QUALITY IN SPORT
eISSN 2450-3118 · Open Access · Peer-reviewed
apcz.umk.pl/QS Nicolaus Copernicus University in Toruń

MARCAK, Maria, DRÓŻDŻ, Michał, KOŻUCH, Anna, NOWICKA, Weronika and RYMARCZYK, Emilia. Physical Activity and In Vitro Fertilization Outcomes: A Stage-by-Stage Narrative Review.. Quality in Sport. 2026;76:76103. https://doi.org/10.12775/QS.2026.76.76103

ARTICLE TIMELINE
Received: 15.09.2026. Accepted: 22.09.2026. Published: 24.09.2026.

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

Physical Activity and In Vitro Fertilization Outcomes: A Stage-by-Stage Narrative Review

Maria Marcak[1], ORCID https://orcid.org/0009-0005-2810-798X
marysiamarcak@gmail.com
[1] Medical University of Silesia in Katowice, 15 Poniatowskiego Street, 40-055 Katowice, Poland

Michał Dróżdż[1], ORCID https://orcid.org/0009-0004-8933-0299
drozdz.m.29@gmail.com
[1] Medical University of Silesia in Katowice, 15 Poniatowskiego Street, 40-055 Katowice, Poland

Anna Kożuch[1], ORCID https://orcid.org/0009-0000-6315-6895
anna.kozuch02@gmail.com
[1] Medical University of Silesia in Katowice, 15 Poniatowskiego Street, 40-055 Katowice, Poland

Weronika Nowicka[1], ORCID https://orcid.org/0009-0002-4555-3189
wronkanowicka@gmail.com
[1] Medical University of Silesia in Katowice, 15 Poniatowskiego Street, 40-055 Katowice, Poland

Emilia Rymarczyk[1], ORCID https://orcid.org/0009-0009-2172-6429
em.rymarczyk@gmail.com
[1] Medical University of Silesia in Katowice, 15 Poniatowskiego Street, 40-055 Katowice, Poland

Corresponding Author
Maria Marcak, marysiamarcak@gmail.com

Abstract
Background. Infertility affects approximately 17.5% of the adult population worldwide. Physical activity is promoted as an element of a healthy lifestyle, yet clinical practice still limits it at selected stages of IVF treatment.

Aim. The aim of this review is to systematize the current literature on the influence of physical activity of the woman, the man, and the couple on treatment outcomes at the individual stages of IVF.

Material and methods. PubMed was searched using two search queries, supplemented with targeted searches.

Results. For women, evidence on the pre-treatment phase is heterogeneous, resembling a "reverse J-curve": benefit at moderate activity, no benefit or risk at extremely high levels. Data on stimulation and embryo transfer are more consistent, not supporting routine restriction and suggesting a psychological benefit of continued activity. In men, evidence is consistent, with no adverse effects. Oocyte retrieval, sperm collection, and joint couple activity remain almost unexamined.

Conclusions. Available evidence does not justify the routine restriction of physical activity during IVF treatment. A recurring theme is the nonlinear dose–response relationship, indicating a benefit of moderate activity. Further studies with objective measurement of exposure, including those focused on the couple, are needed.

Key words: physical activity, in vitro fertilization, assisted reproductive technology, dose-response relationship, embryo transfer, couple-based intervention

1. Introduction
Infertility affects approximately 17.5% of the adult population worldwide over their lifetime and constitutes a significant clinical problem of global scope[1]. This has resulted in the dynamic development of research on assisted reproductive technologies (ART), including in vitro fertilization (IVF), research focusing both on the procedures and treatment programs

themselves and on additional factors influencing the success of the process. This span general clinical overviews of ART [2], safety outcomes for resulting offspring [3], patients knowledge and attitudes towards treatment [4] and the management of specific clinical subgroups, such as recurrent implantation failure [5] and policystic ovary syndrome [6]. One issue that appears particularly important in this context is physical activity. Its positive significance for health and for the proper course of pregnancy and childbirth is widely discussed (including in populations outside the context of assisted reproduction [7]). At the same time, however, many recommendations advise reducing physical activity at certain specific stages of clinical ART practice. These recommendations are not, however, entirely without support, since in physically active women extreme exertion and the accompanying psychological pressure may modulate the ovarian microenvironment, potentially affecting treatment success[8]. A need therefore arises to specify what type and amount of physical exertion confers benefit, and what constitutes potential risk. This narrative review aims to analyze and systematize the available literature on the impact of physical activity on the outcomes of IVF treatment, taking into account a division into the individual stages of treatment, with particular attention paid to the perspective of the couple's physical activity.

