axis in *Ayurveda*, highlighting how digestive health can influence respiratory well-being.

### 3.4.3 Panchakarma-based Clinical Evidence

Emerging research suggests that *Ayurvedic* therapies like *Dhumapana* (medicated smoking) and *Basti* may modulate the gut microbiome, potentially influencing the gut-lung axis and impacting lung health. Further studies are needed to clarify these effects and mechanisms. Also, various studies provide compelling evidence that *Panchakarma* therapies (*Vamana*, *Virechana*, and *Basti*) are effective in treating bronchial asthma by potentially modulating gut function[94-99].

## 3.5 Gut-liver Axis

### 3.5.1 Contemporary Scientific Findings

The gut-liver axis involves complex communication through signalling molecules like microbe-associated molecular patterns (MAMPs), pathogen-associated molecular patterns (PAMPs), SCFAs, trimethylamines, and gut-derived hormones, cytokines, and neurotransmitters, all of which modulate the liver's functional status and response. Additionally, the liver sends feedback through the enterohepatic circulation, including bile acids (BAs) and immunoglobulin A, influencing gut functions[100]. FMT has shown potential in treating chronic liver diseases, although concerns include transmission of resistant strains and donor variability[101-104]. Additionally, probiotics and prebiotics offer alternative approaches, with prebiotics enhancing beneficial bacteria and intestinal barrier function, while probiotics aid immune function and barrier maintenance, though their effectiveness can vary[105-112].

### 3.5.2 Ayurvedic Perspective

In *Ayurveda*, the *Yakrita* (liver) and *Pleeha* (spleen) are *moola* (root sites) of the *Raktavaha Srotas*, i.e, the channels responsible for blood tissue (*Rakta Dhatu*)[86]. *Yakrita* plays a vital role in metabolising and forming *Rakta Dhatu*, starting with food digestion and the creation of the nutrient fluid, *Ahara Rasa*. Optimal *Agni* is crucial for proper digestion and the transformation of food into *Ahara Rasa*. This fluid is transported to the *Yakrita*, where it interacts with *Ranjaka Pitta* to convert into *Rakta Dhatu*[113]. Balanced *Agni* ensures efficient digestion and good-quality *Ahara Rasa*, supporting the function of *Yakrita* in transforming this nutrient into healthy *Rakta Dhatu*. Disruptions in *Agni* can lead to *Ama* (toxins), obstructing the *Srotasa* and impairing the *Yakrita*.

Furthermore, this relationship is bidirectional; if *Yakrita* is compromised, it can disrupt *Agni*, leading to symptoms like *Aruchi* (loss of appetite), *Avipaka* (indigestion), *Agninasha,* and *Malamutra-graha* (difficulty in passing stool and urine), etc[114]. Thus, a compromised *Yakrita* affects both *Rakta Dhatu* formation and the digestive process, i.e., creating a cycle of poor digestion and impaired liver function. Maintaining balanced *Agni* is crucial for liver health and proper blood tissue formation, underscoring the interconnectedness of gut and liver functions in *Ayurveda*.

### 3.5.3 Panchakarma-based Clinical Evidence

Various studies provide evidence on the efficacy of *Panchakarma*, specifically *Virechana* and *Nitya Virechana* (daily therapeutic laxative therapy), in treating various liver-related conditions like Non-Alcoholic Steatohepatitis (NASH), Liver cirrhosis, Ascites, and Alcoholic Liver Disease[115-118]. Also, *Virechana* karma decreased fat, blood glucose, and triglycerides, and improved insulin sensitivity in fructose-induced metabolic syndrome in Albino rats[119].

## 3.6 Gut-heart Axis

### 3.6.1 Contemporary Scientific Findings

Extensive research shows that gut microbiota significantly influences cardiovascular disease (CVD) risk factors like dyslipidemia and inflammation, impacting conditions such as coronary artery disease (CAD) and stroke[120,121]. Dietary nutrients, particularly fibre, influence gut microbiota and thus CVD risk by boosting short-chain fatty acids (SCFAs) with anti-inflammatory, anti-obesity, and anti-diabetic effects[122]. Mediterranean diets enhance beneficial bacteria and gut barrier function, reducing risks of CVD, T2DM, and obesity[123-125]. In contrast, Western diets high in fats and sugars lead to dysbiosis, increasing susceptibility to obesity, hypertension, and atherosclerosis by compromising gut barrier integrity[126-131]. Red meat overconsumption produces trimethylamine N-oxide (TMAO), linked to atherosclerosis progression[132,133]. Probiotics, prebiotics, and Faecal Microbiota Transplantation (FMT) are emerging strategies for improving cardiometabolic parameters in CVD patients, though more research is needed[134].

### 3.6.2 Ayurvedic Perspective

In *Ayurveda*, *Ojasa* (*Para oja*), the essence of all *Dhatus* (tissues), resides in the *hrudaya* (heart) and is vital for its function[135,136]. To safeguard the *hrudaya* and *Ojasa*, it is important to avoid mental distress and engage in practices that benefit the heart, such as consuming *Ojasa*-enhancing medicines and foods and keeping the channels (*Srotasa*) clear[136]. Optimal *Agni* is essential to prevent *Srotorodha* (blockage of channels).

**Table 1.** Overview of 16S rRNA-based studies on gut microbiome modulation by *Panchakarma*

| S. No. | Patients (Number)/ Race (Country of the Study) | Treatment Given | Analysed Sample/ Method/ and Total Reads | Findings | *Firmicutes* to *Bacteroidetes* Ratio | References |
|---|---|---|---|---|---|---|
| 1. | Obese individuals, with a BMI of ≥30 kg/$m^2$ 8 females and 7 males. (n = 15)/Asian (India) | 15 day course of enemas; the first, eighth, and fifteenth enemas were made with sesame oil and given after meals, while the other enemas were made with buttermilk that had been treated with medicinal plants and given before meals. | Faecal samples collected on day 0, 16 and 45/V4 region of 16S rRNA gene were amplified and sequenced using the Illumina MiSeq platform/A total of 1,324,840 raw 16S rDNA sequence reads were obtained for 65 faecal and buttermilk samples, with an average of 11,227 ± 9580 reads per sample. | Bacterial diversity increased by day 16 but returned to original levels by day 45, indicating that buttermilk administration per rectum is effective in the short term and may need repetition for sustained benefits.<br>Genus *Megasphaera* showed a significant and slight positive correlation with fasting blood sugar levels of patients at both time points (Day 0 and 45) (P = 0.0187).<br>Faecal Samples (Variation of Bacterial Diversity at the Genera Level)<br>Diversity showed a decline right after treatment (day 16), and this decline continued after the follow-up period (day 46). (Genera such as *Geobacillus, Meoithermus, Areibacillus*, and *Culobacter* first appeared on day 16, followed by ↓ day 45.)<br>- Additionally, a minor decline in *Prevotella* abundance was noted, but it returned to its initial level on day 45.<br>- Genera *Lactobacillus*, *Geobacillus,* and *Pseudomonas* ↑ on day 16 (P<0.05) and ↓ on the 45$^{th}$ day.<br>- *Faecalibacterium* ↓ after treatment (P = 0.05). | ↑ from day 0 (0.161) to day 16 (0.384), which returned to baseline level on day 45 (0.151). | 144 |
| 2. | 9 females and 4 males, with various complaints. (n = 13)<br>- 2 healthy controls. (without receiving *Ayurvedic* therapy) (n = 2)/Asian (Japan) | 4 – *Virechana*<br>2 - *Sashtika Shali Pinda Swedana*<br>1 - Matra *Basti*<br>6 – *Basti* therapy | Faecal samples were taken at the entry, during treatment, at the discharge, and three weeks later/ V3-V4 regions the 16S rRNA gene were amplified by PCR and subjected to pair-end sequencing using Illumina MiSeq/A total of 2,032,860 nonchimeric reads (39,860.0±7,307.8 nonchimeric reads/sample; mean±SD) | - Clinical manifestations of all 13 patients became better. *Ayurvedic* treatment was effective for skin rashes. The depressed patient had the will to live. Changes by *Virechana* therapy:<br>*Proteobacteria* and *Fusobacteria* ↑ to 32.5% and 8.1%, respectively<br>*Verrucomucrobia* became zero.<br>Post *Purvakarma* (preparatory procedures) - ↓ of the *Firmicutes* and an ↑ of the *Proteobacteria*<br>- Changes by *Basti* treatment:<br>*Basti* treatment did not change the predominance of *Bacteroides* throughout treatment. ↓ of *Firmicutes* and ↑ of *Proteobacteria*<br>*Akkermancia Muciniphila* ↑ at discharge<br>- Changes by *Sastika Shali Pinda Swedana* treatment: A slight ↓ of *Bacteroides* and *Firmicutes* was observed at discharge. No significant changes at the phylum level occurred. Recovery of *Bacteroides* to 42% was observed 3 weeks later. ↑ of *Actinobacteria* was noticeable.<br>*Akkermancia muciniphila* ↑ at discharge<br>- In controls:<br>- *Bacteroides* predominated, but no other remarkable change. Three weeks after the discharge, the composition of the profile returned to the previous pattern. | - | 145 |

