SOUTH BAYLO UNIVERSITY

Recent Research Trends of Acupuncture and Oriental Medicine for Obesity: A Systematic Review and Meta-Analysis

by

Mercy Park

A RESEARCH PROJECT SUBMITTED

IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE

Doctor of Acupuncture and Oriental Medicine

ANAHEIM, CALIFORNIA

June 2024

DISSERTATION OF MERCY PARK

APPROVED BY RESEARCH COMMITTEE

Shan Qin Cui, OMD, L.Ac,

Won Zoe Shin, Ph.D, DAOM, L.Ac

Hanok Lee, DAOM, L.Ac,

Anne Ahn, OMD, L.Ac

Joseph H. Suh, Ph.D, OMD, L.Ac

South Baylo University

Anaheim, California

June 28, 2024

Recent Research Trends of Acupuncture and Oriental Medicine for Obesity:

A Systematic Review and Meta-Analysis

Mercy Park

South Baylo University at Anaheim, 2024

Research Advisor: Won Zoe Shin, DAOM, Ph.D., L.Ac.

ABSTRACT

Obesity is an increasingly common chronic disease worldwide, representing a rapidly growing threat to health in many countries. Nearly two decades have passed since the World Health Organization (WHO) declared obesity a global pandemic in 2004 and initiated the 'War on Obesity.' Despite these efforts, the prevalence of obesity continues to surge globally. Today, obesity is not just a matter of personal health or appearance but a significant international health issue with serious social and economic implications. In response to this trend, the importance of effective and economic obesity treatment has been consistently emphasized. Acupuncture and Oriental Medicine (AOM) are considered to be effective alternative treatments for obesity. This study aimed to establish clinical evidence for the efficacy and safety of AOM treatments used for weight loss across many countries. It also sought to review recent trends in AOM studies for obesity and conduct a comprehensive pooled analysis to examine their anti-obesity effectiveness and safety. We conducted a systematic review using standard methodologies to search, review, analyze, and synthesize published data on the efficacy and safety of weight loss herbal medicine and various acupuncture techniques. A total of 9 electronic databases (PubMed, EMBASE, Cochrane Library, Google Scholar, RISS, OASIS, KISS, KTKP, and

Wanfang) in English, Korean, and Chinese were searched from January 2012 to April 2024 using predetermined search terms to find randomized controlled trials on current obesity AOM treatments with outcomes including weight loss and adverse events. A total of 44 randomized controlled trials (RCTs) were chosen for qualitative review based on the established criteria, and 32 RCTs (12 on Herbal Medicine and 20 on Acupuncture) underwent meta-analysis. We extracted relevant data for qualitative and quantitative analyses of one herbal medicine group and four acupuncture groups. In conclusion, AOM treatment effectively and safely reduces weight, BMI, body circumference, and fat rate and improves biochemical parameters in obese individuals.

Keywords: Obesity, Herbal medicine, Acupuncture, Systematic review, Meta-analysis

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

Praise the Lord! I am deeply grateful to all those who have supported me throughout my doctoral research in Acupuncture & Oriental Medicine, enabling me to complete this journey. I want to express my sincere appreciation to my family, the faculty of South Baylo University, and especially my research advisor, Dr. Won Zoe Shin Ph.D., OMD, L.Ac., whose invaluable support, knowledge, expertise, advice, and motivation have been instrumental in the completion of this project. It has been a great privilege and honor to study under his guidance. I would also like to extend my heartfelt thanks to Dr. Joseph Suh, Ph.D., OMD, L.Ac., for his exceptional guidance and to Dr. Shan Qin Cui, OMD, L.Ac., for her kindness, continuous support, and encouragement.

Furthermore, I am grateful to my mother for her encouragement and constant prayers that have made this achievement possible. I am also immensely thankful to my dear husband for his unconditional and unwavering love, care, support, respect, and faith in me throughout this long academic journey to become a healthcare professional. His presence has been my strength; I could not have accomplished this without him. Thank you for everything, and I love you!

I. INTRODUCTION

It has been almost two decades since the World Health Organization (WHO) proclaimed obesity as a worldwide pandemic in 2004 and initiated the 'War on Obesity.' Despite these efforts, the prevalence of obesity continues to surge in various countries all over the world [1]. Today, obesity is not just a matter of personal health or appearance but a significant international health issue with serious social and economic implications. Obesity is a condition marked by an overabundance of body fat, leading to a body mass index (BMI) of 30 or above. The WHO describes obesity as an atypical or extreme buildup of fat in adipose tissue that harms one's overall well-being and requires long-term management [2]. In 2013, the American Medical Association (AMA) officially classified obesity as a disease [3].

Alarming data from the 2022 OECD Health Survey reveals that the United States accounts for a staggering 73.1% of overweight and obese individuals among its member nations [4]. According to the Obesity Prevalence and Comorbidity Map published by the National Opinion Research Center (NORC) at the University of Chicago, the United States has become one of the most overweight nations globally. Shockingly, over 41.9% of Americans have a BMI of 30 or higher, and some states have reported obesity rates exceeding 50% [5].

The rise in obesity rates among adults is a critical matter. Still, the surge in overweight children and teenagers is an even more significant worry for public health on a global scale [6]. Approximately one-fifth of the global youth population is either overweight or obese, according to recent statistics. In 2020, the Centers for Disease Control and Prevention (CDC) reported that nearly 14.7 million individuals, representing 19.7% of the US population between the ages of 2 and 19, were classified as obese [7]. In addition, the World Obesity Federation's

World Obesity Atlas, published in 2023, reported that some studies have shown that, on average, children and adolescents gained 1.5 kg (3.3lbs) of weight after the COVID-19 lockdown due to reduced physical activity and increased consumption of processed foods. It was also predicted that by 2035, nearly half of adults in the Americas will be affected by obesity (47-49%), and the prevalence of obesity among children and adolescents will increase to 26% for girls and 33% for boys [8].

Lister's Research shows that childhood and adolescent obesity is a significant indicator of ongoing obesity throughout adulthood [9]. This condition goes beyond cosmetic concerns and can result in an increased likelihood of developing type 2 diabetes, hypertension, fatty liver, hypercholesterolemia, cardiovascular and cerebrovascular disease, respiratory conditions like sleep apnea, and oxidative stress. It can also lead to reproductive and endocrine disorders, chronic inflammation, and an increased risk of developing tumors [10][11]. As such, comprehensive and systematic management and treatment for obesity are necessary to address this very serious disease. Currently, standard methods for obesity and overweight include a combination of diet, exercise, medication, and surgery. While diet and exercise can be effective long-term treatments, they can be challenging to maintain and often result in weight regain once discontinued. Medications prescribed for weight loss and obesity treatment, such as liraglutide, exenatide, orlistat, metformin, phentermine, and topiramate, can provide fast results but may also cause gastrointestinal discomfort, insomnia, headache, nausea, and other adverse reactions [12]. Surgical options, like liposuction and gastric reduction, offer significant weight loss benefits but come with high costs, risks, and the potential for serious complications [13].

As the prevalence of obesity continues to rise across all age groups, it is crucial to explore safe, affordable, and effective treatment options. With obesity being a matter of great social and medical concern worldwide, clinical studies on the effectiveness of obesity treatments using Acupuncture and Oriental medicine have become active accordingly. The World Health Organization (WHO) has recognized acupuncture for its safety, efficacy, affordability, convenience, and lack of negative side effects [14]. In East Asian countries like Korea, China, and Japan, acupuncture is commonly used in medical clinics with herbs, cupping, moxibustion, acupressure, Tuina, and electrostimulation to address obesity. Additionally, traditional herbal medicines have been utilized to suppress appetite, promote internal organ harmony, improve energy metabolism and blood circulation, and help the body eliminate waste and toxins [15].

However, previous systematic reviews on obesity found the following limitations. 1) Integrating the effects of Acupuncture and Oriental Medicine(AOM) remains an area lacking in comprehensive studies, with evaluations showing inconsistency; 2) Current research on obesity and overweight treatment has primarily targeted adults, with no comparative analysis of characteristics across age groups, including women and men, and the elderly; 3) Acupuncture treatment studies for overweight and obesity focus on direct measures of obesity without reflecting and synthesizing metabolic indicators. 4) In the case of studies on the treatment of obesity with herbal medicine alone, the number of clinical trials and follow-ups were significantly lower than in studies on acupuncture treatments, and the bias assessment method and reliability grade were not verified clearly. In addition, 5) Acupuncture interventions include a variety of techniques such as Traditional (manual) acupuncture, electro-acupuncture, Auricular acupuncture, Catgut Embedding acupuncture (Long-term acupoint stimulation), and Phamacopuncture, which have not been comprehensively studied or comparatively evaluated.

Therefore, this study aimed to collect clinical studies published from January 2012 to

January 2024 in which Acupuncture and Oriental Medicine (AOM) were used to treat obese patients and to conduct a systematic review and meta-analysis. By reviewing the latest research trends, this study is designed to assess and synthesize recent research findings on the efficacy, safety, and mechanisms of AOM as a treatment for obesity. By incorporating this study's evidence-based approach into clinical practice references for healthcare practitioners, I hope to contribute to improving obesity treatment.

OBJECTIVES

This study aims to review the latest research trends and assess the effectiveness of Acupuncture and Oriental Medicine treatments, widely used to treat obesity. It is also designed to investigate which types of treatments can be offered more effectively through a subgroup analysis.

To effectively execute this research, the following specific objectives have been identified:

1. Conduct a thorough systematic review of current research on Acupuncture and Oriental Medicine (AOM) treatment of obesity, analyzing and evaluating the findings.

2. Use rigorous search methods to select reliable clinical research (RCTs) on AOM treatment of obesity that provide outcome data.

3. Organize the details of each intervention method, participant characteristics, treatment period, treatment result, adverse effects, etc., from the selected clinical studies into a table and extract the data for meta-analysis.

4. Evaluate the efficacy and safety of AOM treatment for obesity from an evidence-based medicine perspective by comprehensively examining the results of systematic reviews and meta-analyses of AOM treatment studies.

LITERATURE REVIEW

1.1 Systemic Review

A systemic review is “the application of scientific strategies that reduce bias by the systematic assembly, critical appraisal, and synthesis of all relevant studies on a specific research topic.” Meta-analysis is a statistical method that quantitatively evaluates the effectiveness of a clinical intervention. It involves synthesizing the summary estimates of two or more individual studies that have conducted randomized controlled trials (RCTs) on the same problem through a systematic review [16]. A systematic review answers a specific clinical question by selecting relevant studies through a meticulous literature search and analyzing them using appropriate methodologies. On the other hand, meta-analysis is a statistical approach to synthesizing individual study data from the studies included in the systematic review.

1.1.1. PRISMA (Preferred Reporting Items for a Systematic Review and Meta-Analysis)

When writing a systemic review report, utilizing the reporting guidelines checklist provided by the PRISMA group is recommended. The PRISMA guidelines were initially released in 2009 and have since been updated in 2020 to incorporate the latest systematic review methodology and language advancements. This updated version includes 27 items to ensure a comprehensive and accurate report [17]. Additionally, PRISMA has introduced extension reporting guidelines, such as PRISMA-A for Acupuncture checklist in 2019[18], PRISMA-M for Moxibustion checklist [19], and PRISMA-CHM for Herbal Medicines in 2020[20], which take into consideration the specificities of AOM clinical research.

1.1.2 Quality Evaluation

Systematic reviews are crucial to evidence-based medicine, and assessing their quality is essential. One such tool developed for this purpose is the AMSTAR scale, which includes 11 items and has been widely used in medical research since its creation in 2007. However, the initial version of AMSTAR had some limitations, such as an absence of an overall score and uneven weighting of items. To address these issues, an upgraded version of AMSTAR was introduced in 2017, known as AMSTAR-2. The new tool simplifies response categories, aligns research questions with the PICO (population, intervention, control group, outcome) framework, includes numerical rating scales for systematic reviews, requires justifications for study design selection, evaluates the risk of bias for included studies, and considers the risk of bias during statistical pooling and interpretation of results. This tool can also be applied to reviews of both randomized and non-randomized studies. These improvements make AMSTAR-2 a more comprehensive and reliable tool for assessing the quality of systematic reviews [21].

A study in the Cochrane Database of Systematic Review analyzed 50 systematic reviews related to acupuncture, retrieved up to 2019, and evaluated them with the AMSTAR-2 tool. The study found that 52% of Cochrane Systematic Reviews (CSRs) were of low quality due to critical methodological weaknesses [22]. It is crucial to incorporate the AMSTAR-2 tool during the initial planning stage to enhance the quality of future systematic reviews on acupuncture.

1.2. Meta-Analysis

The systematic review process involves several critical steps: selecting data sources, extracting data, assessing data quality, presenting results, and applying these findings to clinical practice and research. This process requires a comprehensive and meticulous search for primary research outputs addressing a specific topic. Extracted data must be chosen based on transparent and reproducible criteria, followed by a rigorous critical evaluation of the primary research outputs. Results should be generated using a clear, predetermined methodology. Depending on the methodology employed, extracted data can be used for qualitative and quantitative analysis of individual characteristics. This quantitative analysis, known as meta-analysis, standardizes and synthesizes data to mitigate the limitations and errors inherent in clinical trials, producing robust results that inform real-world practice.

Meta-analysis is a statistical method that combines the results of multiple studies to discover patterns, increase statistical power, and draw more robust conclusions than individual studies alone. Although we will examine the methodology in detail later, it can be summarized as follows: First, p-value combination methods integrate significance levels from different studies. Second, critical information for continuous or quantitative data includes each group's means, standard deviations, sample sizes, and p-values, which are aggregated to evaluate overall effect sizes and variability. Third, for categorical data, relevant information such as odds ratios, relative risks, rate differences, sample sizes, and p-values are collected to analyze the combined risk or prevalence across studies. This approach ensures a comprehensive analysis by integrating various data types to understand the research question better.

1.3. Concepts of Obesity

1.3.1 Obesity in Western Medicine

Obesity is a condition characterized by excessive fat accumulation in adipose tissue, which can negatively affect health. The Body Mass Index (BMI) is commonly used to screen for obesity, calculated by dividing weight in kilograms by height in square meters. A BMI of 30 or higher classifies an individual as obese per the World Health Organization (WHO). Obesity is further categorized into three classes: class 1 (BMI 30-34.9 kg/m^2), class 2 (BMI 35-39.9 kg/m^2), and class 3 (BMI $\geq$ 40 kg/m^2), also known as severe or morbid obesity [2][8].

However, it is important to note that BMI has limitations. It does not distinguish between fat and lean body mass or account for fat distribution, which may impact associated health risks [23]. The diagnosis of obesity requires a thorough evaluation that encompasses a medical history review, physical examination, and BMI measurement. To address the shortcomings of body mass index (BMI) and to obtain a more comprehensive evaluation of the health hazards linked with obesity, additional metrics such as waist-to-hip ratio (WHR), waist circumference (WC), and waist-to-height ratio (WHtR) are being employed as diagnostic indicators of obesity [24].

Obesity is associated with numerous health complications, including cardiovascular diseases, type 2 diabetes, certain cancers, and musculoskeletal disorders. It also has significant psychological and social impacts, reducing quality of life and increasing healthcare costs. The underlying causes of obesity are multifactorial, involving genetic, behavioral, environmental, and metabolic factors [2].

1.3.1.1 Metabolic Syndrome and Hormonal Factors

Metabolic syndrome is a cluster of conditions that occur together, increasing the risk of heart disease, stroke, and type 2 diabetes. These conditions include increased blood pressure, high blood sugar levels, excess body fat around the waist, and abnormal cholesterol or triglyceride levels. Obesity is a significant risk factor for developing metabolic syndrome, and the presence of metabolic syndrome exacerbates the health risks associated with obesity.

Hormonal factors also play a critical role in obesity. Insulin resistance, a hallmark of metabolic syndrome, is often associated with obesity and can lead to type 2 diabetes. Additionally, adipose tissue functions as an endocrine organ, secreting hormones and cytokines that influence energy metabolism, appetite regulation, and inflammation. Hormonal imbalances, such as those seen in polycystic ovary syndrome (PCOS) in women, can contribute to obesity and complicate its management [8].

1.3.1.2 General Guidelines and Recommendations

Several organizations have established guidelines for the diagnosis and management of obesity. The American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE) provide detailed protocols for screening, evaluating, and treating obesity. They stress the importance of using a variety of approaches, including lifestyle changes, behavioral therapy, medication, and, in some cases, bariatric surgery. The guidelines from the American Heart Association (AHA), American College of Cardiology (ACC), and The Obesity Society (TOS) for managing overweight and obese adults recommend strongly providing interventions to reduce dietary energy intake, lifestyle intervention programs, and promoting overall health behaviors for weight loss. Similarly, the American Association of Clinical Endocrinologists (AACE) Clinical Practice Guidelines for Obese Patients recommend lifestyle treatments to reduce caloric intake, healthy dietary planning, physical activity, and behavioral interventions to improve overall health and quality of life.

Therefore, understanding and diagnosing obesity requires a multifaceted approach that includes BMI, waist circumference, and a thorough clinical evaluation of associated health risks, including metabolic syndrome and hormonal imbalances. Adhering to established guidelines ensures a standardized and effective management plan for individuals with obesity.

1.3.1.3. Western Medicine for Obesity

Over the past decades, the medical treatment of obesity has primarily focused on three mechanisms: promoting energy expenditure, lowering calorie absorption, and reducing energy intake. Despite this focused approach, pharmacological management of obesity has a long history marked by significant disappointments [25]. Today, the primary tools used to treat obesity include lifestyle management, lipid reduction, and weight loss surgery, which aim to reduce or absorb food intake and increase its utilization. However, these methods are not without their drawbacks. Body weight increases, and recovery is often associated with adverse drug reactions, surgery complications, and other issues, highlighting the lack of effective and safe therapies for obesity [26].

Western drug treatment for obesity is generally recommended for people with a body mass index (BMI) of 30.0 or higher or 27.0 or higher if accompanied by obesity-related complications. The effectiveness of the medication is evaluated after three months of use. If a weight loss of more than 5% of the initial weight (or more than 3% in patients with diabetes) is observed, the treatment is continued. Otherwise, the medication is discontinued or switched to another drug.

Anti-obesity medications are categorized into four main types based on their mechanisms of action: appetite suppressants, fat absorption inhibitors, thermogenic agents, and fat metabolism modulators. The U.S. Food and Drug Administration (FDA) has approved five anti-obesity medications for long-term use. These include Orlistat, which inhibits lipase function in the gastrointestinal tract; Phentermine/Topiramate-ER, which modulates GABA receptors to suppress appetite; Phentermine, which enhances norepinephrine release; Lorcaserin, a serotonin receptor agonist; Naltrexone/Bupropion-ER, which combines opioid receptor antagonism with dopamine/norepinephrine inhibition, and Liraglutide, an injectable GLP-1 receptor agonist.

Despite the availability of these treatments, the pharmacological management of obesity has significant limitations. Weight regain and associated adverse drug reactions, such as gastrointestinal issues, cardiovascular complications, and negative moods, are common. As a result, there is an ongoing need for more effective and safer therapies for obesity.

1.3.2. Obesity in Oriental Medicine

The topic of obesity was introduced in ancient times, specifically in the "Yellow Emperor's Inner Cannon" (黃帝內經). This text employs a range of descriptive terms like fat, fat and plump, fat person, large person, and obese person to reference obesity. In terms of its origins, the text notes that individuals with broad shoulders and armpits, short necks, and thick and dark skin are predisposed to obesity. Furthermore, the text suggests that excessive consumption of fatty foods contributes to the condition [27]. Moreover, ancient texts have described the physiological traits of obese individuals as having "dense and sluggish blood flow with reduced Qi circulation." This suggests obesity can lead to impaired circulation and symptoms related to Qi deficiency, dampness stagnation, and poor circulation. Further, the text of Donguibogam（東醫寶鑑）also highlights the link between obesity and various adult diseases, such as diabetes and stroke. These insights from the past underscore the significant impact of obesity on modern-day health concerns [10].

1.3.2.1. AOM Diagnosis for Obesity

Acupuncture and Oriental Medicine (AOM), including Traditional Korean Medicine (TKM) and Traditional Chinese Medicine (TCM), offers a unique approach to obesity treatment through its diagnostic system called ‘Biàn Zhèng Shī Zhì (辨證施治),' or pattern differentiation and treatment. According to the theory of AOM, obesity can be mainly classified into two categories - excess syndrome and deficiency syndrome. The excess syndrome is caused by dampness, phlegm, blood stasis, and heat accumulation in the stomach and spleen. In contrast, the deficiency syndrome is caused by Qi deficiency, spleen deficiency, and yang deficiency. Moreover, obesity can also be caused by factors such as excessive eating, excessive nutrition, hypoactivity, inherent traits and physical constitution, and exogenous dampness [28].

Also, the diagnosis of obesity in Oriental medicine involves various criteria, with the EBM-Based Committee for Development of Clinical Guidelines for Obese Oriental Medicine proposing six primary types: Liver Qi Deficiency, Food Stagnation, Yang Deficiency, Spleen Deficiency, Phlegm, and Blood Stagnation. Each diagnosis is crucial in understanding and treating obesity according to the patient's specific constitution and symptoms. In Oriental medicine clinics, a comprehensive approach is used, including body constitution, organ diagnosis, nutrition, specific areas of obesity, and so on. This allows for a detailed understanding of the patient's constitution and condition, providing tailored treatments that are the cornerstone of Oriental medicine's approach to obesity. This approach tailors personalized treatments based on individual characteristics and conditions, aligning with personalized medicine principles. OM treatments for obesity often include herbal medicine, acupuncture, dietary therapy, and exercise, all customized according to the patient's lifestyle, constitution, and underlying causes of obesity [29].

1.3.2.2. AOM Treatment for Obesity

Acupuncture and Oriental Medicine (AOM) are widely used in clinical settings to treat obesity, and the medical community is growing interested in their effectiveness and safety. The treatment of AOM focuses on addressing various symptoms caused by obesity to promote overall health while managing body weight. This holistic approach involves regulating the functions of the internal organs and examining their interrelationships. Comprehensive treatment methods include dietary therapy, exercise therapy, behavioral modification therapy, traditional(manual) acupuncture, electroacupuncture, ear acupuncture, Cat-gut embedding acupuncture, pharmacopuncture, moxibustion, cupping, herbal medicine, tuina, and qigong. Recently, new modalities such as high-frequency therapy and transcutaneous electrical nerve stimulation have been explored. However, research on the mechanisms and efficacy of these new treatments is still in its early stages.

Various acupuncture treatments for obesity have been studied and implemented in clinical settings, with clinical trials using traditional manual acupuncture showing generally positive results. Ear acupuncture, due to its convenience, is frequently used as an adjunct treatment for obesity. By stimulating brain nerves and connecting body correspondence points such as shenmen, endocrine points, stomach points, spleen points, and qi points, ear acupuncture reduces the desire for food, regulates endocrine function, enhances digestive function, and promotes overall energy flow, thereby contributing to its therapeutic effects. Electroacupuncture is one of the most commonly utilized acupuncture treatments for localized obesity, particularly in the abdominal area. It is often combined with other acupuncture techniques but has also shown significant results when used alone. Cat-gut embedding acupuncture and pharmacopuncture therapy have been actively researched in Korea and China. Recent animal studies and randomized controlled trials suggest substantial effects, indicating high future research value, although their use is limited in the United States.

Herbal medicine is one of the most frequently used treatments for obesity in Oriental medicine. This treatment primarily involves decoctions but also includes pills and powders prescribed in various combinations. Recent laboratory and clinical studies have been increasing, reporting intriguing results. However, herbal medicine treatment varies significantly depending on the patient's diagnosis, and specific adjustments to the herbal formula may be made based on the patient's unique characteristics. This variability makes it challenging to standardize prescriptions and efficiently process treatment outcomes.

In addition, many studies on AOM treatments still have limitations at the case report level, especially in herbal medicine. They lack the robustness of randomized controlled trials, which limits the evidence base for these treatments. Despite this, the strengths of AOM lie in its holistic and individualized approach, aiming not only to reduce weight but also to improve overall health and balance within the body.

Nevertheless, the benefits of AOM methods include minimal side effects, the ability to address multiple symptoms simultaneously, and a comprehensive approach to improving physical and mental health. This integrative and patient-centered method aligns well with modern personalized and holistic healthcare concepts, offering a promising complementary approach to conventional obesity treatments.

II. MATERIALS AND METHODS

2.1. Materials

2.1.1 PICO-SD

The PICO-SD (Patient, Intervention, Comparison, Outcome design) was applied to Acupuncture and Oriental Medicine (AOM) articles that studied the effectiveness of AOM in obese patients. The PICO was "Are AOM interventions effective and safe in treating obesity?". The meta-analysis population (P) was all ages diagnosed with overweight and obesity, the intervention (I) was acupuncture or herbal medicine alone or in combination with allopathic treatment, the comparison intervention (C) was allopathic treatment, the outcome (O) was literature with comparable clinical outcomes or measurable objective indicators, and the study type (SD) was clinical studies excluding animal experiments.

Table 1. PICPOT-SD Key Questions

PICPOT-SD Element(initial)	**Meaning**	**Examples of Study Elements to Review**
P	Patient/ Participant/ Population/ Problem	Inclusions, exclusions, and a table of baseline characteristics noting such things as the proportion of screened individuals enrolled, demographics, attrition before randomization (+ reasons), the severity of the condition, comorbidities, etc.
I	Intervention/ Index test/ Prognostic factor/ Exposure	Dosing, frequency, methods, monitoring, noting deviations from current practice, duration. Note the likelihood of exposure.
C	Comparator/ Comparison/ Control	See Intervention, plus dose equivalency.

P	Performance outcomes of study	Training of staff and quality control. The presence or avoidance of key biases in those studies still passing a validity screening, such as likely balance in study groups, the success of blinding, including blinded assessment, balance in co-interventions, adherence, protocol deviations, missing information, etc.
O	Outcomes	Chosen endpoints (definitions, surrogates, composites), individual items from composite outcomes, placebo event rates, etc.
T	Time issues	Concurrence in studied groups, treatment duration, follow-up duration, seasonal issues, changes over time, such as infectious disease issues, registry issues, etc.
S	Setting	Multicenter, single-center, primary, secondary versus tertiary care centers, university settings, etc., noting differences for interest settings.
D	Design of study	Experiment or observation, randomization, run-in periods to assess the likelihood of nonadherence, application of intervention, care experiences, measurement methods, analysis methods including blinded assessment, alpha spending, populations for analysis, imputation, censoring rules, etc.

2.1.2 Data source

This study aimed to systematically appraise the evidence for using Acupuncture & Oriental Medicine in Obesity. For the meta-analysis, RCT studies were searched in databases on AOM treatments. The following electronic databases were searched to identify relevant studies uploaded from January 2012 to April 2024. The survey was conducted with limited language options, specifically English, Korean, and Chinese.

- English databases: The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (via PubMed), EMBASE
- Korean databases: Oriental Medicine Advanced Searching Integrated System (OASIS),

Korean Studies Information Service System (KISS), Research Information Sharing Service (RISS), Korean Traditional Knowledge Portal (KTKP)

- Chinese database: Wanfang Data (万方数据)
- Other resources: Google Scholar and electronic references in relevant publications.

2.1.3. Searching keywords

The language restrictions for searching studies are English, Chinese, and Korean, and the search terms are "中药," "针," and "针灸" in addition to "肥胖" in Chinese, and a combination of "한약," "침," "침술," and "비만," in Korean. For searching the English studies, a combination of relevant keywords can be used, such as "Obesity," “Overweight,” "acupuncture," "Korean Medicine," "Traditional Chinese Medicine (TCM)," "herbal medicine," “Randomized control trial” and so on. Include studies that use at least one of the following outcome variables: (1) effectiveness rate, (2) objective obesity-related measures such as weight, BMI, metabolic markers, etc., before and after treatment, or (3) adverse events.

2.1.4. Selection of Materials

In this study, we searched for randomized controlled trials (RCTs), specifically focusing on human studies. We did not restrict publication types, including journal articles, dissertations, and conference proceedings. Studies were included if they specifically mentioned 'obesity' as a criterion for participant recruitment. For this study, acupuncture and Oriental medicine (AOM) encompassed herbal medicine and acupuncture.

Inclusion criteria

The following criteria decided the studies for meta-analysis:

(1) RCTs compare acupuncture and/or related therapies with a valid comparison that evaluates the intervention's effect.

(2) Patients who are diagnosed with any obesity.

(3) All types of acupuncture or related techniques are considered for the intervention group, including manual acupuncture, long-term acupoint stimulation (LAS, catgut embedding acupuncture), electroacupuncture, auricular acupuncture, and pharmacopuncture.

(4) Any form of herbal prescriptions, articles on the effects of compounds, and single herbal prescriptions for obesity were included.

Exclusion criteria

Specific exclusion criteria were applied to conduct a meta-analysis. Even if all the inclusion criteria above were met, studies were excluded if they did not report clear data necessary for meta-analysis. Studies that did not provide weight-related outcomes were excluded expressly. The studies also needed to report clearly on baseline and resulting measurement index scores, including averages and standard deviations. The number of patients in both the intervention and control groups also had to be specified. Only studies meeting these rigorous data reporting standards were included in the meta-analysis. The exclusion of duplicate articles is prioritized to ensure the inclusion of only pertinent research articles. A meticulous review of the title and abstract of each article will be conducted to eliminate any articles that fail to meet the PICO-SD criteria established earlier. Furthermore, articles reporting animal experiments and studies for which the full text is unavailable will be excluded, as well as studies not written in Korean, English, or Chinese.

2.1.5. Data Extraction

We systematically extracted data from the eligible studies into a spreadsheet for comprehensive synthesis. This included information on the author, year of publication, country of origin, participant demographics (age, sample size of experimental and control groups), intervention duration, regimen details, outcome measures, and adverse events for thorough analysis.

2.2. Methods

2.2.1 Meta-Analysis

In meta-analysis, calculating the standardized mean difference (SMD) is essential for comparing and integrating results from multiple independent studies. This standardization allows for consistent study comparisons using different methodologies, measurement units, sample sizes, and populations. By converting diverse outcome measures into a common scale, the SMD facilitates combining results into a single, comprehensive effect size. This process also enables the assessment of heterogeneity among studies, enhancing the reliability of the meta-analytic conclusions. Therefore, extracting and standardizing data such as sample sizes, mean differences, and standard deviations from each study is crucial for accurate and meaningful synthesis in meta-analysis.

2.2.2. Fixed effects model vs Random effects model

Meta-analysis also represents a quantitative and formal approach to manipulating data to evaluate a body of research to obtain a more consolidated outcome. In this process, each included study is expected to provide a point estimate of effect size and a measure of precision, often expressed in standard deviation. Meta-analysis outcomes are generally more precise than individual studies as they synthesize data from several related studies. Nonetheless, researchers must grapple with the critical issues of variability in clinical settings and heterogeneity in intervention methods across the included studies. The fixed effect model assumes one true effect size underlying all included studies, presuming qualitative homogeneity. Conversely, the random effects model accommodates variations in true effect sizes due to clinical heterogeneity. The choice between these models hinges on the presence of heterogeneity, necessitating consideration of both quantitative and qualitative aspects.

2.2.3. Forest plot

In our meta-analysis, we utilized a forest plot to visually summarize and compare the results of the clinical studies under examination. The forest plot serves as a graphical representation of the effect sizes of individual studies and the overall combined effect. Each square within the plot denotes the effect size of a single study, with its size being proportional to the study's weight in the analysis. Including horizontal lines intersecting the squares illustrates the confidence intervals, while a diamond positioned at the base of the plot signifies the overall effect estimate. This visual aid facilitates the assessment of variation among the study results, evaluation of result consistency, and determination of the overall intervention efficacy. Additionally, the forest plot aids in the identification of potential publication bias or heterogeneity among the studies encompassed.

2.2.4. Publication bias and funnel plot

Publication bias is a significant concern in meta-analysis, as it can distort the overall effect estimate. Meta-analysis results are based on the published data (and occasionally unpublished data) of the studies of interest, making the accuracy and quality of the included studies crucial. There is extensive evidence that studies with statistically significant results or those that support the desired hypothesis are more likely to be published. Conversely, studies with nonsignificant or contrary findings often remain unpublished in researchers' files, a phenomenon known as the "file drawer problem." One method to detect publication bias is through a funnel plot, which is a scatter plot of the observed effect sizes on the x-axis and the standard error on the y-axis. A symmetrical inverted funnel shape suggests a lower likelihood of publication bias, whereas an asymmetrical plot indicates a higher probability of such bias.

2.2.5. Assessment of risk of bias

We applied the Cochrane 'Risk-of-bias' tool for randomized controlled trials (RoB 2) to select individual articles to assess bias across seven categories. These categories are random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other biases. The risk of bias for each domain was assessed using the Cochrane Collaboration tool, which categorizes it as "low risk," "high risk," or "moderate risk." This comprehensive assessment evaluates potential biases in the study design, conduct, and reporting of randomized trials.

2.2.6. Data Analysis

All continuous data (i.e., body weight and BMI) were presented as mean difference (MD) with a 95% confidence interval (CI). The frequency of adverse events was presented as a risk ratio (RR) with a 95% CI. These parameters were entered and analyzed using RStudio and Jamovi 2.5.5 for data analysis. For studies with low heterogeneity ($I^2 \leq 50\%$), a fixed effects model was used, while for studies with high heterogeneity ($I^2 > 50\%$), a random effects model was adopted. If possible, sensitivity analyses of subgroups were performed to identify sources of heterogeneity. Publication bias for BMI outcomes was assessed through visual inspection of funnel plots with pseudo-95% CI limits and quantified using Egger's regression and Begg's correlation tests. Statistical significance was set at a p-value of less than 0.05.

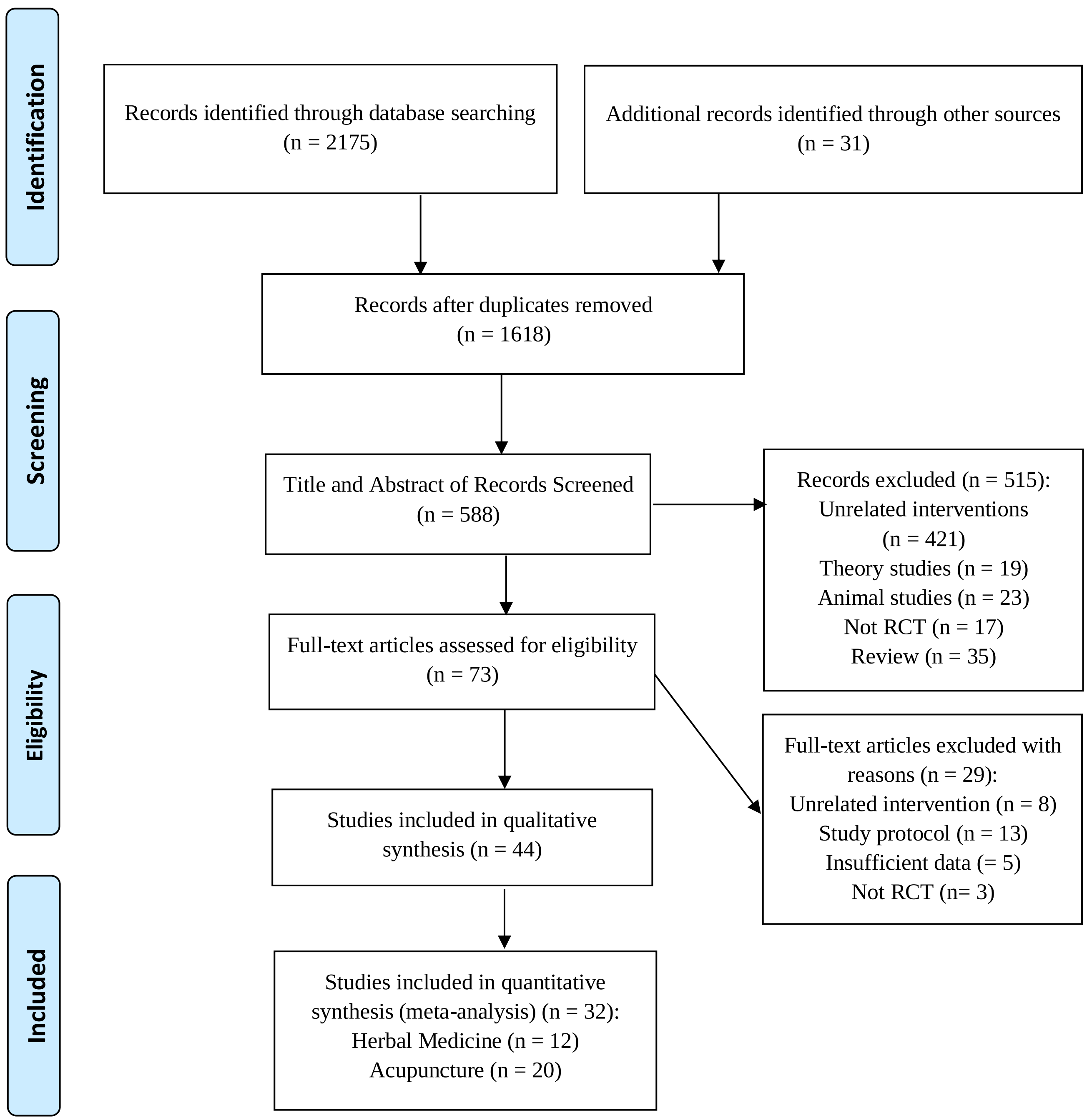

Figure 1. Flow chart of the paper selection process

III. RESULTS

3.1. Study Inclusion

The initial search identified 2,206 potential studies. We reviewed the titles and abstracts of various studies based on specific eligibility criteria to identify potential randomized controlled trials (RCTs). Subsequently, we retrieved the full text of the selected studies for further screening. Of the 73 articles with the full text available, 44 studies were chosen for qualitative analysis. As a result, 32 studies met the criteria for inclusion and were subjected to this systematic review and meta-analysis (Fig. 1), which included 32 intervention arms with 4,763 patients. Of these, 12 studies included 12 intervention arms that evaluated oriental herbal medicines versus the control group, and 20 studies included 20 intervention arms that evaluated acupuncture versus the control group for treating obesity. Herbal medicine treatment included Lingguizhugan-tang, Taeeumjowi-tang, Bofutsusho-san, Qingxue Dan, Jiangtangtiaozhi-san, etc., as polyherbs, and Gan Cao, Hu Lu Ba, Bai Dou Kou, etc., as single herbs. Acupuncture treatment included manual acupuncture, electro-acupuncture, auricular acupuncture, auricular acupressure, and catgut embedding acupuncture (LAS).

3.2. Outcomes

3.2.1 Herbal Medicine

Each study is represented in a square and a horizontal line graph. The square's position shows the Effect Size for that study, and the horizontal line displays the 95% Confidence Interval. The size of the square indicates the weight of each study, which is determined by the study's sample size. At the bottom of the graph is a diamond shape representing the combined effect size of all studies. The width of the diamond represents the 95% confidence interval of the pooled effect size. If the diamond does not cross the vertical line (Line of No Effect), it indicates that the effect is significant.

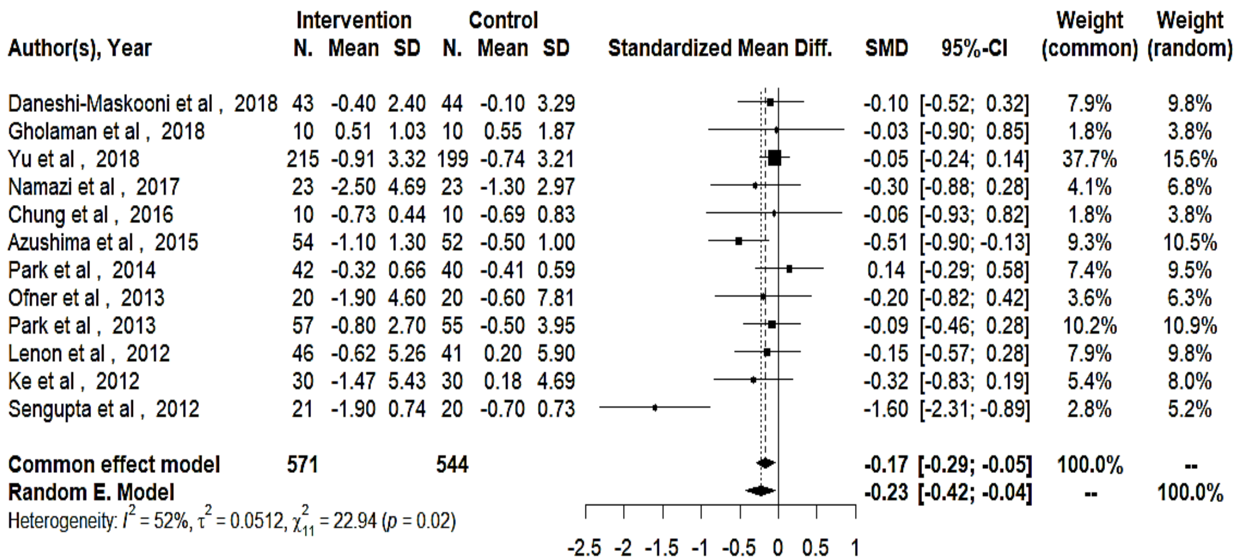

Figure 2. Forest plot of Herbal Medicine Subgroup vs Control Groups

Table 4 indicates that 13 studies were initially identified for qualitative research, and one study (Cho 2017) was excluded due to insufficient data. Figure 2 summarizes the meta-analysis results, which grouped the twelve types of herbal obesity treatments used in 12 studies. In these 12 studies, 1,166 participants were involved and randomly assigned to either the experimental or control groups in a 1:1 ratio. The trials lasted one to six months, with 11 RCTs conducted over two to three months. The results from the random-effects model, which considers variations in actual effect sizes among the studies, indicate that the average BMI reduction in the experimental group, compared to the control group, was a weighted mean difference (WMD) of -0.23 (95% CI, -0.42 to -0.04) for the herbal treatments.

Table 2. Randon-Effects Model of Herbal Medicine Subgroup

Random-Effects Model (k = 12)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	-0.230	0.0991	-2.32	0.020	-0.424	-0.036

Note. Tau^2 Estimator: Restricted Maximum-Likelihood

The analysis utilized the standardized mean difference as the outcome measure, with a random-effects model fitted to the data. The amount of heterogeneity (i.e., tau^2) was estimated using the restricted maximum-likelihood estimator. Table 2 shows that the effect size is statistically significant: z = -2.32, p = 0.020.

Table 3. Heterogeneity Statistics of Herbal Medicine Subgroup

Heterogeneity Statistics

Tau	Tau^2	I^2	H^2	R^2	df	Q	p
0.232	0.054 (SE= 0.0478)	52.17%	2.091	.	11.000	23.165	0.017

In Table 3, heterogeneity is an indicator of the consistency of the results of each study. If the horizontal lines overlap a lot, heterogeneity is low; if they don't overlap, heterogeneity is high. The results of heterogeneity tests (e.g., I^2 statistic, Cochran's Q test) are also shown. The higher the I^2 value, the greater the variability between studies. The heterogeneity indices indicate a moderate level of variability among the studies. Specifically, the I^2 value of 52.73% suggests that over half of the variability in effect sizes is due to differences between studies rather than sampling error. The Q statistic (Q(12) = 23.16, p = 0.017) confirms the presence of significant heterogeneity. This implies that the results across the studies are inconsistent and that factors other than chance contribute to the observed differences in effect sizes.

Table 4. Herbal Medicine Subgroup: Characteristics of RCTs

Author, Year, Country	Characteristics of Participants/ Age (m ± sd)	Initial BMI (m ± sd)	Analyzed Sample Size: Intervention /Control	Control Group	Intervention: ①Type of Herb; ②Dose/(Duration); ③Ingredient	Lifestyle Intervention: ①Low-Calorie Diet; ②Exercise	Outcomes: (m ± sd) ①Body Weight (kg); ②Body Mass Index (kg/m^2); ③Body Fat (%); ④Waist Circumference (cm); ⑤Waist to Hip Ratio; ⑥Triglyceride (mg/dL); ⑦HDL-c (mg/dL); ⑧LDL-c (mg/dL)	Adverse events reported (n)
Lenon et al., 2012, Australia [30]	Adults + Simple obesity (39.3±13.2)	(35.3±4.8)	50/42	Placebo	①RCM-104 ②2g, 3x/day (12 weeks) ③Lu Cha Ye (*Camellia Sinensis* 40%), Jue Ming Zi (*Cassia Obtusifolia* 40%), Huai Hua (*Sophora Japonica* 20%)	None	①99.5±15.1→ 98.0±15.4 ②35.9±4.9 → 35.3±5.7 ③42.2±9.2 → 41.3±9.2 ④108.5±12.3 → 106.6±12.5 ⑤0.87±0.08 → 0.87±0.07	IG: Nausea (4), Headache (9)
Ke et al., 2012, China [31]	Adults + Obesity + Impaired Glucose Tolerance (45.7±7.5)	(28.7±3.4)	40/45	Lifestyle Intervention	①Modified Linggui Zhugan Decoction ②2x/day, one month, Stopped one month, Three consecutive cycles/ (6 months) ③Fu Ling (*Poria*), Gui Zhi (*Ramulus Cinnamomi*), Bai Zhu (*Radix Atractylodis Macrocephalae*), Gan Cao (*Radix Glycyrrhizae*), Dang Shen (*Radix Codonopsis*), Da Huang (*Radix et Rhizome Rhei*)	①A 5-day Very LCD: 3 phases (pre-treatment preparation phase, VLCDs phase and convalescence phase), three times	②28.7±3.4 → 25.0±1.8 ④91.21±7.07 → 83.76±3.45 ⑥3.34±2.51 → 2.18±1.32 ⑦1.13±0.27 → 1.22±0.34 ⑧3.69±1.08 → 2.35±0.52	None
Sengupta et al., 2012, India [32]	Adults + Simple obesity (41.6±1.37)	(34.41±0.74)	21/20	Placebo + Lifestyle Intervention	①LI85008F ②900mg, 3x/day (8 weeks) ③Moringa Olefera Leaves(60%), Murrya Koenigii Leaves(30%), Curcuma Longa Rhizomes(10%)	①2,000 kcal standard diet ② Walk 5x/week, 30 minutes	①86.16±2.75 → 81.40±2.69 ②34.41±0.74 → 32.51±0.75 ④106.68 ±1.67 → 94.16±2.17 ⑤0.91±0.01 → 0.87±0.02 ⑥0.32±0.02 → 0.29±0.01(mM/L) ⑦2.12±0.08 → 2.23±0.07(mM/L) ⑧9.21±0.29 → 7.67±0.28(mM/L)	None
Ofner et al., 2013, Austria [33]	Adults + Simple Obesity + Overweight (48.1±9.6)	(31.2 ± 4.7)	20/20	Lifestyle Intervention	①SRD as Exadipin® (AapoSpa) ②200mg, 64 IU 3x/day, with meal (4 weeks) ③Salacia Reticulata Root Powder (with 60 mg saponins), Vitamin D3 (64 IU)	② 2x/week lifestyle & fitness training programs, 45 minutes	①87.0±8.8 → 81.7±8.5 ②31.2±4.7 → 29.3±4.5 ③36.1±5.6 → 31.6±5.2	None
Park et al., 2013, Korea [34]	Adults + Obesity + Controlled hypertension or Type II DM or treated hyperlipidemia (39.2±9.5)	(31.8±2.6)	55/57	Placebo	①TJ001(Taeeumjowi-tang) ②7g /day (12 weeks) ③Yi Yi Ren (*Coicis Semen* 3.75g), Li Zi (*Castaneae Semen* 3.75g), Lai Fu Zi (*Raphani Semen* 2.5g), Wu Wei Zi (*Schisandrae Fructus* 1.25g), Ma Huang (*Ephedrae Herba* 1.25g), Jie Geng (*Platycodonis Radix* 1.25g), Shi Chang Pu (*Acori Tatarinowii Rhizoma* 1.25g), Mai Dong (*Liriopis Tuber* 1.25g)	①1,500 kcal a day for men and 1,200 kcal a day for women	①82.2±10.5 → 80.3±10.5 ②31.8±2.60 → 31.0±2.80 ③392.5±134.6 → 383.4±137.0(cm^2) ④99.6±7.00 → 96.3±7.90 ⑤0.90±0.05 → 0.89±0.05 ⑥134.6±66.9 → 133.3±64.5 ⑦46.1±10.6 → 45.9±9.70	None

Park et al., 2014, Korea [35]	Adults + Simple obesity (41.56±8.62)	(29.72±6.17)	42/40	Placebo	①Bofutsushosan ②2.84g / day (8 weeks) ③*Zingiberis Rhizoma Recens* 16.7mg, *Glycyrrhizae Radix* 83.3mg, *Scutellariae Radix 83.3mg*, *Gardeniae Fructus* 50mg, *Gypsum Fibrosum* 83.3mg, *Saposhnikoviae Radix* 50mg, *Rhei Rhizoma* 62.5mg, *Natrii Sulfas* 31.3mg, *Platycodi Radix* 83.3mg, *Atractylodis marcrocephalae Rhizoma* 83.3mg, *Schizonepetae Herba* 50mg, *Chuanxiong Rhizoma* 50mg, *Angelicae Gigantis Radix* 50mg, *Menthae Herba* 50mg, *Ephedrae Herba* 50mg, *Forsythiae Fructus* 50mg, *Talcum* 125mg, *Paeoniae Radix Alba* 50mg	①20–25 kcal/kg	① − 0.86±1.73 ② − 0.32±0.66 ③ − 0.67±1.6 ④ − 1.79±2.93 ⑥ − 7.43±59.61 ⑦ − 2.81±8.24	IG: dyspepsia and epigastric pain (7), headache (2), diarrhea (3), nausea and vomiting (2), palpitations (1) CG: dyspepsia and epigastric pain (3) headache (1).
Azushima et al., 2015, Japan [36]	Adults + Obesity + Hypertension (59.2±14.5)	(31.3± 5.0)	42/46	Anti-hypertensive agents	①Bofu-tsusho-san ②2.5g ~7.5g/ day (24 weeks) ③*Scutellariae Radix* 7.6%, *Glycyrrhizae Radix* 7.6%, *Platycodi Radix* 7.6%, *Gypsum Fibrosum* 7.6%, *Atractylodis Rhizoma* 7.6%, *Rhei Rhizoma* 5.7%, *Schizonepetae Spica* 4.6%, *Gardeniae Fructus* 4.6%, *Paeoniae Radix* 4.6%, *Cnidii Rhizoma* 4.6%, *Angelicae Radix* 4.6%, *Menthae Herba* 4.6%, *Ledebouriellae Radix* 4.6%, *Ephedrae Herba* 4.6%, *Forsythiae Fructus* 4.6%, *Zingiberis Rhizoma* 1.1%, *Kadinum* 11.4%, *Natrium Sulfuricum* 2.7%	①25-30 kcal/kg standard diet	①82.5±16.4→80.5±15.6 ②31.3±5.0→30.3±4.9 ④105±12→103±12 ⑥185±133→159±79 ⑦57±17→58±15 ⑧119±31→121±31	IG: Gastric irritation, constipation, and elevation of serum hepatic enzyme level (3)
Chung et al., 2016, Korea [37]	Adults + Obesity + 2 more Metabolic Risk Factors (50.00 ± 5.85)	(29.50±3.63)	10/10	Placebo	①QXD(Qing Xue Dan) ②900 mg/ day (12 weeks) ③*Scutellariae Radix* 0.28g, *Coptidis Rhizoma* 0.28g, *Phellodendri Cortex* 0.28g, *Gardeniae Fructus* 0.28g, *Rhei Rhizoma* 0.07g	None	②29.5±3.6 → 28.8±3.4 ④96.26±10.14 → 93.20±9.00 ⑤0.94±0.05 → 0.92±0.05 ⑥206±64 → 185±68 ⑦40±4 → 43±9 ⑧131±41→136±43	IG: Burning sensation, indigestion and fatigue (NR)
*Cho et al., 2017, Korea [38]	Adults + Simple obesity + Overweight (39.5 ± 11.2)	(27.1±1.5)	20/19	Placebo	①YY-312, ②800 mg, 3x/day (12 weeks) ③*Imperata cylindrica Beauvois, Citrus unshiu Markovich, Evodia officinalis Dod*	① 500 kcal reduced /day	①75.0±11.0 → 70.6±11.4 ②27.1±1.5 → 25.8±1.9 ③32.2±5.5 → 30.0±5.9 ④88.3±6.5 → 85.6±6.7 ⑥111.0±58.6 → 107.4 ± 47.2 ⑦53.1±10.1 → 49.6±8.3 ⑧128.4±31.5 → 128.0±33.5	IG: upper respiratory tract infections (3), neurologic symptoms such as headache and dizziness (2), skin rash(1), musculoskeletal pain(1), fatigue(1) CG: upper respiratory tract infections (4), neurologic symptoms such as headache and dizziness (2), skin

								rash(1), musculoskeletal pain(1)
Namazi et al., 2017, Iran [39]	Adults + Simple obesity (37.4±14.7)	(34.3±5.2)	23/23	Placebo	①Dried Glycyrrhiza Glabra Licorice Extract ②1.5g, 1x/day (8 weeks) ③Gan Cao (*Glycyrrhiza Glabra Licorice*)	①calorie restricted diet	①89.8±18.4 → 82.7±12.5 ②34.3±5.2 → 33.4±3.3 ④109.2±14.0 → 110.3±11.0 ⑤0.93±0.08 → 0.91±0.08	None
Daneshi-Maskooni et al., 2018, Iran [40]	Adults + Obesity + Non-Alcoholic Fatty Liver Disease (45.5 ± 8.9)	(30.5±2.4)	43/44	Placebo	①Green Cardamom ②3g /day (8 weeks) ③Bai Dou Kou (*Fructus Amomi Rotundus*)	②Moderate-intensity aerobic physical activity at least 3x/week, 30–45 minutes	①85.2±11.3 → 84.2±11.3 ②30.5±2.4 → 30.1±2.4	None
Gholaman et al., 2018, Iran [41]	Adults + Obesity, + Women + Type II DM (44.2±2.5)	(32.56±2.15)	10/10	placebo	①Fenugreek ②15g/day (8 weeks) ③Hu Lu Ba (*Trigonella foenum-graecum*)	②Running endurance training program, 3x/ week, 30-55 minutes	①82.79±2.76 → 77.03 ± 2.66 ②32.56±2.15 → 30.28±1.91 ③36.5±2.78 → 33.79±2.61 ⑥156.68±13.25 → 144.18±13.16 ⑦44.3±5.55 → 63.2±6.49 ⑧196.2±17.01 → 149.0±17.86	None
Yu et al., 2018, China [42]	Adults + Obesity + Type II DM & Hyperlipidemia (52.82 ± 9.01)	(28.24±3.31)	215/199	Metformin 0.25g, 3x/day	①JTTZ (Jiang Tang Tiao Zhi granule) ②1 Bag/ day (12 weeks) ③*Aloe vera, Coptis chinensis, Rhizoma anem arrhenae, Red yeast rice, Momordica charantia, Salvia miltiorrhiza, Schisandra chinensis, Dried ginger*	①Diet ②Exercise	①77.82±12.08 → 75.34±12.05 ②28.24±3.31→27.33±3.34 ⑥3.43±2.83 → 2.79±1.86 ⑧3.21±0.96 → 2.92±0.73	IG: Non-severe adverse events (13) CG: Non-severe adverse events (9)

Abbreviations: IG, Intervention Group; CG, Control Group; DM, Diabetes Mellitus; *Study is excluded in Meta-analysis.

3.2.2 Acupuncture

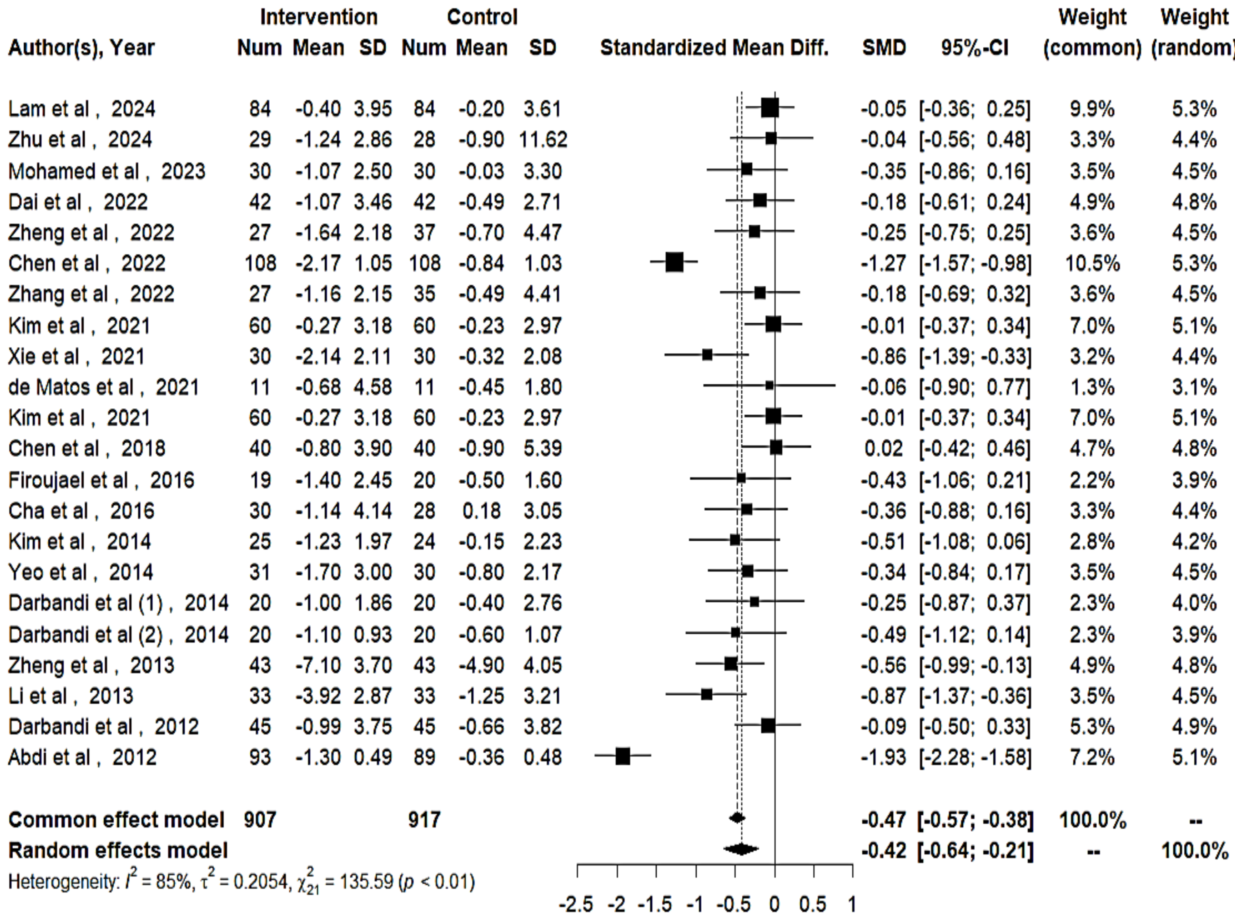

Figure 3. Total Forest plot of Acupuncture Group vs Control Groups

Figure 3 summarizes the meta-analysis of all acupuncture treatment groups with 20 studies. In these 20 studies, 1,824 participants were involved and randomly assigned to either the experimental or control groups in a 1:1 ratio. The overall mean BMI reduction in the experimental group compared to the control group, weighted mean difference (WMD) for the acupuncture treatments, was -0.42 (95% CI, -0.64 to -0.21) according to the random effect model. The acupuncture treatments were subdivided into manual acupuncture (MA), auricular acupuncture (AA), electro-acupuncture (EA), and catgut-embedding acupuncture (LAS). A meta-analysis was performed for each treatment subgroup below.

3.2.2.1 Traditional Manual Acupuncture (MA) Subgroup Meta-analysis

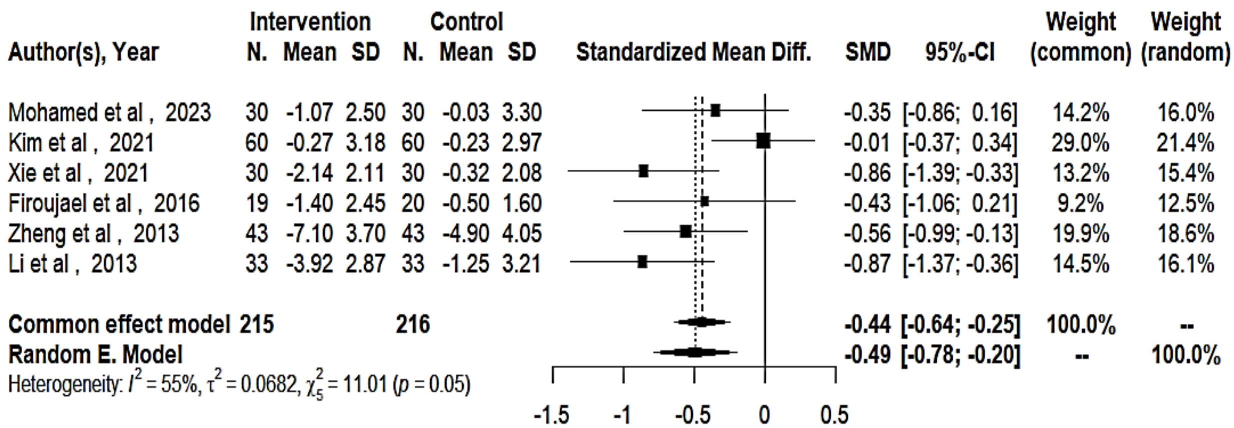

Figure 4. Forest plot of Traditional Manual Acupuncture Subgroup vs Control Groups

The meta-analysis of six studies was conducted meticulously, assessing the effectiveness and safety of traditional manual acupuncture in treating obesity. Figure 4 illustrates the average difference in BMI reduction between the separate studies and the combined analysis used to gauge effectiveness. The comparison analysis is conducted among groups using identical MA treatment methods. Applying the common-effect model to examine the effect size yields the following results: The weighted mean difference (WMD) for the traditional manual acupuncture treatments was -0.44 (95% CI, -0.64 to -0.25).

Table 5. Randon-Effects Model of Traditional Manual Acupuncture Subgroup

Random-Effects Model (k = 6)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	-0.489	0.147	-3.32	< .001	-0.778	-0.200
	.	.	.	.	.	.

Note. Tau² Estimator: Restricted Maximum-Likelihood

The analysis utilized the standardized mean difference as the outcome measure, with a random-effects model fitted to the data. The amount of heterogeneity (i.e., tau^2) was estimated using the restricted maximum-likelihood estimator. Table 5 shows that the effect size is statistically significant: z = -3.32, p = 0.01.

Table 6. Heterogeneity Statistics of Herbal Medicine Subgroup

Heterogeneity Statistics

Tau	Tau^2	I^2	H^2	R^2	df	Q	p
0.261	0.0683 (SE= 0.082)	53.45%	2.148	.	5.000	11.036	0.051

However, high heterogeneity ($I^2 = 53.45\%$, Q(6) = 11.03, $p < 0.051$) indicates substantial variability among the studies. This heterogeneity suggests that while the average treatment effect is significant, the effect varies significantly across different studies.

Table 7 indicates that seven studies were initially identified for qualitative research, but only six were included in the meta-analysis. One study (Abdi et al.) was found to be a potential outlier and overly influential during the preliminary screening. It was, therefore, excluded from the meta-analysis due to its involvement with complex treatments.

Table 7. Traditional Manual Acupuncture Subgroup: Characteristics of RCTs

Author, Year, Country	Characteristics of Participants/ Age (m ± sd)	Initial BMI (m ± sd)	Analyzed Sample Size: Intervention /Control	Control group	Intervention Group	Frequency (Duration)	Treated acupoints	Outcomes ①Body Weight (kg); ②Body Mass Index (kg/m^2); ③Body Fat (%); ④Waist Circumference (cm); ⑤Waist to Hip Ratio; ⑥Triglyceride (mg/dL); ⑦HDL-c (mg/dL); ⑧LDL-c (mg/dL);	Adverse events reported (n)
*Abdi(2) et al, 2012, Iran [43]	Adults + Simple Obesity (37.14± 0.99)	32.30±0.52	196/161	Sham acupuncture	Manual acupuncture + EA	2x/week, 20 minutes (6 weeks)	ST25, GB28, REN12, REN9, REN4, SP6, LI11, ST40, REN6, SP9	①84.10±1.67→81.23±1.68 ②32.30±0.52→31.17±0.53 ③37.00±0.69→36.03±0.7 ④102.39±1.28→95.12±1.2 ⑥112.48±6.24→92.51±4.40 ⑦42.60±0.99→38.51±0.88 ⑧108.19±3.44→91.34±3.48	None
Li et al., 2013, China [44]	Adults + Obesity + Type II DM (50.11±11.13)	(29.45±3.45)	33/33	Metformin 2x/day, 0.5g	Manual acupuncture + Metformin	1x/day, 30 minutes (8 weeks)	REN12, REN10, REN4, ST25, ST26, ST28, SP15, SP14, ST40, SP9, ST36, SP6, LI11, LI4	①81.87±14.23→74.35±11.29 ②29.45±3.45→25.53±2.15 ④94.56±8.12→86.23±7.96	NR
Zheng et al., 2013, China [45]	Adults + Obesity + PCOS women (25.67±3.9)	(29.45±3.7)	43/43	Metformin 3x/day, 250mg (1st week), 1x/day, 500mg (after)	Manual acupuncture	2x/week, 30minutes (6 months)	REN4, REN6, REN10, REN12, ST21, ST25, ST28	②29.4±3.7→22.3±3.7 ⑤0.81±0.07 → 0.69±0.08 ⑥2.8±0.6→1.9±0.9 ⑦3.4±1.2→2.5±1.7 ⑧1.2±0.2→1.6±0.4	IG: None CG: Nausea or vomiting (7) Mild diarrhea (10) Slight dizziness (4)
Firouzjaei et al., 2016, China [46]	Adults + Obesity, + Type II DM (42.2)	(27.6± 2.5)	19/20	Sham acupuncture + Metformin 1-2/day, 500mg	Manual acupuncture + Metformin + EA + AA	1x/2days, 30 minutes + metformin (3 weeks)	MA: REN12, ST36, SP6, REN9, LI4, LI11, REN6	①82.6±6→78.4±6 ②27.6±2.5→26.2±2.4 ⑥2.59±0.6→2.24±0.5(mmol l^{-1}) ⑦4.05±0.5→3.68±0.5(mmol l^{-1}) ⑧1.08±0.1→1.29±0.1(mmol l^{-1})	NR
Xie et al., 2021, China [47]	Adults + Obesity + Iron-deficiency (NR)	30.75 ±2.16	30/30	Sham acupuncture	Manual acupuncture	1x/ 2 days, 30 minutes (first 6 weeks) + 2x/week (last 2 weeks)	REN12, REN4, ST27, SP14, TE6, SI3, ST40, KI2, SP3, GB41	①86.83±7.55→79.60±7.42 ②30.75±2.16→28.61±2.06 ④99.17±5.85→93.15±4.07 ⑤0.99±0.02 → 0.94±0.04	None
Kim et al., 2021, Korea [48]	Adults + Obesity + Premenopausal Women (36.83±8.79)	28.53 ± 3.22	60/60	Sham acupuncture +LCD	Manual acupuncture + EA + LCD	2x/week, 30 minutes (6 weeks)	MA: LI4, LI11, SP6, ST36, REN6, REN12 +EA: ST25, ST28	①75.43±9.67→74.64±9.57 ②28.53±3.22→28.26±3.15 ④88.67±7.59→86.63±7.74 ⑤0.89±0.05 → 0.88±0.06 ⑥130.07±64.31→137.75±86.38 ⑦56.02±12.94→54.07±13.19 ⑧127.35±35.70→125.25±32.74	NR
Mohamed et al., 2023, Egypt [49]	Adults + Obesity + Chronic subjective Tinnitus (44.10±3.69)	33.82±2.51	30/30	Sham acupuncture	Manual acupuncture	3x/week, 20 minutes (8 weeks)	TE3, TE5, TE17, TE18, TE19, TE20, TE21, TE22, GB2, GB8, GB20, LI4, LI11, KI3, SP6, ST36, ST25, GB28, REN4, REN9, REN12	②33.82±2.51→32.75±2.49 ④112.66±17.37→109.66±17.70 ⑥176.53±87.70→139.53±58.30 ⑦50.75±11.17→52.64±9.80 ⑧114.58±37.13→80.76±13.16	None

Abbreviations: NR, Not Recorded; EA, Electro-Acupuncture; AA, Auricular Acupuncture; LCD, Low-Calorie Diet; *Study is excluded in Meta-analysis.

3.2.2.2. Auricular Acupuncture (AA) subgroup Meta-analysis

Table 10 indicates that 11 studies were initially identified for qualitative research. However, only seven studies were included in the meta-analysis due to insufficient data, the inclusion of other treatments, and the fact that the comparison group was the same as the treatment group.

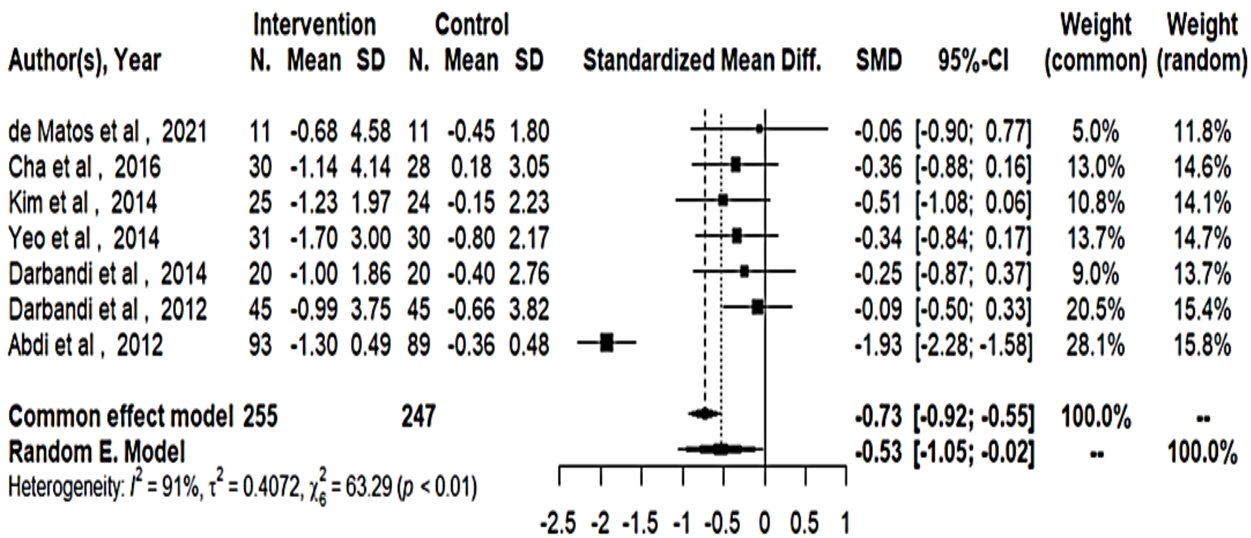

Figure 5. Forest plot of Auricular Acupuncture (AA) Subgroup vs Control Groups

Figure 5 shows that the meta-analysis using a random-effects model included seven Auricular Acupuncture treatment subgroup studies. Based on the random effects model, the estimated average standardized mean difference was -0.5329 (95% CI: -1.05 to -0.02), indicating a significant difference from zero (z = -2.0214, p = 0.0432). This demonstrates that the treatment method studied has a statistically significant effect.