The perspective of the couple's physical activity, rather than the woman's alone, is marginalized in the available literature. It may be hypothesized that jointly undertaken physical activity could foster a better psychological state in both partners and increase mutual motivation to engage in actions with a documented beneficial effect on IVF success. This hypothesis, however, remains, as this review demonstrates, empirically unverified to date. The perspective of male physical activity likewise remains insufficiently studied. It has been noted, as a limitation of one large study, that a woman's physical activity may correlate with that of her partner, which could secondarily affect semen quality and constitute a confounding factor in the interpretation of results pertaining solely to the woman[9]. This observation suggests that the actual influence of male physical activity on treatment success may extend beyond a direct improvement in semen parameters alone. However this remains a potential confounding factor rather than an established mechanism. Of importance to this review is the fact that physical activity, unlike age or genetic factors, is a modifiable factor, and therefore remains an important target for educational intervention among couples undergoing treatment for infertility[10].

2.3.1. AI.

AI was used for language and stylistic editing of the text and translation. After using this tool, the content obtained was reviewed and edited as necessary. The authors accept full responsibility for the substantive content of the publication.

2.3.2. Search Strategy

The literature search was conducted in the PubMed database, considering scientific papers published up to July 15, 2026. Two separate search strategies were applied in order to capture evidence concerning both women and men undergoing treatment with assisted reproductive technologies (ART).

In the first search (targeting the woman) the following keywords were used: "exercise", "physical activity", "physical exercise", "sport", "training", in combination with "in vitro fertilization", "IVF", "ICSI", "intracytoplasmic sperm injection", "assisted reproductive technology", "embryo transfer", "ovarian stimulation", as well as "women", "woman", "maternal", "female partner", "ovarian reserve", "oocyte", "pregnancy outcome", "live birth".

In the second search (targeting the man) the same keywords concerning physical activity and ART were used, in combination with the terms: "men", "man", "paternal", "male partner", "semen quality", "semen", "sperm", "spermatozoa", "male infertility".

The searches were limited to studies published within the last 10 years, conducted in humans, in English, with free access to the full text.

Only studies conducted exclusively in humans undergoing an assisted reproduction procedure, and thematically directly related to physical exertion, were included in the review. Studies in which the findings were confounded by conditions unrelated to the PA–fertility–obesity axis were excluded, as were survey-based studies.

The initial searches yielded 413 records. An additional 17 records were identified through targeted supplementary searches, conducted to fill gaps identified at the initial stage of the review, concerning in particular the physical activity of male partners and specific procedural stages of IVF. A total of 430 records were imported.

The publications were imported into Rayyan for screening. One hundred thirty potential duplicates were identified and manually verified, leaving 309 publications for the screening stage, subsequently conducted by a single reviewer on the basis of title and abstract according to the inclusion and exclusion criteria discussed above. Two hundred sixty-seven publications were excluded on the basis of title and nine on the basis of abstract, yielding 33 studies ultimately included in the narrative synthesis.

Obesity was not treated as an exclusion criterion, given its high prevalence in ART populations and the fact that it is the subject of several reference studies meeting the remaining inclusion criteria.

In the course of further work on the review, additional targeted searches were conducted to fill identified thematic gaps and to incorporate more recent studies published after the closure of the original search. Eight additional primary studies were thereby included, bringing the total to 41 studies forming the evidence base of this review. In addition, several further sources providing general background, physiological mechanism, or theoretical context were consulted.

3. Physiological Background

Physical exertion, depending on its intensity and volume, may exert opposing effects on the body. On the one hand, moderate activity improves insulin sensitivity and overall metabolic status, which supports the proper functioning of the hormonal axis underlying fertility. On the other hand, physical exertion increases oxygen consumption by skeletal muscle and secondarily intensifies the production of reactive oxygen species (ROS). This process is not unequivocally harmful: moderate exposure to ROS serves an adaptive function and strengthens the body's own antioxidant mechanisms. Only when the production of reactive oxygen species exceeds the compensatory capacity of these mechanisms does oxidative stress occur, which may adversely affect reproductive cells. A good example of this dual-sided nature is the finding that physical activity undertaken before IVF treatment alone induces a measurable increase in a marker of oxidative stress in saliva[11]. Nevertheless, the net effect remained beneficial for the number of mature oocytes, suggesting that in the majority of the women studied the positive, metabolic pole of this relationship prevailed. An equally important mechanism explaining the potential harmfulness of high exposure to physical activity is the so-called Relative Energy Deficiency in Sport (RED-S). RED-S is a state of chronic energy unavailability in which the body attempts to suppress processes not essential for survival, including the hypothalamic–pituitary–gonadal axis. In women, this leads to disturbances in the pulsatile secretion of GnRH and secondary menstrual disorders, whereas in men it leads to decreased testosterone concentration and impaired spermatogenesis.[12].