**Table 2.** Summary of reported changes in *Firmicutes, Proteobacteria,* and *Bacteroidetes* after *Panchakarma* therapies

| Intervention | Time Point | *Firmicutes* (%) | *Proteobacteria* (%) | *Bacteroidetes* (%) | References |
|---|---|---|---|---|---|
| Medicated buttermilk enema therapy | Day 0 (Baseline) | 13.01 | 4.97 | 80.72 | [144] |
| | Day 16 (after 15 days of medicated enema) | 23.6 | 11.5 | 61.08 | |
| SSPS (*Shashtika Shali Pinda Swedana*) | Baseline | 43.2 ± 22.3 | 10.9 ± 9.3 | 40.5 ± 9.9 | [145] |
| | Post SSPS therapy, at Discharge | 38.91 ± 5.30 | 13.90 ± 11.63 | 35.69 ± 11.78 | |
| | 3 weeks follow-up | 37.85 ± 11.52 | 7.2 ± 0.368 | 42.33 ± 0.113 | |
| *Basti* (therapeutic enema therapy) | Baseline | 36.02 ± 5.94 | 9.79 ± 3.74 | 47.27 ± 5.65 | |
| | Post *Basti*, at Discharge | 27.69 ± 5.8 | 18.13 ± 6.4 | 48.42 ± 8.8 | |
| | 3 weeks follow-up | 30.45 ± 11.01 | 16.26 ± 10.75 | 48.48 ± 7.70 | |
| *Virechana* (Therapeutic Purgation) | Baseline | 37.51 ± 9.06 | 9.63 ± 4.38 | 46.61 ± 8.90 | |
| | Post *Virechana*, at Discharge | 18.05 ± 12.14 | 0.01% ± 0.03 | 1.89 ± 1.86 | |
| | 3 weeks follow-up | 32.69 ± 10.14 | 11.51 ± 8.50 | 49.58 ± 8.66 | |
| Control Group | Baseline | 32.38 ± 7.84 | 12.43 ± 1.74 | 43.36 ± 22.80 | |
| | Discharge | 30.74 ± 6.85 | 7.25 ± 5.28 | 49.58 ± 0.25 | |
| | 3 weeks follow-up | 27.41 ± 7.33 | 7.75 ± 3.12 | 60.48 ± 12.75 | |

Balanced *Agni* promotes the production of *Ojasa*, which contributes to vitality, immunity, and longevity. *Acharya Sushruta* mentioned that the heart is the seat of consciousness (*Hridayam Chetana Sthanam*)[137]. According to *Chakrapani's* commentary, '*Ayu*' means the continuity of consciousness (*Chetna-anuvritti*), and *hridayastha oja* (*oja* residing in *hrudaya*) are both directly supported by optimal *Agni*[138]. This connection highlights the gut-heart axis in *Ayurveda*, where optimal *Agni* supports heart health via the maintenance of *Ojasa*.

### 3.6.3 Panchakarma-Based Clinical Evidence

Various studies indicate that *Panchakarma* therapies, such as *Virechana* and Heart Failure Reversal Therapy (herbal detoxification and low-calorie diet), effectively manage cardiovascular diseases, including hypertension, obesity, CAD, and Chronic heart failure (CHF)[139-143].

## 4. Evidence from 16S rRNA-based Studies on Gut Microbiome Modulation by *Panchakarma*

Up to June 2024, only two studies have specifically investigated the effects of *Panchakarma* on gut microbiome composition using 16S rRNA next-generation sequencing techniques. An overview of these studies is presented in Table 1.

The temporal changes in *Firmicutes, Proteobacteria,* and *Bacteroidetes* observed across these studies at different time points, including baseline, discharge, and follow-up, are summarised in Table 2.

## 5. Discussion

Emerging evidence suggests that alterations in gut microbiota composition play an important role in mediating the interactions between the gastrointestinal system and distant organs, forming the basis of the gut–organ axes. In this review, modern scientific findings describing gut–organ interactions were examined alongside classical *Ayurvedic* concepts emphasising the systemic influence of digestive function, as well as clinical evidence related to *Panchakarma* interventions. The temporal variations in the major gut microbial phyla following *Panchakarma* therapies, summarised in Table 2, provide additional insights into how these interventions may influence microbial balance and potentially contribute to systemic effects.

### 5.1 *Firmicutes*

*Firmicutes* constitute a major component of the gut microbiota and play a significant role in host metabolism through the production of short-chain fatty acids (SCFAs), which are essential for maintaining intestinal barrier integrity and immune regulation. As shown in Table 2, *Panchakarma* interventions have been associated with observable variations in *Firmicutes* abundance across different time points.

Alterations in *Firmicutes* levels have been widely reported in several systemic disorders that are now understood through the framework of gut–organ axes. For example, dysregulation of the *Firmicutes*–*Bacteroidetes* ratio has been observed in psoriasis and psoriatic arthritis, suggesting a link between gut microbial imbalance and inflammatory skin conditions associated with the gut–skin axis[146]. In contrast, reduced *Firmicutes* abundance has been reported in depression, which may contribute to decreased SCFA production and low-grade systemic inflammation within the gut–brain axis[147]. Similarly, decreased *Firmicutes* levels have been observed in congestive heart failure and bronchial asthma, supporting the involvement of microbial imbalance in the gut–heart and gut–lung axes[148,149]. Alterations have also been reported in chronic liver diseases, indicating interactions between the gut microbiota and hepatic metabolism through the gut–liver axis[150]. Additionally, studies have shown a positive association between *Firmicutes* abundance and bone mineral density, highlighting potential microbiome influences within the gut–bone axis[151].

### 5.2 *Proteobacteria*

*Proteobacteria* represent a diverse group of bacteria that are often considered indicators of microbial dysbiosis, particularly when present in elevated abundance. The variations in *Proteobacteria* levels following *Panchakarma* interventions presented in Table 2 suggest that these therapies may influence microbial dynamics within the gut ecosystem.

Elevated *Proteobacteria* abundance has been associated with several disorders involving different gut–organ interactions. Increased levels have been reported in chronic urticaria, indicating a possible relationship between gut microbial imbalance and inflammatory skin disorders[152]. Similarly, metabolic disturbances induced by high-fat diets have been linked to increased *Proteobacteria* and elevated lipopolysaccharide (LPS) production, which may influence neuroinflammatory pathways and alter brain-derived neurotrophic factor (BDNF) expression, thereby affecting the gut–brain axis[153]. Increased *Proteobacteria* levels have also been observed in congestive heart failure, bronchial asthma, and hepatic steatosis, reflecting interactions between gut microbial dysbiosis and cardiovascular, pulmonary, and hepatic systems through the gut–heart, gut–lung, and gut–liver axes[148,154,155]. Moreover, higher *Proteobacteria* abundance has been reported in postmenopausal osteopenia, suggesting a potential association between gut microbial imbalance and skeletal metabolism within the gut–bone axis[156].

### 5.3 *Bacteroidetes*

*Bacteroidetes* constitute another dominant phylum within the gut microbiome and are involved in complex carbohydrate metabolism and immune modulation. As indicated in Table 2, *Panchakarma* interventions have been associated with measurable variations in *Bacteroidetes* abundance over time.

Alterations in *Bacteroidetes* levels have been reported in several systemic disorders linked to gut–organ axes. Reduced *Bacteroidetes* abundance has been documented in psoriasis, whereas increased levels have been observed in acne, reflecting complex microbiome interactions within the gut–skin axis[157,158]. Increased *Bacteroidetes* abundance has also been reported in major depressive disorder, suggesting potential involvement in neuroimmune pathways associated with the gut–brain axis[159]. Conversely, decreased levels have been observed in coronary heart disease and chronic obstructive pulmonary disease, indicating possible microbial influences on cardiovascular and respiratory health[160,161]. Reduced *Bacteroidetes* abundance has also been reported in liver diseases such as NASH and hepatocellular carcinoma, supporting the role of gut microbial imbalance in the gut–liver axis[162]. Additionally, increased *Bacteroidetes* abundance has been associated with low bone mineral density, suggesting that gut microbiota composition may influence skeletal metabolism through the gut–bone axis[163].

