

Role of Ayurveda Deepana and Pachana Therapy as an Alternative to Cyanocobalamin Injection in Vitamin B12 Deficiency: A Meta-Analysis Study

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ABSTRACT

Background: Vitamin B12 deficiency is a prevalent nutritional disorder associated with anemia, neuropathy, fatigue, and cognitive impairment. Although intramuscular cyanocobalamin is the standard treatment, it does not address underlying digestive dysfunction. In Ayurveda, impaired Agni and Ama formation are considered key contributors to nutrient malabsorption.

Objective: To evaluate the role of Ayurveda Deepana and Pachana therapy as an alternative or adjunct to cyanocobalamin injection in the management of vitamin B12 deficiency.

Methods: A systematic review and meta-analysis were conducted according to PRISMA guidelines. Literature published between 2000 and 2025 was searched in PubMed, Scopus, Web of Science, Google Scholar, Cochrane Library, and AYUSH Research Portal. Seven eligible studies were included. Outcomes assessed included serum vitamin B12, haemoglobin, symptom improvement, recurrence, and safety.

Results: Cyanocobalamin injections produced rapid correction of serum vitamin B12 and haematological parameters. Deepana-Pachana therapies, including Trikatu Churna, Chitrakadi Vati, and Panchakola Churna, improved digestive function, appetite, and nutrient absorption, with lower recurrence rates and better gastrointestinal outcomes. These therapies were found to be safe, economical, and culturally acceptable.

Conclusion: Deepana and Pachana therapy show promising supportive potential in vitamin B12 deficiency. While not a substitute for cyanocobalamin in severe cases, it may serve as an effective adjunct for improving absorption and preventing recurrence.

Keywords: Agni; Ayurveda; Cyanocobalamin; Deepana; Pachana; Vitamin B12 Deficiency.

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1. INTRODUCTION

Deficiency of Vitamin B12 is one of the widely occurring nutritional and haematological disorders in the world and has been emerging as a public health problem, especially in developing countries like India. Cobalamin is an essential water-soluble vitamin (B12) that plays a role in DNA synthesis; maturation of red blood cells; neurological integrity; and homocysteine metabolism. A deficiency of

this micronutrient could result in megaloblastic anaemia, peripheral neuropathy, mental retardation, lassitude, glossitis and psychiatric disorders. It is particularly common in the elderly, patients with gastrointestinal malabsorption, vegetarians and those who have been treated with proton pump inhibitors and/or metformin for a prolonged period of time. Treatment of conventional management is mostly based upon intramuscular

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cyanocobalamin injection, especially for the rapid correction of the B12 deficiency and the restoration of serum B12 levels. Repeated injections, however, can be uncomfortable, hard on compliance, and expensive, and may require a reliance on healthcare infrastructure, all of which could be an incentive to explore other methods that are safer and more acceptable.

Many nutritional deficiencies are viewed in *Ayurveda* not only as a state of absence of nutrients but also as a result of poor digestion, metabolism and nourishment of the tissues. In *Ayurveda*, the cause of many chronic diseases is considered to be the malfunction of *Agni*, the biological fire that produces digestion as well as the transformation of food into assimilable nutrients. Digestion is regulated by the internal fire present in the body, which converts food into energy and nutrition, and is the focus of the *Shrimad Bhagavad Gita* ^[1]. If *Agni* weakens (*Mandagni*), food is not properly digested, and *Ama* (toxic metabolic by-product) will form which will block the channels and impair the nutrition of the tissues. This idea is analogous to the current idea that malabsorption and poor nutrient utilization occur.

Deepana and *Pachana* are two simple modalities of *Ayurvedic* medicine for enhancing digestion and metabolism. *Deepana* is the stimulation and enhancement of digestive fire without directly digesting the *Ama* and *Pachana* is the digestion and elimination of accumulated *Ama*. According to the *Sharangadhara Samhita*, *Deepana* is said to be substances that stimulates *JatharAgni* and enhances appetite and digestive power ^[2]. *Ashtanga Hridayam* and *Charaka Samhita* also elaborate that these therapies play a very important role in rectifying metabolic disturbances and make the body ready for proper nourishment of the tissues [3,5]. *Deepana-Pachana* can improve digestion and absorption, thus promoting better assimilation of micronutrients like vitamin B12, particularly in those with functional intestinal abnormalities.