4. Research results

The influence of physical activity on the course and outcomes of ART appears to remain incompletely understood and some recommendations remain in conflict with one another. This review was undertaken to provide such systematization, in view of the growing use of ART and the increasing awareness among patients of the importance of physical activity.

It is worth mentioning at the begining that, some of the studies discussed below are not fully independent of one another: the meta-analysis by Rao et al. [13] includes within its pool as many as four studies that this review discusses separately (Morris et al., Gaskins et al., Evenson et al., and Palomba et al.). The discussion below consistently distinguishes between these.

4.1 Pre-treatment / Preconception Phase

The evidence on women's physical activity before IVF treatment does not point in one simple direction. Instead, the picture is more complex: it's not whether a woman is active or not that matters, but how much, how often, and how intensely.

The nonlinear pattern noted above is most evident in the two largest studies to date on this subject: one fully independent, the other the largest single component of the Rao meta-analysis. Geiger et al. [9], in the largest cohort in the literature to date divided women into three groups by exercise frequency: no regular activity, 1–2×/week, and more than 2×/week. Both the pregnancy rate and the cumulative live birth rate were highest in the moderate group, rather than in the most and less active group.

A similar nonlinearity, but with with a different exposure distribution, was described earlier by Morris et al. [14]. A subgroup of women exercising ≥4 h/week for 1–9 years was associated with a worse outcome. This effect disappeared with a longer training history, which means of more than nine years.

Interestingly, these two largest studies diverge with respect to miscarriage risk: Geiger showed the lowest risk in the most active group, whereas Morris reported an elevated risk in his high-exposure subgroup. This difference illustrates how sensitive this field of research is to the way exposure is defined.

Rao et al. [13], pooling eight studies, found higher clinical pregnancy and live birth rates among physically active women, with no significant difference in miscarriage risk. This is a surprising result. As shown above, Morris's own study gave a mixed result, not a clearly positive one. This suggests that the other seven studies in the pool must have been positive enough to outweigh it. For example, Evenson et al. [15] found that more activity before treatment was linked to a higher chance of pregnancy, while Gaskins et al. [16] found no such link at all. Not all studies show a link with clinical outcome.

Two independent studies found the same pattern: a benefit for oocyte numbers, but not for pregnancy itself. Sõritsa et al. [17] demonstrated a beneficial effect of light PA on the number of oocytes and embryos obtained, but without translating into clinical outcome. Prémusz et al.

[11] reported exactly the same pattern: a significant association with oocyte number, but not with pregnancy itself

Ricci et al.[18] found that women reporting five or more hours per week of recreational activity had a lower chance of clinical pregnancy than less active women. This fits the same pattern seen in Morris and Geiger: it is very high activity, not activity itself, that may cause harm.

A possible explanation for this inconsistency is provided by Läänelaid et al. [19]. Measuring PA in both partners simultaneously, they found that couples ultimately qualified for treatment spent less time in high-intensity PA than couples who conceived spontaneously, an observation suggesting that lower activity may be a consequence, rather than a cause, of the more severe form of infertility underlying qualification for treatment.

So far, this evidence comes only from observation, which cannot prove that physical activity actually causes better outcomes. To answer that, we need randomized controlled trials (RCTs). A few such trials exist for this stage, and they too disagree with each other. In the FIT-PLESE trial [20], adding diet and medication on top of exercise worked no better than exercise alone. Similarly, in the study by Wang et al. [21] a lifestyle intervention did not improve treatment outcomes. Different results were obtained in the smaller study by Espinós et al. [22], in which a 12-week intervention significantly improved the outcome; however, the authors note that their result may be a coincidence.

It's worth comparing this to a study by Palomba et al. [23], which looked at almost the exact same group of women as FIT-PLESE, but this time, instead of an RCT, it was just an observational study. The implantation rate, clinical pregnancy rate, and live birth rate were markedly and significantly higher in the regularly active group, with no difference in the number or quality of oocytes obtained between groups.

For men, the picture is much simpler: observational and experimental studies agree with each other. None of the studies found any harm from physical activity, and most point to a benefit.

The strongest evidence is provided by an experimental study. Lo Giudice et al. [24], in a meta-analysis of six randomized controlled trials, demonstrated a significant association between regular exercise and sperm concentration, motility, count, and morphology. In men, RCT evidence confirms the direction suggested by observational studies.

The largest single observational study remains that of Matorras et al. [25]: 207 men presenting as sperm donors, divided into four groups by PA level. No association was found with basic (conventional) semen parameters; however, in the high and very-high activity groups, the fertilization rate in IVF cycles was significantly higher. This lack of association with what is visible under the microscope, alongside an association with actual fertilizing capacity, most likely stems from the fact that conventional semen analysis does not capture functional characteristics of the sperm, which only become apparent at the stage of fertilization itself.

