International Journal of Community Medicine and Public Health
Alkhamis FH. Int J Community Med Public Health. 2024 Nov;11(11):4423-4431
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040
DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20242995

Meta-Analysis

Assessment of the effect of using intrauterine platelet-rich-plasma on the success of assisted reproduction: a systematic review and meta-analysis of randomized controlled trials

Fatimah Hussain Alkhamis*

Department of Obstetrics and Gynecology, King Faisal University, Alhsa, Saudi Arabia

Received: 07 September 2024
Accepted: 01 October 2024

***Correspondence:**
Dr. Fatimah Hussain Alkhamis,
E-mail: Falkhamis@kfu.edu.sa

ABSTRACT

Intrauterine administration of platelet-rich-plasma (PRP) has shown potential in improving pregnancy outcomes in assisted reproductive technology (ART). However, the efficacy of PRP in enhancing clinical pregnancy and live birth rates remains a topic of debate. This meta-analysis evaluated the effectiveness of intrauterine PRP administration in improving clinical pregnancy and live birth rates. A systematic search of electronic databases was conducted to identify randomized controlled trials (RCTs) comparing intrauterine PRP administration with control in women undergoing ART. The primary outcomes were clinical pregnancy rates and live birth rates. Data were extracted and pooled using a random-effects model to calculate odds ratios (ORs) with 95% confidence intervals (CIs). Heterogeneity was assessed using the I^2 statistic. Nineteen RCTs involving 1,918 participants were included for clinical pregnancy rates, and six RCTs involving 777 participants were included for live birth rates. The pooled OR for clinical pregnancy rates was 2.49 (95% CI: 1.84, 3.35), indicating a significant improvement in the PRP group. For live birth rates, the pooled OR was 3.28 (95% CI: 1.18, 9.09), also favouring the PRP group. Moderate heterogeneity was observed for clinical pregnancy rates (I^2=43%), while substantial heterogeneity was observed for live birth rates (I^2=77%). Funnel plots showed no significant publication bias for either outcome. Intrauterine PRP administration significantly improves clinical pregnancy and live birth rates in women undergoing ART. The pooled ORs of 2.49 for clinical pregnancy rates and 3.28 for live birth rates support the potential clinical utility of PRP in enhancing ART outcomes.

Keywords: PRP, ART, Clinical pregnancy rates, Live birth rates, Meta-analysis

INTRODUCTION

Infertility, defined as the inability to conceive after one year of unprotected intercourse, affects approximately 10-15% of couples worldwide, creating a significant psychological and economic burden for those affected.[1,2] ART has revolutionized the management of infertility, offering hope to many couples. However, despite advances in ART, success rates remain suboptimal, with clinical pregnancy rates and live birth rates not meeting expected outcomes for many patients. This has led to ongoing research and development of adjunctive therapies aimed at improving these success rates.[3,4]

One such adjunctive therapy that has garnered considerable interest in recent years is PRP. PRP is an autologous concentration of platelets in a small volume of plasma, derived from the patient's own blood. Platelets are rich in growth factors and cytokines that play critical roles in tissue repair, angiogenesis, and inflammation modulation.[5] These properties have been leveraged in various medical fields, including orthopedics, dermatology, and dentistry, for enhancing tissue regeneration and healing. The potential of PRP to improve endometrial receptivity and enhance ART outcomes has prompted researchers to explore its application in reproductive medicine.[5,6]

The biological basis for PRPs use in infertility treatment lies in its ability to promote cellular proliferation, angiogenesis, and tissue remodeling. The endometrium, a dynamic tissue that undergoes cyclical changes in response to hormonal stimuli, is crucial for successful embryo implantation and pregnancy.[6,7] In some cases, particularly in women with thin endometrium or recurrent implantation failure (RIF), the endometrial environment may be suboptimal for implantation. By introducing PRP into the uterine cavity, it is hypothesized that the growth factors contained in PRP can enhance endometrial thickness, improve blood flow, and create a more favorable environment for embryo implantation.[6-8]

Several small-scale studies and case series have reported promising results with intrauterine PRP administration, suggesting improved endometrial thickness and higher pregnancy rates in women undergoing ART. However, these findings have been inconsistent, and the evidence remains inconclusive due to the variability in study designs, PRP preparation protocols, and patient populations. Moreover, the mechanisms through which PRP exerts its effects on the endometrium are not fully understood, necessitating further research to elucidate these pathways.[7,9,10]

A critical factor influencing the effectiveness of PRP therapy is the preparation method. Various techniques exist for PRP preparation, leading to differences in platelet concentration, the presence of leukocytes, and the overall quality of the PRP product.[11] These variations can significantly impact the biological activity of PRP and, consequently, its clinical efficacy. Standardizing PRP preparation methods and understanding the optimal concentration and composition for reproductive applications are essential for advancing this therapeutic modality.[10-12]

The potential benefits of PRP extend beyond clinical pregnancy rates. Improving live birth rates, reducing miscarriage rates, and enhancing overall reproductive outcomes are key objectives in reproductive medicine.[13,14] By systematically reviewing and analyzing the existing literature, it is possible to identify trends, highlight gaps in knowledge, and provide recommendations for future research. The primary aim of this meta-analysis is to systematically evaluate the efficacy of intrauterine PRP administration in enhancing clinical pregnancy rates and live birth rates in women undergoing ART.