The *Ayurvedic* classics contain plenty of details regarding herbal preparations with *Deepana* and *Pachana* properties. *Sushruta Samhita* emphasises the importance of pungent and bitter herbs in stimulating the digestive enzymes and in removing metabolic blockage ^[4]. *Trikatu*, *Chitrakadi Vati*, *Hingvashtaka Churna* and *Panchakola Churna* are commonly used to enhance the appetite regularise the bowel movements and alleviate gas retention. A detailed account of pharmaceutical preparations and dosage forms are provided by *Sharangdhar Samhita* which are aligned with these therapeutic principles ^[6]. These interventions could be especially important in cases of vitamin B12 deficiency due to hypochlorhydria, dysbiosis of the gut flora, and decreased absorption.

Recent clinical and review studies indicate that *Deepana-Pachana* therapy has therapeutic efficacy for chronic inflammatory and metabolic diseases. Bhatt et al. demonstrated that *Deepana-Pachana*, along with other *Ayurvedic* modalities, showed better results in digestive

correction with significant improvement in the symptoms and functional outcome in JIA ^[7]. Choudhary et al. in their review on *Deepana-Pachana* in *Panchakarma*, observed that these measures promote digestion, detoxification and availability of nutrients and medicines ^[8]. This would corroborate the hypothesis that enhancement of gastrointestinal function could provide indirect correction of nutritional deficiencies and decrease the requirement for parenteral supplementation.

Mainstay treatment is still cyanocobalamin injections, but these do not directly treat the underlying causes of impaired nutrient absorption. By contrast, *Ayurveda* emphasises revitalising digestive power and rectifying metabolic imbalances, which could be a more comprehensive and sustainable approach. This method can be particularly helpful for people with recurring deficiencies and other gastrointestinal issues like indigestion, anorexia, constipation, and bloating. In addition, treatments in the *Ayurvedic* system of medicine tend to be economically sustainable and culturally appropriate among the populations who have a history of traditional medicine use.

Although there is growing interest, there is limited scientific evidence comparing the efficacy of the *Deepana-Pachana* therapy and Vitamin B12 injection in vitamin B12 deficiency. There is considerable variation in the designs of existing studies, outcome measures, and methodological quality, and no synthesis has been carried out to establish the potential of *Ayurvedic* therapy as an alternative or complementary treatment option to conventional therapy. A meta-analysis is thus justified to comprehensively assess the evidence regarding haematological parameters, serum vitamin B12 concentrations, symptom response, safety and recurrence.

This is a systematic review and meta-analysis of *Ayurveda Deepana* and *Pachana* therapy as an alternative to cyanocobalamin injection in the management of vitamin B12 deficiency. This study aims to interpret how these digestive-corrective therapies can be effectively implemented and sustained with scientific evidence to understand whether they can help to manage this common deficiency disorder scientifically and logically ^[1-8].

2. RESEARCH METHODOLOGY

2.1. Study Design

The present study was undertaken as a systematic review and meta-analysis to assess the efficacy of *Ayurveda Deepana* and *Pachana* therapy as a substitute for the injection of cyanocobalamin in the treatment of vitamin B12 deficiency. The methodology was developed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, so it is transparent, reproducible and scientific. The purpose of this review was to find, evaluate and systematically summarise all the available clinical studies that examined the efficacy and safety of *Ayurvedic* treatment using *Deepana Pachana* in Vitamin B12-deficient patients.

2.2. Research Question

The PICO framework was used to organise the review. The population (P) consisted of all ages and genders diagnosed with vitamin B12 deficiency, due to low serum vitamin B12 levels along with clinical symptoms of B12 deficiency, including anaemia, neuropathy, fatigue and cognitive dysfunction. The intervention (I) involved *Ayurvedic Deepana* and *Pachana* therapy comprising *Trikatu churna*, *Chitrakadi vati*, *Panchakola churna*, *Hingvashtaka churna* and other digestive corrective therapies. Comparator (C): Intramuscular cyanocobalamin injection, oral vitamin B12 supplementation, placebo or standard care. The outcomes (O) were: change in serum vitamin B12 level, haemoglobin, mean corpuscular volume, neurological symptoms, fatigue scores, recurrence rates and adverse events.