The largest observational study and the RCT meta-analysis both point consistently to a benefit of PA. But does this hold at every intensity, or only up to a point, as seen in women? An answer to this question is provided by Donato et al. [26]. Their subjects were healthy young men, not men undergoing fertility treatment, so the results should be applied with some caution. Moderate-to-vigorous activity was associated with more favorable sperm concentration and count, while time spent watching television was associated with their deterioration. For motility and morphology, however, a nonlinear relationship emerged, shaped like an inverted U, with the best outcome at moderate intensity, not maximal. This is exactly the same pattern of nonlinearity that was suggested in the female population by Geiger, Morris, and Ricci.

Two further, smaller studies also speak in favor of PA. Sharqawi et al. [27] linked a healthy lifestyle, including sporting activity, to longer sperm telomere length. Humaidan et al. [28] showed that an intervention combining PA with antioxidant supplementation reduced sperm DNA fragmentation and seminal oxidative stress; this effect, however, cannot be attributed to physical activity alone, as it was studied in combination with supplementation.

In summary, the available data, encompassing both observational studies and RCTs, consistently indicate the absence of a harmful effect of male physical activity at the pre-treatment stage, and in many respects point to a beneficial effect. The only significant caveat, based on a single study (Donato et al. [26]), is the suggestion that for some semen parameters, moderate rather than maximal intensity may be optimal, a theme consistent with what was observed in the female population.

4.2. Ovarian Stimulation

Standard clinical practice recommends limiting physical activity during stimulation, citing the risk of ovarian torsion and ovarian hyperstimulation syndrome (OHSS). The pathomechanism of this phenomenon is related to the fact that, following controlled hyperstimulation, the ovaries enlarge as multiple follicles develop simultaneously, increasing ovarian weight and thereby the likelihood of rotation around the axis of the ovarian ligament, a phenomenon that may be further potentially provoked by physical activity. The situation differs for OHSS: under the influence of hCG (used as the ovulation trigger), granulosa cells secrete VEGF, which increases capillary permeability, thereby increasing the fragility and vascularization of the organ and secondarily elevating the risk of torsion[29]. These rationales rest on solid pathophysiological grounds; however, as the review of available data below shows, they have been verified only to a limited extent.

The largest study comes to the fore here. Olaso et al. [30], in a sample of 617 women, measuring PA two ways: a questionnaire for everyone, plus objective accelerometers for a subgroup, thereby classifying patients into three groups: low, moderate, and high activity. Both methods agreed: overall, PA showed no link to the number of oocytes retrieved or matured. This is a notable result, as it preliminarily excludes the possibility that patients' own self-reporting biased the outcome. More importantly, however, this result was not homogeneous across the entire study population: stratification by clinical variables (BMI, presence of endometriosis, ovulatory disorders) revealed that in these specific subgroups, high PA was associated with a superior ovarian response, showing an increased number of mature oocytes. The authors emphasize that further research is needed on this topic, particularly conducted within the specified subgroups, since the underlying cause of infertility may differentially affect the relationship between PA and the stimulation stage.

Sõritsa et al. [17] showed that, during the stimulation period itself, women significantly reduce their physical activity and increase sedentary time (time spent sitting or reclining, during which the body's energy expenditure is very low, below 1.5 MET) relative to baseline values. Nevertheless, a higher level of PA within this time window was associated with a more favorable ovarian response.

These two studies, however, concern only ovarian response; they do not directly test the essence of the clinical recommendation: whether continuing physical activity actually increases the risk of complications such as ovarian torsion. An answer to this question is provided by the only available experimental evidence. In the PACE trial (Shapiro et al., [31]), continuing physical activity in accordance with DHHS guidelines, as opposed to standard physical restriction, was not associated with any case of ovarian torsion, lowered patients' stress levels, and did not worsen IVF outcomes. This result, however, requires cautious interpretation, since at present it is based only on a conference report.

This picture is partly corroborated by two other studies. Palomba et al. [23] found that active women had better implantation and pregnancy rates, yet no difference in oocyte number or quality, which is consistent with Olaso's overall finding.. Prémusz et al. [11], in a considerably smaller sample, in contrast reported a statistically significant association between PA and oocyte number. It is also worth noting that Geiger et al. [9], in the largest available cohort, demonstrated a higher oocyte count among regularly physically active women; their exposure, however, concerned only the period preceding the start of treatment, not the stimulation phase itself, which limits direct comparability with the other studies in this subsection.