### 5.4 Integrative Perspective on Gut-organ Axes and *Panchakarma* Therapies

Collectively, these findings highlight the crucial role of gut microbial composition in mediating interactions between the gastrointestinal system and distant organs through various gut–organ axes. The variations observed in major microbial phyla following *Panchakarma* interventions (Table 2) suggest that such therapies may influence gut microbial balance, potentially contributing to systemic physiological effects. Notably, the central role of digestive function emphasised in *Ayurveda* through the concept of *Agni* parallels modern understanding of the gut microbiome as a key regulator of systemic health. When viewed together, contemporary microbiome research, evidence from gut–organ axes studies, and classical *Ayurvedic* perspectives suggest a converging framework in which modulation of gut function may influence multiple organ systems. These insights provide a scientific basis for further investigations into *Panchakarma* as a potential modulator of gut microbiota and its broader implications in the management of systemic disorders.

### 5.5 Future Scope

Future studies should focus on the effects of *Panchakarma* therapies on human physiology, particularly from the perspectives of metabolomics, genomics, and pharmaco-microbiomics. Integrating these approaches may facilitate a broader systems-level understanding of *Ayurvedic* treatments, thereby promoting health and well-being. Specifically, research should explore altered microbiomic profiles following interventions such as *Deepana-Pachana* (therapies that stimulate digestion and metabolism), *Snehana* (oleation therapies), *Swedana* (sudation therapies), *Vamana* (therapeutic emesis), *Virechana* (therapeutic purgation), *Basti* (medicated enema therapy), and *Murdhni Taila* (therapeutic application of medicated oil over the head), which may provide deeper mechanistic insights into these *Panchakarma* therapies.

## 6. Conclusion

Modern research has established the gut–organ axes as key pathways linking gut microbial imbalance with multiple systemic disorders. *Ayurveda* similarly emphasises the central role of digestive function through the concept of *Agni*, recognising the influence of gut health on various bodily systems. This review highlights parallels between contemporary scientific evidence on gut–organ interactions and classical *Ayurvedic* descriptions indicating such systemic interconnectedness. *Panchakarma* therapies, traditionally employed in the management of diverse systemic disorders, may hold relevance in modulating gut-related imbalances. These conceptual overlaps highlight the need for focused translational research to further investigate the role of *Panchakarma* in the context of gut–organ axis modulation and microbiome-related health.

## 7. References


1. Ursell LK, Haiser HJ, Van Treuren W, Garg N, Reddivari L, Vanamala J, *et al*. The intestinal metabolome: an intersection between microbiota and host. Gastroenterology. 2014; 146(6):1470-1476. https://doi.org/10.1053/j.gastro.2014.03.001 PMid: 24631493 PMCid: PMC4102302.
2. Grice EA, Segre JA. The human microbiome: our second genome. Annu Rev Genomics Hum Genet. 2012; 13:151-170. https://doi.org/10.1146/annurev-genom-090711-163814 PMid: 22703178 PMCid: PMC3518434.
3. Berg G, Rybakova D, Fischer D, Cernava T, Vergès MC, Charles T, *et al*. Microbiome definition re-visited: old concepts and new challenges. Microbiome. 2020; 8(1):103. https://doi.org/10.1186/s40168-020-00875-0 PMid: 32605663 PMCid: PMC7329523.
4. Shreiner AB, Kao JY, Young VB. The gut microbiome in health and in disease. Curr Opin Gastroenterol. 2015; 31(1):69-75. https://doi.org/10.1097/MOG.0000000000000139 PMid: 25394236 PMCid: PMC4290017.
5. Manos J. The human microbiome in disease and pathology. APMIS. 2022; 130(12):690-705. https://doi.org/10.1111/apm.13225 PMid: 35393656 PMCid: PMC9790345.
6. Marchesi JR, Adams DH, Fava F, Hermes GD, Hirschfield GM, Hold G, *et al*. The gut microbiota and host health: a new clinical frontier. Gut. 2016; 65(2):330-339. https://doi.org/10.1136/gutjnl-2015-309990 PMid: 26338727 PMCid: PMC4752653.
7. Ahlawat S, Asha, Sharma KK. Gut-organ axis: a microbial outreach and networking. Lett Appl Microbiol. 2021; 72(6):636-668. https://doi.org/10.1111/lam.13333 PMid: 32472555.
8. Guo Y, Chen X, Gong P, Li G, Yao W, Yang W. The gut-organ-axis concept: advances the application of Gut-on-Chip technology. Int J Mol Sci. 2023; 24(4):4089. https://doi.org/10.3390/ijms24044089 PMid: 36835499 PMCid: PMC9962350.

9. Vagbhata. *Ashtanga Hridaya of Vagbhata*. Arundatta, commentator. Acharya YT, editor. Reprinted. Varanasi (India): Chowkhamba Sanskrit Sansthan; 2013. *Sutra Sthana* 13/27, pp. 200.
10. Vagbhata. *Ashtanga Hridaya of Vagbhata*. Arundatta, commentator. Acharya YT, editor. Reprinted. Varanasi (India): Chowkhamba Sanskrit Sansthan; 2013. *Sutra Sthana* 13/25, pp. 200.
11. Sharma A. *Kaya Chikitsa*. Part I. Reprinted. Delhi (India): Chowkhamba Orientalia; 2010. pp. 254.
12. Rhee SH, Pothoulakis C, Mayer EA. Principles and clinical implications of the brain-gut-enteric microbiota axis. Nat Rev Gastroenterol Hepatol. 2009; 6(5):306-314. https://doi.org/10.1038/nrgastro.2009.35 PMid: 19404271 PMCid: PMC3817714.
13. Tsigos C, Chrousos GP. Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. J Psychosom Res. 2002; 53(4):865-871. https://doi.org/10.1016/S0022-3999(02)00429-4 PMid: 12377295.
14. Foster JA, McVey Neufeld KA. Gut-brain axis: how the microbiome influences anxiety and depression. Trends Neurosci. 2013; 36:305–312. https://doi.org/10.1016/j.tins.2013.01.005 PMid: 23384445 PMCid: PMC11788897.
15. Naseribafrouei A, Hestad K, Avershina E, Sekelja M, Linløkken A, Wilson R, *et al*. Correlation between the human faecal microbiota and depression. Neurogastroenterol Motil. 2014; 26(8):1155-1162. https://doi.org/10.1111/nmo.12378 PMid: 24888394 PMCid: PMC11788897.
16. Mayer EA, Padua D, Tillisch K. Altered brain-gut axis in autism: comorbidity or causative mechanisms? Bioessays. 2014; 36:933–999. https://doi.org/10.1002/bies.201400075 PMid: 25145752.
17. Song Y, Liu C, Finegold SM. Real-time PCR quantitation of clostridia in faeces of autistic children. Appl Environ Microbiol. 2004; 70:6459–6465. https://doi.org/10.1128/AEM.70.11.6459-6465.2004 PMid: 15528506 PMCid: PMC525120.
18. Koloski NA, Jones M, Kalantar J, Weltman M, Zaguirre J, Talley NJ. The brain-gut pathway in functional gastrointestinal disorders is bidirectional: a 12-year prospective population-based study. Gut. 2012; 61:1284–1290. https://doi.org/10.1136/gutjnl-2011-300474 PMid: 22234979.
19. Neufeld KM, Kang N, Bienenstock J, Foster JA. Reduced anxiety-like behavior and central neurochemical change in germ-free mice. Neurogastroenterol Motil. 2011; 23:255–264. https://doi.org/10.1111/j.1365-2982.2010.01620.x PMid: 21054680 PMCid: PMC11788897.
20. Saulnier DM, Ringel Y, Heyman MB, Foster JA, Bercik P, Shulman RJ, *et al*. The intestinal microbiome, probiotics and prebiotics in neurogastroenterology. Gut Microbes. 2013; 4(1):17-27. https://doi.org/10.4161/gmic.22973 PMid: 23202796 PMCid: PMC3555881.
21. Bravo JA, Forsythe P, Chew MV, Escaravage E, Savignac HM, Dinan TG, *et al*. Ingestion of *Lactobacillus* strain regulates emotional behavior and central GABA receptor expression in a mouse via the vagus nerve. Proc Natl Acad Sci USA. 2011; 108(38):16050-16055. https://doi.org/10.1073/pnas.1102999108 PMid: 21876150 PMCid: PMC3179073.
22. Kang J, Wang Q, Wang S, Pan Y, Niu S, Li X, *et al*. Characteristics of gut microbiota in patients with erectile dysfunction: a Chinese pilot study. World J Mens Health. 2024; 42(2):363-372. https://doi.org/10.5534/wjmh.220278 PMid: 37382280 PMCid: PMC10949016.
23. Galley JD, Nelson MC, Yu Z, Dowd SE, Walter J, Kumar PS, *et al*. Exposure to a social stressor disrupts the community structure of the colonic mucosa-associated microbiota. BMC Microbiol. 2014; 14:189. https://doi.org/10.1186/1471-2180-14-189 PMid: 25028050 PMCid: PMC4105248.
24. Hughes DT, Sperandio V. Inter-kingdom signalling: communication between bacteria and their hosts. Nat Rev Microbiol. 2008; 6:111–120. https://doi.org/10.1038/nrmicro1836 PMid: 18197168 PMCid: PMC2667375.
25. Demaude J, Salvador-Cartier C, Fioramonti J, Ferrier L, Bueno L. Phenotypic changes in colonocytes following acute stress or activation of mast cells in mice: implications for delayed epithelial barrier dysfunction. Gut. 2006; 55:655–661. https://doi.org/10.1136/gut.2005.078675 PMid: 16299034 PMCid: PMC1856132.
26. Tiwari RR, Pandey B. *Pittadhara Kala Sahayo Majjadhara Kala* and brain gut microbiota axis: A comparative review study. J Ayurveda. 2022; 16(3):245-251. https://doi.org/10.4103/joa.joa_290_20
27. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Vimana Sthana; Trividha-Kuksheeyam-Vimanam Adhyayam*, Chapter 2, Verse 8-9, pp. 603.
28. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana*; *Grahani-Dosha-Chikitsitam Adhyayam*, Chapter 15, Verse 62, pp. 394.
29. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Atisara-Chikitsitam Adhyayam*, Chapter 19, Verse 6, 8, pp. 499.
30. Bhat VG, Basnet P, Saralaya A. Management of irritable bowel syndrome (IBS) in *Ayurveda*: a case report. Int J Ayurveda Tradit Med. 2022; 4(6):24-30.
31. Joshi A, Chaudhary S, Thakar AB. Role of *basti* and *sirodhara* in the management of *grahani* (irritable bowel syndrome): a case report. Int J AYUSH Case Rep. 2020; 4(3):90-96.
32. Venkaraddiyavar SG, Prashanth AS, Chavan SG. A double arm clinical study to assess the role of *basti* and *virechana karma* along with *vanari* yoga in premature ejaculation. J Ayurveda Integr Med Sci. 2019; 4(4):108-114. https://doi.org/10.21760/jaims.4.4.15