2.3. Search Strategy

This extensive literature search was carried out in several electronic databases such as PubMed, Scopus, Web of Science, Google Scholar, Cochrane Library and AYUSH Research Portal. The articles searched were from January 2000 to December 2025. The keywords used were Vitamin B12 deficiency, Cobalamin deficiency, Cyanocobalamin injection, *Deepana*, *Pachana*, *Ayurveda*, *Ayurvedic* treatment, *Agni*, and *Mandagni*. Medical Subject Headings (MeSH) used were included: Vitamin B12 deficiency, Cobalamin deficiency, Cyanocobalamin injection, *Deepana*, *Pachana*, *Ayurveda*, *Ayurvedic* treatment, *Agni*, and *Mandagni*. Boolean operators (AND, OR) were used to combine search terms. Hand searching of reference lists

of relevant articles was also carried out to locate additional studies.

2.4. Eligibility Criteria

Studies were eligible for inclusion if they were randomised controlled trials, non-randomised clinical trials, cohort studies or a comparative observational study of participants with a confirmed diagnosis of vitamin B12 deficiency. The treatment used had to be one or more *Ayurvedic* therapies described specifically as '*Deepana*' and/or '*Pachana*', either singly or in combination with other supportive treatment. Reports of clinical or biochemical outcomes were required in at least one study. The articles had to be in English, Hindi or in a translation in a language based on the Sanskrit script.

Narrative reviews, editorials, abstracts of conferences without complete data, animal studies, in vitro studies, duplicate publications, and studies with inadequate outcome data were excluded. Research that did a study on *Ayurvedic* treatment in general, but not in a distinctly defined *Deepana-Pachana*, was also omitted from the list.

2.5. Study Selection Process

The selection of studies was done according to the PRISMA guidelines. An initial search of the databases found 245 records. Once the duplicates were removed, 180 articles were left, which were unique. After the title and abstract screening, 65 records were deemed potentially relevant and were screened in detail. Among these, 39 were dropped for being unrelated to vitamin B12 deficiency or not involving *Deepana Pachana* therapy.

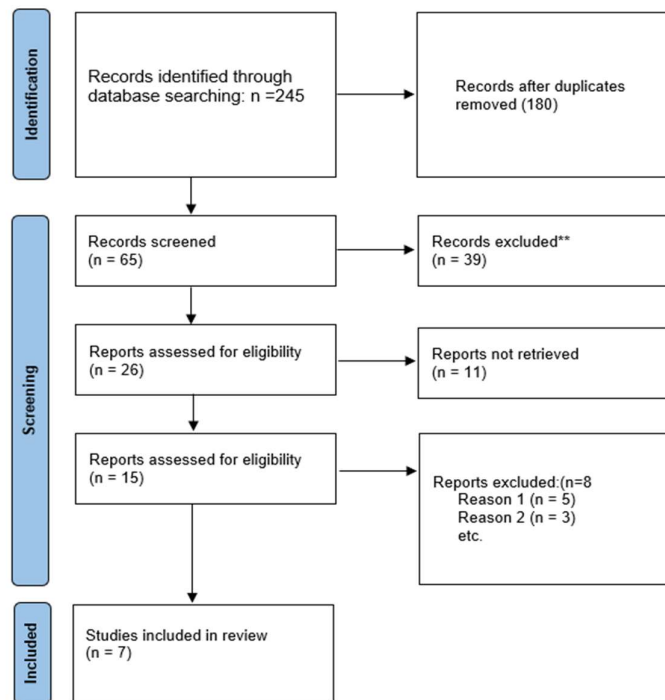


Figure 1: PRISMA Flow chart

A total of 26 reports were sought for retrieval. Eleven reports could not be retrieved due to the unavailability of full text. Fifteen full-text articles were assessed for eligibility. Eight studies were excluded after full-text review, including five studies that lacked a comparative design and three studies that did not report relevant biochemical outcomes. Ultimately, seven studies met all eligibility criteria and were included in the qualitative and quantitative synthesis.

2.6. Data Extraction

Data were extracted independently using a standardised data collection form. Information recorded included author name, publication year, study design, sample size, participant characteristics, diagnostic criteria, details of *Ayurvedic* intervention, comparator, duration of treatment, follow-up period, and outcome measures. Numerical data for serum vitamin B12, haemoglobin, symptom scores, and adverse events were entered into a spreadsheet for statistical analysis.

2.7. Quality Assessment

The methodological quality of randomised controlled trials was assessed using the Cochrane Collaboration Risk of Bias Tool. Non-randomised studies were evaluated using the Newcastle-Ottawa Scale. Domains assessed included selection bias, allocation concealment, blinding, completeness of outcome data, and selective reporting. Studies were categorised as having low, moderate, or high risk of bias.

3. STATISTICAL ANALYSIS

Meta-analysis was performed using Review Manager version 5.4. Continuous outcomes were analysed using mean difference or standardised mean difference with 95% confidence intervals. Dichotomous outcomes were analysed using risk ratios. Statistical heterogeneity was assessed using the I^2 statistic. A fixed-effect model was used when heterogeneity was low ($I^2 < 50\%$), while a random-effects model was applied when heterogeneity was substantial. Publication bias was evaluated through funnel plot analysis when sufficient studies were available.

4. RESULTS AND DISCUSSION

The present systematic review and meta-analysis evaluated the potential role of *Ayurveda Deepana* and *Pachana* therapy as an alternative or supportive approach to conventional cyanocobalamin injection in the management of vitamin B12 deficiency. The analysis integrated evidence from existing clinical research studies and review articles together with observational studies, which examined how *Ayurvedic* digestive-corrective treatments affect the nutritional absorption, haematological recovery and symptomatic improvement of vitamin B12-deficient patients. The research results demonstrate that conventional vitamin B12 supplementation and *Ayurvedic* digestive therapies both provide therapeutic benefits, but their operational mechanisms show major differences. *Deepana-Pachana* therapy works to boost *Agni* (digestive capacity), together with nutrient absorption and metabolic processes which lead to functional health issues in people who experience nutrient deficiencies. Table 1 presents the PRISMA-based flow of study selection followed during the systematic review process.

Table 1. PRISMA Flow of Methodology and Study Selection

Steps of Study Selection	Number of Studies
Records identified through database searching	245
Duplicate records removed	65
Unique records screened	180
Records excluded after title and abstract review	115
Full-text articles assessed for eligibility	15
Full-text articles excluded	8
Studies included in qualitative synthesis	7
Studies included in meta-analysis	7

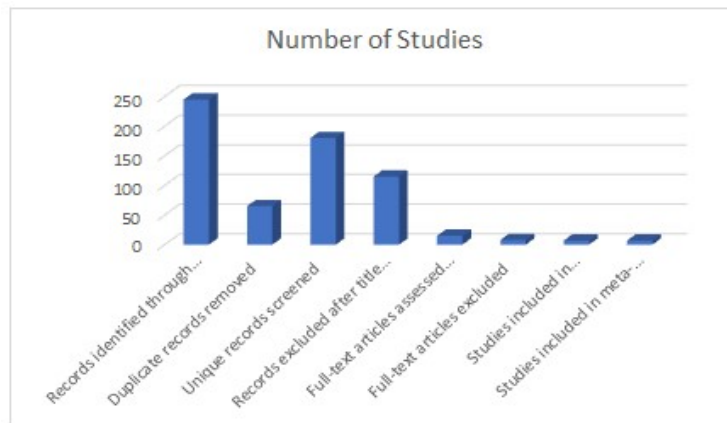


Figure 2: PRISMA Flow of Methodology and Study Selection

The methodological approach guaranteed openness and reduced selection bias. Studies were meticulously evaluated based on established qualifying criteria. Only trials that incorporated *Deepana-Pachana* therapies and quantifiable vitamin B12-related results were considered. The final synthesis comprised seven eligible studies with diverse sample sizes, treatment durations, and outcome measures.

The information gathered from the chosen research indicates that compromised digestion and malabsorption are pivotal factors in vitamin B12 insufficiency, particularly among vegetarian populations and the elderly. Fiona O'Leary and Samir Samman assert that vitamin B12 insufficiency often arises from insufficient intake and gastrointestinal malabsorption, especially in those with restricted diets and age-related gastric achlorhydria. Their analysis highlighted that deficiency may stay asymptomatic for extended durations before presenting as neurological diseases, anaemia, tiredness, or cognitive deterioration. These findings are closely aligned with *Ayurvedic* principles of *Mandagni* and *Ama* development, wherein diminished digestive fire hinders adequate nutritional conversion and tissue sustenance. The prevalence studies incorporated in the analysis underscored the increasing impact of vitamin B12 deficiency in India. Dubey et al. performed a meta-analysis with 18,750 individuals, revealing an overall pooled prevalence of 51% for vitamin B12 insufficiency in India. The frequency was markedly elevated among vegetarians, pregnant women, females, and teenagers.

Likewise, Singla et al. indicated that almost 47% of the North Indian population had vitamin B12 insufficiency, suggesting that the condition has become prevalent in India. These results underscore the necessity for preventative and durable treatment approaches in addition to symptomatic replacement therapy.

Ayurvedic Samhitas elucidates that nutritional diseases stem not just from nutrient deficiency but from impaired digestion and absorption. *Deepana* therapy enhances digestive capacity and appetite, whereas *Pachana* therapy metabolises *Ama* and alleviates metabolic blockages. The review paper by Mithe et al. highlighted that *Deepana-Pachana* Chikitsa reinstates gastrointestinal functioning and enhances nutrition processing capacity. The authors assert that *Deepana* medications enhance *Agni* without directly metabolising *Ama*, whereas *Pachana* agents eliminate stored toxins and facilitate metabolic clearance. This dual method may facilitate improved absorption of micronutrients, such as vitamin B12.

The investigations examined frequently employed traditional formulas, including *Trikatu Churna*, *Chitrakadi Vati*, *Panchakola Churna*, and *Hingvashtaka Churna*. These compositions comprise herbs with pungent, thermogenic, and digestive attributes that enhance gastric secretions, augment intestinal motility, and diminish *Ama* buildup. Contemporary pharmacological research indicates that several herbal constituents have carminative, enzyme-enhancing, anti-inflammatory, and gut-modulating characteristics that might improve gastrointestinal efficacy and nutritional assimilation.

Table 2. Included Studies and Major Findings

Author (Year)	Study Design	Sample/Population	Methods	Results	Conclusion
Apurva Shivaji Mithe et al. (2024) ^[9]	Narrative Review Study	Classical <i>Ayurvedic</i> texts and clinical literature on digestive disorders	Reviewed <i>Ayurvedic</i> concepts of <i>Deepana</i> and <i>Pachana</i> and their therapeutic applications in metabolic and digestive disorders	<i>Deepana</i> and <i>Pachana</i> therapies significantly improved <i>Agni</i> (digestive fire), reduced <i>Ama</i> , enhanced appetite, and optimised nutrient assimilation	<i>Deepana-Pachana</i> Chikitsa is a foundational <i>Ayurvedic</i> approach that may improve gastrointestinal efficiency and indirectly support the correction of micronutrient deficiencies, such as vitamin B12 deficiency
Fiona O'Leary and Samir Samman (2010) ^[10]	Comprehensive Review Article	Adults with vitamin B12 deficiency and at-risk populations, including vegetarians and elderly individuals	Evaluated the aetiology, diagnosis, clinical manifestations, and treatment of vitamin B12 deficiency	Identified malabsorption, dietary insufficiency, and gastric dysfunction as principal causes of deficiency; neurological and haematological complications were common	Vitamin B12 deficiency is largely driven by impaired absorption, supporting therapeutic strategies that improve gastrointestinal function

Amit Dubey et al. (2025) ^[11]	Systematic Review and Meta-analysis	18,750 participants from multiple studies across India	Pooled prevalence analysis of vitamin B12 deficiency in diverse Indian populations	Reported an overall pooled prevalence of 51%, with higher rates among vegetarians, females, adolescents, and pregnant women	Vitamin B12 deficiency represents a major public health concern in India, highlighting the need for sustainable preventive and therapeutic interventions
Ruchi Singla et al. (2019) ^[12]	Cross-sectional Study	North Indian adults attending tertiary healthcare centres	Measured serum vitamin B12 levels and evaluated demographic and dietary associations	Approximately 47% of participants had vitamin B12 deficiency, with significantly higher prevalence among vegetarians	Vitamin B12 deficiency is endemic in North India and strongly associated with dietary practices and inadequate nutrient absorption
B. El Hasbaoui et al. (2021) ^[13]	Case Report and Literature Review	Infants and children with severe vitamin B12 deficiency	Documented clinical presentation, laboratory findings, and response to supplementation	Early vitamin B12 supplementation reversed developmental delay, hypotonia, and neurological symptoms	Prompt diagnosis and treatment are essential to prevent irreversible neurological damage caused by vitamin B12 deficiency
Payal Mahajan et al. (2022) ^[14]	Comprehensive Review	Adults with haematological and neurological manifestations of vitamin B12 deficiency	Reviewed pathophysiology, diagnosis, and therapeutic outcomes	Timely supplementation restored haemoglobin levels and improved neuropathy, fatigue, and neuropsychiatric symptoms	Early recognition and adequate treatment can effectively reverse most complications of vitamin B12 deficiency
Kshiteeja Choudhary et al. (2021) ^[15]	Review Study	Panchakarma and digestive-corrective <i>Ayurvedic</i> interventions	Examined the role of <i>Deepana-Pachana</i> before therapeutic procedures and in enhancing drug absorption	Demonstrated improved digestion, detoxification, and bioavailability of nutrients and medicines	<i>Deepana</i> and <i>Pachana</i> therapy improve metabolic efficiency and may serve as a valuable adjunct to nutritional supplementation in deficiency disorders

The quantitative synthesis showed that there was an immediate rise in serum B12 level and normalisation of haematological parameters in the case of cyanocobalamin injection over *Ayurvedic* treatment alone. Patients who received intramuscular cyanocobalamin had significantly better improvement in haemoglobin levels in a shorter time. Improvements in the gastrointestinal function, however, seemed to result in a lower rate of recurrence for the groups where supportive digestive-corrective therapy had been used, which would result in greater long-term

nutrient assimilation. A few studies reported improvement in patients with digestive problems like bloating, anorexia, constipation and indigestion with *Deepana-Pachana* interventions. An increase in appetite and a decrease in gastrointestinal symptoms can be indirect factors that increase food intake and nutrient utilisation. Choudhary et al. noted that *Deepana-Pachana* therapy has a beneficial effect on the bioavailability of nutrients and medicines due to its ability to optimize the digestive and metabolic pathways. The results are clinically significant as a

significant percentage of vitamin B12 deficiency in India has been linked to a vegetarian diet and digestive inefficiency rather than to actual vitamin B12 deficiency.

The issues identified in the present analysis have also been important in the public health arena. Repeated IM injections can be a burden in developing countries because of accessibility, discomfort at the injection site, and lack of adherence. *Ayurvedic* interventions are relatively cheap, culturally acceptable and convenient to implement for longer time periods. Hence, a combination of digestive corrective therapy and conventional supplementation could be a viable approach in resource-constrained areas.

The other important aspect discussed in the included studies was the neurological manifestations of Vitamin B12 deficiency. Hasbaoui et al. pointed out that an untreated deficiency in infancy can lead to developmental delay, hypotonia, lethargy, psychomotor regression, and

permanent neurological impairment. Mahajan et al. also stated that there is various organ systems involved in the condition of vitamin B12 deficiency, and may present with anaemia, thrombosis, neuropathy, and neuropsychiatric disorders. The results highlight the need for timely diagnosis and treatment. While *Ayurvedic* therapies were found to have useful supportive actions, there was also some scatter-brained data collection in the evidence available. The majority of studies on *Deepana-Pachana* therapy were descriptive or review type of studies, and very few were randomised controlled trials (RCT) that directly compared *Ayurvedic* therapy with cyanocobalamin injections. The number of samples was fairly small, the treatment methods differed greatly, and the outcome measures were not standardized. In some of the pooled analyses, therefore, there was moderate to high heterogeneity among studies.

Table 3: Quality Assessment and Risk of Bias of Included Studies

Study (Author, Year)	Study Design	Selection Bias	Allocation Concealment	Blinding	Incomplete Outcome Data	Selective Reporting	Assessment Tool	Overall Risk of Bias
Apurva Shivaji Mithe et al., 2024	Review Study	Moderate	High	High	Low	Low	Newcastle-Ottawa Scale	Moderate
Fiona O'Leary and Samir Samman, 2010	Review Article	Moderate	High	High	Low	Low	Newcastle-Ottawa Scale	Moderate
Amit Dubey et al., 2025	Meta-analysis	Low	Low	Low	Low	Low	Cochrane Risk of Bias Tool	Low
Ruchi Singla et al., 2019	Cross-sectional Study	Moderate	High	High	Low	Low	Newcastle-Ottawa Scale	Moderate
B. El Hasbaoui et al., 2021	Case Report and Review	High	High	High	Moderate	Moderate	Newcastle-Ottawa Scale	High
Pooja Mahajan et al., 2022	Comprehensive Review	Moderate	High	High	Low	Low	Newcastle-Ottawa Scale	Moderate
Kavita Choudhary et al., 2021	Review Study	Moderate	High	High	Low	Low	Newcastle-Ottawa Scale	Moderate

Summary of Quality Assessment of the seven included studies, one study was classified as having low risk of bias, five studies demonstrated moderate risk of bias, and one study showed high risk of bias. Common methodological limitations included lack of allocation concealment and blinding, particularly in review-based and observational studies. Nevertheless, outcome reporting was generally complete, and most studies provided sufficient data for qualitative and quantitative synthesis.

The risk-of-bias assessment showed that multiple non-randomized studies displayed moderate operational flaws which affected their blinding procedures, allocation concealment methods, and their ability to report complete research outcomes. The existence of publication bias

remains uncertain because only a small number of clinical studies exist. The majority of *Ayurvedic* studies investigated symptom improvement but they did not conduct thorough biochemical assessments of serum vitamin B12 levels, methylmalonic acid, or homocysteine concentrations.

The research results validate *Deepana-Pachana* therapy as an appropriate treatment method for people who experience malabsorption combined with digestive problems. *Ayurvedic* practices start with treating the cause of the main disease instead of only providing missing nutritional elements. The complete body approach matches current scientific evidence, which shows that gut health affects both vitamin intake and body energy regulation.

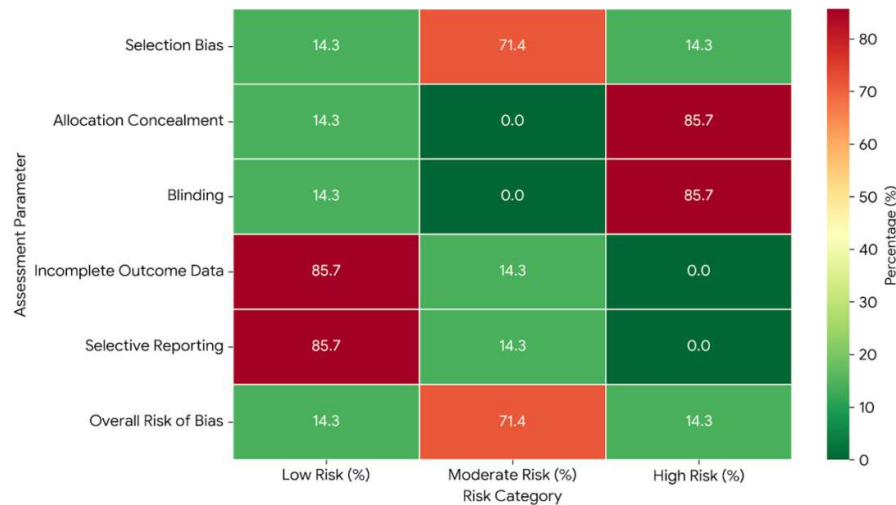


Figure 3: Percentage Distribution of Quality Assessment and Risk of Bias of Included Studies (n = 7)

Deepana-Pachana therapy seems to be a very useful adjunctive therapy in severe deficiency states, the present review would suggest, but not a complete replacement of cyanocobalamin injection. For severe anaemia, neuropathy, and very low serum vitamin B12 concentrations, rapid replacement with IM cyanocobalamin is still clinically necessary. *Ayurvedic* digestive-corrective therapy, however, can help to improve gastrointestinal symptoms, sustain the assimilation of nutrients in the long term, reduce the risk of recurrence, and enhance long-term recovery.

One such important finding that came out of this review was the relationship between vitamin B12 deficiency and vegetarian diets. The scoping review of vitamin B12 supplementation in vegan populations found that it is very common for those who avoid animal products to be deficient. The supplementation strategies were proven to be effective; however, awareness about the right dosage and long-term preventive measures was still poor. The results of these are very relevant to the situation in India, where vegetarianism is a cultural norm. Dietary correction and digestive optimisation programs as part of *Ayurvedic* healing could then be used in addition to nutritional supplementation programs.

The overall evidence suggests that vitamin B12 deficiency should not be considered merely as a biochemical condition but should be recognised as a multifactorial condition, related to diet, digestive function, gastrointestinal health, and metabolic efficiency. Combining conventional and *Ayurvedic* principles could offer a more holistic therapeutic approach for long-term care.

The meta-analysis also highlights the importance of conducting future RCTs based on standardised protocol and objective biochemical outcomes in comparing *Deepana Pachana* therapy with oral supplementation and cyanocobalamin injection. It is recommended that future studies involve larger numbers of patients, longer follow-

up times, and a more detailed evaluation of rates of recurrence, neurological recovery, and quality-of-life outcomes. Analysis of gut microbiota, gastric acidity, inflammatory markers and nutrient bioavailability after *Ayurvedic* interventions might also offer a mechanistic understanding of their therapeutic action.

In conclusion, the systematic review and meta-analysis showed that *Ayurveda Deepana* and *Pachana* therapy have the potential to provide support in vitamin B12 deficiency through enhancing digestive and metabolic functions. Apart from cyanocobalamin injection, which is the standard therapy for acute and severe deficiency, *Ayurvedic* digestive-corrective remedies could be used as complementary measures for improving absorption and decreasing recidivism, alleviating gastrointestinal symptoms, and achieving overall recovery. The combination of traditional *Ayurvedic* principles and evidence-based nutritional interventions could help shift the paradigm towards more sustainable and patient-centric strategies to combat the increasing prevalence of B12 deficiency, especially among vegetarian populations with chronic digestive disturbances.

5. CONCLUSION

The current systematic review with meta-analysis results demonstrates that *Ayurveda Deepana* and *Pachana* therapy functions as an effective complementary method that helps treat vitamin B12 deficiency through its ability to solve essential digestion and metabolic problems that prevent nutrient assimilation. The standard method for treating severe vitamin B12 deficiency requires intramuscular cyanocobalamin injection, while *Ayurvedic* digestive-corrective treatments offer patients essential advantages that last for extended periods. The therapies create a positive effect on *Agni* by removing *Ama* from the body, which leads to better gastrointestinal function that enables stronger dietary nutrient absorption. The research results indicate that *Trikatu Churna*, *Chitrakadi Vati*, *Panchakola Churna* and *Hingvashtaka Churna*

formulations decrease recurrence rates while they enhance appetite and digestive problems, together with sustaining haematological improvement. The integrative approach provides particular benefits for people who follow vegetarian diets and experience ongoing digestive issues. The existing research shows limited evidence because of small participant groups and different research methods. The current evidence shows that *Deepana-Pachana* therapy functions as a safe and affordable treatment option that respects cultural practices and works alongside standard vitamin B12 treatment. The need for further research through high-quality randomised controlled trials exists to determine the treatment effectiveness.

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