Taken together, these sources lead to the conclusion that the rationale for clinical restriction of physical activity during stimulation rests more on a pathophysiological mechanism than on direct empirical evidence. None of the studies identified confirms an increased risk associated with maintaining moderate physical activity during this period.

4.3. Oocyte Retrieval / Sperm Collection

For these stages, the available literature is very limited. Only one study identified in this review examines the association between PA and the oocyte retrieval stage [31]. It showed that women continuing physical activity on the day of oocyte retrieval experienced a reduction in the level of stress reported after the procedure, with no case of ovarian torsion in either of the compared groups. This study, however, is not yet available as a full text, only as a conference report.

With regard to the stage of sperm collection, no study was identified that directly addresses the time window of the collection procedure itself. The available literature focuses almost exclusively on the period of sexual abstinence as a factor influencing semen quality, entirely omitting the role of physical activity.

The stage discussed above appears to be the most poorly studied link in the IVF cycle with respect to recommendations concerning physical activity. Particularly notable is the gap concerning male physical activity, filling which could be especially important for the group of men who are already physically active. This review has allowed this gap to be identified; further research is needed to fully explore this aspect of the topic.

4.4. Embryo Transfer and the Waiting Period

This review includes five studies addressing the influence of physical activity during the embryo transfer period. None of them confirms a harmful effect of PA at this stage. Rodríguez-Purata et al. [32], by contrast, put forward the thesis that widespread recommendations of physical restriction confer no benefit. Two groups of women were compared: an early-mobilization group and a group adopting a restrictive, resting regimen. Clinical pregnancy rates were significantly higher among women who resumed normal activity immediately than among those who adopted a restrictive, resting regimen (OR = 0.75; 95% CI 0.7–0.9). A similar directional trend was observed for live births, though it did not reach statistical significance (OR = 0.77; CI 0.5–1.2).

Remy et al. [33], analyzing occupational, physical, and sexual activity during the three days following transfer, found no difference in the activity undertaken between patients who became pregnant and those in whom implantation failed. Similar findings emerge from the study by Jacobs et al. [34], the SSTEP trial, which was methodologically advanced in that participants continuously wore an activity-monitoring band throughout the cycle, providing objective data on activity and sleep, while stress was assessed both by questionnaire and salivary cortisol. Regardless of the measurement method used, neither physical activity nor stress, nor sexual activity habits or sleep quality, showed an association with cycle outcome. A limitation was its small sample size and its focus on a single protocol.

Evenson et al. [15] analyzed a cohort, among whom the median vigorous activity during this period was 0 minutes per day. Since vigorous activity was, in practice, absent in most patients, it was not possible to compare the potential harms or benefits of implementing PA in this window.

Beyond pregnancy outcomes, one study also looked at a different kind of benefit: mental wellbeing. Wang et al. [35] demonstrated a significant reduction in the severity of anxiety and general psychopathological symptoms, as measured by the SCL-90 scale, among patients with a higher level of physical activity compared with patients with a lower level. Only patients without previously diagnosed mental disorders were included in the study. As this study, uniquely among those cited above, concerns so-called long-protocol ovulation-induction cycles, its results should not be extrapolated directly to women treated with other protocols.

The embryo transfer stage is the one for which the evidence is most consistent among all those discussed in this work. None of the five studies demonstrated a harmful effect of physical activity. Rodríguez-Purata et al. [32] suggest that recommended bed rest is associated with a worse outcome, although for live births the difference was not statistically significant, and this conclusion should therefore be interpreted with caution. The remaining three studies (Evenson, Remy, Jacobs/SSTEP) found no association whatsoever between PA or stress and pregnancy outcome. Additionally, Wang et al. [35] showed that maintaining physical activity helps patients psychologically during this period, even where it does not affect the treatment outcome itself.

4.5. Early Pregnancy

This subsection considers four studies reporting an outcome concerning miscarriage.

Rao et al. [13] found no significant difference in miscarriage risk between physically active and inactive women. This study includes Morris et al. [14], who, in a narrow group of women exercising very heavily (≥4 h/week for 1–9 years), demonstrated a twofold higher risk of miscarriage, but also Palomba et al. [23], where no difference was found at all (16.7% vs. 18.8%). It is thus apparent that the signal reported by Morris pertains only to a narrow, extreme subgroup, and disappears once averaged together with the remaining studies, including Palomba.

Geiger et al. [9] showed that the most physically active women had a significantly lower risk of miscarriage than inactive women, a difference that remained significant even after adjustment for age and other factors. This is the first piece of evidence independent of the Rao meta-analysis, and it points toward a benefit, rather than an increased risk, associated with high physical activity.