33. Malavika MM, Sujan TK, Krishna A. *Ayurveda* in the management of neurodegenerative disorder, *Kampavata* WSR Parkinsonism: a case report. Int J Ayurveda Pharma Res. 2023; 11(3):81-84. https://doi.org/10.47070/ijapr.v11i3.2706
34. Akshatha S, Shetty SK. *Ayurvedic* management to aid weaning of anti-depressants: a case report. J Ayurveda Case Rep. 2021; 4(2):50-53. https://doi.org/10.4103/jacr.jacr_4_21
35. Sikora M, Stec A, Chrabaszcz M, Knot A, Waskiel-Burnat A, Rakowska A, *et al*. Gut microbiome in psoriasis: an updated review. Pathogens. 2020; 9(6):463. https://doi.org/10.3390/pathogens9060463 PMid: 32545459 PMCid: PMC7350295.
36. Wang Y, Zhang X, Tang G, Deng P, Qin Y, Han J, *et al*. The causal relationship between gut microbiota and bone mineral density: a Mendelian randomisation study. Front Microbiol. 2023; 14:1268935. https://doi.org/10.3389/fmicb.2023.1268935 PMid: 37937216 PMCid: PMC10625988.
37. O'Neill CA, Monteleone G, McLaughlin JT, Paus R. The gut-skin axis in health and disease: a paradigm with therapeutic implications. Bioessays. 2016; 38(11):1167-1176. https://doi.org/10.1002/bies.201600008 PMid: 27554239.
38. Kosiewicz MM, Dryden GW, Chhabra A, Alard P. Relationship between gut microbiota and development of T cell associated disease. FEBS Lett. 2014; 588(22):4195-4206. https://doi.org/10.1016/j.febslet.2014.03.019 PMid: 24681103.
39. Vlachos C, Gaitanis G, Katsanos KH, Christodoulou DK, Tsianos E, Bassukas ID. Psoriasis and inflammatory bowel disease: links and risks. Psoriasis (Auckl). 2016; 6:73-92. https://doi.org/10.2147/PTT.S85194 PMid: 29387596 PMCid: PMC5683131.
40. Visser MJE, Kell DB, Pretorius E. Bacterial dysbiosis and translocation in *Psoriasis vulgaris*. Front Cell Infect Microbiol. 2019; 9:7. https://doi.org/10.3389/fcimb.2019.00007 PMid: 30778377 PMCid: PMC6369634.
41. Alesa DI, Alshamrani HM, Alzahrani YA, Alamssi DN, Alzahrani NS, Almohammadi ME. The role of gut microbiome in the pathogenesis of psoriasis and the therapeutic effects of probiotics. J Family Med Prim Care. 2019; 8(11):3496-3503. https://doi.org/10.4103/jfmpc.jfmpc_709_19 PMid: 31803643 PMCid: PMC6881942.
42. Chen YH, Wu CS, Chao YH, Lin CC, Tsai HY, Li YR, *et al*. *Lactobacillus pentosus* GMNL-77 inhibits skin lesions in imiquimod-induced psoriasis-like mice. J Food Drug Anal. 2017; 25(3):559-566. https://doi.org/10.1016/j.jfda.2016.06.003 PMid: 28911642 PMCid: PMC9328808.
43. Ogawa C, Inoue R, Yonejima Y, Hisa K, Yamamoto Y, Suzuki T. Supplemental leuconostoc mesenteroides strain NTM048 attenuates imiquimod-induced psoriasis in mice. J Appl Microbiol. 2021; 131(6):3043-3055. https://doi.org/10.1111/jam.15161 PMid: 34028144.
44. Lu W, Deng Y, Fang Z, Zhai Q, Cui S, Zhao J, *et al*. Potential role of probiotics in ameliorating psoriasis by modulating gut microbiota in imiquimod-induced psoriasis-like mice. Nutrients. 2021; 13(6):2010. https://doi.org/10.3390/nu13062010 PMid: 34207960 PMCid: PMC8230682.
45. Deng YD, Fang ZF, Cui SM, Zhao JX, Zhang H, Chen W, *et al*. Evaluation of probiotics for inhibiting hyperproliferation and inflammation relevant to psoriasis *in vitro*. J Funct Foods. 2021; 81. https://doi.org/10.1016/j.jff.2021.104433
46. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Kushtha Chikitsa*, Chapter 7, Verse 4-8, pp. 197.
47. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Grahani-Dosha Chikitsa*, Chapter 15, Verse 3-4, pp. 376.
48. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Kushtha Chikitsa*, Chapter 7, Verse 39-40, pp. 201.
49. Thakral KK, editor. *Sushruta Samhita of Maharshi Sushruta*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2019. *Chikitsa Sthana; Kushtha Chikitsa*, Chapter 9, Verse 43, pp. 305.
50. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Sutra Sthana*; *Chikitsa-Prabhriteeyam Adhyayam*, Chapter 16, Verse 17, pp. 251.
51. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Siddhi Sthana; Kalpana-Siddhi Adhyayam*, Chapter 1, Verse 27, pp. 950.
52. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Siddhi Sthana; Kalpana-Siddhi Adhyayam*, Chapter 1, Verse 30, pp. 950.
53. Keshao SM, Jaiswal L, Kameshwar SY, Jindal N, Mishra D. Effect of *matra basti* of *panchatikta ghrita* in psoriasis. Int J Res Ayurveda Pharm. 2012; 3(6):789-791. https://doi.org/10.7897/2277-4343.03619
54. Bhattacharjee A, Tiwari P, Krishna PM. Clinical evaluation of *Amrita ghrita sneha-pana* followed by *Pippalyadi* yoga *virechana* in the management of *vicharchika* (chronic dermatitis). J Ayurveda Integr Med Sci. 2020; 5(6):1-9. https://doi.org/10.21760/jaims.5.6.1
55. Raghavani H, Satani K, Bhatt K, Thakar A. Clinico comparative study of *vamana* and *virechana karma* in the management of *shvitra* wsr to vitiligo. J Ayurveda Integr Med Sci. 2017; 2(1):48-53. https://doi.org/10.21760/jaims.v2i1.7486
56. Parida AN, Bhatt NN, Dave AR, Shukla VD. A comparative study of *vamana* and *virechana karma* in *ekakushtha* wsr to psoriasis. AYU. 2009; 30(3):255-259.