Table 8. Randon-Effects Model of Auricular Acupuncture (AA) Subgroup

Random-Effects Model (k = 7)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	-0.533	0.264	-2.02	0.043	-1.050	-0.016
	.	.	.	.	.	.

Note. Tau^2 Estimator: Restricted Maximum-Likelihood

However, heterogeneity tests (Q(6) = 63.5902, $p < 0.0001$, $I^2 = 85.9930\%$) indicate high variability among the studies, suggesting considerable differences between them. The study by Abdi(1) et al., 2012 was identified as a potential outlier with excessive influence.

Table 9. Heterogeneity Statistics of Auricular Acupuncture (AA) Subgroup

Heterogeneity Statistics

Tau	Tau^2	I^2	H^2	R^2	df	Q	p
0.638	0.4075 (SE= 0.2803)	85.99%	7.139	.	6.000	63.590	< .001

Table 10. Auricular Acupuncture Subgroup: Characteristics of RCTs

Author, Year, Country	**Characteristics of Participants/ Age (m ± sd)**	**Initial BMI (m ± sd)**	**Analyzed Sample Size: Intervention /Control**	**Control group**	**Intervention Group**	**Frequency (Duration)**	**Treated acupoints**	**Outcomes** ①**Body Weight (kg);** ②**Body Mass Index (kg/m^2);** ③**Body Fat (%);** ④**Waist Circumference (cm);** ⑤**Waist to Hip Ratio;** ⑥**Triglyceride (mg/dL);** ⑦**HDL-c (mg/dL);** ⑧**LDL-c (mg/dL);**	**Adverse events reported (n)**
Abdi(1) et al., 2012, Iran [50]	Adults + Simple Obesity (37.29±1.00)	(32.15±0.47)	93/89	Sham acupuncture +LCD	Auricular acupuncture +LCD	2x/ week (6 weeks)	Shen Men (TF4), Stomach (CO4), Hunger point, Mouth (CO1), Center of Ear (HX1), Sanjiao (CO17)	①84.33±1.64 → 81.24±2.02 ②32.15±0.47 → 30.90±0.61 ④102.75±1.33 → 99.55±1.64 ⑤0.89±0.007 → 0.89±0.009 ⑥109.16±4.51 → 105.52±6.52 ⑦37.61±0.87 → 58.11±5.81 ⑧92.31±2.73 → 89.53±6.79	None
Darbandi et al., 2012, Iran [51]	Adults + Simple Obesity + Overweight (37.57±9.26)	(32.11±3.78)	45/45	Sham acupressure + LCD	Auricular acupressure + LCD	2x/week (6 weeks) + LCD	Shenmen (TF4), stomach (CO4), hungry point, mouth (CO1), center of ear (HX1), Sanjiao (CO17)	①81.89±11.58 → 79.09±11.84 ②32.11±3.78 → 31.12±3.73 ③31.21±7.90 → 29.90±7.74(kg)	None
Darbandi et al., 2014, Iran [52]	Adults + Simple Obesity + Men (39.0±1.8)	(33.4±2.6)	20/20	Sham acupuncture + LCD	Auricular acupuncture +LCD	2x/week (6 weeks) + LCD + Acupressure before eating.	Shenmen (TF4), stomach (CO4), hungry point, mouth (CO1), center of ear (HX1), Sanjiao (CO17)	②33.4±2.6→32.4±0.4 ④108.3±3.8→103.9±1.0	None
Yeo et al., 2014, Korea [53]	Adults + Simple Obesity (34.7±11.9)	(28.5±4.5)	31/30	Sham acupuncture	Auricular acupuncture	1x/week (8 weeks)	Shenmen, Stomach, Spleen, Hunger, Endocrine	①74.5±15.0 → (+1.7±0.6) ②28.5±4.5 → (− 6.1±2.0%) ③37.0±6.3 → (− 1.9±1.8) ④91.5±10.7 → (− 4.1±1.9) ⑥146.9±97.0 → NR ⑦55.6±12.8 → NR ⑧112.7±29.7 → NR	NR
*Yeh et al, 2014, China [54]	Adults + Simple Obesity + Overweight (32.8 ± 9.5)	NR	36/34	Sham acupressure + Nutrition Consultation	Auricular acupressure + Nutrition consultation	1x/ week (10 weeks)	Shenmen (TF4), Stomach (CO4), Endocrine (CO18), Hunger point	⑥155.72±102.95 → 118.34±52.10	NR
Kim et al., 2014, Korea [55]	Adults + Simple Obesity + Overweight + Women (20.6±0.82)	(25.34±1.96)	25/24	Sham acupressure	Auricular acupressure	3x/ day Acupressure (4 weeks)	Shenmen, Mouth, Stomach, Endocrine, Small Intestine	①65.6±5.01 → 62.5±5.00 ②25.34±1.96 → 24.11±1.99 ③30.43±3.08 → 29.29±3.18 ⑤0.79±0.02 → 0.78±0.03	None

Cha et al., 2016, Korea [56]	Adults + Simple Obesity + Overweight + Women (49.57±7.13)	(27.62±4.58)	30/28	Sham acupressure	Auricular acupressure	1x/week Acupressure (8 weeks)	Hunger, Endocrine, Spleen, Shenmen, Stomach	①66.89±8.08 → 65.81±7.94 ②27.62±4.58 → 26.48±4.58 ③24.35±6.55 → 24.00±6.33(kg) ④92.60±6.56→ 88.93±6.39 ⑥144.20±85.39 → 123.63±65.25 ⑦51.23±13.65 → 51.90±14.57 ⑧124.17±55.73 → 132.65±47.24	Itchiness (2), Scaling (1)
*Firouzjaei et al., 2016, China [46]	Adults, Obesity + Type II DM (42.2)	(27.6±2.5)	19/20	Sham acupuncture + Metformin 1-2/day, 500mg	Auricular acupuncture + Metformin + MA + EA	1x/ 2days (3 weeks), + Metformin 1-2/day, 500mg	AA: Sanjiao, Jidian (Hunger), Wei (Stomach), Shenmen, Neifenmi(Endocrine), Pi(Spleen)	①82.6±6→78.4±6 ②27.6±2.5→26.2±2.4 ⑥2.59±0.6→2.24±0.5(mmol l^{-1}) ⑦4.05±0.5→3.68±0.5(mmol l^{-1}) ⑧1.08±0.1→1.29±0.1(mmol l^{-1})	NR
*Lillingston et al., 2019 Grenada [57]	Adults + Simple Obesity + Overweight + Women (NR)	NR	30/28	Sham acupuncture	Auricular acupuncture	1x/ week, 20 minutes (6 weeks)	Fizzy-o-Therapy Protocol: Shenmen, Point1, Point2, Appetite Control Point	① − 1.18(lbs) ② − 0.31 ④ − 4.64(in)	NR
de Matos et al., 2021, Portugal [58]	Adults + Simple Obesity + Overweight + Women (30.9±6.8)	(28.3±4.6)	11/11	LCD	Auricular acupuncture +LCD	(6 weeks)	Psychosomatic, Aggression, Point Zero, Barbiturat, Porta Fortunae.	②28.3±4.6 → 27.62±4.57 ③35.9±7.5 → 34.63±7.54 ④84.2±12.8 → 80.87±11.00	None
*de Matos et al., 2021, Portugal [58]	Adults + Simple Obesity + Overweight + Women (32.4±10.9)	(27.6±2.4)	9/11	LCD	Auricular acupuncture +LCD	(6 weeks)	Shenmen (TF4), Stomach (CO4), Hunger, Mouth (CO1), Point Zero (HX1), Sanjiao (CO17)	②27.6±2.4 → 27.18±2.62 ③36.6±4.0 → 35.52±4.47 ④82.9±8.3 → 79.68±7.35	None

Abbreviations: NR, Not Recorded; EA, Electro-Acupuncture; MA, Traditional Manual Acupuncture; AA, Auricular Acupuncture; LCD, Low-Calorie Diet; *Study is excluded in Meta-analysis.

3.2.2.3. Electro-Acupuncture (EA) Subgroup Meta-analysis

Table 12 indicates that eight studies were initially identified for qualitative research. However, due to insufficient data and the inclusion of other treatments, only three studies were included in the meta-analysis.

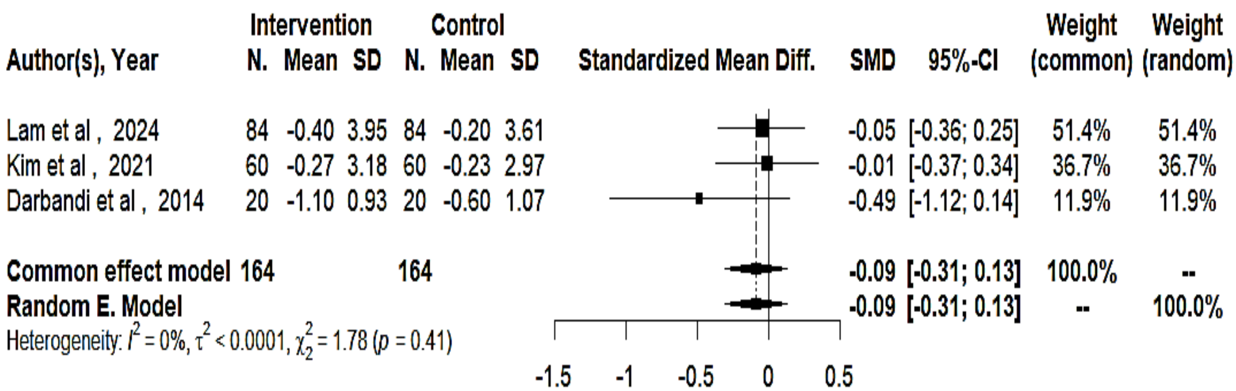

Figure 6. Forest plot of Electro-Acupuncture (EA) Subgroup vs Control Group

Figure 6 shows that the meta-analysis included three studies, with observed standardized mean differences ranging from -0.49 to -0.05, all being negative. In Table 10, the estimated average standardized mean difference using the random-effects model was -0.09 (95% CI: -0.31 to 0.13), indicating no significant difference from zero (z = -0.812, p = 0.417).

Table 11. Randon-Effects Model of Electro-Acupuncture (EA) Subgroup

Random-Effects Model (k = 3)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	-0.0899	0.111	-0.812	0.417	-0.307	0.127
	.	.	.	.	.	.

Note. Tau^2 Estimator: Restricted Maximum-Likelihood

Table 11 also shows that the Q-test showed no significant heterogeneity (Q(3) = 1.782, p = 0.410, tau^2 = 0.0000, I^2 = 0.0084%). The 95% prediction interval ranged from -0.307 to 0.127, suggesting possible positive outcomes in some studies. Based on studentized residuals and Cook's distances, no studies were identified as outliers or overly influential. Neither rank correlation nor regression tests indicated any funnel plot asymmetry (p = 1.000 and p = 0.41, respectively).

Table 12. Heterogeneity Statistics of Electro-Acupuncture (EA) Subgroup

Heterogeneity Statistics

Tau	Tau^2	I^2	H^2	R^2	df	Q	p
0.002	0 (SE= 0.0378)	0.01%	1.000	.	2.000	1.782	0.410

Table 13. Electro-Acupuncture Subgroup: Characteristics of RCTs

Author, year, Country	Characteristics of Participants/ Age (m ± sd)	Initial BMI (m ± sd)	Analyzed Sample Size: Intervention /Control	Control group	Intervention Group	Frequency (Duration)	Treated acupoints	Outcomes ①Body Weight (kg); ②Body Mass Index (kg/m²); ③Body Fat (%); ④Waist Circumference (cm); ⑤Waist to Hip Ratio; ⑥Triglyceride (mg/dL); ⑦HDL-c (mg/dL); ⑧LDL-c (mg/dL);	Adverse events reported (n)
*Abdi(2) et al, 2012, Iran 196 [50]	Adults + Simple Obesity (37.14± 0.99)	32.30±0.52	196/161	Sham acupuncture	Electro-acupuncture +MA	2x/week (6 weeks), 30-40Hz, 20 minutes	ST25, GB28, REN12, REN9, REN4, SP6, LI11, ST40, REN6, SP9	①84.10±1.67→81.23±1.68 ②32.30±0.52→31.17±0.53 ③37.00±0.69→36.03±0.7 ④102.39±1.28→95.12±1.2 ⑥112.48±6.24→92.51±4.40 ⑦42.60±0.99→38.51±0.88 ⑧108.19±3.44→91.34±3.48	None
*Darbandi et al, 2013, Iran [51]	Adults + Simple Obesity (36.50±9.26)	32.07±4.82	42/44	Sham acupuncture +LCD	Electro-acupuncture +LCD	2x/week (6 weeks) 30-40 Hz, dense-disperse-wave, 390 Ms, 20 minutes	ST25, GB28, REN12, REN9, REN4, SP6, LI11, ST40, REN6, SP9	①82.98±15.00 → 80.37±15.47 ②32.08±4.83 → 31.05±5.18	None
Darbandi et al, 2014, Iran [52]	Obese Adult Men (38.0±0.9)	33.4±1.3	20/20	Sham acupuncture + LCD	Electro-acupuncture + LCD	2x/week (6 weeks) 30-40Hz, dense-disperse wave, 20 minutes	ST25, GB28, REN12, REN9, REN4, SP6, LI11, ST40, REN6, SP9	②33.4±1.3→32.3±0.2 ④108.2±2.7→102.7±1.1	None
*Firouzjaei et al, 2016, China [46]	Adults, + Obesity + Type II DM (42.2)	27.6± 2.5	19/20	Sham acupuncture + Metformin 1-2/day, 500mg	Electro-acupuncture + Metformin + MA, AA	1x/2days (3 weeks), 15 Hz/10 mA, 30 minutes	EA: ST25, SP15, ST28	①82.6±6→78.4±6 ②27.6±2.5→26.2±2.4 ⑥2.59±0.6→2.24±0.5(mmol l⁻¹) ⑦4.05±0.5→3.68±0.5(mmol l⁻¹) ⑧1.08±0.1→1.29±0.1(mmol l⁻¹)	NR
*Kim et al., 2021, Korea [48]	Adults, Obesity + Premenopausal Women (36.83±8.79)	28.53 ± 3.22	60/60	Sham acupuncture	Electro-acupuncture +MA	2x/week (6 weeks), 25Hz/2mA (25 minutes) 60Hz/2mA (5 minutes)	EA: ST25, ST28	①75.43±9.67→74.64±9.57 ②28.53±3.22→28.26±3.15 ④88.67±7.59→86.63±7.74 ⑤0.89±0.05 → 0.88±0.06 ⑥130.07±64.31→137.75±86.38 ⑦56.02±12.94→54.07±13.19 ⑧127.35±35.70→125.25±32.74	NR
*Notonegoro et al, 2022, Indonesia [59]	Obese Adult (18-60yrs)	30.18±2.40	17/17	Thread-embedded acupuncture (LAS) + LCD	Electro-acupuncture + LCD	3x/weeks (4 times) EA: continuous wave 2 Hz, 30 minutes	REN12, REN9, REN6, REN4, ST25, SP15, ST40	①76.03±10.52→ 74.15±9.74 ④93.79±7.18→87.65±7.93	None
*Rerksuppaphol et al, 2022, Thailand [60]	38±9	29±4	38/38	Electro-acupuncture (5 Minutes)	Electro-acupuncture (30 minutes)	2x/ week (first 8 weeks), Break (8 weeks), 2x/ week (last 8 weeks) 40 Hz and 3 mA (24 weeks)	REN4, REN6, REN10, REN12, ST36, ST40, SP6, ST25, ST26	①71.9±9.3 → −1.5(−1.8, −1.2) ②28.7±9.1 → −0.61(−0.75, −0.46) ③37.8±6.0 → −0.7(−0.9, −0.5) ④92.1±7.6 → −4.5(−5.4, −3.6) ⑥140.3±47.6 → −32.7(−47.4, −18.0) ⑦52.4±6.5 → 1.9(−1.9, 5.8) ⑧146.1±29.5 → −43.8(−58.3, −29.3)	None
Lam et al, 2024, China [61]	Adults + Simple Obesity (47.5±11.0)	(29.9±4.2)	84/84	Sham acupuncture + LCD	Electro-acupuncture + LCD	50 Hz	ST25, SP-15, GB26, REN6, REN12, ST36, ST40, SP-6	①79.2±13.3 → −2.3 (−2.0 to −0.7) ②29.9±4.2 → −0.4 (−0.6 to −0.1) ③36.2±6.0 → −0.3(−0.9 to 0.3) ④98.9±10.2 → −1.8(−2.3 to −0.4)	

Abbreviations: NR, Not Recorded; MA, Traditional Manual Acupuncture; AA, Auricular Acupuncture; LCD, Low-Calorie Diet; *Study is excluded in Meta-analysis.

3.2.2.4. Catgut Embedding Acupuncture (LAS) Subgroup Meta-analysis

Table 15 indicates that six studies were identified for qualitative research and included in the meta-analysis.

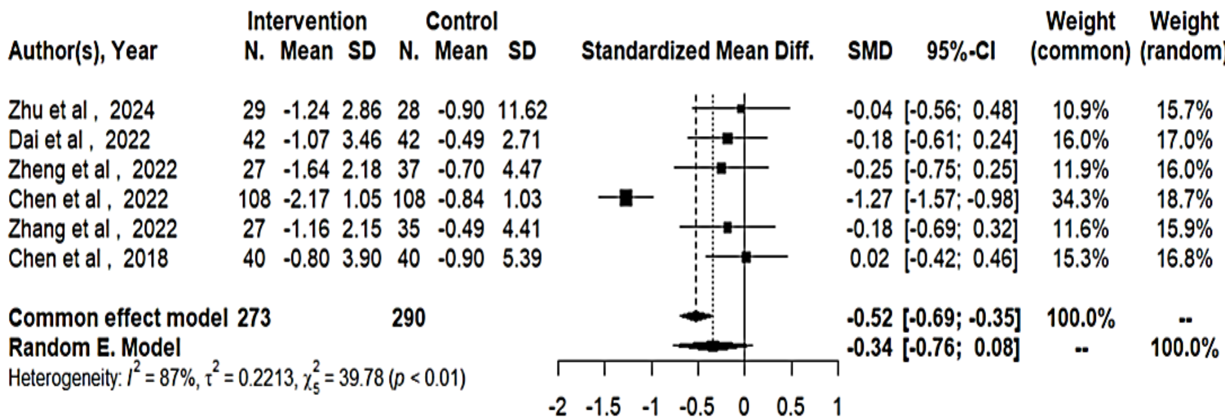

Figure 7. Forest plot of Catgut Embedding Acupuncture (LAS) Subgroup vs Control Group

Figure 7 shows that the meta-analysis included six studies with standardized mean differences ranging from -1.27 to 0.02, with the majority being negative (83%). The estimated average standardized mean difference using the random-effects model was -0.34 (95% CI: -0.76 to 0.08), indicating no significant difference from zero (z = -1.60, p = 0.109) in Table 13.

Table 14. Randon-Effects Model of Catgut Embedding Acupuncture (LAS) Subgroup

Random-Effects Model (k = 6)

	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	-0.342	0.214	-1.60	0.109	-0.761	0.077
	.	.	.	.	.	.

Note. Tau² Estimator: Restricted Maximum-Likelihood

The Q-test revealed significant heterogeneity ($Q(5) = 39.8589$, $p < 0.0001$, $tau^2 = 0.2214$, $I^2 = 82.1230\%$). The 95% prediction interval ranged from -1.3549 to 0.6708, suggesting that some studies might have positive outcomes despite the average being negative. One study (Chen et al., 2022) was identified as a potential outlier and overly influential.

Table 15. Heterogeneity Statistics of Electro-Acupuncture (EA) Subgroup

Heterogeneity Statistics

Tau	Tau²	I²	H²	R²	df	Q	p
0.470	0.2214 (SE= 0.1731)	82.12%	5.594	.	5.000	39.859	< .001

Table 16. Catgut Embedding Acupuncture Subgroup (LAS): Characteristics of RCTs

Author, Year, Country	Characteristics of Participants/ Age (M ± SD)	Initial BMI (M ± SD)	Analyzed Sample Size: Intervention /Control	Control group	Intervention Group	Frequency (Duration)	Treated acupoints	Outcomes ①Body Weight (kg); ②Body Mass Index (kg/m^2); ③Body Fat (%); ④Waist Circumference (cm); ⑤Waist to Hip Ratio; ⑥Triglyceride (mg/dL); ⑦HDL-c (mg/dL); ⑧LDL-c (mg/dL);	Adverse events reported (n)
Chen et al., 2018, China [62]	Adults + Obesity + Women (39.9 ± 9.8)	(30.7 ± 3.9)	45/45	Sham acupuncture	Long-term acupoint stimulation (LAS, Catgut Embedding Acupuncture)	1x/ week (6 weeks)	REN6, REN9, ST28, KD14, ST36	①78.3±12.1→76.6±12.12 ②30.7±3.9→29.9±3.9 ④96.6±10.2→91.7±11.2 ⑤0.89±0.10→0.86±0.07 ⑥162.3±99.9→142.7±92.9 ⑦47.0±9.8→47.5±10.0 ⑧120.5±30.0→122.0±28.9	Local pain (10), Local bruising (14), itchiness, and stinging sensation (5) resolved in a day.
Dai et al., 2022, China [63]	Adults + Obesity (33.05 ± 6.60)	(29.98±4.78)	42/42	Sham acupuncture + Lifestyle intervention	Long-term acupoint stimulation (LAS, Catgut Embedding Acupuncture) + LCD	1x/ 10 days (8 times)	REN12, ST25, ST40, BL20	①83.99±20.33→80.15±4.17 ②29.98±4.78→28.59±1.56 ④99.79±13.62→94.43±5.08 ⑥1.80±1.52→1.48±1.43(mmol l^{-1}) ⑦1.21±0.24→1.31±0.72(mmol l^{-1}) ⑧3.11±0.68→3.11±0.19(mmol l^{-1})	Uncomfortable tingling sensation (1)
Zhang et al., 2022, China [64]	Adults + Women + Abdominal Obesity with strong appetite (33.15 ± 7.53)	(28.79±2.01)	27/37	Sham acupuncture	Long-term acupoint stimulation (LAS, Catgut Embedding Acupuncture)	1x/ 12 weeks	BL20, BL21, BL25, REN12, ST25, LV13	①73.71±5.79→69.60±7.32 ②28.79±2.01→27.15±2.35	NR
Chen et al., 2022, China [65]	Adults + Obesity (31.66 ± 6.55)	(27.42±1.47)	108/108	Sham acupuncture	Long-term acupoint stimulation (LAS, Catgut Embedding acupuncture)	1x/ 2 weeks (16 weeks)	TE6, ST25, BL21, ST36, REN12, LI11), ST24, BL20, ST40, REN9	①72.90±7.35→67.13±0.59 ②27.42±1.47→25.25±0.22 ④90.00±5.00→83.14±6.85	Hematoma around the site of the needling (8)
Zhang et al., 2023, China [66]	Adults + Obesity (36.28 ± 9.60)	(27.94±3.45)	60/63	Sham acupuncture	Long-term acupoint stimulation (LAS, Catgut Embedding acupuncture)	1x/ 12 weeks	BL20, BL21, BL25, CV12, ST25, LV13	①74.81±13.08→NR ②27.94±3.31→ NR ④94.00±9.70→ NR	Hematoma (7)
Zhu et al., 2024, China [67]	Adults + Obesity + gastrointestinal internal heat-type (32.34 ± 7.20)	(31.17±2.99)	29/28	Sham acupuncture + Lifestyle intervention	Long-term acupoint stimulation (LAS, Catgut Embedding acupuncture) + Lifestyle intervention (LCD, Exercise)	1x/ 10 days (2 months)	REN12, REN10, ST25, SP15, ST28, LI11, SP9, ST34, ST40, SP6	①85.57±13.20 → 79.39±11.52 ②31.17±2.99 → 28.93±2.73 ④96.19±9.33 → 90.21±8.10 ⑤0.88±0.06 → 0.84±0.06 ⑥2.11±1.17 → 1.92±0.75 ⑦1.25±0.22 → 1.22±0.14 ⑧3.14±0.76 → 3.16±0.69	None

Abbreviations: NR, Not Recorded; LCD, Low-Calorie Diet

3.3. Risk of Bias

3.3.1 Herbal Medicine

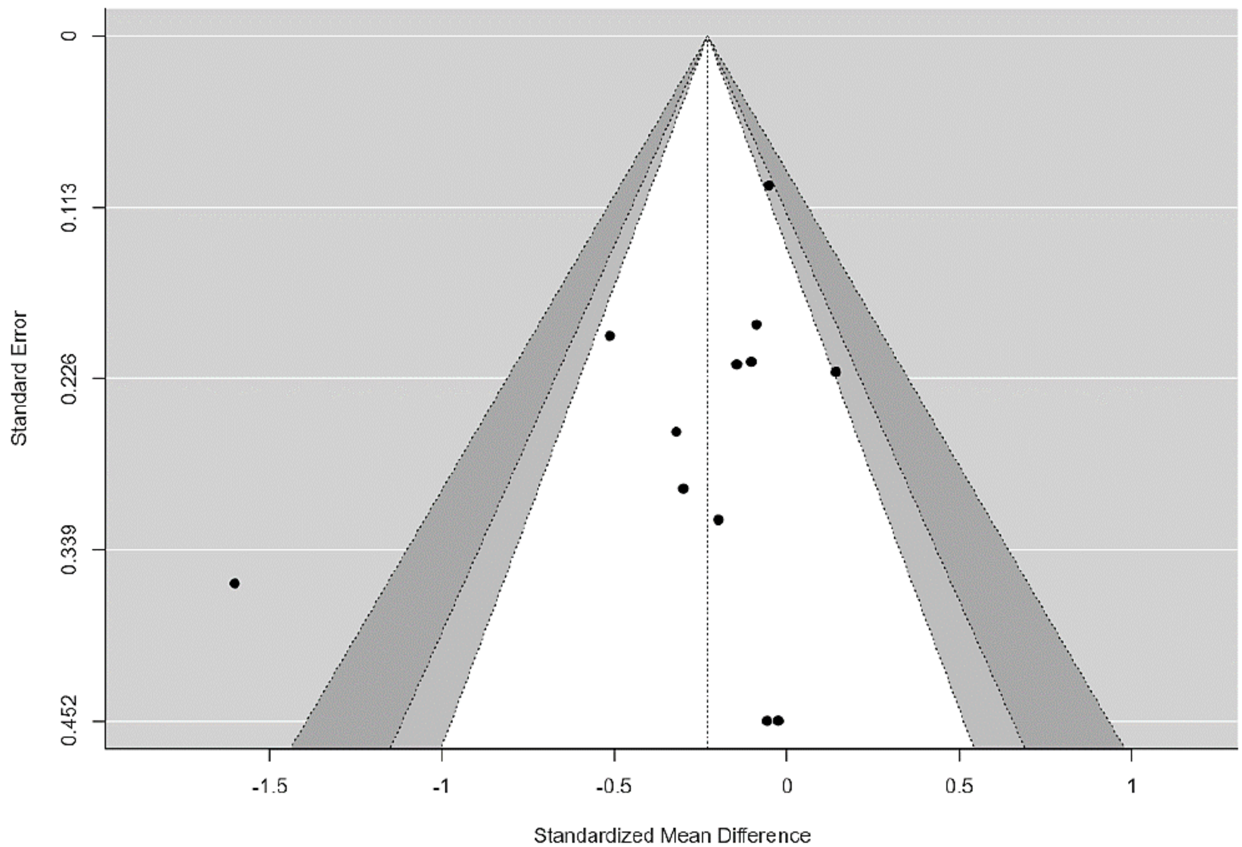

Figure 8. Funnel plot of Herbal Medicine Group

Funnel Plot is a visual tool used in meta-analysis to assess publication bias and heterogeneity among studies. In a Funnel Plot, the central line represents the combined effect size, and studies should be symmetrically distributed around this line if there is no publication bias. Larger studies appear near the top of the plot, close to the central line, while smaller studies are spread out at the bottom. Asymmetry in the plot suggests potential publication bias or heterogeneity.

In Figure 8, the Funnel Plot of Herbal Medicine Group shows that most estimates are negative, with some possibly being positive. The regression test indicated no funnel plot asymmetry (p = 0.2056), and the rank correlation test also showed no asymmetry (p = 0.3108), suggesting no publication bias. However, one study (Sengupta et al., 2012) was identified as a potential outlier and overly influential, indicating it might disproportionately affect the overall results.

3.3.2 Acupuncture

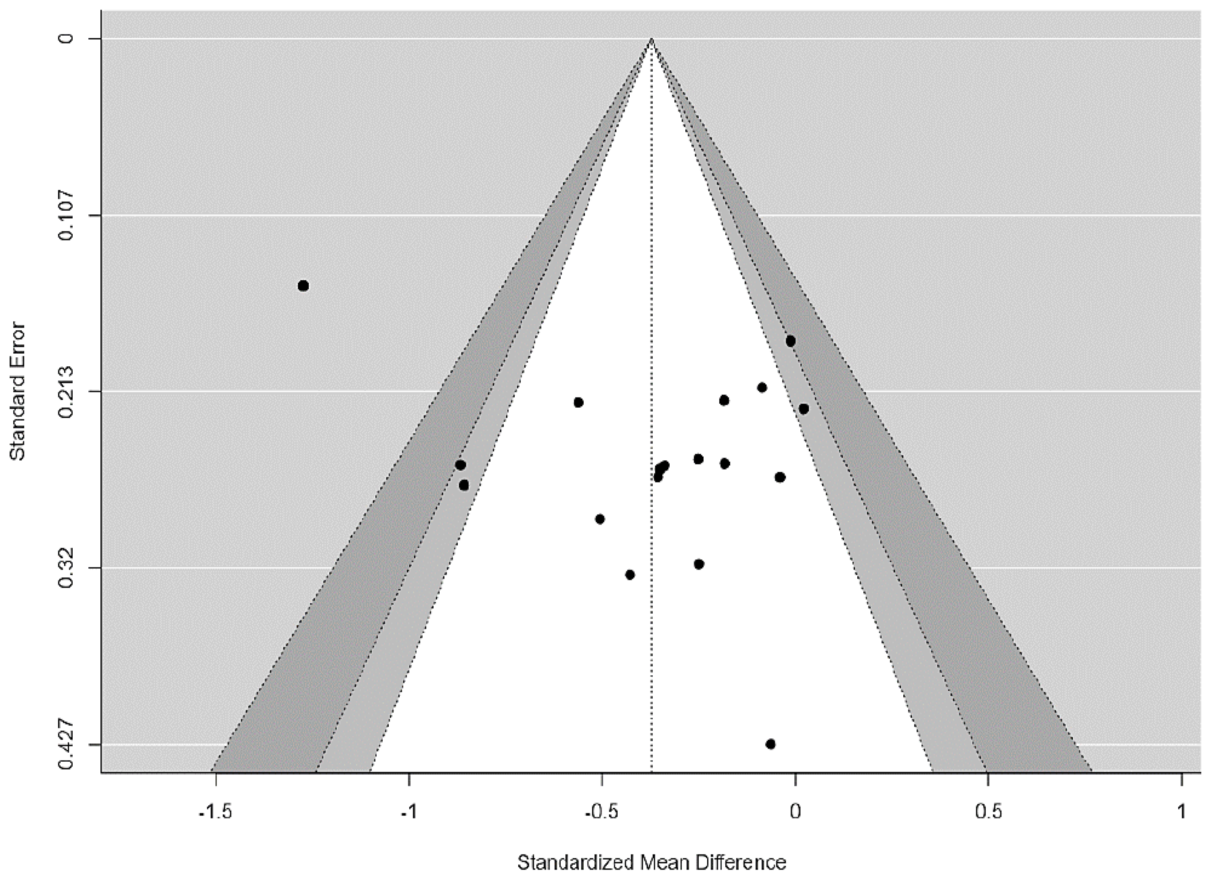

Figure 9. Funnel plot of Acupuncture Group

In Figure 9, the Funnel Plot displays the most negative estimates at 92%. The average standardized mean difference using the random-effects model was estimated to be -0.3733 (95% CI: -0.5444 to -0.2021), indicating a significant difference from zero ($z = -4.2746$, $p < 0.0001$). The Q-test revealed significant heterogeneity ($Q(23) = 96.5380$, $p < 0.0001$, $I^2 = 68.9418\%$). The regression test suggested funnel plot asymmetry ($p = 0.0498$), but the rank correlation test did not ($p = 0.2957$). According to Cook's distances, two studies (Chen (1), (2) 2022) were deemed overly influential, but no outliers were identified based on studentized residuals.

3.5. Adverse event

The adverse effects of herbal medicine were mild symptoms such as dyspepsia, headache, constipation, fatigue, etc. There were no severe adverse effects on most acupuncture treatment groups; however, catgut embedding acupuncture often reported hematoma and tingling sensations.

3.6. Publication bias

Publication bias occurs when the likelihood of research results being published is influenced by the nature and direction of the results. Positive or statistically significant findings are more likely to be published, potentially skewing the overall conclusions of meta-analyses. Funnel plots are used to detect publication bias, with asymmetry indicating possible bias visually. Statistical tests such as Egger's regression test and Begg's rank correlation test also help identify publication bias.

3.5.1 Herbal Medicine

Table 17. Publication Bias Assessment of Herbal Medicine Group

Test Name	value	p
Fail-Safe N	38.000	< .001
Begg and Mazumdar Rank Correlation	-0.242	0.311
Egger's Regression	-1.267	0.205
Trim and Fill Number of Studies	0.000	.

Note. Fail-safe N Calculation Using the Rosenthal Approach

In the provided analysis, the funnel plot included 12 studies, with most estimates being negative (92%). The estimated average standardized mean difference using the random-effects model was -0.23 (95% CI: -0.42 to -0.036), showing a significant difference from zero ($z = -2.32$, $p = 0.02$). The Q-test indicated significant heterogeneity ($Q(11) = 23.33$, $p = 0.016$, $tau^2 = 0.055$, $I^2 = 52.72\%$). No funnel plot asymmetry was indicated by either the rank correlation test ($p = 0.31$) or the regression test ($p = 0.21$), suggesting no publication bias.

3.5.2 Acupuncture

Table 18. Publication Bias Assessment of Acupuncture Group

Publication Bias Assessment

Test Name	value	p
Fail-Safe N	564.000	< .001
Begg and Mazumdar Rank Correlation	-0.156	0.296
Egger's Regression	1.962	0.050
Trim and Fill Number of Studies	6.000	.

Note. Fail-safe N Calculation Using the Rosenthal Approach

In the analysis of the Acupuncture group, the regression test indicated funnel plot asymmetry ($p = 0.0498$), suggesting potential publication bias. However, the Begg and Mazumdar rank correlation test did not show significant asymmetry ($p = 0.296$). The Fail-Safe N was 564 ($p < 0.001$), indicating a robust result despite potential bias. Therefore, while there is some evidence of publication bias, the findings remain reliable.

3.7. Risk of Bias

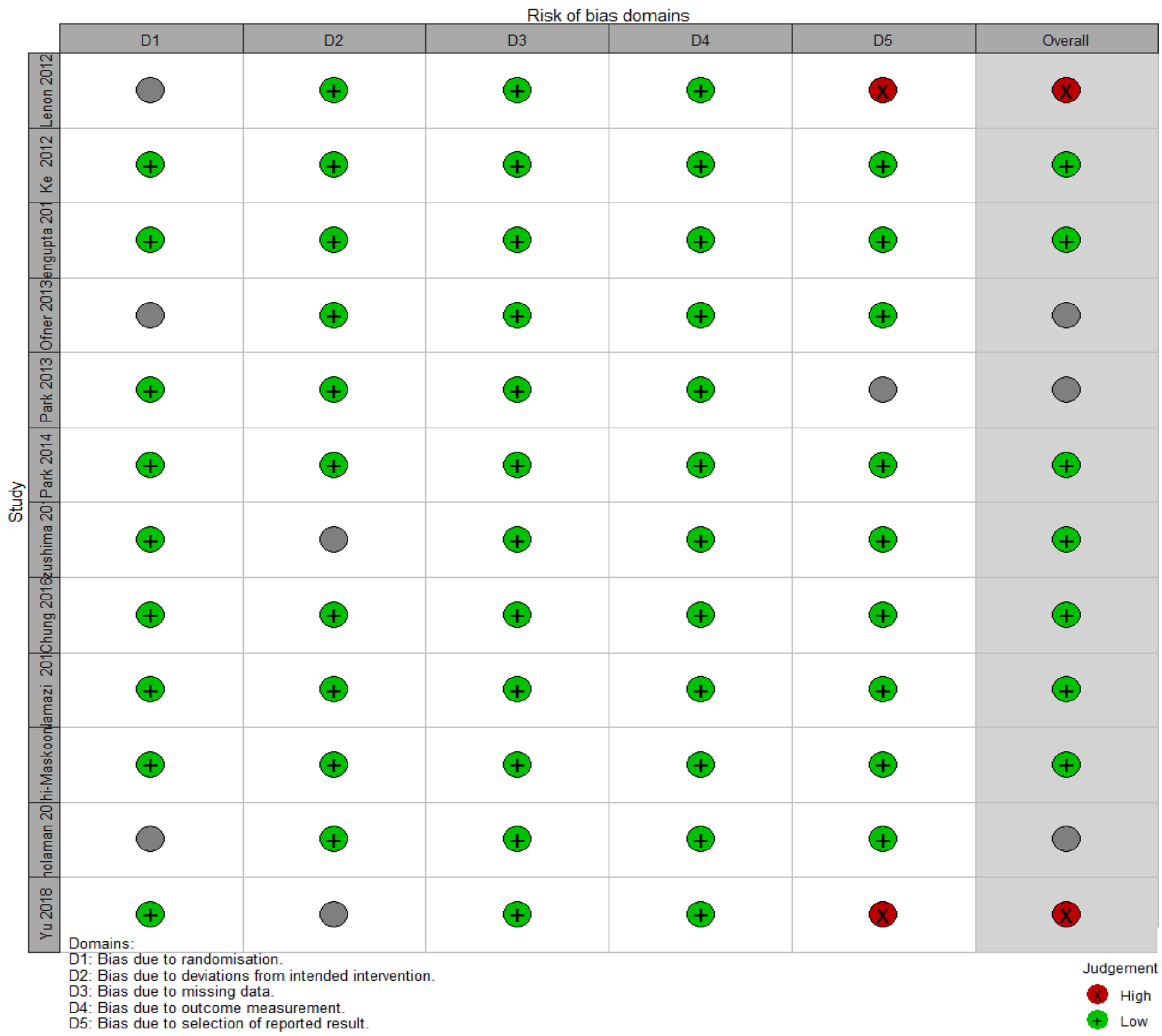

Figure 10. Risk of Bias Graph of 12 Herbal Medicine Studies

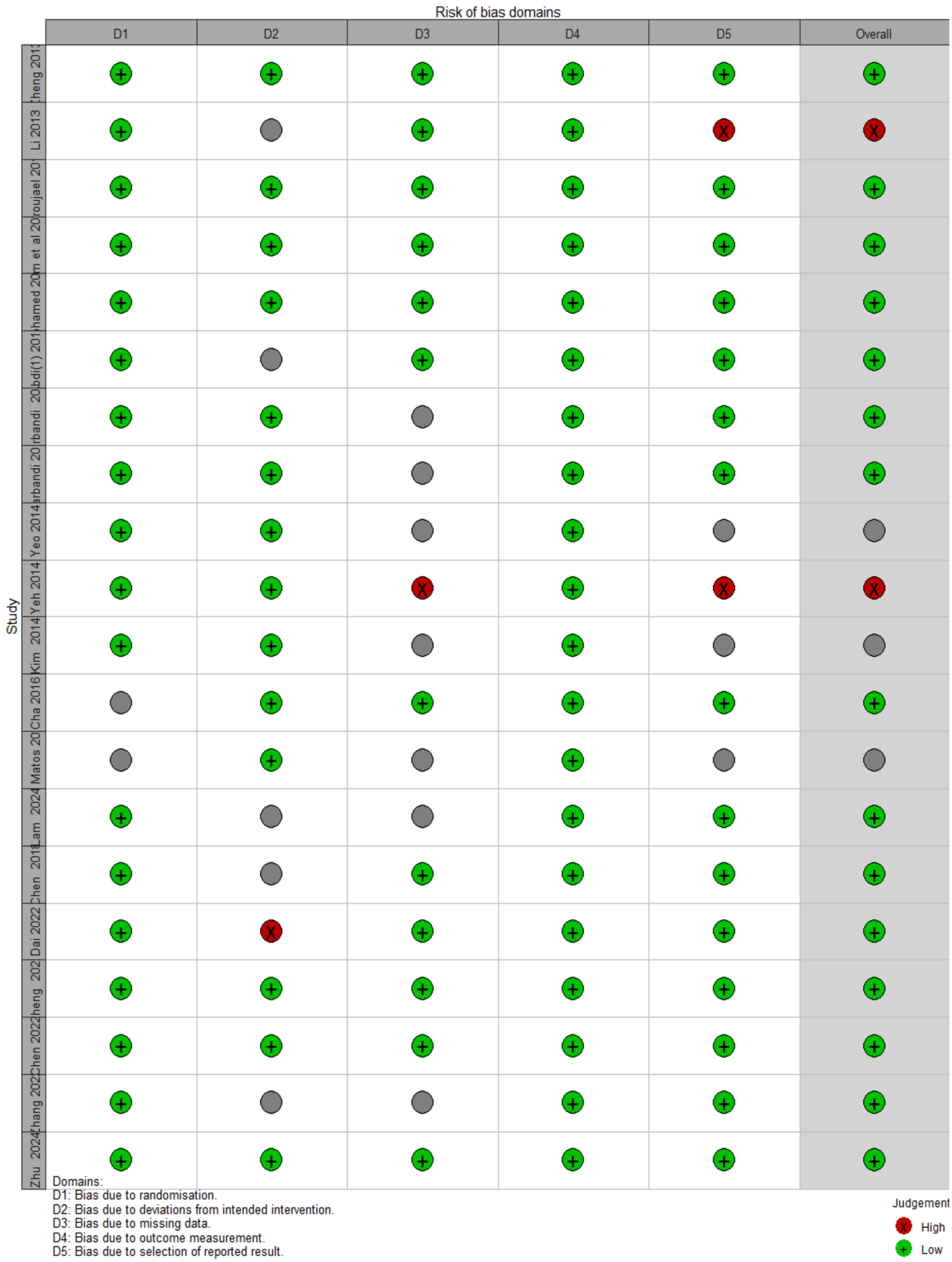

Figure 11. Risk of Bias Graph of 20 Acupuncture Studies

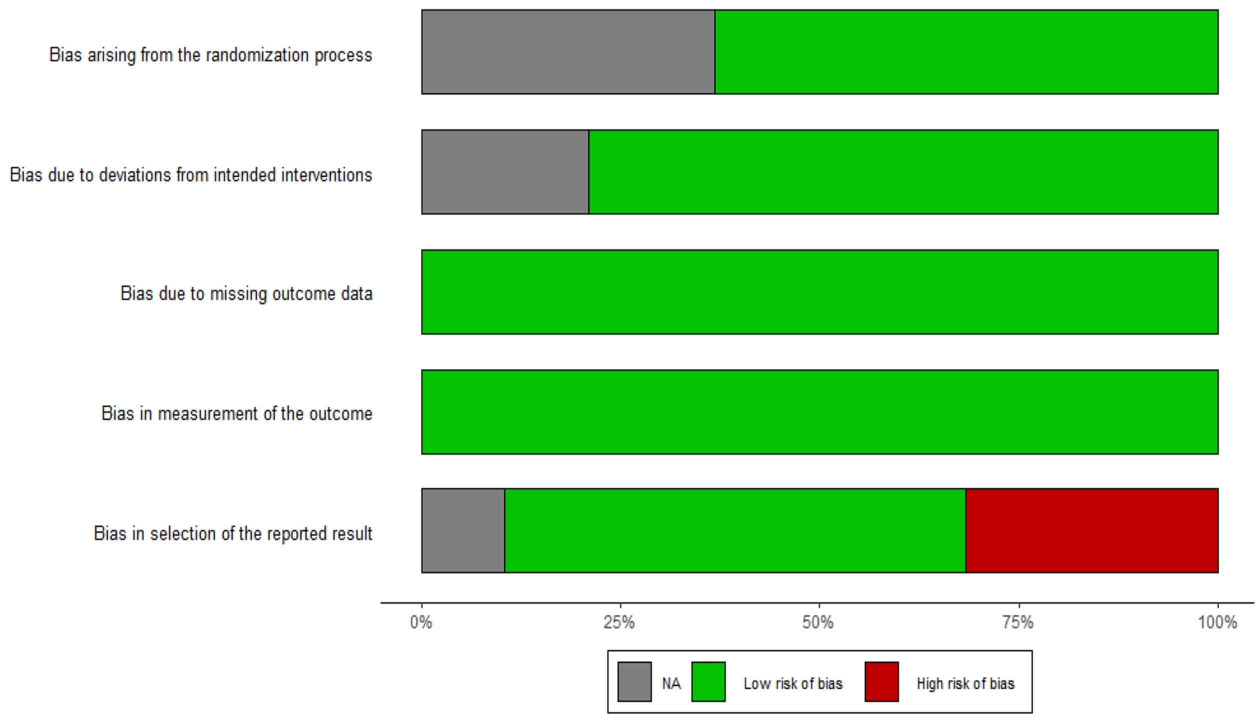

Figure 12. Summary of Risk of Bias Graph of 12 Herbal Medicine Studies

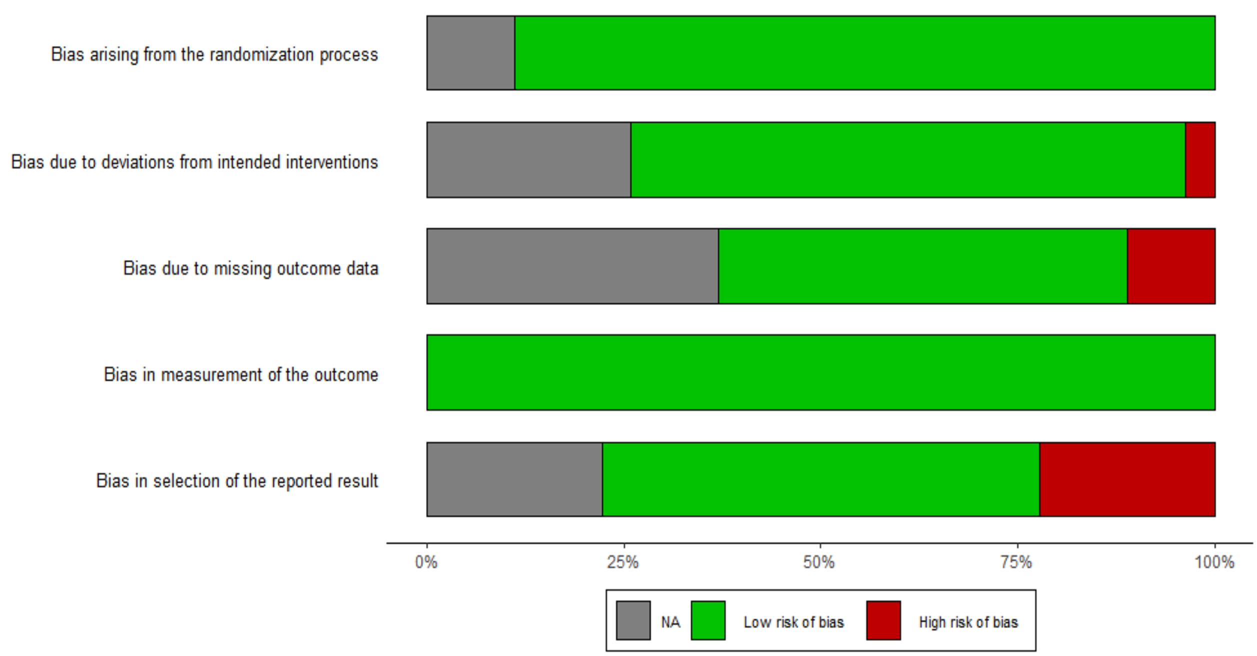

Figure 11. Summary of Risk of Bias Graph of 20 Acupuncture Studies

IV. DISCUSSION

This study represents the first systematic review and meta-analysis of randomized controlled trials (RCTs) examining herbal medicine for obesity treatment and the first comparative meta-analysis assessing various herbal medicine and acupuncture through subgroup analyses. Our objective was to present recent trends and robust evidence demonstrating that the overall efficacy of Acupuncture and Oriental Medicine (AOM) treatments is significantly greater than that of placebo/control groups. Additionally, our findings indicate that acupuncture and herbal medicine exhibit higher effectiveness in treating obesity compared to control groups. Furthermore, we found that the effectiveness of these AOM treatments remains significant even when combined with lifestyle management or other therapies.

Since 2012, there have been very few randomized controlled trials regarding the effects of pharmacopuncture on obesity. Most of the studies were limited to animal experiments and clinical case reports, thus failing to address the latest trends in pharmacopuncture treatment [68].

The limitations of this study are as follows. First, the meta-analysis included a total of 32 studies with 4,763 participants. The relatively small number of participants limited the ability to understand the overall research trends fully. Second, four studies reported a high risk of bias due to insufficient outcome data and selective reporting. This suggests that future studies should minimize missing data and specify the reasons and numbers for dropouts to conduct high-quality randomized controlled trials. Third, there were limitations related to the nature of obesity treatment. The treatment duration in the included studies varied from 4 to 10 weeks, but obesity requires consistent management, indicating the need for long-term treatment periods. This suggests the possibility of improvements in the statistically insignificant effects on body weight (BW) observed in some studies. Fourth, this study only analyzed changes in BMI, which is insufficient to assess the anti-obesity effects of AOM treatment. Comprehensive meta-analyses involving detailed measures such as weight changes, waist circumference, waist-to-hip ratio, and blood test indicators are necessary to evaluate the effects comprehensively. Additionally, since existing high-quality studies primarily involved East Asian participants, there is a need for studies that include diverse ethnic groups. Clinical trials should also incorporate important metabolic indicators such as blood pressure, glucose, and lipids. Given the small sample sizes and high heterogeneity in the existing studies, careful interpretation of the results is necessary. Lastly, the included studies lacked follow-up, making it impossible to evaluate the long-term effects and sustainability of weight loss. Hence, further research is required to assess the long-term efficacy of AOM in obesity management.

V. CONCLUSION

This systemic review and meta-analysis prove that Acupuncture and Oriental Medicine (AOM) are significantly effective in treating obesity. Most RCTs showed a positive reduction in body weight, BMI, and waist-to-hip ratio after receiving AOM treatments. Also, there was a significant change in the blood test after consuming herbal medicine and acupuncture treatment. There is reportedly an improvement in numerical values such as Body fat, Triglyceride, HDL, and LDL. AOM treatment is frequently combined with a low-calorie diet and exercise, showing more positive outcomes than treatment alone. The positive efficacy of AOM treatment for obesity is still being proved and established, but some studies have inconsistent results in some details. This may be caused by the diversity of study protocols, such as the acupuncture method, comparative groups, and results. Therefore, further studies must be conducted to overcome the limitations of a small sample size, the effect of short and long-term treatment, and consistency in blinding.

REFERENCES

[1] Byung Jun Kim, et al. Effect of Complex Korean Medicine Treatment on Obese Patient: A Retrospective Study. J Korean Med Obes Res (JKOMOR), 2022 Jan; 22(1):47-53. https://www.cdc.gov/ncbddd/disabilityandhealth/obesity.html#:~:text=An%20adult%20who%20has%20a,or%20higher%20is%20considered%20obese.

[2] World Health Organization (WHO). Obesity and Overweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

[3] Theodore K. Kyle, at el. Regarding Obesity as a Disease: Evolving Policies and Their Implications. Endocrinol Metab Clin North Am. 2016 Sep; 45(3): 511–520. doi: 10.1016/j.ecl.2016.04.004 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4988332/

[4] The Korea Disease Control and Prevention Agency. Public Health Weekly Report 2022; 15(41): 2704-2705 Published online October 13, 2022 https://www.phwr.org/journal/view.html?doi=10.56786/PHWR.2022.15.41.2704

[5] National Opinion Research Center (NORC), the Obesity Prevalence and Comorbidity Map. https://obesitymap.norc.org/

[6] Gregg EW, et el. Global health effects of obesity and overweight. N Engl J Med. 2017;377:80–1.

[7] Centers for Disease Control and Prevention (CDC). Childhood Obesity Facts, https://www.cdc.gov/obesity/data/childhood.html

[8] World Obesity Federation. World Obesity Atlas 2023. https://data.worldobesity.org/publications/?cat=19

[9] Hong YH. Pediatric obesity: life cycle approach of pediatrician and society. Clin Exp Pediatr. 2022 Jan;65(1):29-30. doi: 10.3345/cep.2021.01536. Epub 2021 Dec 28. PMID: 34961298; PMCID: PMC8743431.

[10] Lee DH, Childhood and Adolescent Obesity, Daily Health Newspaper, 2011

[11] Weihrauch-Blüher S, et al. Childhood obesity: increased risk for cardiometabolic disease and cancer in adulthood, Metabolism 2019;92:147–52.

[12] Vibha Singhal, at el. Pharmacotherapy in Pediatric Obesity: Current Evidence and Landscape, Curr Opin Endocrinol Diabetes Obes. 2021 Feb 1; 28(1): 55–63. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8082722/

[13] Wang G, et al. Controversy and reflection on the selection of bariatric and metabolic surgery in extremely obese patients. Chin J Gen Surg. 2022;31:1272–84

[14] Belivani M, et al. Acupuncture in the treatment of obesity: a narrative review of the literature. Acupuncture Med. 2013;31:88–97

[15] Kyungli Kim, et al. Review of Korean Clinical Studies on Treatment for Childhood Obesity J Pediatr Korean Med. August, 2016;30(3):108-120

[16] Woo Jong Shin. An Introduction of the Systematic Review and Meta-Analysis. Hanyang Med Rev 2015; 35:9-17

[17] Matthew J Page. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews, BMJ 2021;372:n71 http://dx.doi.org/10.1136/bmj.n71

[18] Wang et al. Reporting items for systematic reviews and meta-analyses of acupuncture: the PRISMA for acupuncture checklist. BMC Complementary and Alternative Medicine (2019) 19:208 https://doi.org/10.1186/s12906-019-2624-3

[19] Zhang et al. PRISMA extension for moxibustion 2020: recommendations, explanation, and Elaboration. Systematic Reviews (2020) 9:247 https://doi.org/10.1186/s13643-020-01502-7

[20] Zhang et al. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Extension for Chinese Herbal Medicines 2020 (PRISMA-CHM 2020). The American Journal of Chinese Medicine, Vol. 48, No. 6, 1279–1313 https://www.worldscientific.com/doi/epdf/10.1142/S0192415X20500639

[21] Perry et al. A comparison of two assessment tools used in overviews of systematic reviews: ROBIS versus AMSTAR-2. Syst Rev (2021) 10:273 https://doi.org/10.1186/s13643-021-01819-x

[22] Zhaochen et al. The quality of Cochrane systematic reviews of acupuncture: an overview. BMC Complementary Medicine and Therapies (2020) 20:307 https://doi.org/10.1186/s12906-020-03099-9

[23] World Health Organization (WHO). Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser (2020), 894, 1–253.

[24] American Association of Clinical Endocrinologists. AACE/TOS/ASMBS Guidelines & Diagnosis and treatment of obesity. Endocrine Practice, 22(Suppl 3) (2016), 1–203.

[25] Tak, Y. J., and Lee, S. Y. (2021). Long-term efficacy and safety of anti-obesity treatment: Where do we stand? Curr. Obes. Rep. 10, 14–30. doi:10.1007/s13679-020-00422-w

[26] Ghasemi, A., and Jeddi, S. (2017). Anti-obesity and anti-diabetic effects of nitrate and nitrite. Nitric Oxide 70 (1), 9–24. doi:10.1016/j.niox.2017.08.003

[27] Korea Institute of Oriental Medicine, Obesity – Korean Medicine Clinical Practice Guidelines, EBM Based Obesity K Med Development Committee (2016), 1-196

[28] Giovanni Maciocia. Diagnosis in Chinese Medicine – A Comprehensive Guide 2nd Edition. ELSEVIER. (2019).

[29] Korea Institute of Oriental Medicine. (2016). EBM-based Committee for Development of Clinical Guidelines for Obese Oriental Medicine.

[30] Lenon GB, Li KX, Chang YH, Yang AW, Da Costa C, Li CG, Cohen M, Mann N, Xue CC. Efficacy and Safety of a Chinese Herbal Medicine Formula (RCM-104) in the Management of Simple Obesity: A Randomized, Placebo-Controlled Clinical Trial. Evid Based Complement Alternat Med. 2012;2012:435702. doi: 10.1155/2012/435702. Epub 2012 Feb 20. PMID: 22550541; PMCID:

[31] Ke B, Shi L, Jun-jie Z, Chen DS, Meng J, Qin J. Protective effects of modified linggui zhugan decoction combined with short-term very low calorie diets on cardiovascular risk factors in obese patients with impaired glucose tolerance. J Tradit Chin Med. 2012 Jun;32(2):193-8. doi: 10.1016/s0254-6272(13)60010-2.

[32] Sengupta K, Mishra AT, Rao MK, Sarma KV, Krishnaraju AV, Trimurtulu G. Efficacy and tolerability of a novel herbal formulation for weight management in obese subjects: a randomized double blind placebo controlled clinical study. Lipids Health Dis. 2012 Sep 20;11:122. doi: 10.1186/1476-511X-11-122.

[33] Ofner M, Tomaschitz A, Wonisch M, Litscher G. Complementary treatment of obesity and overweight with salacia reticulata and vitamin d. Int J Vitam Nutr Res. 2013;83(4):216-23. doi: 10.1024/0300-9831/a000162.

[34] Park S, Nahmkoong W, Cheon C, Park JS, Jang BH, Shin Y, Kim KS, Go H, Song YK, Ko SG. Efficacy and Safety of Taeeumjowi-tang in Obese Korean Adults: A Double-Blind,

Randomized, and Placebo-Controlled Pilot Trial. Evid Based Complement Alternat Med. 2013;2013:498935. doi: 10.1155/2013/498935.

[35] Park J, Bose S, Hong SW, Lee DK, Yoo JW, Lim CY, Lee M, Kim H. Impact of GNB3-C825T, ADRB3-Trp64Arg, UCP2-3'UTR 45 bp del/ins, and PPARγ-Pro12Ala polymorphisms on Bofutsushosan response in obese subjects: a randomized, double-blind, placebo-controlled trial. J Med Food. 2014 May;17(5):558-70. doi: 10.1089/jmf.2013.2836.

[36] Azushima K, Tamura K, Haku S, Wakui H, Kanaoka T, Ohsawa M, Uneda K, Kobayashi R, Ohki K, Dejima T, Maeda A, Hashimoto T, Oshikawa J, Kobayashi Y, Nomura K, Azushima C, Takeshita Y, Fujino R, Uchida K, Shibuya K, Ando D, Tokita Y, Fujikawa T, Toya Y, Umemura S. Effects of the oriental herbal medicine Bofu-tsusho-san in obesity hypertension: a multicenter, randomized, parallel-group controlled trial (ATH-D-14-01021.R2). Atherosclerosis. 2015 May;240(1):297-304. doi: 10.1016/j.atherosclerosis.2015.01.025.

[37] Chung W, Ryu J, Chung S, Kim S. [Effect of Qingxue Dan on obesity and metabolic biomarker: a double-blind randomized-controlled pilot study]. J Tradit Chin Med. 2016 Jun;36(3):291-8. Chinese. doi: 10.1016/s0254-6272(16)30040-1.

[38] Cho YG, Jung JH, Kang JH, Kwon JS, Yu SP, Baik TG. Effect of a herbal extract powder (YY-312) from Imperata cylindrica Beauvois, Citrus unshiu Markovich, and Evodia officinalis Dode on body fat mass in overweight adults: a 12-week, randomized, double-blind, placebo-controlled, parallel-group clinical trial. BMC Complement Altern Med. 2017 Jul 28;17(1):375. doi: 10.1186/s12906-017-1871-4.

[39] Namazi N, Alizadeh M, Mirtaheri E, Farajnia S. The Effect of Dried *Glycyrrhiza Glabra L*. Extract on Obesity Management with Regard to PPAR-γ2 (Pro12Ala) Gene Polymorphism in Obese Subjects Following an Energy Restricted Diet. Adv Pharm Bull. 2017 Jun;7(2):221-228. doi: 10.15171/apb.2017.027.

[40] Daneshi-Maskooni M, Keshavarz SA, Qorbani M, Mansouri S, Alavian SM, Badri-Fariman M, Jazayeri-Tehrani SA, Sotoudeh G. Green cardamom increases Sirtuin-1 and reduces inflammation in overweight or obese patients with non-alcoholic fatty liver disease: a double-blind randomized placebo-controlled clinical trial. Nutr Metab (Lond). 2018 Sep 25;15:63. doi: 10.1186/s12986-018-0297-4.

[41] Gholaman M, Gholami M. Effect of Eight Weeks' Endurance Training along with Fenugreek Ingestion on Lipid Profile, Body Composition, Insulin Resistance and VO2max in Obese Women's with Type2 Diabetes. J. Med. Plants 2018; 17 (65) :83-92 URL: http://jmp.ir/article-1-1955-en.html

[42] Yu X, Xu L, Zhou Q, Wu S, Tian J, Piao C, Guo H, Zhang J, Li L, Wu S, Guo M, Hong Y, Pu W, Zhao X, Liu Y, Pang B, Peng Z, Wang S, Lian F, Tong X. The Efficacy and Safety of the Chinese Herbal Formula, JTTZ, for the Treatment of Type 2 Diabetes with Obesity and Hyperlipidemia: A Multicenter Randomized, Positive-Controlled, Open-Label Clinical Trial. Int J Endocrinol. 2018 Apr 1;2018:9519231. doi: 10.1155/2018/9519231.

[43] Abdi H, Zhao B, Darbandi M, Ghayour-Mobarhan M, Tavallaie S, Rahsepar AA, Parizadeh SM, Safariyan M, Nemati M, Mohammadi M, Abbasi-Parizad P, Darbandi S, Akhlaghi S, Ferns GA. The effects of body acupuncture on obesity: anthropometric parameters, lipid profile, and inflammatory and immunologic markers. ScientificWorldJournal. 2012;2012:603539. doi: 10.1100/2012/603539. Epub 2012 Apr 29.

[44] LI Yong-hua , CUI Shu-mei , XU Hong-tao , MA Jian.Clinical Observation on Diabetic Patients with Obesity by Acupuncture[J].Journal of Clinical Acupuncture and Moxibustion,2013(9):30-32.

[45] Zheng YH, Wang XH, Lai MH, Yao H, Liu H, Ma HX. Effectiveness of abdominal acupuncture for patients with obesity-type polycystic ovary syndrome: a randomized controlled trial. J Altern Complement Med. 2013 Sep;19(9):740-5. doi: 10.1089/acm.2012.0429.

[46] Firouzjaei A, Li GC, Wang N, Liu WX, Zhu BM. Comparative evaluation of the therapeutic effect of metformin monotherapy with metformin and acupuncture combined therapy on weight loss and insulin sensitivity in diabetic patients. Nutr Diabetes. 2016 May 2;6(5):e209. doi: 10.1038/nutd.2016.16.

[47] Xie XC, Cao YQ, Gao Q, Wang C, Li M, Wei SG. Acupuncture Improves Intestinal Absorption of Iron in Iron-deficient Obese Patients: A Randomized Controlled Preliminary Trial. Chin Med J (Engl). 2017 Mar 5;130(5):508-515. doi: 10.4103/0366-6999.200549.

[48] Kim K-W, Shin W-C, Choi MS, et al. Effects of acupuncture on anthropometric and serum metabolic parameters in premenopausal overweight and obese women: a randomized, patient- and assessor-blind, sham-controlled clinical trial. Acupuncture in Medicine. 2021;39(1):30-40. doi:10.1177/0964528420912259

[49] Ali Ismail AM. Lipid Profile Response to Acupuncture in Obese Patients with Subjective Tinnitus: a Randomized Controlled Trial. J Acupunct Meridian Stud. 2023 Feb 28;16(1):11-19. doi: 10.51507/j.jams.2023.16.1.11.

[50] Abdi(2) H, Abbasi-Parizad P, Zhao B, Ghayour-Mobarhan M, Tavallaie S, Rahsepar AA, Parizadeh SM, Safariyan M, Nemati M, Mohammadi M, Darbandi M, Darbandi S, Ferns GA.

Effects of auricular acupuncture on anthropometric, lipid profile, inflammatory, and immunologic markers: a randomized controlled trial study. J Altern Complement Med. 2012 Jul;18(7):668-77. doi: 10.1089/acm.2011.0244.

[51] Darbandi M, Darbandi S, Mobarhan MG, et al. Effects of Auricular Acupressure Combined with Low-Calorie Diet on the Leptin Hormone in Obese and Overweight Iranian Individuals. Acupuncture in Medicine. 2012;30(3):208-213. doi:10.1136/acupmed-2011-010121

[52] Darbandi M, Darbandi S, Owji AA, Mokarram P, Mobarhan MG, Fardaei M, Zhao B, Abdi H, Nematy M, Safarian M, Parizadeh MR, Dabbaghmanesh MH, Abbasi P, Ferns G. Auricular or body acupuncture: which one is more effective in reducing abdominal fat mass in Iranian men with obesity: a randomized clinical trial. J Diabetes Metab Disord. 2014 Dec 5;13(1):92. doi: 10.1186/s40200-014-0092-3.

[53] Yeo S, Kim KS, Lim S. Randomised clinical trial of five ear acupuncture points for the treatment of overweight people. Acupunct Med. 2014 Apr;32(2):132-8. doi: 10.1136/acupmed-2013-010435.

[54] Yeh ML, Chu NF, Hsu MY, Hsu CC, Chung YC. Acupoint Stimulation on Weight Reduction for Obesity: A Randomized Sham-Controlled Study. West J Nurs Res. 2015 Dec;37(12):1517-30. doi: 10.1177/0193945914548707.

[55] Kim D, Ham OK, Kang C, Jun E. Effects of auricular acupressure using Sinapsis alba seeds on obesity and self-efficacy in female college students. J Altern Complement Med. 2014 Apr;20(4):258-64. doi: 10.1089/acm.2012.0283.

[56] Cha HS, Park H. [Effects of Auricular Acupressure on Obesity in Women with Abdominal Obesity]. J Korean Acad Nurs. 2016 Apr;46(2):249-59. Korean. doi: 10.4040/jkan.2016.46.2.249.

[57] Lillingston F, Fields P, Waechter R. Auricular Acupuncture Associated with Reduced Waist Circumference in Overweight Women-A Randomized Controlled Trial. Evid Based Complement Alternat Med. 2019 Dec 18;2019:6471560. doi: 10.1155/2019/6471560.

[58] de Matos¨ DT, Santos MJ, Moreira A, Machado J, Vieira A. Weight and Abdominal Adiposity Loss with Auricular Acupuncture – A Randomized Controlled Trial. J Exp Pathol. 2021;2(3):105-116.

[59] Notonegoro C, Simadibrata C, Kresnawan T. Comparison of Therapeutic Effects Between Electroacupuncture and Thread-Embedded Acupuncture in Obese Patients Undergoing a Dietary Intervention. Med Acupunct. 2022 Dec 1;34(6):380-390. doi: 10.1089/acu.2022.0009.

[60] Rerksuppaphol L, Rerksuppaphol S. Efficacy of short duration versus conventional electroacupuncture in the treatment of obesity: a randomized crossover study. J Tradit Chin Med. 2022 Apr;42(2):256-263. doi: 10.19852/j.cnki.jtcm.2022.02.006.

[61] Lam TF, Lyu Z, Wu X, Wong YP, Cao P, Wong EY, Hung HB, Zhang S, Bian Z, Zhong LLD. Electro-acupuncture for central obesity: a patient-assessor blinded, randomized sham-controlled clinical trial. BMC Complement Med Ther. 2024 Jan 29;24(1):62. doi: 10.1186/s12906-024-04340-5.

[62] Chen IJ, Yeh YH, Hsu CH. Therapeutic Effect of Acupoint Catgut Embedding in Abdominally Obese Women: A Randomized, Double-Blind, Placebo-Controlled Study. J Womens Health (Larchmt). 2018 Jun;27(6):782-790. doi: 10.1089/jwh.2017.6542.

[63] Dai L, Wang M, Zhang KP, Wang L, Zheng HM, Li CB, Zhou WJ, Zhou SG, Ji G. Modified acupuncture therapy, long-term acupoint stimulation versus sham control for weight control: a multicenter, randomized controlled trial. Front Endocrinol (Lausanne). 2022 Jul 28;13:952373. doi: 10.3389/fendo.2022.952373.

[64] Zhang X, Li Q, Yi R, Xing C, Jin Y, Meng J, Zhao S, Liang F, Guo T. Effect of Acupoint Catgut Embedding for Abdominally Obese Female with Strong Appetite: Mixed Analysis of a Randomized Clinical Trial. Diabetes Metab Syndr Obes. 2022 Oct 31;15:3387-3395. doi: 10.2147/DMSO.S388485.

[65] Chen X, Huang W, Wei D, Zhao JP, Zhang W, Ding DG, Jiao Y, Pan HL, Zhang JJ, Zhong F, Gao F, Jin YT, Zheng YW, Zhang YJ, Huang Q, Zeng XT, Zhou ZY. Effect of Acupoint Catgut Embedding for Middle-Aged Obesity: A Multicentre, Randomised, Sham-Controlled Trial. Evid Based Complement Alternat Med. 2022 Feb 27;2022:4780019. doi: 10.1155/2022/4780019.

[66] Xinghe Z, Qifu LI, Rong YI, Chonghui X, Yuhao J, Jiangqiong M, Jialei F, Siwen Z, Fanrong L, Taipin G. Effect of catgut embedding at acupoints versus non-acupoints in abdominal obesity: a randomized clinical trial. J Tradit Chin Med. 2023 Aug;43(4):780-786. doi: 10.19852/j.cnki.jtcm.20230608.002.

[67] Qingqing Zhu, Jian Cheng, Xiaolan Xu, Tangying Xu, Xingjiang Gu, Yun Xia, Lingzhen Mao, Nannan Hu, Yuexia Fang, The effects of catgut embedding in patients with obesity of gastrointestinal internal heat: A randomized controlled trial, European Journal of Integrative Medicine, Volume 66, 2024, 102327, ISSN 1876-3820

[68] Kim, Seyun, Mi-Yeon Song, Won-Seok Chung, Hyungsuk Kim, Woo-Chul Shin, Junhyuk Kang, Joonwon Seo et al. Effects of Pharmacoacupuncture for Obesity: A Systematic Review and Meta-Analysis, Journal of Korean Medicine for Obesity Research 23, no. 2 (2023): 112-124.