In summary, the Morris study suggested a risk associated with extreme activity, but this is confirmed neither by the result of the eight studies (Rao) nor by the newer, largest, and independent study (Geiger), which in fact points in the opposite direction. There are therefore no solid grounds to claim that ordinary, or even high, physical activity increases the risk of miscarriage.

4.6 The Couple's Perspective as a Whole

Among all the studies analyzed, only one, Läänelaid et al. [19], measures physical activity in both partners simultaneously and analyzes it at the level of the couple. In this study, PA was assessed objectively (accelerometry) in both partners in parallel. It was found that couples ultimately qualifying for IVF/ICSI spent significantly less time in high-intensity activity than couples who conceived spontaneously, whereas the couple's combined physical activity time showed no association with the probability of achieving pregnancy.

Several other publications suggest, based on their titles, an approach centered on the couple as the unit of study; however, a closer examination reveals that this is not actually the case. Urata et al. [36] studied only women, with the sole element concerning the partner being a single question posed to the woman about his smoking status, rather than a measurement of his own physical activity. PA itself did not prove to be a significant predictor of any of the outcomes assessed. Steegers-Theunissen et al. [37] move in a similar direction, albeit for a different reason: they do not measure couples' actual physical activity, but instead present a modeled simulation of the population-level effects of lifestyle programs.

Several formal, couple-targeted lifestyle intervention protocols also exist (Malekpour [38]; Sunyach [39]; Dupont [40]; Boedt [41], Boedt [42]), following the same underlying pattern: nominally directed at the couple, yet in practice centered primarily on the woman.

No study was identified linking couples' jointly undertaken physical activity with a psychological effect or with adherence to recommendations in the context of IVF. The closest thematically is the PCEP program [43], a couple-focused research intervention for couples undergoing treatment, but one based on meditation and psychoeducation, not on physical movement.

The picture that emerges from this can be termed the "illusion of the couple" in IVF research: literature describing its studies as concerning the couple almost always, in practice, reduces to measuring the woman alone. A couple exercising together, as a potential source of mutual motivation and support during treatment, remains an area that has not yet been studied.

5. Discussion

A central finding is that the relationship between physical activity and IVF outcomes is not linear. Moderate levels of physical activity appear to be beneficial or neutral, while very high levels may be associated with adverse outcomes, although this is not consistently observed. A similar pattern was reported in the largest studies (Geiger et al. [9]; Morris et al.[14]), as well as in studies examining very high levels of activity (Ricci et al. [18]). Comparable findings have also been reported in men (Donato et al.[26]). It is worth noting that this type of relationship is not specific to reproductive medicine: an analogous shape, referred to as the "reverse J-curve", has previously been described with respect to for example cardiovascular and musculoskeletal health, whereby moderate exertion confers the greatest benefit, and its extreme intensification may negate or reverse that benefit. The same pattern, likely driven by the same oxidative stress mechanism, has also been reported in an unrelated field: research on aerobic exercise and neuroplasticity [44]. This conceptual framework appears to fit well with the picture emerging from the IVF literature and may offer a more precise explanation.

This same nonlinear relationship may also explain the discrepancy between observational studies and randomized controlled trials, as seen when comparing Palomba with FIT-PLESE. If only moderate-intensity activity is truly beneficial, then RCTs defining the intervention simply as to ncrease activity without an upper limit, may inadvertently include participants exceeding this optimal range, thereby diluting the measurable effect. Trial duration may also play a role: the 16-week intervention period used in FIT-PLESE is shorter than the approximately 90-day cycle of oocyte maturation, which may be insufficient to detect a true biological effect. Also not without significance is the risk of reverse causation within the observational studies themselves, since it is possible that lower physical activity is a consequence, rather than a cause, of a more severe form of infertility, as directly indicated by the data of Läänelaid et al. [19].

An interesting question is raised by the contrast itself between the female and male populations: why, in men, does evidence from randomized controlled trials confirm the direction suggested by observational studies, whereas in women these two levels of evidence remain in conflict? The explanation appears to lie in the fact that the RCT meta-analysis in men measures primarily semen parameters and the effect of physical activity upon them, whereas the principal RCTs in women measure live birth, an outcome ultimately determined by a long chain of further factors and events: fertilization, implantation, placental development, and the successful continuation of pregnancy to term. It is worth noting that when studies in women measured an endpoint equally close to the PA "exposure", namely the number and quality of oocytes, as in Sõritsa [17] or Prémusz [11], the result was consistently positive, analogous to the findings in men. This suggests that the observed "sex asymmetry" is in fact the same phenomenon of effect dilution along the biological chain described earlier, only viewed from a different angle: in men, the principal available evidence concerns a proximal endpoint, whereas in women it concerns a distal one.