METHODS

This systematic review and meta-analysis adhered to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines.[15] We conducted a thorough search of existing literature to identify RCTs evaluating the effect of intrauterine PRP administration on the success of ART outcomes. The study design was structured to ensure a rigorous, transparent, and reproducible synthesis of the evidence.

Data sources and search strategy

An extensive search of electronic databases, including PubMed, Web of Science, Scopus, Medline, the Cochrane Library, and Google Scholar, was conducted. The search was designed to capture all relevant studies up to the cut-off date. Search terms included combinations of "platelet-rich plasma," "PRP," "intrauterine," "assisted reproduction," "ART," "IVF," "clinical pregnancy," "live birth," and "randomized controlled trials." Additionally, reference lists of retrieved articles were manually searched to identify any studies that might have been missed in the initial search.

The selection process involved two phases: title and abstract screening followed by full-text review. Initially, duplicates were removed, and the remaining titles and abstracts were screened independently by two reviewers to assess their eligibility based on predefined inclusion criteria. Studies were included if they were RCTs comparing intrauterine PRP administration with a control (placebo or no treatment) in women undergoing ART. Studies focusing on other interventions or non-randomized studies were excluded. Disagreements during the screening process were resolved through discussion or consultation with a third reviewer.

Data extraction was performed independently by two reviewers using a standardized data extraction form. Extracted data included study characteristics (authors, year of publication, country, study duration), participant characteristics (sample size, age, BMI), intervention details (PRP preparation and administration), and outcomes (clinical pregnancy rates, live birth rates). Where necessary, authors of included studies were contacted for additional information or clarification of data.

Statistical analysis

The primary outcomes of interest were clinical pregnancy rates and live birth rates. Results were synthesized and presented in narrative form and supported by forest plots for quantitative data. Data analyses were conducted using review manager (RevMan) software, version 5.4 (The Cochrane collaboration). Pooled ORs with 95% CIs were calculated using a random-effects model, which accounts for variability both within and between studies. Heterogeneity among studies was assessed using the I^2 statistic, with I^2 values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. A p value of less than 0.10 was considered indicative of significant heterogeneity.

Publication bias was assessed using funnel plots. A symmetrical funnel plot indicates the absence of publication bias, while an asymmetrical plot suggests the presence of publication bias. No ethical approval is required for this type of studies as we used secondary data only.

RESULTS

The initial database search yielded 497 records from PubMed, Web of Science, Scopus, Medline, the Cochrane Library, and Google Scholar. After removing 204 duplicates, 293 records were left for title and abstract screening. During this phase, 241 records were excluded based on the predefined inclusion and exclusion criteria. Consequently, 52 full-text articles were sought for retrieval, but 2 were not obtained. Therefore, 50 articles were assessed for eligibility, leading to the exclusion of 31 articles due to various reasons such as not meeting the inclusion criteria or insufficient data. Ultimately, 19 RCTs were included in the quantitative synthesis of this meta-analysis (Figure 1).

Characteristics and findings of the included studies

The characteristics and findings of the included studies are summarized in Table 1. The included studies spanned multiple countries, with a significant number conducted in Iran, reflecting regional interest in the potential benefits of PRP in assisted reproduction. Other studies were from Saudi Arabia, Egypt, Russia, and Bahrain, illustrating a diverse geographical representation. The study durations varied, typically ranging from one to four years. For instance, Abduljabbar et al conducted their study from 2020 to 2021 in Saudi Arabia, while Nazari et al spanned from 2018 to 2020 in Iran.[16,26]

Sample sizes also showed variability across the studies. The PRP group sample sizes ranged from 11 in Pourkaveh et al to 196 in Nazari et al with corresponding control group sizes ranging from 9 to 197.[26,29] Age distribution was generally similar across the studies, with mean ages typically in the early to mid-30s. For example, Baybordi et al reported a mean age of 37.33±6.44 years in the PRP group and 32.41±5.65 years in the control group, while Dawood reported mean ages of 30.5±3.4 and 29.6±2.9 years, respectively.[19,20]

BMI was reported in several studies, indicating generally comparable distributions between the PRP and control groups. For instance, Baybordi et al found mean BMIs of 26.64±3.30 in the PRP group and 26.86±3.63 in the control group.[19] Similarly, Nazari et al reported mean BMIs of 24.73±3.53 and 25.19±3.01, respectively.[26]

Clinical pregnancy rates varied significantly among studies. Abduljabbar et al reported clinical pregnancy rates of 34.3% in the PRP group compared to 14.3% in the control group.[16] Similarly, El-Samman et al observed rates of 45.8% vs 22.9%.[22] Live birth rates, when reported, also showed favorable outcomes for the PRP group. For instance, Safdarian et al found live birth rates of 58.3% in the PRP group compared to 28.3% in control group.[31] Overall, these findings suggest a positive impact of PRP on both clinical pregnancy and live birth rates.

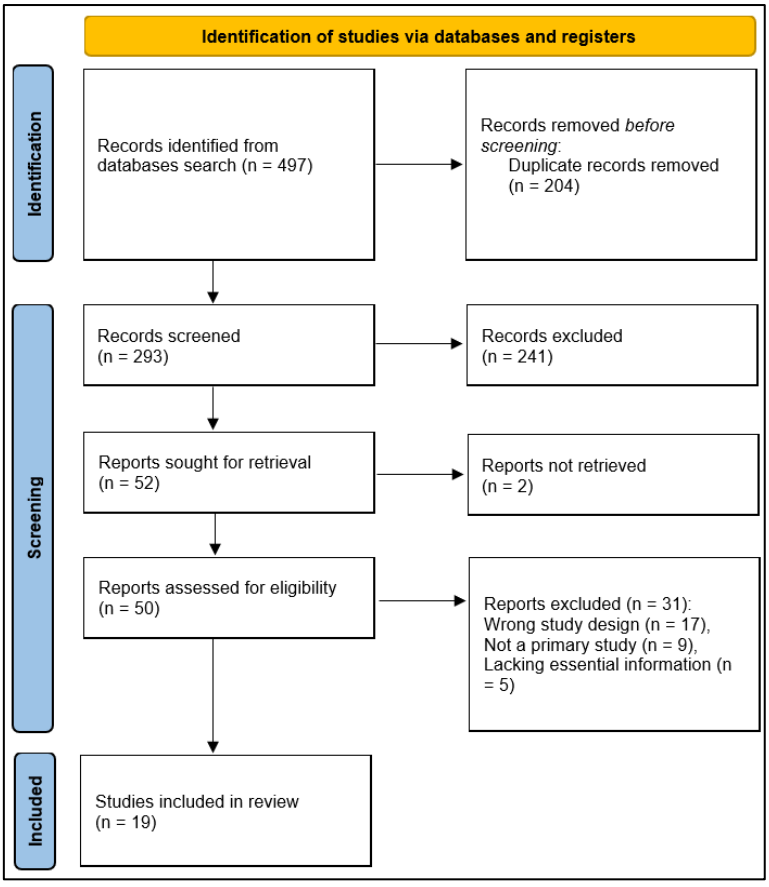

Figure 1: PRISMA flow diagram for summary of the records screening process.

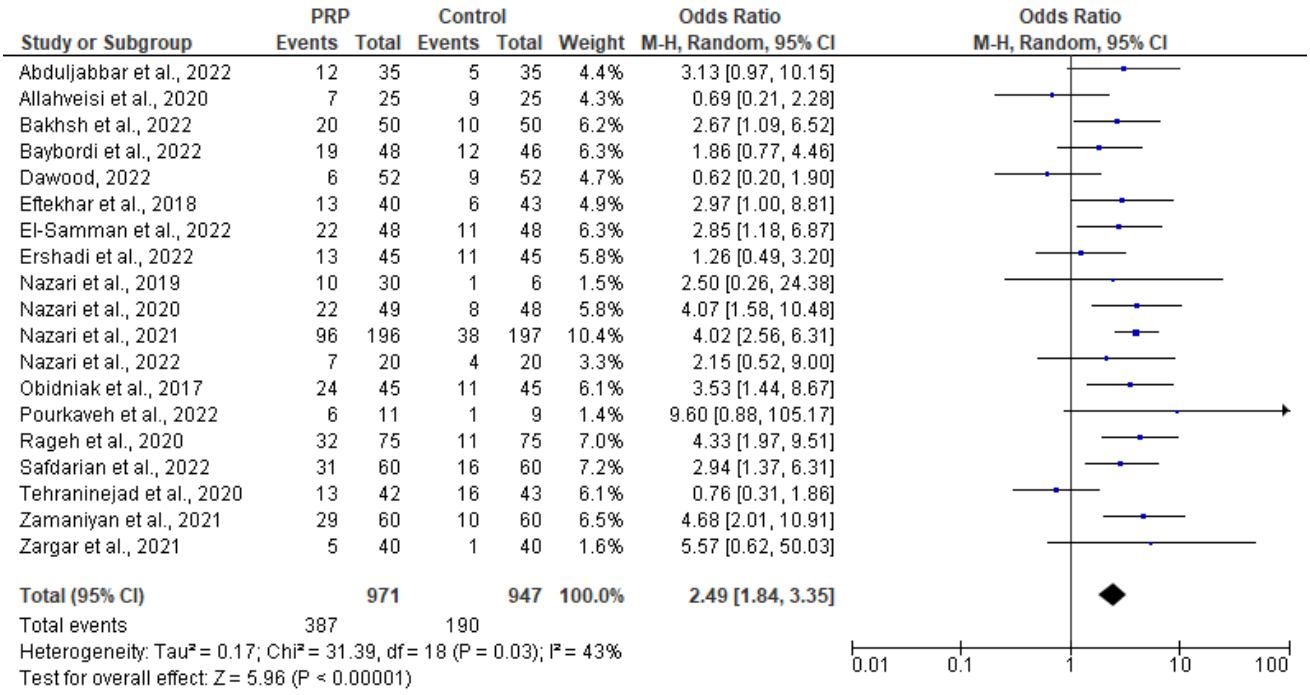

Figure 2: Forest plot comparing clinical pregnancy rates among PRP group versus controls.

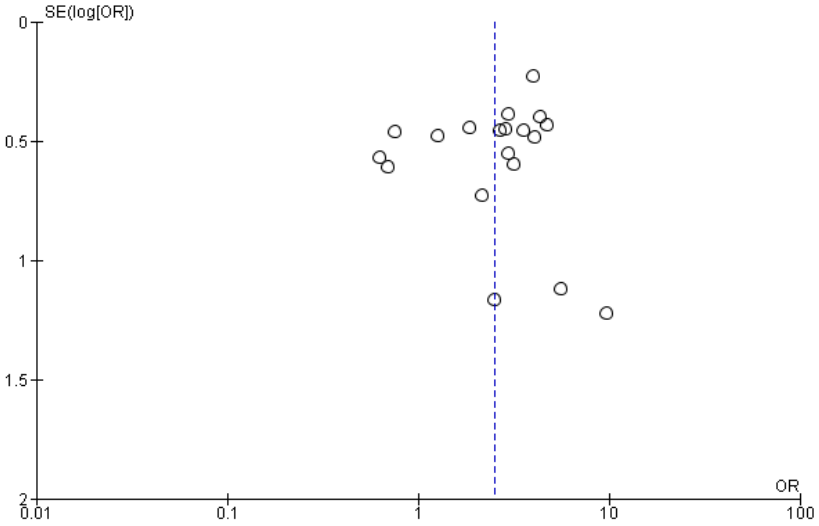

Figure 3: Funnel plot for records comparing clinical pregnancy rates among PRP group versus controls.

Quantitative data synthesis

Clinical pregnancy rates

The clinical pregnancy rates between the PRP group and the control group are summarized in the forest plot in Figure 2. The analysis included data from 19 studies, with 971 participants in the PRP group and 947 in the control group. The meta-analysis revealed a statistically significant higher clinical pregnancy rate in the PRP group compared to the control group, with an overall OR of 2.49 (95% CI: 1.84, 3.35). The heterogeneity among the studies was moderate, with an I^2 of 43%, indicating some variability in the effect estimates across the studies.

Notable findings include Nazari et al who reported 96 clinical pregnancies out of 196 in the PRP group compared to 38 out of 197 in the control group, resulting in an OR of 4.02 (95% CI: 2.56, 6.31).[26] Similarly, Pourkaveh et al showed an OR of 9.60 (95% CI: 0.88, 105.17) despite a smaller sample size.[29] Contrarily, Dawood found no significant difference, with an OR of 0.62 (95% CI: 0.20, 1.90).[20] The overall effect, supported by a Z value of 5.96 ($p<0.00001$), strongly favors the PRP group.

Funnel plot for clinical pregnancy rates

The funnel plot for clinical pregnancy rates (Figure 3) demonstrates a symmetrical distribution of the studies, suggesting the absence of publication bias. This symmetrical distribution supports the reliability and validity of the meta-analysis findings, as it implies that the effect sizes are not significantly influenced by selective reporting or other biases.

Live birth rates

The live birth rates between the PRP group and the control group are detailed in the forest plot in Figure 4. This analysis included data from six studies, with 389 participants in the PRP group and 388 in the control group. The overall effect estimate indicated a statistically significant higher live birth rate in the PRP group compared to the control group, with an OR of 3.28 (95% CI: 1.18, 9.09). However, substantial heterogeneity was observed (I^2=77%), indicating considerable variability among the studies.

For example, Nazari et al reported 77 live births out of 196 in the PRP group compared to 11 out of 197 in the control group, with an OR of 10.94 (95% CI: 5.59, 21.43).[26] Safdarian et al showed an OR of 3.54 (95% CI: 1.65, 7.58), indicating a significant positive effect of PRP.[31] In contrast, Allahveisi et al found no significant difference, with an OR of 0.81 (95% CI: 0.23, 2.88).[17] Despite the high heterogeneity, the pooled analysis confirmed the beneficial effect of PRP on live birth rates, as evidenced by a Z value of 2.28 (p=0.02).

Funnel plot for live birth rates

The funnel plot for live birth rates (Figure 5) shows a symmetrical distribution, suggesting no evidence of publication bias. The studies are evenly dispersed around the mean effect size, reinforcing the credibility of the meta-analysis findings. This symmetry implies that the observed effect sizes are representative of the true effect and are not skewed by selective reporting or other biases.

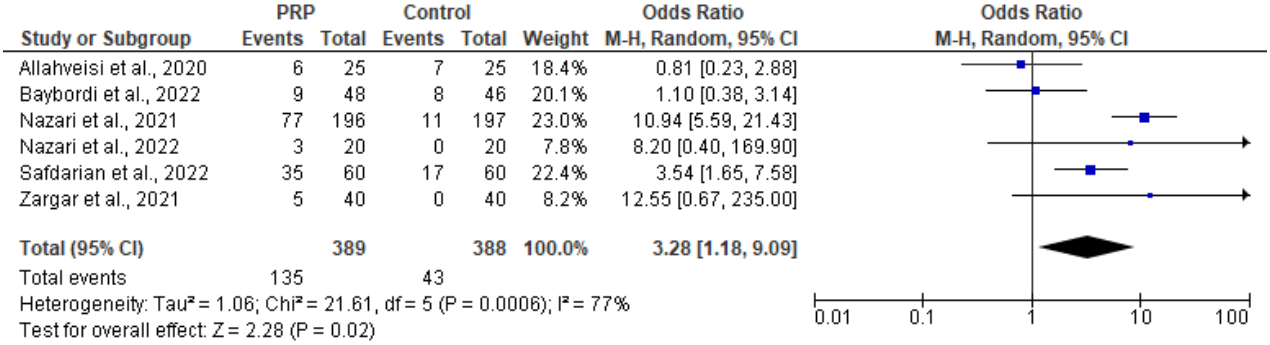

Figure 4: Forest plot comparing live birth rates among PRP group versus controls.

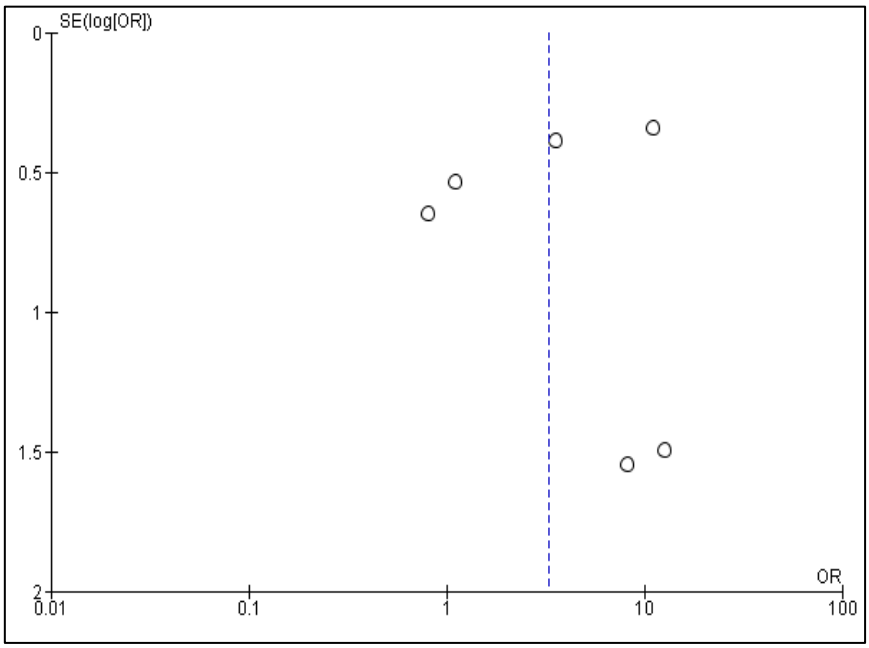

Figure 5: Funnel plot for records comparing live birth rates among PRP group versus controls.

Table 1: Characters and outcomes of the included RCTs, (n=19).

Study	Country	Duration	sample size (PRB)	Sample size (Control)	Age group (PRB) (in years)	Age group (Control) (in years)	BMI (PRB)	BMI (Control)	Clinical pregnancy rate (PRP)	Clinical pregnancy rate (Control)	Live birth rate (PRP)	Live birth rate (Control)
Abduljabbar et al, 2022[16]	Saudi Arabia	2020-2021	35	35	35.9±4.5	34.6±4.3	NR	NR	34.3%	14.3%	NR	NR
Allahveisi et al ,2020[17]	Iran	2018-2019	25	25	33±0.9	33.8±0.5	26±0.5	25.8±0.5	28.0%	36.0%	24.0%	28.0%
Bakhsh et al, 2022[18]	Iran	NR	50	50	35	32.7	25.3	25.9	40.0%	20.0%	NR	NR
Baybordi et al, 2022[19]	Iran	2017-2019	48	46	37.3±6.4	32.4±5.7	26.6±3.3	26.9±3.6	39.6%	26.1%	18.8%	17.4%
Dawood, 2022[20]	Egypt	2018-2021	52	52	30.5±3.4	29.6±2.9	25.2 (23.5-28.4)	27.7 (25-29.7)	11.5%	17.3%	NR	NR
Eftekhar et al, 2018[21]	Iran	2016-2017	33	33	32±2.2	32.4±2.6	NR	NR	32.5%	14.0%	NR	NR
El-Samman et al, 2022[22]	Egypt	2019-2021	48	48	29.6±0.5	28.4±0.7	24.6±0.6	25.6±0.5	45.8%	22.9%	NR	NR
Ershadi et al, 2022[23]	Iran	2019	45	45	31.3±4.3	31.2±4.8	26.5±3.2	27.7±3	28.9%	24.4%	NR	NR
Nazari et al, 2019[24]	Iran	2016-2017	30	30	34±2.8	32.3±4.8	24.3±2.2	25.5±2.7	33.3%	16.7%	NR	NR
Nazari et al, 2020[25]	Iran	2016-2017	49	48	35.4±3.5	35±4.2	25.6±3.1	25.5±2.7	44.9%	16.7%	NR	NR
Nazari et al, 2021[26]	Iran	2018-2020	196	197	34.1±3.8	33.6±4.0	24.8±3.5	25.1±3.0	49.0%	19.3%	39.3%	5.6%
Nazari et al, 2022[27]	Iran	2019-2020	20	20	35.7±5.1	34.8±4.6	26.4±3.4	26.6±4.2	35.0%	20.0%	15.0%	0.0%
Obidniak et al, 2017[28]	Russia	NR	45	45	NR	NR	NR	NR	53.3%	24.4%	NR	NR
Pourkaveh et al, 2022[29]	Iran	2018	11	9	35.1±2.1	34.7±2	23.1±1.3	23.1±2.1	54.5%	11.1%	NR	NR
Rageh et al, 2020[30]	Bahrain	2018-2019	75	75	29.3±3.5	29.9±4.0	26.7±1.1	26.6±1.1	42.7%	14.7%	NR	NR
Safdarian et al, 2022[31]	Iran	2017-2020	60	60	33.4±4.9	34±3.7	24.9±2.8	25.2±2.7	51.7%	26.7%	58.3%	28.3%
Tehranineja d et al, 2020[32]	Iran	2016-2018	42	43	32.9±3	33.5±2.5	26.2±2.8	26.3±3.3	31.0%	37.2%	NR	NR
Zamaniyan et al, 2021[33]	Iran	2016-2019	60	60	33.9±6.3	33.1±5	26.5±4.5	25.0±3.7	48.3%	16.7%	NR	NR
Zargar et al, 2021[34]	Iran	NR	40	40	34.1±5.1	32.8±5.2	NR	NR	12.5%	2.5%	12.5%	0.0%

DISCUSSION

Intrauterine administration of PRP has emerged as a novel intervention in ART, particularly for women experiencing RIF.[6,7] PRP is derived from autologous blood and contains a high concentration of growth factors that are believed to enhance endometrial receptivity and improve pregnancy outcomes.[5] Despite its potential, the clinical efficacy of PRP in improving pregnancy and live birth rates remains a subject of debate.[7,8] This meta-analysis aimed to systematically evaluate the existing literature to determine the overall effectiveness of PRP in improving clinical pregnancy and live birth rates in women undergoing ART.

Our meta-analysis included 19 RCTs with a total of 1,918 participants (971 in the PRP group and 947 in the control group) for clinical pregnancy rates and six trials with 777 participants (389 in the PRP group and 388 in the control group) for live birth rates. The pooled OR for clinical pregnancy rates was 2.49 (95% CI: 1.84, 3.35), indicating a significant improvement in the PRP group compared to controls. For live birth rates, the pooled OR was 3.28 (95% CI: 1.18, 9.09), also favoring the PRP group. The heterogeneity among studies was moderate for clinical pregnancy rates (I^2=43%) and substantial for live birth rates (I^2=77%). Funnel plots indicated no significant publication bias for either outcome.

The significant improvement in clinical pregnancy rates with PRP treatment is consistent with the findings of several individual studies included in our meta-analysis. For instance, Nazari et al reported an OR of 4.02 (95% CI: 2.56, 6.31), while Abduljabbar et al observed an OR of 3.13 (95% CI: 0.97, 10.15).[16,26] These findings suggest that PRP can substantially enhance endometrial receptivity, likely through the growth factors and cytokines it contains, which promote cell proliferation, angiogenesis, and tissue remodeling.[35,36]

However, not all studies reported a positive effect. Dawood, for example, found no significant difference in clinical pregnancy rates between the PRP and control groups (OR: 0.62, 95% CI: 0.20, 1.90).[20] This variability in outcomes could be attributed to differences in study design, patient populations, PRP preparation methods, and timing of administration. It is also worth noting that some studies with smaller sample sizes, such as Pourkaveh et al reported highly variable ORs (9.60, 95% CI: 0.88, 105.17), indicating a need for larger, well-designed trials to confirm these findings.[29]

The overall OR of 2.49 (95% CI: 1.84, 3.35) from our meta-analysis suggests a robust benefit of PRP in increasing clinical pregnancy rates. The moderate heterogeneity (I^2=43%) indicates that while there is some variability among the studies, the overall effect is consistent and significant. This finding is in line with the physiological rationale behind PRP use, as the growth factors present in PRP are known to improve the local environment of the endometrium, potentially leading to better implantation rates.[7,35]

The pooled OR for live birth rates was 3.28 (95% CI: 1.18, 9.09), indicating a significant improvement in the PRP group. This result is particularly important as live birth rate is the ultimate goal of ART. Studies such as Nazari et al and Safdarian et al reported substantial increases in live birth rates with PRP, with ORs of 10.94 (95% CI: 5.59, 21.43) and 3.54 (95% CI: 1.65, 7.58), respectively.[26,31] These findings suggest that PRP not only improves implantation rates but may also enhance subsequent pregnancy maintenance and fetal development.

The substantial heterogeneity (I^2=77%) observed for live birth rates indicates significant variability among the included studies. Factors contributing to this heterogeneity could include differences in PRP preparation and administration protocols, variations in patient characteristics such as age and underlying infertility diagnoses, and differing ART protocols used across studies. Despite this variability, the significant pooled OR supports the potential clinical utility of PRP in improving live birth outcomes.

The results of this meta-analysis suggest that intrauterine PRP administration can be a valuable adjunct to traditional ART protocols, particularly for women with a history of RIF or those with thin endometrium. The significant improvements in both clinical pregnancy and live birth rates indicate that PRP could enhance the overall success rates of ART, making it a promising intervention for this challenging patient population.[7,8]

For clinicians, these findings highlight the potential benefits of incorporating PRP into their practice. However, given the variability in PRP preparation and administration, it is crucial to follow standardized protocols and consider individual patient characteristics when deciding on PRP use. Further research is needed to refine these protocols and identify the patient populations most likely to benefit from PRP treatment.

Limitations

While our meta-analysis provides strong evidence supporting the efficacy of PRP in improving pregnancy outcomes, several limitations should be acknowledged. First, the heterogeneity among studies, particularly for live birth rates, indicates variability in study design, patient populations, and PRP protocols. This heterogeneity may limit the generalizability of our findings. Second, the included studies varied in sample size and quality, with some studies having small sample sizes or potential biases in methodology. Third, the follow-up duration in some studies was insufficient to assess long-term outcomes such as live birth rates and neonatal health.

To build on the findings of this meta-analysis, future research should focus on several key areas. First, large-scale, multicenter RCTs with standardized PRP preparation and administration protocols are needed to confirm the efficacy of PRP and reduce heterogeneity in study outcomes. Second, studies should aim to identify the optimal PRP preparation methods, including the concentration of platelets and the timing and frequency of administration. Third, research should explore the mechanisms by which PRP enhances endometrial receptivity and pregnancy outcomes, potentially leading to the development of more targeted and effective treatments.

CONCLUSION

In conclusion, this meta-analysis provides compelling evidence that intrauterine PRP administration significantly improves clinical pregnancy and live birth rates in women undergoing ART. The pooled ORs of 2.49 (95% CI: 1.84, 3.35) for clinical pregnancy rates and 3.28 (95% CI: 1.18, 9.09) for live birth rates indicate a substantial benefit of PRP treatment. These findings are supported by the physiological rationale behind PRP use and are consistent with several previous reviews and meta-analyses. However, the heterogeneity among studies and the need for standardized PRP protocols highlight the importance of further research to confirm these results and optimize PRP treatment strategies. Despite these challenges, the potential of PRP to enhance ART outcomes offers a promising avenue for improving reproductive success in women facing infertility challenges.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Vander Borght M, Wyns C. Fertility and infertility: Definition and epidemiology. Clin Biochem. 2018;62:2-10.
2. La Marca A, Mastellari E. Infertility: Epidemiology and etiology. In: Female Reproductive Dysfunction. 2020;211-33.
3. Farquhar C, Marjoribanks J. Assisted reproductive technology: an overview of Cochrane Reviews. Cochrane Database Syst Rev. 2018;8:CD013145.
4. Chambers GM, Dyer S, Zegers-Hochschild F, de Mouzon J, Ishihara O, Banker M, et al. International Committee for Monitoring Assisted Reproductive Technologies world report: assisted reproductive technology, 2014. Hum Reprod. 2021;36(11):2921-34.
5. Peter I, Wu K, Diaz R, Borg-Stein J. Platelet-rich plasma. Phys Med Rehabil Clin N Am. 2016;27(4):825-53.
6. Farimani M, Bahmanzadeh M, Poorolaja J. A new approach using autologous platelet-rich plasma to treat infertility and to improve population replacement rate. J Res Health Sci. 2016;16(3):172.
7. Bos-Mikich A, de Oliveira R, Frantz N. Platelet-rich plasma therapy and reproductive medicine. J Assist Reprod Genet. 2018;35(5):753-6.
8. Sfakianoudis K, Simopoulou M, Nitsos N, Lazaros L, Rapani A, Pantou A, et al. Successful implantation and live birth following autologous platelet-rich plasma treatment for a patient with recurrent implantation failure and chronic endometritis. In Vivo. 2019;33(2):515-21.
9. Kusumi M, Ihana T, Kurosawa T, Ohashi Y, Tsutsumi O. Intrauterine administration of platelet-rich plasma improves embryo implantation by increasing the endometrial thickness in women with repeated implantation failure: a single-arm self-controlled trial. Reprod Med Biol. 2020;19(4):350-6.
10. Mouanness M, Ali-Bynom S, Jackman J, Seckin S, Merhi Z. Use of intra-uterine injection of platelet-rich plasma (PRP) for endometrial receptivity and thickness: a literature review of the mechanisms of action. Reprod Sci. 2021;28(6):1659-70.
11. Chang Y, Li J, Chen Y, Wei L, Yang X, Shi Y, Liang X. Autologous platelet-rich plasma promotes endometrial growth and improves pregnancy outcome during *in vitro* fertilization. Int J Clin Exp Med. 2015;8(1):1286.
12. Nazari L, Salehpour S, Hoseini S, Zadehmodarres S, Ajori L. Effects of autologous platelet-rich plasma on implantation and pregnancy in repeated implantation failure: A pilot study. Int J Reprod Biomed. 2016;14(10):625.
13. Tandulwadkar SR, Naralkar MV, Surana AD, Selvakarthick M, Kharat AH. Autologous intrauterine platelet-rich plasma instillation for suboptimal endometrium in frozen embryo transfer cycles: a pilot study. J Hum Reprod Sci. 2017;10(3):208-12.
14. Pantos K, Simopoulou M, Pantou A, Rapani A, Tsioulou P, Nitsos N, et al. A case series on natural conceptions resulting in ongoing pregnancies in menopausal and prematurely menopausal women following platelet-rich plasma treatment. Cell Transplant. 2019;28(9-10):1333-40.
15. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
16. Abduljabbar HS, Hashim H, Abduljabar HH, Elnaeim AA, Abduljabar NH. The effect of autologous platelet-rich plasma treatment on *in vitro* fertilization/intracytoplasmic sperm injection and its impact on the endometrium and clinical pregnancy rate. Cureus. 2022;14(8):e27913.
17. Allahveisi A, Seyedoshohadaei F, Rezaei M, Bazrafshan N, Rahimi K. The effect of platelet-rich plasma on the achievement of pregnancy during frozen embryo transfer in women with a history of failed implantation. Heliyon. 2020;6(3):e03577.

18. Bakhsh AS, Maleki N, Sadeghi MR, SadeghiTabar A, Tavakoli M, Zafardoust S, Karimi A, Askari S, Jouhari S, Mohammadzadeh A. Effects of autologous platelet-rich plasma in women with repeated implantation failure undergoing assisted reproduction. JBRA Assist Reprod. 2022;26(1):84.
19. Baybordi E, Mohseni J, Mosapour P. The effect of platelet-rich plasma on the improvement of pregnancy results in repeated implantation failure: a randomized controlled trial. Int J Reprod Biomed. 2022;20(9):753-60.
20. Dawood AS. Intrauterine infusion of autologous platelet-rich plasma before frozen embryo transfer in patients with prior implantation failure: a randomized controlled study. Egypt J Fertil Steril. 2022;26(1):12-22.
21. Eftekhar M, Neghab N, Naghshineh E, Khani P. Can autologous platelet rich plasma expand endometrial thickness and improve pregnancy rate during frozen-thawed embryo transfer cycle? A randomized clinical trial. Taiwanese J Obstet Gynecol. 2021;60(5):973.
22. El-Samman AA, Wafa YA, Al-Omda FA, Ali MA. Autologous intrauterine platelet rich plasma instillation in repeated implantation failure in assisted reproductive techniques. Al-Azhar Int Med J. 2022;3(2):100-6.
23. Ershadi S, Noori N, Dashipoor A, Ghasemi M, Shamsa N. Evaluation of the effect of intrauterine injection of platelet-rich plasma on the pregnancy rate of patients with a history of implantation failure in the *in vitro* fertilization cycle. J Family Med Prim Care. 2022;11(5):2162-6.
24. Nazari LS, Hoseini S, Zadehmodarres S, Azargashb E. Effects of autologous platelet-rich plasma on endometrial expansion in patients undergoing frozen-thawed embryo transfer: a double-blind RCT. Int J Reprod Biomed. 2019;17(6):445-50.
25. Nazari LS, Hosseini MS, Hashemi Moghanjoughi P. The effects of autologous platelet-rich plasma in repeated implantation failure: a randomized controlled trial. Hum Fertil (Cambridge). 2020;23(3):209-13.
26. Nazari L, Salehpour S, Hosseini S, Sheibani S, Hosseinirad H. The effects of autologous platelet-rich plasma on pregnancy outcomes in repeated implantation failure patients undergoing frozen embryo transfer: a randomized controlled trial. Reprod Sci. 2021;29(3):993-1000.
27. Nazari LS, Hosseini S, Hashemi T, Borumandnia N, Azizi E. Effect of autologous platelet-rich plasma for treatment of recurrent pregnancy loss: a randomized controlled trial. Obstet Gynecol Sci. 2022;65(3):266-72.
28. Obidniak D, Gzgzyan A, Feoktistov A, Niauri D. Randomized controlled trial evaluating efficacy of autologous platelet-rich plasma therapy for patients with recurrent implantation failure. Fertil Steril. 2017;108(3):e370.
29. Pourkaveh B, Pakravesh J, Shabani M, Gachkar L, Nazarian H, Ghaffari Novin M, et al. Intrauterine platelet rich plasma (PRP) infusion could change the leukemia inhibitory factor (LIF) pattern in the endometrial secretion of women with recurrent implantation failure: a randomized clinical trial. Int J Med Toxicol Forensic Med. 2022:38493.
30. Rageh K. PRP in recurrent implantation failure: hope or hype? Arab Gulf Sci Res. 2020;38:24.
31. Safdarian LA, Aghahoseini M, Lak P, Mosa SH, Sarvi F, Mahdavi A, et al. Efficacy of the intrauterine infusion of platelet-rich plasma on pregnancy outcomes in patients with repeated implantation failure: a randomized control trial. Int J Womens Health. 2022;10(1):38-44.
32. Tehraninejad ES, Kashani NG, Hosseini A, Tarafdari A. Autologous platelet-rich plasma infusion does not improve pregnancy outcomes in frozen embryo transfer cycles in women with history of repeated implantation failure without thin endometrium. J Obstet Gynaecol Res. 2021;47(1):147-51.
33. Zamaniyan MPS, Heidaryan Gorji H, Moradi S, Jamal J, Yahya Poor Aghmashhadi J, Hossein Mohammadi M. Effect of platelet-rich plasma on pregnancy outcomes in infertile women with recurrent implantation failure: a randomized controlled trial. Gynecol Endocrinol. 2021;37(2):141-5.
34. Zargar MPR, Najafian M, Choghakabodi PM. Effects of intrauterine autologous platelet-rich plasma infusions on outcomes in women with repetitive *in vitro* fertilization failures: a prospective randomized study. Clin Exp Obstet Gynecol. 2021;48(1):180-5.
35. Bos-Mikich A, Ferreira MO, De Oliveira R, Frantz N. Platelet-rich plasma or blood-derived products to improve endometrial receptivity? J Assist Reprod Genet. 2019;36(4):613-20.
36. Mouanness M, Ali-Bynom S, Jackman J, Seckin S, Merhi Z. Use of intra-uterine injection of platelet-rich plasma (PRP) for endometrial receptivity and thickness: a literature review of the mechanisms of action. Reprod Sci. 2021;28(6):1659-70.

Cite this article as: Alkhamis FH. Assessment of the effect of using intrauterine platelet-rich-plasma on the success of assisted reproduction: a systematic review and meta-analysis of randomized controlled trials. Int J Community Med Public Health 2024;11:4423-31.