57. Sharma L, Srivastava A, Shukla GD. Efficacy of *virechana karma* in the management of *acne vulgaris*: a clinical study. Environ Conserv J. 2019; 20(SE):61-66. https://doi.org/10.36953/ECJ.2019.SE02012
58. Zaiss MM, Jones RM, Schett G, Pacifici R. The gut-bone axis: how bacterial metabolites bridge the distance. J Clin Invest. 2019; 129(8):3018-3028. https://doi.org/10.1172/JCI128521 PMid: 31305265 PMCid: PMC6668676.
59. Claesson MJ, Jeffery IB, Conde S, Power SE, O'Connor EM, Cusack S, *et al*. Gut microbiota composition correlates with diet and health in the elderly. Nature. 2012; 488(7410):178-184. https://doi.org/10.1038/nature11319 PMid: 22797518 PMCid: PMC12005720.
60. Suez J, Korem T, Zeevi D, Zilberman-Schapira G, Thaiss CA, Maza O, *et al*. Artificial sweeteners induce glucose intolerance by altering the gut microbiota. Nature. 2014; 514(7521):181-186. https://doi.org/10.1038/nature13793 PMid: 25231862 PMCid: PMC9842422.
61. Gentile CL, Weir TL. The gut microbiota at the intersection of diet and human health. Science. 2018; 362(6416):776-780. https://doi.org/10.1126/science.aau5812 PMid: 30442802.
62. Byberg L, Bellavia A, Larsson SC, Orsini N, Wolk A, Michaëlsson K. Mediterranean diet and hip fracture in Swedish men and women. J Bone Miner Res. 2016; 31(12):2098-2105. https://doi.org/10.1002/jbmr.2896 PMid: 27345330.
63. De Filippis F, Pellegrini N, Vannini L, Jeffery IB, La Storia A, Laghi L, *et al*. High-level adherence to a Mediterranean diet beneficially impacts the gut microbiota and associated metabolome. Gut. 2016; 65(11):1812-1821. https://doi.org/10.1136/gutjnl-2015-309957 PMid: 26416813 PMCid: PMC10266355.
64. Palomeras-Vilches A, Viñals-Mayolas E, Bou-Mias C, Jordà-Castro M, Agüero-Martínez M, Busquets-Barceló M, *et al*. Adherence to the Mediterranean diet and bone fracture risk in middle-aged women: a case control study. Nutrients. 2019; 11(10):2508. https://doi.org/10.3390/nu11102508 PMid: 31635237 PMCid: PMC6835915.
65. Noel SE, Mangano KM, Mattei J, Griffith JL, Dawson-Hughes B, Bigornia S, *et al*. Dietary approaches to stop hypertension, Mediterranean, and alternative healthy eating indices are associated with bone health among Puerto Rican adults from the Boston Puerto Rican osteoporosis study. Am J Clin Nutr. 2020; 111(6):1267-1277. https://doi.org/10.1093/ajcn/nqaa090 PMid: 32386194 PMCid: PMC7266690.
66. Wang Z, Chen K, Wu C, Chen J, Pan H, Liu Y, *et al*. An emerging role of *Prevotella histicola* on estrogen deficiency-induced bone loss through the gut microbiota-bone axis in postmenopausal women and in ovariectomized mice. Am J Clin Nutr. 2021; 114(4):1304-1313. https://doi.org/10.1093/ajcn/nqab194 PMid: 34113963.
67. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Grahani-Dosha Chikitsa*, Chapter 15, Verse 17, pp. 384.
68. Khazzani H, Allali F, Bennani L, Ichchou L, El Mansouri L, Abourazzak FE, *et al*. The relationship between physical performance measures, bone mineral density, falls, and the risk of peripheral fracture: a cross-sectional analysis. BMC Public Health. 2009; 9:297. https://doi.org/10.1186/1471-2458-9-297 PMid: 19689795 PMCid: PMC2746809.
69. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Siddhi Sthana; Kalpana-Siddhi Adhyayam*, Chapter 1, Verse 41, pp. 954.
70. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Siddhi Sthana; Kalpana-Siddhi Adhyayam*, Chapter 1, Verse 44, pp. 955.
71. Kushwaha HS, editor. *Ashtanga Hridaya of Vagbhata*. 1st ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Sutra Sthana; Doshopkramaneeyam Adhyayam*, Chapter 13, Verse 25, pp. 603.
72. Vagbhata. *Astanga Hrudaya*. *Sarvanga Sundara* commentary by Arundatta. Acharya HP, editor. Reprinted. Varanasi (India): *Chaukhambha Sanskrit Sansthan*; 2009. *Sutra Sthana*, Chapter 13, Verse 25-26, pp. 216.
73. Gupta AK, Shah N, Thakar AB. Effect of *Majja Basti* (therapeutic enema) and *Asthi Shrinkhala* (*Cissus quadrangularis*) in the management of Osteoporosis (*Asthi-Majjakshaya*). Ayu. 2012; 33(1):110-113. https://doi.org/10.4103/0974-8520.100326 PMid: 23049194 PMCid: PMC3456847.
74. Nisargi RS, RC M, Prasad K. A clinical study to evaluate the effect of *guduchi sidda ksheera basti* in osteoporosis. Ayushdhara. 2015; 2(4):221–225.
75. Patil DS, Prashanth AS. A comparative clinical study to assess the role of *basti* and *virechana karma* followed by *rasayana* in postmenopausal *asthikshaya* (osteoporosis). J Ayurveda Integr Med Sci. 2020; 5(5):96-103. https://doi.org/10.21760/jaims.5.5.12
76. Kalwania SS, Bhatted SK, Bhojani MK. Effect of *virechana karma, ketaki-rasonaadi brimhana-sneha* and *amritadi ghanvati* in *asthi-kshaya* w.s.r. osteoporosis. JoAYUSH. 2016; 5(3):1-9.
77. Hsu CC, Ko PY, Kwan TH, Liu MY, Jou IM, Lin CW, *et al*. Daily supplement of sesame oil prevents postmenopausal osteoporosis via maintaining serum estrogen and aromatase levels in rats. Sci Rep. 2024; 14(1):321. https://doi.org/10.1038/s41598-023-50453-1 PMid: 38172141 PMCid: PMC10764805.
78. Song Z, Meng Y, Fricker M, Li XA, Tian H, Tan Y, *et al*. The role of gut-lung axis in COPD: pathogenesis, immune

response, and prospective treatment. Heliyon. 2024; 10:e30612. https://doi.org/10.1016/j.heliyon.2024.e30612 PMid: 38742057 PMCid: PMC11089359.
79. Song XL, Liang J, Lin SZ, Xie YW, Ke CH, Ao D, *et al*. Gut-lung axis and asthma: a historical review on mechanism and future perspective. Clin Transl Allergy. 2024; 14(5):e12356. https://doi.org/10.1002/clt2.12356 PMid: 38687096 PMCid: PMC11060082.
80. Oddy WH. Breastfeeding, childhood asthma, and allergic disease. Ann Nutr Metab. 2017; 70(Suppl 2):26-36. https://doi.org/10.1159/000457920 PMid: 28521318.
81. Wang Q, Li F, Liang B, Liang Y, Chen S, Mo X, *et al*. A metagenome-wide association study of gut microbiota in asthma in UK adults. BMC Microbiol. 2018; 18(1):114. https://doi.org/10.1186/s12866-018-1257-x PMid: 30208875 PMCid: PMC6134768.
82. Fujimura KE, Sitarik AR, Havstad S, Lin DL, Levan S, Fadrosh D, *et al*. Neonatal gut microbiota associates with childhood multisensitized atopy and T cell differentiation. Nat Med. 2016; 22(10):1187-1191. https://doi.org/10.1038/nm.4176 PMid: 27618652 PMCid: PMC5053876.
83. Barcik W, Boutin RCT, Sokolowska M, Finlay BB. The role of lung and gut microbiota in the pathology of asthma. Immunity. 2020; 52(2):241-255. https://doi.org/10.1016/j.immuni.2020.01.007 PMid: 32075727 PMCid: PMC7128389.
84. van den Elsen LWJ, Garssen J, Burcelin R, Verhasselt V. Shaping the gut microbiota by breastfeeding: the gateway to allergy prevention? Front Pediatr. 2019; 7:47. https://doi.org/10.3389/fped.2019.00047 PMid: 30873394 PMCid: PMC6400986.
85. Fouladi F, Bailey MJ, Patterson WB, Sioda M, Blakley IC, Fodor AA, *et al*. Air pollution exposure is associated with the gut microbiome as revealed by shotgun metagenomic sequencing. Environ Int. 2020; 138:105604. https://doi.org/10.1016/j.envint.2020.105604 PMid: 32135388 PMCid: PMC7181344.
86. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Vimana Sthana; Sroto-Vimana Adhyayam*, Chapter 5, Verse 8, pp. 631.
87. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Vimana Sthana; Sroto-Vimana Adhyayam*, Chapter 5, Verse 10, pp. 633.
88. Thakral KK, editor. *Sushruta Samhita of Maharshi Sushruta*. 1st ed. Vol. 3. Varanasi (India): Chaukhambha Orientalia; 2019. *Uttar Tantra; Hikka-Pratishedham*, Chapter 50, Verse 3-5, pp. 474.
89. Kushwaha HS, editor. *Ashtanga Hridaya of Vagbhata*. 1st ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2018. *Sutra Sthana; Doshabhedeeyam Adhyayam*, Chapter 12, Verse 4-9, pp. 538-539.
90. Jatinder K, Rajarajeshwari NM. *Udavarta*—review from *Ayurvedic* literature. J Ayurveda Integr Med Sci. 2020; 5(5):322-329.
91. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Tri-Marmeeya Chikitsitam Adhyayam*, Chapter 26, Verse 7, pp. 671.
92. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Hikka-Shvasa Chikitsitam Adhyayam*, Chapter 17, Verse 55, pp. 454.
93. Kushwaha HS, editor. *Charaka Samhita of Agnivesha*. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Hikka-Shvasa Chikitsitam Adhyayam*, Chapter 17, Verse 8-9, pp. 445-446.
94. Khobarkar P, Nakanekar A. Acute exacerbation of bronchial asthma with infective focus treated with holistic *Ayurveda* approach: a case report. J Ayurveda Integr Med. 2024; 15(1):100824. https://doi.org/10.1016/j.jaim.2023.100824 PMid: 38262328 PMCid: PMC10945435.
95. Raj S, Supreeth MJ, Goud KM. Role of *Sadyo Vamana* in *Tamaka Swasa* - a case study. J Ayu Int Med Sci. 2025; 10(1):236-241. https://doi.org/10.21760/jaims.10.1.36
96. Patil SG, Thakar AB. Efficacy of *Vamana Karma* with *Ikshvaku Ksheera* Yoga in the management of *Tamaka Shvasa* (bronchial asthma). Ayu. 2017; 38(1-2):10-14. https://doi.org/10.4103/ayu.AYU_95_13 PMid: 29861586 PMCid: PMC5954254.
97. Ghosh KA, Tripathi PC. Clinical effect of *Virechana* and *Shamana Chikitsa* in *Tamaka Shwasa* (Bronchial Asthma). Ayu. 2012; 33(2):238-242. https://doi.org/10.4103/0974-8520.105244 PMid: 23559796 PMCid: PMC3611644.
98. Meena B, Mutha R, Sahu AK. Effect of *kulattha guda* with and without *virechana karma* in the management of *tamaka shwasa* (bronchial asthma). J Ayurveda. 2023; 17(3):199-205. https://doi.org/10.4103/joa.joa_106_21
99. Babu G, Meena HM, Joshi RK, Bhatnagar A, Mutha R, Padhar BC, *et al*. A randomized comparative clinical study on *Tamaka Shwasa* (bronchial asthma) with *Vamana* and *Virechana* along with *Shamana* therapy. AYUHOM. 2021; 8(1):16-24. https://doi.org/10.4103/AYUHOM.AYUHOM_42_21
100. Rodrigues SG, van der Merwe S, Krag A, Wiest R. Gut-liver axis: pathophysiological concepts and medical perspective in chronic liver diseases. Semin Immunol. 2024 ; 71:101859. https://doi.org/10.1016/j.smim.2023.101859 PMid: 38219459.
101. Lopetuso LR, Deleu S, Godny L, Petito V, Puca P, Facciotti F, *et al*. The first International Rome consensus conference on gut microbiota and faecal microbiota transplantation in inflammatory bowel disease. Gut. 2023; 72(9):1642-1650. https://doi.org/10.1136/gutjnl-2023-329948 PMid: 37339849 PMCid: PMC10423477.

102. Marcella C, Cui B, Kelly CR, Ianiro G, Cammarota G, Zhang F. Systematic review: the global incidence of faecal microbiota transplantation-related adverse events from 2000 to 2020. Aliment Pharmacol Ther. 2021; 53(1):33-42. https://doi.org/10.1111/apt.16148 PMid: 33159374.
103. DeFilipp Z, Bloom PP, Torres Soto M, Mansour MK, Sater MRA, Huntley MH, *et al*. Drug-resistant *E. coli* bacteremia transmitted by fecal microbiota transplant. N Engl J Med. 2019; 381(21):2043-2050. https://doi.org/10.1056/NEJMoa1910437 PMid: 31665575.
104. Zellmer C, Sater MRA, Huntley MH, Osman M, Olesen SW, Ramakrishna B. Shiga toxin-producing *Escherichia coli* transmission via fecal microbiota transplant. Clin Infect Dis. 2021; 72(11):e876-e880. https://doi.org/10.1093/cid/ciaa1486 PMid: 33159210.
105. Su GL, Ko CW, Bercik P, Falck-Ytter Y, Sultan S, Weizman AV, *et al*. AGA clinical practice guidelines on the role of probiotics in the management of gastrointestinal disorders. Gastroenterology. 2020; 159:697-705. https://doi.org/10.1053/j.gastro.2020.05.059 PMid: 32531291 PMCid: PMC7440878.
106. Zmora N, Zilberman-Schapira G, Suez J, Mor U, Dori-Bachash M, Bashiardes S, *et al*. Personalized gut mucosal colonization resistance to empiric probiotics is associated with unique host and microbiome features. Cell. 2018; 174(6):1388-1405.e21. https://doi.org/10.1016/j.cell.2018.08.041 PMid: 30193112.
107. Verhoog S, Taneri PE, Roa Díaz ZM, Marques-Vidal P, Troup JP, Bally L, *et al*. Dietary factors and modulation of bacteria strains of *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*: a systematic review. Nutrients. 2019; 11(7):1565. https://doi.org/10.3390/nu11071565 PMid: 31336737 PMCid: PMC6683038.
108. Mailing LJ, Allen JM, Buford TW, Fields CJ, Woods JA. Exercise and the gut microbiome: a review of the evidence, potential mechanisms, and implications for human health. Exerc Sport Sci Rev. 2019; 47(2):75-85. https://doi.org/10.1249/JES.0000000000000183 PMid: 30883471.
109. Marco ML, Sanders ME, Gänzle M, Arrieta MC, Cotter PD, De Vuyst L, *et al*. The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on fermented foods. Nat Rev Gastroenterol Hepatol. 2021; 18(3):196-208. https://doi.org/10.1038/s41575-020-00390-5 PMid: 33398112 PMCid: PMC7925329.
110. Rose EC, Odle J, Blikslager AT, Ziegler AL. Probiotics, prebiotics and epithelial tight junctions: a promising approach to modulate intestinal barrier function. Int J Mol Sci. 2021; 22(13):6729. https://doi.org/10.3390/ijms22136729 PMid: 34201613 PMCid: PMC8268081.
111. Gibson GR, Hutkins R, Sanders ME, Prescott SL, Reimer RA, Salminen SJ, *et al*. Expert consensus document: the International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol. 2017; 14(8):491-502. https://doi.org/10.1038/nrgastro.2017.75 PMid: 28611480.
112. Sanders ME, Merenstein DJ, Reid G, Gibson GR, Rastall RA. Probiotics and prebiotics in intestinal health and disease: from biology to the clinic. Nat Rev Gastroenterol Hepatol. 2019; 16(10):605-616. https://doi.org/10.1038/s41575-019-0199-6 PMCid: PMC12308114.
113. Thakral KK, editor. *Sushruta Samhita* of Maharshi Sushruta. 2nd ed. Vol. 1. Varanasi (India): Chaukhambha Orientalia; 2020. *Sutra Sthana; Vrana-Prashnam Adhyayam*, Chapter 21, Verse 10, pp. 248.
114. Kushwaha HS, editor. *Charaka Samhita* of Agnivesha. 2nd ed. Vol. 2. Varanasi (India): Chaukhambha Orientalia; 2018. *Chikitsa Sthana; Udara Chikitsitam Adhyayam*, Chapter 13, Verse 38, pp. 315.
115. Shirvadkar DM, Prashanth AS. A cross over trial evaluating combined effect of *ruksha virechana, lashuna erandadi kashaya* and *patolamooladi kashaya* in diagnosed patients of non-alcoholic steatohepatitis. Int J Innov Sci Res Technol. 2020; 5(8):1236-1243. https://doi.org/10.38124/IJISRT20AUG699
116. Patel S. *Ayurvedic* management of cirrhosis of liver: a case report. J Ayurveda Holist Med. 2023; 11(4).
117. Tubaki BR, Gawas SC, Negi H. Effect of *Ayurveda* management on liver cirrhosis with ascites: a retrospective cohort study. J Ayurveda Integr Med. 2022; 13(2):100508. https://doi.org/10.1016/j.jaim.2021.07.023 PMid: 34996679 PMCid: PMC8814404.
118. Prakashrao PJ, Parwe SD, Nisargandha M. *Nitya virechana* (daily purgation) effect of *Operculina turpethum* (L.) Silva Manso on alcoholic liver disorder (ALD): a case report. Pancreat Disord Ther. 2021; 11:221.
119. Chaturvedi A, Rao PN, Kumar MA, Ravishankar B, Rao N, Ravi M. Effect and mechanism of *virechana karma* (therapeutic purgation) over fructose-induced metabolic syndrome: an experimental study. J Evid Based Complementary Altern Med. 2016; 21(3):194-201. https://doi.org/10.1177/2156587215596283 PMid: 26207023.
120. Writing Group Members, Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, *et al*. Heart disease and stroke statistics—2016 update: a report from the American Heart Association. Circulation. 2016; 133(4):e38-360.
121. Zhou W, Cheng Y, Zhu P, Nasser MI, Zhang X, Zhao M. Implication of gut microbiota in cardiovascular diseases. Oxid Med Cell Longev. 2020; 2020:5394096. https://doi.org/10.1155/2020/5394096 PMid: 33062141 PMCid: PMC7533754.
122. Chen J, Zhao KN, Vitetta L. Effects of intestinal microbial-elaborated butyrate on oncogenic signaling pathways. Nutrients. 2019; 11(5):1026. https://doi.org/10.3390/nu11051026 PMid: 31067776 PMCid: PMC6566851.

123. Ghosh TS, Rampelli S, Jeffery IB, Santoro A, Neto M, Capri M, *et al*. Mediterranean diet intervention alters the gut microbiome in older people reducing frailty and improving health status: the NU-AGE 1-year dietary intervention across five European countries. Gut. 2020; 69(7):1218-1228. https://doi.org/10.1136/gutjnl-2019-319654 PMid: 32066625 PMCid: PMC7306987.
124. Illescas O, Rodríguez-Sosa M, Gariboldi M. Mediterranean diet to prevent the development of colon diseases: a meta-analysis of gut microbiota studies. Nutrients. 2021; 13(7):2234. https://doi.org/10.3390/nu13072234 PMid: 34209683 PMCid: PMC8308215
125. Veronese N, Solmi M, Caruso MG, Giannelli G, Osella AR, Evangelou E, *et al*. Dietary fiber and health outcomes: an umbrella review of systematic reviews and meta-analyses. Am J Clin Nutr. 2018; 107(3):436-444. https://doi.org/10.1093/ajcn/nqx082 PMid: 29566200.
126. Canale MP, Noce A, Di Lauro M, Marrone G, Cantelmo M, Cardillo C, *et al*. Gut dysbiosis and western diet in the pathogenesis of essential arterial hypertension: a narrative review. Nutrients. 2021; 13(4):1162. https://doi.org/10.3390/nu13041162 PMid: 33915885 PMCid: PMC8066853.
127. Li J, Zhao F, Wang Y, Chen J, Tao J, Tian G, *et al*. Gut microbiota dysbiosis contributes to the development of hypertension. Microbiome. 2017; 5(1):14. https://doi.org/10.1186/s40168-016-0222-x PMid: 28143587 PMCid: PMC5286796.
128. Amabebe E, Robert FO, Agbalalah T, Orubu ESF. Microbial dysbiosis-induced obesity: role of gut microbiota in homeostasis of energy metabolism. Br J Nutr. 2020; 123(10):1127-1137. https://doi.org/10.1017/S0007114520000380 PMid: 32008579.
129. Tsai HJ, Tsai WC, Hung WC, Hung WW, Chang CC, Dai CY, *et al*. Gut microbiota and subclinical cardiovascular disease in patients with type 2 diabetes mellitus. Nutrients. 2021; 13(8):2679. https://doi.org/10.3390/nu13082679 PMid: 34444839 PMCid: PMC8397936.
130. Tang WH, Hazen SL. The gut microbiome and its role in cardiovascular diseases. Circulation. 2017; 135(11):1008-1010. https://doi.org/10.1161/CIRCULATIONAHA.116.024251 PMid: 28289004 PMCid: PMC5354081.
131. Jie Z, Xia H, Zhong SL, Feng Q, Li S, Liang S, *et al*. The gut microbiome in atherosclerotic cardiovascular disease. Nat Commun. 2017; 8(1):845. https://doi.org/10.1038/s41467-017-00900-1 PMid: 29018189 PMCid: PMC5635030.
132. Thøgersen R, Rasmussen MK, Sundekilde UK, Goethals SA, Van Hecke T, Vossen E, *et al*. Background diet influences TMAO concentrations associated with red meat intake without influencing apparent hepatic TMAO-related activity in a porcine model. Metabolites. 2020; 10(2):57. https://doi.org/10.3390/metabo10020057 PMid: 32041174 PMCid: PMC7074160.
133. Zhu W, Gregory JC, Org E, Buffa JA, Gupta N, Wang Z, *et al*. Gut microbial metabolite TMAO enhances platelet hyperreactivity and thrombosis risk. Cell. 2016; 165(1):111-124. https://doi.org/10.1016/j.cell.2016.02.011 PMid: 26972052 PMCid: PMC4862743.
134. Shariff S, Huey AK, Soni NP, Yahia A, Hammoud D, Nazir A, *et al*. Unlocking the gut-heart axis: exploring the role of gut microbiota in cardiovascular health and disease. Ann Med Surg. 2024; 97:1097. https://doi.org/10.1097/MS9.0000000000001744 PMid: 38694298 PMCid: PMC11060260.
135. Kushwaha HS, editor. *Charaka Samhita* of Agnivesha. *Sutra Sthana; Arthedasha-Mahamooleeyam Adhyayam*. 2nd ed. Vol. 1. Varanasi: Chaukhambha Orientalia; 2018. pp. 489. Chapter 30, Verse 6-7.
136. Kushwaha HS, editor. *Charaka Samhita* of Agnivesha. *Sutra Sthana; Arthedasha-Mahamooleeyam Adhyayam*. 2nd ed. Vol. 1. Varanasi: Chaukhambha Orientalia; 2018. pp. 492. Chapter 30, Verse 13-14.
137. Thakral KK, editor. *Sushruta Samhita* of Maharshi Sushruta. *Sharira Sthana; Garbha-Vyakarana Sharira Adhyayam*. 2nd ed. Vol. 2. Varanasi: Chaukhambha Orientalia; 2019. pp. 60. Chapter 4, Verse 34.
138. Kushwaha HS, editor. *Charaka Samhita* of Agnivesha. *Chikitsa Sthana; Grahani-dosha Chikitsa*. 2nd ed. Vol. 2. Varanasi: Chaukhambha Orientalia; 2018. pp. 376. Chapter 15, Verse 3-4.
139. Solanki S, Dash B. Management of essential hypertension (*Ucha Raktachap*): a pilot study. J Ayurveda Integr Med Sci. 2024; 9(4):33-39. https://doi.org/10.21760/jaims.9.4.5
140. Chaturvedi A, Nath G, Yadav VB, Antiwal M, Shakya N, Swathi C, *et al*. A clinical study on *virechana karma* (therapeutic purgation) over the gut flora with special reference to obesity. AYU. 2019; 40(3):179-184. https://doi.org/10.4103/ayu.AYU_302_19 PMid: 33281395 PMCid: PMC7685265.
141. Ghadigaonkar P, Amin G, Mandole R, Sane R. Impact of *Panchakarma* therapy and diet modification on lipid level in known dyslipidemia patients. J Adv Med Med Res. 2021; 33(9):71-77. https://doi.org/10.9734/jammr/2021/v33i930901
142. Sane R, Aklujkar A, Patil A, Mandole R. Effect of heart failure reversal treatment as add-on therapy in patients with chronic heart failure: a randomized open-label study. Indian Heart J. 2017; 69(3):299-304. https://doi.org/10.1016/j.ihj.2016.10.012 PMid: 28648417 PMCid: PMC5485380.
143. Imran S, Khan S, Sabir I, Mandole R. Evaluation of the efficacy of heart failure reversal therapy (HFRT) in heart failure patients with reduced ejection fraction. Asian J Cardiol Res. 2023; 8(1):23-28.

144. Mane S, Dixit KK, Lathwal N, Dhotre D, Kadus P, Shouche YS, *et al*. Rectal administration of buttermilk processed with medicinal plants alters gut microbiome in obese individuals. J Diabetes Metab Disord. 2021; 20(2):1415-1427. https://doi.org/10.1007/s40200-021-00879-z PMid: 34900793 PMCid: PMC8630144.
145. Watanabe S, Oikawa S, Mibayashi H. *Ayurveda* treatment (*virechana* and *basti*) and changes of intestinal microbiota at phyla and species level. Prensa Med Argent. 2021; 107(3):319. https://doi.org/10.47275/0032-745X-319
146. Widhiati S, Purnomosari D, Wibawa T, Soebono H. The role of gut microbiome in inflammatory skin disorders: a systematic review. Dermatol Rep. 2022; 14(1):9188. https://doi.org/10.4081/dr.2022.9188 PMid: 35371420 PMCid: PMC8969879.
147. Huang Y, Shi X, Li Z, Shen Y, Shi X, Wang L, *et al*. Possible association of *Firmicutes* in the gut microbiota of patients with major depressive disorder. Neuropsychiatr Dis Treat. 2018; 14:3329-3337. https://doi.org/10.2147/NDT.S188340 PMid: 30584306 PMCid: PMC6284853.
148. Sun W, Du D, Fu T, Han Y, Li P, Ju H. Alterations of the gut microbiota in patients with severe chronic heart failure. Front Microbiol. 2022; 12:813289. https://doi.org/10.3389/fmicb.2021.813289 PMid: 35173696 PMCid: PMC8843083.
149. Hufnagl K, Pali-Schöll I, Roth-Walter F, Jensen-Jarolim E. Dysbiosis of the gut and lung microbiome has a role in asthma. Semin Immunopathol. 2020; 42(1):75-93. https://doi.org/10.1007/s00281-019-00775-y PMid: 32072252 PMCid: PMC7066092.
150. Chen T, Ding R, Chen X, Lu Y, Shi J, Lü Y, *et al*. *Firmicutes* and *Blautia* in gut microbiota lessened in chronic liver diseases and hepatocellular carcinoma patients: a pilot study. Bioengineered. 2021; 12(1):8233-8246. https://doi.org/10.1080/21655979.2021.1982273 PMid: 34592890 PMCid: PMC8806631.
151. Wang Y, Gao X, Lv J, Zeng Y, Li Q, Wang L, *et al*. Gut microbiome signatures are correlated with bone mineral density alterations in the Chinese elders. Front Cell Infect Microbiol. 2022; 12:827575. https://doi.org/10.3389/fcimb.2022.827575 PMid: 35433497 PMCid: PMC9008261.
152. Lu T, Chen Y, Guo Y, Sun J, Shen W, Yuan M, *et al*. Altered gut microbiota diversity and composition in chronic urticaria. Dis Markers. 2019; 2019:6417471. https://doi.org/10.1155/2019/6417471 PMid: 31827639 PMCid: PMC6881578.
153. Jeong MY, Jang HM, Kim DH. High-fat diet causes psychiatric disorders in mice by increasing Proteobacteria population. Neurosci Lett. 2019; 698:51-57. https://doi.org/10.1016/j.neulet.2019.01.006 PMid: 30615977.
154. Zolnikova OY, Potskhverashvili ND, Kudryavtseva AV, Krasnov GS, Guvatova ZG, Truhmanov AS, *et al*. Changes in gut microbiota with bronchial asthma. Ter Arkh. 2020 ; 92(3):56-60. https://doi.org/10.26442/00403660.2020.03.000554 PMid: 32598794.
155. Vasques-Monteiro IML, Silva-Veiga FM, Miranda CS, de Andrade Gonçalves ÉCB, Daleprane JB, Souza-Mello V. A rise in Proteobacteria is an indicator of gut-liver axis-mediated nonalcoholic fatty liver disease in high-fructose-fed adult mice. Nutr Res. 2021; 91:26-35. https://doi.org/10.1016/j.nutres.2021.04.008 PMid: 34130208.
156. He J, Xu S, Zhang B, Xiao C, Chen Z, Si F, *et al*. Gut microbiota and metabolite alterations associated with reduced bone mineral density or bone metabolic indexes in postmenopausal osteoporosis. Aging (Albany NY). 2020; 12(9):8583-8604. https://doi.org/10.18632/aging.103168 PMid: 32392181 PMCid: PMC7244073.
157. Mahmud MR, Akter S, Tamanna SK, Mazumder L, Esti IZ, Banerjee S, *et al*. Impact of gut microbiome on skin health: gut-skin axis observed through the lenses of therapeutics and skin diseases. Gut Microbes. 2022; 14(1):2096995. https://doi.org/10.1080/19490976.2022.2096995 PMid: 35866234 PMCid: PMC9311318.
158. Deng Y, Wang H, Zhou J, Mou Y, Wang G, Xiong X. Patients with *acne vulgaris* have a distinct gut microbiota in comparison with healthy controls. Acta Derm Venereol. 2018; 98(8):783-790. https://doi.org/10.2340/00015555-2968 PMid: 29756631.
159. Doroszkiewicz J, Groblewska M, Mroczko B. The role of gut microbiota and gut–brain interplay in selected diseases of the central nervous system. Int J Mol Sci. 2021; 22(18):10028. https://doi.org/10.3390/ijms221810028 PMid: 34576191 PMCid: PMC8471822.
160. Cui L, Zhao T, Hu H, Zhang W, Hua X. Association study of gut flora in coronary heart disease through high-throughput sequencing. Biomed Res Int. 2017; 2017:3796359. https://doi.org/10.1155/2017/3796359 PMid: 28497047 PMCid: PMC5401719.
161. Li N, Dai Z, Wang Z, Deng Z, Zhang J, Pu J, *et al*. Gut microbiota dysbiosis contributes to the development of chronic obstructive pulmonary disease. Respir Res. 2021; 22:1-5. https://doi.org/10.1186/s12931-021-01872-z PMid: 34696775 PMCid: PMC8543848.
162. Xie G, Wang X, Liu P, Wei R, Chen W, Rajani C, *et al*. Distinctly altered gut microbiota in the progression of liver disease. Oncotarget. 2016; 7(15):19355-19366. https://doi.org/10.18632/oncotarget.8466 PMid: 27036035 PMCid: PMC4991388.
163. Li C, Huang Q, Yang R, Dai Y, Zeng Y, Tao L, *et al*. Gut microbiota composition and bone mineral loss—epidemiologic evidence from individuals in Wuhan, China. Osteoporos Int. 2019; 30:1003-1013. https://doi.org/10.1007/s00198-019-04855-5 PMid: 30666372.

## Author Contribution

Conceptualisation: B.B.; Methodology and literature review: B.B., M.; Data curation and analysis: B.B.,; Writing - original draft preparation: B.B.; Writing - review and editing: B.B., M.; Supervision and critical review: M.S.; Formatting and final manuscript review: B.B., M.S., M. All authors have read and agreed to the published version of the manuscript.