This picture is further complicated by comparison with existing syntheses on the topic. The meta-analysis by Rao et al. [13] and the more recent meta-analysis by Kakargia et al. [45] are consistent with one another regarding clinical pregnancy, implantation, and miscarriage risk. They diverge, however, on live births: whereas Rao demonstrated a significant benefit here, Kakargia did not confirm it at the level of statistical significance. The authors of the more recent meta-analysis emphasize that the available evidence remains insufficient for definitive conclusions, owing to the low quality and high heterogeneity of the included studies. From a clinical practice perspective, the results of this review do not provide grounds for the routine restriction of physical activity at those stages for which the available literature is sufficiently abundant to support such a conclusion, chiefly the embryo transfer stage and ovarian stimulation. This is particularly clear during embryo transfer, as current evidence does not support the widely recommended bed rest. Moreover, one study (Rodríguez-Purata et al.[32]) that bed rest may even be harmful. Similarly, at the stimulation stage, despite a solid pathophysiological rationale for caution, the available data do not confirm an increased risk associated with maintaining moderate physical activity.

The most original contribution of this review, however, remains the identification of a gap concerning the couple as the unit of analysis. Among more than forty studies analyzed, only one measures the physical activity of both partners simultaneously, and none examines jointly undertaken physical activity as an element of psychological support or adherence to recommendations. Interestingly, even studies not focused on this question have noted the problem. One large study pointed out, as a limitation, that a woman's physical activity may correlate with her partner's, which could affect semen quality and bias results meant to reflect the woman alone [9]. This independent observation reinforces the need for couple-based research in this field.

The limitations of this review must be considered on two separate levels. The first concerns the quality and heterogeneity of the source literature itself. Studies used different definitions and methods to measure physical activity, and most were observational rather than experimental. Several also combined physical activity with diet or medication in a single treatment arm, making it impossible to know how much of any benefit came from physical activity alone[46]. Obese women were overrepresented in some subtopics, and data on the oocyte retrieval and sperm collection stage were almost entirely absent.The second level concerns limitations of this review's own methodology, related to the single-database search, the single reviewer, and the narrative, rather than systematic, nature of the data selection and synthesis. Also worth noting is the partial overlap of primary studies included within the meta-analyses (Rao et al.[13]; Kakargia et al.[45]) with studies cited separately, a distinction that has been consistently indicated in the text, although the very possibility of such overlap illustrates a systemic risk inherent to narrative reviews of this kind. Finally, most studies originate from single centers in highly developed countries, which limits the generalizability of the conclusions to other populations and healthcare systems.

Future research should focus first on the objective measurement of physical activity within specific, narrowly defined time windows, particularly during the periprocedural window of oocyte retrieval and sperm collection, where available data are currently practically absent, as well as on the design of studies with a couple-based research character, encompassing simultaneous measurement and potential intervention in both partners.

6. Conclusions

This review provides no grounds for the routine restriction of physical activity during IVF treatment, although this conclusion requires qualification arising from the uneven quality and heterogeneity of the available evidence. It is most solidly grounded for the embryo transfer stage, and least so for the oocyte retrieval and sperm collection stage, where the absence of evidence of harm simply reflects an almost complete absence of studies.

The central, recurring theme of this entire review is the nonlinear relationship between the level of physical activity and treatment outcomes, a relationship resembling the "reverse J-curve" concept described in other areas of medicine, suggesting that it is moderate activity, rather than its absence or its highest intensity, that is most often associated with a more favorable outcome, although not all studies confirm this pattern, and its biological mechanisms remain hypothetical.

One of the more original contributions of this review should be regarded as the identification of two clear research gaps: the almost complete absence of data concerning the couple as the unit of analysis, and concerning the periprocedural stage. Both gaps point toward a direction for future research: toward the objective measurement of physical activity within precisely defined time windows, and toward projects of a couple-based research character, encompassing both partners simultaneously. Until such data become available, the formulation of definitive, universal recommendations remains premature. Still, the available evidence does not support the common practice of restricting ordinary, moderate physical activity.

Disclosure:
Author Contributions
Conceptualization: [MM], [MD]
Methodology: [WN], [MD], [AK]
Check: [WN], [AK], [MD]
Investigation: [MM], [MD]
Data curation: [MM], [WN], [AK], [ER]
Writing -rough preparation: [MM]
Writing -review and editing: [MM], [MD]
Visualization: [MM], [WN], [AK]
Project administration: [WN], [MD]

Funding
The article did not receive any funding

Institutional Review Board Statement
Not Applicable.

Informed Consent Statement
Not Applicable.

Data Availability Statement
Not Applicable.

Acknowledgements
This research has not received any administrative or technical support.

Conflicts of Interest
The authors declare no conflict of interest.

All authors have read and agreed with the published version of the manuscript.

AI Declaration
In preparing this work, the authors used Claude (Anthropic) for the purpose of language and stylistic editing, translation of the manuscript into English, assistance with literature searches to address gaps identified during the review process. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

References:

1. Cox, C.M.; Thoma, M.E.; Tchangalova, N.; Mburu, G.; Bornstein, M.J.; Johnson, C.L.; Kiarie, J. Infertility Prevalence and the Methods of Estimation from 1990 to 2021: A Systematic Review and Meta-Analysis. *Human Reproduction Open* **2022**, *2022*, hoac051, https://doi.org/10.1093/hropen/hoac051.

2. Rozen, G.; Stern, K. An Update on Fertility Assistance and Assisted Reproductive Technologies. *Australian Journal of General Practice* **2023**, *52*, 11–17, https://doi.org/10.31128/AJGP-08-22-6512.
3. Wang, C.; Lv, H.; Ling, X. Association of Assisted Reproductive Technology, Germline de Novo Mutations and Congenital Heart Defects in a Prospective Birth Cohort Study. *Cell Research* **2021**, *31*, 919–928, https://doi.org/10.1038/s41422-021-00521-w.
4. Mosleh, R.; Assi, H.; Kassir, J.; Ajami, H.; Azoury, J.; Ajrouche, R.; Al-Hajje, A. Analysis of Status and Influencing Factors of Knowledge, Attitudes, and Expectations towards Assisted Reproductive Technology among Infertile Women in Lebanon: A Cross-Sectional Study. *PLoS One* **2026**, *21*, e0331989, https://doi.org/10.1371/journal.pone.0331989.
5. Cimadomo, D.; de los Santos, M.J.; Griesinger, G.; Lainas, G.; Le Clef, N.; McLernon, D.J.; Montjean, D.; Toth, B.; Vermeulen, N.; Macklon, N. ESHRE Good Practice Recommendations on Recurrent Implantation Failure. *Human Reproduction Open* **2023**, *2023*, hoad023, https://doi.org/10.1093/hropen/hoad023.
6. Alexander M. Kotlyar; David B. Seifer Women with PCOS Who Undergo IVF: A Comprehensive Review of Therapeutic Strategies for Successful Outcomes. *Reprod Biol Endocrinol* **2023**, *21*, 70–70, https://doi.org/10.1186/s12958-023-01120-7.
7. Mena, G.P.; Mielke, G.I.; Brown, W.J. The Effect of Physical Activity on Reproductive Health Outcomes in Young Women: A Systematic Review and Meta-Analysis. *Human Reproduction Update* **2019**, *25*, 541–563, https://doi.org/10.1093/humupd/dmz013.
8. Panas, Z.; Ślinko, I.; Kuliś, G.; Dryl Jarmoc, E.; Krawczuk, K.; Dziemiańczuk, J.; Zimowski, M.; Kadysz, P.; Kolanek, A.; Czajkowski, M. Biological Clock and Reproductive Longevity: Molecular Insights into Ovarian Aging and the Role of Physical Activity. *Quality in Sport* **2026**, *54*, 70260, https://doi.org/10.12775/QS.2026.54.70260.
9. Geiger, J.; Quaas, A.; Quaas, P.; Schötzau, A.; Heinzelmann-Schwarz, V.; Gobrecht-Keller, U.; Fischer, M. Impact of Maternal Physical Activity on Outcome of Assisted Reproduction. *Frontiers in Endocrinology* **2026**, *17*, 1893897, https://doi.org/10.3389/fendo.2026.1893897.
10. Cieślik, A.; Kosieradzka, K.; Kosecka, K.; Adamowicz, D.; Rudziński, P.; Jargieło, A.; Łopuszyńska, I.; Stańczyk, J.; Meliksetian, A.; Wosińska, A. Do Lifestyle Habits Have an Impact on Infertility in Couples? A Systematic Review of the Topic. *Journal of Education, Health and Sport* **2023**, *26*, 81–98, https://doi.org/10.12775/JEHS.2023.26.01.009.
11. Prémusz, V.; Lendvai-Emmert, D.; Makai, A.; Amrein, K.; Chauhan, S.; Bódis, J.; Kovács, K.A.; Várnagy, Á. Pre-Treatment Physical Activity Could Positively Influence Pregnancy Rates in IVF despite the Induced Oxidative Stress: A Cohort Study on Salivary 8-Hydroxy-2′-Deoxyguanosine. *Antioxidants* **2022**, *11*, 1586, https://doi.org/10.3390/antiox11081586.
12. