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Review Article

## A Review of Acupuncture Treatment for Infertility

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### ABSTRACT

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#### Keywords:

acupoint, acupuncture, infertility

The purpose of this study was to analyze acupuncture treatment methods and acupoint used to treat infertility in the last decade. The data were retrieved from 2010.1 to 2021.8. using national and international electronic databases (PubMed, EMBASE, OASIS, NDSL, and KISS). “Infertility,” “sterility,” “acupuncture,” “electroacupuncture,” “bloodletting,” “pharmacopuncture,” were used as search terms. All studies were mainly concerned with acupuncture treatment of infertility, but the studies which were not related included; (1) infertility or acupuncture treatment; (2) animal studies; (3) review/meta/protocol or clinical study; comparative studies and case reports which were excluded from this review. Only clinical trials for acupuncture treatment of infertility were included in this review ( $n = 18$ ). For infertility treatment studies using acupuncture, polycystic ovarian syndrome was the main cause of infertility, the most common acupoint used was CV4, CV3, CV6, SP6, BL23, and the treatment effect significantly improved in the group receiving acupuncture treatment compared with the control group, or the group taking Western medicine alone. In some studies, the group using acupuncture treatment did not show side effects. Acupuncture is an effective treatment for infertility.

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### Introduction

Infertility refers to a case in which pregnancy is not possible within 1 year while having a normal sex life without using contraception. Most (85% to 90%) healthy couples of a fertile age, can become pregnant within 1 year, whilst the remaining 10% to 15% of couples are diagnosed with infertility [1]. A diagnosis of infertility may cause a variety of physical and mental stress symptoms in people experiencing infertility. From a personal aspect, there may be a loss of self-esteem and self-confidence, and from a social aspect, stress may be experienced in the marital home, within the extended family, and in various social relationships [2].

It was reported that the frequency of infertility may be getting higher because of the increasing age of marriage, a long period of contraception in early stage of marriage, the frequency of miscarriages, sexual disturbance, an increase in social stress, and the development of diagnosis and treatment for infertility [3].

Low birthrates are a big social problem and the increase in infertile couples may be a factor in low birthrates [4].

As infertility becomes more recognized as a social problem in relation to the decline in domestic fertility rates, various oriental medicine studies on infertility are being conducted. Cho et al [5] reported on clinical reviews of infertile female patients who received oriental medicine at health centers, and Yang et al [6] analyzed studies of infertility using Korean medicine as a treatment. To date there have been no studies which have systematically analyzed the latest trends in infertility treatment using acupuncture.

Therefore, this review analyzed the last decade of research trends in infertility treatment using acupuncture.

### Materials and Methods

#### Data sources and searches

This review was based on studies, retrieved from national and international electronic databases (PubMed, EMBASE, NDSL, OASIS and KISS), which were published from January 2010 to August 2021. The search was conducted using the search terms

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“infertility,” “sterility,” “acupuncture,” “electroacupuncture,” “bloodletting,” and “pharmacopuncture” (Fig. 1).

### Data selection

Using the title of the study, this review was conducted on the original text which included: (1) infertility; (2) acupuncture; and (3) clinical data including the gender of the patient (which was not limited when selecting the original text).

When selecting the original text: (1) original text which was not related to infertility or acupuncture treatment; (2) animal experiments; (3) original text related to clinical research/comparative research/case reports (4) original texts written in foreign languages other than English and Chinese were excluded from the study. Among the original texts, in vitro fertilization-related texts, which were not directly related to symptoms of infertility, were excluded because they were judged to be inconsistent with the direction of this study. From the entire content of the original text selected through the first screening work: (1) the original text without the overall content; (2) the original text not related to infertility acupuncture treatment was excluded from the study.

### Data analysis

The frequency and distribution of each item was summarized in a table and where necessary, the overall distribution was plotted in a graph and tables and graphs were prepared using Excel 2019 (Microsoft Corp., Redmond, WA, USA).

### Results

The list of 18 studies to be analyzes are shown in Table 1.

#### Classification according to the cause of infertility

The results of analyzing infertility treatment studies using acupuncture according to the cause of infertility are shown in Table 2, Fig. 2.

#### Classification according to treatment method

The results of analyzing infertility treatment studies that used acupuncture, according to the acupuncture treatment method are shown in Table 3. It was divided into a single acupuncture group, a parallel group with acupuncture and other herbal treatments, and a parallel group with Western medicine. When the study was divided into 2 or more groups it was divided based on the group that combined the most treatments.

#### List of acupoint used according to the cause of infertility and treatment method

The results of analyzing acupoints used in infertility treatment studies using acupuncture according to the cause and treatment method of infertility are shown in Table 4.

#### Top 5 usage acupoints used according to the cause of infertility

The results of analyzing the most commonly used acupoint according to the cause of infertility in infertility treatment studies using acupuncture are shown in Table 5.

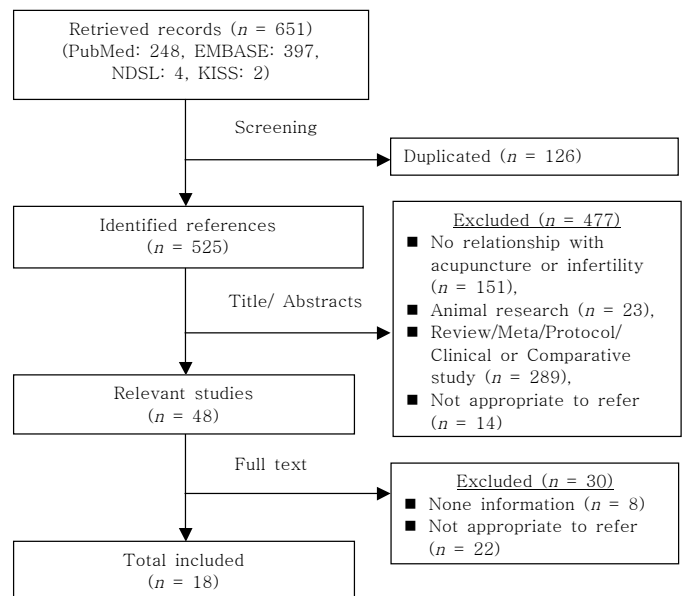


Fig. 1. Reference flow chart.

### Discussion

Infertility can be defined as the condition in which a woman cannot become pregnant despite having a normal married life for about 1 year. Not being able to become pregnant continuously who have not pregnant in the past, was called primary infertility, and if a couple had conceived experience but was not pregnant even a year after the miscarriage or delivery, it was called secondary infertility [7].

In Korea, the number of patients claiming health insurance due to infertility increased by 4.2% annually from 162,000 in 2008 to 191,000 in 2012 [8]. In 2012, the number of patients suffering infertility per 100,000 population by age, was the highest in women aged 30-34 ( $n = 3,658$ ), followed by women aged 35-39 ( $n = 1,920$ ), and women aged 25-29 ( $n = 1,352$ ) [8].

In Western medicine the major cause of infertility is ovulation disorder (15%), followed by oviduct and abdominal abnormalities (30% to 40%), and male factors (30% to 40%), and in some cases the cause is unknown [1]. Infertile patients may receive internal medication, and/or surgical procedures depending on the causes of ovulation disorders, endometriosis, oviduct factors, aging, genetic factors, and cancer status of patients [9].

Oriental medicine puts more emphasis on functional aspects such as uterine deficiency cold, deficiency of Qi and blood, menstrual irregularities, yin deficiency, and Chiljeongsang than on organic aspects such as uterine or ovarian abnormalities [10]. While Western medicine puts more emphasis on the causes and on organic aspects [10]. The cause of male infertility has been reported to be mainly kidney essence deficiency, and it was recognized as stagnation of Qi, dampness-phlegm, blood stasis, damp-heat, and trauma [11].

Research on infertility has been conducted in oriental medicine, as Kwon et al [12] reported in 2006, on studies in the last 3 years,

Table 1. List of Clinical Studies for Infertility.

No.	1st Author [ref]	Study title	Journal	Y
1	You XM [38]	Clinical study on warming-needle moxibustion for infertility patients with thin endometrium.	World Journal of Acupuncture-Moxibustion	2018
2	Yin Y [17]	Clinical therapeutic effects of acupuncture combined with Chinese herbal medicine on infertility of polycystic ovary syndrome in the patients with ovulation induction with letrozole	Chinese acupuncture & moxibustion	2018
3	Tian LY [34]	Different traditional Chinese medicine treatments on Tubal obstructive infertility	World Journal of Acupuncture-Moxibustion	2015
4	Qin W [23]	Effect of acupoint catgut embedding therapy combined with Chinese medicine for nourishing the kidneys and promoting blood circulation and improving blood glucose and lipid levels as well as the pregnancy rate in obese PCOS patients with infertility	Exp Ther Med	2016
5	Lin QP [21]	Effect of electroacupuncture combined with ginger-isolated moxibustion on endometrial receptivity in infertile patients with polycystic ovarian syndrome	World Journal of Acupuncture-Moxibustion	2021
6	El-Shamy FF [25]	Effectiveness of Laser Acupoints on Women with Polycystic Ovarian Syndrome: A Randomized Controlled Trial	J Lasers Med Sci	2018
7	Yu L [20]	Therapeutic effects on ovulation and reproduction promotion with acupuncture and clomiphene in polycystic ovary syndrome	Chinese acupuncture & moxibustion	2018
8	Zheng C [35]	Therapeutic effects on infertility of ovulation failure in the patients with kidney deficiency treated with abdominal acupuncture and periodic therapy of Chinese herbal medicine	Chinese acupuncture & moxibustion	2019
9	Zhuo Y [14]	The "regulating conception-governor vessel" acupuncture method for infertility of polycystic ovarian syndrome	Chinese acupuncture & moxibustion	2016
10	Ma H [15]	Flying needling therapy combined with clomiphene for ovulation failure in polycystic ovary syndrome: a randomized controlled trial	Chinese acupuncture & moxibustion	2016
11	Jiang D [18]	Infertility in polycystic ovary syndrome treated with acupuncture and clomiphene: a randomized controlled trial	Chinese acupuncture & moxibustion	2015
12	Xu J [16]	Efficacy of acupuncture as adjunctive treatment on infertility patients with polycystic ovary syndrome	Chinese acupuncture & moxibustion	2018
13	Wxu MB [30]	Comparative observation of the effect of electroacupuncture combined with heat-sensitive moxibustion and Western medicine for premature ovarian failure	World Journal of Acupuncture-Moxibustion	2017
14	Ketabchi AA [41]	The effects of acupuncture treatment in infertile patients with clinical varicocele	Nephro-Urology Monthly	2018
15	Kucuk EV [42]	Randomised clinical trial of comparing effects of acupuncture and varicocelectomy on sperm parameters in infertile varicocele patients	Andrologia	2016
16	Rouhani M [28]	Efficacy of a persian herbal remedy and electroacupuncture on metabolic profiles and anthropometric parameters in women with polycystic ovary syndrome: A randomized controlled trial	Galen Medical Journal	2019
17	Li WD [31]	Premature ovarian failure treated with acupoint catgut implantation and artificial periodic therapy: a randomized controlled trial	Chinese acupuncture & moxibustion	2014
18	Budihastuti UR [19]	Electroacupuncture Effect on Polycystic Ovary Syndrome to Improve Oocytes' Growth	Medical Acupuncture	2019

she described the success in infertility treatments which are published every year in overseas journals through cooperation with oriental medicine and Western medicine [12]. The combination of pycological treatment in oriental medicine was reported to be helpful in continuing infertility treatment, so it is necessary to study oriental medicine infertility treatment more systematically in the future [12].

In this review, studies on acupuncture research for infertility published in the last decade were analyzed in order to present the direction of acupuncture research to help acupuncture treatment of infertility in the future.

There were 18 infertility studies selected for analysis according to

the cause and treatment method of infertility. Acupoint used based on this were analyzed according to the cause, and most commonly used in infertility treatment.

In the study of infertility treatment using acupuncture, polycystic ovarian syndrome (PCOS) was the most common cause of infertility, followed by premature ovarian failure (POF), varicocele, tubal obstruction, ovulation failure, and thin endometrium (Fig. 2). Considering that male factors account for 30-40% of the causes of infertility [1], studies on male infertility are needed in the future.

As a result of analyzing infertility treatment studies using acupuncture according to the treatment method (Table 3), the types of acupuncture used were acupuncture, electroacupuncture,

Table 2. Basic Classification of the Condition/Disease.

Classification	N	%
Polycystic Ovary Syndrome	338	63
Premature Ovarian Failure	73	14
Infertility- tubal obstructive	35	6
Infertility- ovulation failure	27	5
Infertility- thin endometrium	20	4
Male infertility- varicocele	41	8
Total	534	100

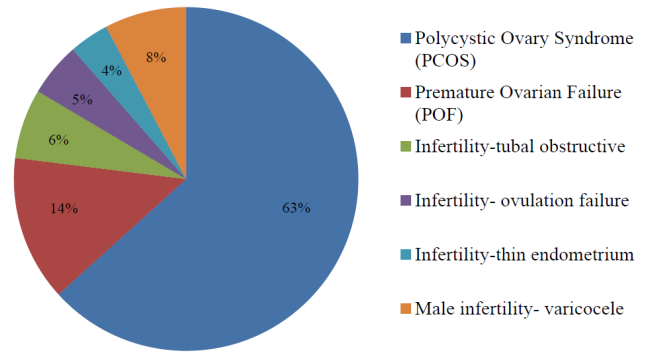


Fig. 2. Basic classification of condition/disease.

Table 3. Classification of Treatment Methods for Infertility.

Classification	Treatment (type)	Method [ref]	N	
Polycystic Ovary Syndrome	Single treatment (KM)	AC [14]	50	
		EA [19]	22	
		LA [25]	13	
	Combined treatment (KM)	CGE-HM [23]	19	
		AC-WM [15,16]	59	
		EA-WM [20]	40	
		Combined treatment (KM & WM)	AC-EA-MX-WM [21]	35
	Premature Ovarian Failure	Combined treatment (KM)	AC-EA-HM-WM [17,18]	60
			AC-WN-HM-WM [18]	40
		Combined treatment (KM & WM)	AC-EA-MX [30]	40
Infertility- tubal obstructive	Combined treatment (KM)	CGE-WM [31]	33	
		AC-MX [34]	35	
Infertility- ovulation failure	Combined treatment (KM)	AC-HM [35]	27	
Infertility- thin endometrium	Combined treatment (KM)	EA-WN [38]	20	
Male infertility- varicocele	Single treatment (KM)	AC [41,42]	41	
Total	-	-	534	

AC, acupuncture; CGE, catgut embedding; EA, electroacupuncture; HM, herbal medicine; KM, Korean medicine; LA, laser acupuncture; MX, moxibustion; WM, western medication; WN, warm needle.

and laser acupuncture. In addition to acupuncture, studies were conducted in parallel with moxibustion, herbal medicine, and Western medicine. There were 3 studies on the use of acupuncture alone, including varicocele, 1 case with electroacupuncture alone, and 1 case with laser acupuncture alone. Other than that, in most

cases, various herbal treatments, and Western medicine were used in parallel. However, in the case of varicocele, which is the cause of male infertility, there are only studies using acupuncture alone, so it is thought that studies using various oriental medicine treatments for male infertility are needed in the future.

Table 4. Classification of Acupoints for Infertility.

Classification	Method [ref]	Acupoints
PCOS	AC [14]	GV2, GV3, GV4, CV3, CV4, CV6, CV12
	EA [19]	LI4, ST29, ST36, SP6, CV3, CV6
	LA [25]	ST29, SP6, CV4, CV5
	AC-EA-MX-WM [21]	Menstrual: LI4, ST29, SP6, LR3, EX-CA1(AC); ST29, EX-CA1(EA); Follicular: ST36, KI3, KI12, CV6, Ovary(Extra)(AC); CV4, CV8(MX); ST36, SP6, KI12, Ovary(Extra)(EA); Ovulatory: LI4, SP6, SP10, GB27, LR3, CV3, Ovary(Extra)(AC); SP6, SP10, GB27, CV3, CV6, Ovary(Extra)(EA); Luteal: ST36, SP6, SP10, KI3, EX-CA1(AC); CV4(MX); ST36, SP10, EX-CA1(EA)
	CGE-HM [23]	ST36, ST40, SP6, SP10, BL23, CV3, CV4, CV12
	AC-WM [15,16]	ST36, SP6, BL18, BL20, BL21, BL23, CV3, CV4, CV6, CV9, CV12, EX-CA1
	EA-WM [20]	SP6, SP8, BL22, BL23, BL32, KI12, CV3, CV4, CV6, EX-CA1
	AC-EA-HM-WM [17,28]	LI4, ST21, ST25, ST28, ST29, ST36, ST40, SP6, SP9, SP10, LR13, CV3, CV4, CV6, CV12, EX-CA1(AC); ST25, ST28, ST36, LR13(EA)
AC-WN-HM-WM [18]	ST29, ST36, SP6, SP10, CV3, CV12, EX-CA1(AC); ST29, CV3, CV12(WN)	
POF	AC-EA-MX [30]	SP6, SP10, BL17, BL18, BL20, BL23, BL32, LR3, CV4, EX-CA1(AC); SP10, BL18, BL23, EX-CA1(EA); BL17, BL23(MX)
	CGE-WM [31]	(Main) ST36, SP6, PC6, CV12; (Additional) ST40, BL20, BL21, BL23, BL26, BL32, GV4, CV3, CV6, CV7, EX-CA1
tubal obstructive	AC-MX [34]	KI13, KI14, KI15, CV3, CV4, CV6, CV7
ovulation failure	AC-HM [35]	ST28, ST29, KI13, CV4, CV6, CV10, CV12
thin endometrium	EA-WN [38]	ST36, SP6, GB26, GV20, CV3, CV4, CV6, EX-CA1 (EA); ST29, SP8, CV4, CV6, EX-CA1, (WN)
Male infertility- varicocele	AC [41,42]	ST29, BL23, BL32, CV3, CV4, CV6

AC, acupuncture; CGE, catgut embedding; EA, electroacupuncture; HM, herbal medicine; KM, Korean medicine; LA, laser acupuncture; MX, moxibustion; WM, western medication; WN, warm needle; PCOS, polycystic ovary syndrome; POF, premature ovarian failure.

Table 5. Top 5 Usage Acupoints in Treatment for Various Type of Infertility.

No.	PCOS	n	POF	n	IF	n	VA	n
1	SP6, CV4	9/11	SP6	2/2	CV6	3/3	ST29	2/2
2	CV3, CV6	7/11	BL20	2/2	CV4	3/3	BL23	2/2
3	ST36, EX-CA1	6/11	BL23	2/2	CV3	2/3	BL32	2/2
4	ST29	5/11	BL32	2/2	KI13	2/3	CV3	2/2
5	SP10, BL23, CV12	4/11	EX-CA-1	2/2	ST29	2/3	CV4, CV6	2/2

IF, infertility; PCOS, polycystic ovary syndrome; POF, premature ovarian failure; VA, varicocele.

PCOS is 1 of the most common endocrine abnormalities in women of childbearing age and is a complex syndrome caused by functional abnormalities in the hypothalamus-pituitary gland-ovarian axis, and adrenal glands. It refers to a series of symptoms such as menstrual disorders such as oligomenorrhea, amenorrhea,

anovulation, infertility, hirsutism, and ovarian features with polycystic findings [13].

Zhuo et al [14] reported that endometrial thickness increased in the group treated with acupuncture compared with the group taking clomiphene ( $p < 0.01$ ), and that the ovulation rate was

significantly improved [88.0% in the acupuncture group compared with 70.0% in the group taking clomiphene group ( $p < 0.05$ )]. Ma et al [15] reported that the treatment rate for ovulation disorder was 69.6% in the group taking clomiphene, 66.7% in the acupuncture group, and 86.2% in the group taking clomiphene + acupuncture group, so clomiphene + acupuncture treatment groups had significantly higher treatment rates ( $p < 0.05$ ). The acupuncture group and the acupuncture + clomiphene treatment group had fewer side effects ( $p < 0.05$ ). Xu et al [16] reported that in the group taking clomiphene the ovulation rate was 80.0%, and the clomiphene + acupuncture treatment group was 93.3%, the pregnancy rate was 33.3% in the group taking clomiphene, and 43.3% in the group taking clomiphene + acupuncture treatment. The ovulation rate and pregnancy rate were significantly higher in the group taking clomiphene + acupuncture treatment ( $p < 0.05$ ).

Yin et al [17] reported that the ovulation rate and pregnancy rate after treatment were most successful (in the order) Western medication + herbal medicine + electroacupuncture treatment group, Western medication + herbal medicine group, and Western medication alone group ( $p < 0.05$ , in all groups). In the case of luteinized unruptured follicle, there were no cases in the group using Western medication + herbal medicine + electroacupuncture treatment, 3 cases (7.5%) in the group Western medication + herbal medicine and 5 cases (12.5%) in the group Western medication alone.

Jiang et al [18] reported that endometrial thickness was better in the acupuncture + moxibustion + herbal medicine group, and the clomiphene + acupuncture + moxibustion + herbal medicine group compared with the clomiphene alone group, but there was no difference between the 2 groups ( $p > 0.05$ ). As for the pregnancy rate, the acupuncture + moxibustion + herbal medicine group had the highest rate ( $p < 0.05$ ), and the miscarriage rate was the lowest in the clomiphene + acupuncture + moxibustion + herbal medicine group ( $p < 0.01$ ), it was judged that it was more effective to take both Western medication and oriental treatment including acupuncture than to take Western medication alone.

In the case of using electroacupuncture, Budihastuti et al [19] reported on follicle growth; the group that combined electroacupuncture treatment and lifestyle management had an average follicle measurement of  $16.13 \pm 2.43$  mm which was significantly larger than the group who addressed lifestyle management alone which was  $13.72 \pm 1.20$  mm ( $p = 0.001$ ). Yu et al [20] reported that the ovulation rate and pregnancy rate were higher in the group who received clomiphene + electroacupuncture treatment compared with the group that received clomiphene alone. Lin et al [21] reported that in the case of endometrial thickness, there was a significant difference between the group who received Western medication alone ( $0.14 \pm 0.08$  mm), compared with the group which received Western medication + electroacupuncture + ginger moxibustion treatment ( $0.21 \pm 0.13$  mm;  $p < 0.01$ ). The pregnancy rate was significantly different between the group who received Western medication alone (30.30%) and the group who received Western medication + electroacupuncture + ginger moxibustion treatment (56.25%;  $p < 0.05$ ), and the early miscarriage rate was determined to be significantly lower in the Western medication + electroacupuncture + ginger moxibustion treatment group (10.53%) than in the Western medication alone group (50.00%;  $p < 0.05$ ).

The causes of hyperinsulinemia in patients with PCOS may include genetic factors, or acquired factors, of which obesity is the most important cause. It has been reported that abdominal obesity plays an important role in the pathophysiology of hyperinsulinemia in patients with PCOS [22].

In the case of catgut embedding, Qin et al [23] reported that

the waist-to-hip ratio and body mass index (BMI) were improved in the group who received herbal medicine + catgut embedding, and in the group using catgut embedding alone, compared with the herbal medicine alone group ( $p < 0.05$ ), and there was no significant difference between these 2 groups ( $p > 0.05$ ). In the case of pregnancy rate, it was highest in the herbal medicine + catgut embedding group compared with the other groups in the study ( $p > 0.05$ ). Since most of the Korean studies on research using catgut embedding are focused on the musculoskeletal system, facial paralysis, and plastic surgery [24], research on infertility treatment using catgut embedding is required in the future.

In the case of laser acupuncture, El-Shamy et al [25] reported that the group who received laser acupuncture treatment insulin resistance were significantly reduced than placebo treatment group ( $p < 0.05$ ). But there was no significant change in follicle stimulating hormone (FSH) levels (both,  $p > 0.05$ ).

A method to correct insulin and glucose metabolism by using an agent that increases insulin sensitivity in patients with insulin-resistant polycystic ovary syndrome was reported in a Cochrane Database System Review in 2003 [26]. However, in 2008, even in patients with PCOS whose insulin resistance had not been proven on examination, it has been suggested that use of insulin response improving agent should be considered such as metformin primarily [27].

Rouhani et al [28] reported that in the group who received metformin + electroacupuncture + herbal medicine showed the greatest decrease in body fat and BMI compared with the groups receiving metformin only, metformin + electroacupuncture group and metformin + electroacupuncture + herbal medicine group. High density lipoprotein and low-density lipoprotein decreased in the metformin + electroacupuncture group, and metformin + electroacupuncture + herbal medicine group so it was judged that the combination treatment with acupuncture and oriental medicine treatment could treat metabolic complications and overweight problems better than metformin alone.

POF is a syndrome characterized by amenorrhea accompanied by hypergonadotropin induced hypogonadism before the age of 40, it is divided into primary and secondary POF according to menstrual history [29].

Xu et al [30] reported that the cured and effective rates (due to POF) of the electroacupuncture + heat-sensitive moxibustion group was 72.5% which was superior to that of the Western medication group (37.5%;  $p < 0.05$ ). Li et al [31] reported that the treatment and remarkably effective rates were seen in the Western medication group of 75.8%, and in the catgut embedding + Western medication group 81.8% ( $p < 0.05$ ).

About 30-40% of female infertility is due to oviduct and abdominal factors. Oviduct factors include damage and closure of the oviduct (which is usually accompanied by pelvic inflammatory diseases or previous pelvic or oviduct surgery) [32]. If an obstruction was observed on the hysterosalpingography, a selective hysterosalpingogram can be performed to attempt an opening, because obstruction of the oviduct is a reversible blockage [33].

Tian et al [34] reported that the total effective rate of infertility in the group treated with retention enema + herbal medicine was 45.71%, whilst the group treated with herbal medicine was 77.14%, and the group treated with acupuncture + moxibustion was 85.71%, but there was no statistical difference between the herbal medicine group and the acupuncture + moxibustion group ( $p > 0.05$ ).

Infertility due to ovulation failure refers to infertility caused by a disorder in the ovulation process that occurs when the mature follicle ruptures and the egg is released from the ovary. It is the easiest type of infertility to diagnose and the most treatable

(accounting for 30-40% of female infertility factors) [32].

Zheng et al [35] reported that the ovulation rate was 59.3% in the acupuncture + herbal medicine therapy group, 55.6% in the acupuncture treatment group, and 53.3% in the Western medication group. The difference was not significant between the 3 groups ( $p > 0.05$ ). The endometrial thickness in the periovulatory period significantly increased as compared with the thickness before treatment in the acupuncture + herbal medicine therapy group ( $p < 0.05$ ), and in the acupuncture treatment group ( $p < 0.05$ ). The total effective rate was 88.9% in the acupuncture + herbal medicine therapy group, and was 92.6% in the acupuncture treatment group, which was higher than in the Western medication group which was 56.7% (both,  $p < 0.01$ ). There was no adverse reaction in the acupuncture + herbal medicine therapy group and the acupuncture treatment group.

The incidence of infertility due to uterine factors is approximately 5-10% [32], it is thought that there is the most appropriate endometrial thickness for implantation and endometrial thickness for implantation affects the pregnancy rate [36].

If the thickness of the endometrium before ovulation was less than 6 mm, pregnancy would be impossible, and if the thickness is less than 8 mm, the possibility of preclinical miscarriage increases, and the shape of the endometrium on ultrasound is related to whether or not pregnancy has established [37].

You et al [38] reported that the average endometrial thickness in the electroacupuncture + warm-needle moxibustion group increased from  $5.23 \pm 1.57$  mm to  $8.31 \pm 2.80$  mm after treatment, while the average endometrial thickness in the Western medication group increased from  $5.27 \pm 0.99$  mm to  $8.32 \pm 1.97$  mm after treatment, and the difference were statistically significant in both groups ( $p < 0.05$ ). After treatment for 3 menstrual cycles, the pregnancy rate of those who received electroacupuncture + warm-needle moxibustion was 25%, and in the Western medication group it was 15%.

There are several causes of male infertility, but varicocele is relatively common in men, especially young men [39]. Varicocele can cause male infertility by causing hormonal dysfunction, increased testicular temperature, regurgitation of toxic metabolites in the adrenal or kidneys, and testicular hypoxia. Surgical correction through varicocelectomy using microsurgery can reduce DNA damage in the sperm nucleus, as well as improve other indicators of semen analysis [40].

Ketabchi et al [41] reported that the acupuncture treatment group had a significant increase in the percentage of normal-shaped and motility sperm in comparison with the control group. Pregnancy rates in the acupuncture treatment group was significantly better than control group. Kucuk et al [42] reported that sperm concentration and motility improved significantly in the subinguinal microscopic varicocelectomy group, and the acupuncture treatment group after treatment. The increase in sperm concentration was higher in the acupuncture treatment group compared with the subinguinal microscopic varicocelectomy group ( $p = 0.039$ ).

The most commonly used acupoint for each cause of infertility are as follows: SP6, CV4, CV3, CV6, ST36, EX-CA1, ST29, SP10, BL23, CV12 for PCOS, SP6, BL20, BL23, BL32, EX-CA1 for POF, CV6, CV4, CV3, KI13, ST29 for remaining causes of infertility, ST29, BL23, BL32, CV3, CV4, VC6 for varicocele (Table 5).

Among the most commonly used acupoint CV4, CV3, CV6, SP6, and BL23 were used the most, and KI13 was also widely used. So, the function of the uterus is dominated by Ren channels and Chong channels, and is dominated not only by the heart but also by the Foot-three Yin meridians (spleen, liver, kidney) [43] can be inferred from the point of view.

We determined that the treatment effect for infertility significantly improved in the group using acupuncture treatment compared with the control group, or the group taking Western medicine alone, but there was a limitation in that there were more cases of using an acupuncture, moxibustion and herbal medicine combination of treatments than cases of using acupuncture alone.

In addition, considering that studies have been conducted focusing on PCOS among the causes of infertility, more diverse studies on infertility, and active studies on male infertility are needed in the future.

## Conclusion

The final 18 papers related to infertility were analyzed to find out the research trends of infertility treatment using acupuncture from January 2010 to August 2021 and to help set future research directions.

1. As a result of analyzing infertility studies that used acupuncture according to the cause of infertility, PCOS was the most frequent, followed by POF, varicocele, tubal obstruction, ovulation failure, and thin endometrium.

2. In infertility treatment studies using acupuncture, the treatment effect for infertility was significantly improved in the group using acupuncture treatment compared with the control group, or the group taking Western medicine alone. In some studies, the group using acupuncture treatment did not show side effects.

3. The most commonly used acupoint in infertility studies using acupuncture were CV4, CV3, CV6, SP6, and BL23.

## Conflicts of Interest

Ho Sueb Song has been the editor in chief of Journal of Acupuncture Research since April 2011, but had no role in the decision to publish this original article. No other potential conflict of interest relevant to this article was reported.

## Ethical Statement

This research did not involve any human or animal experiment.

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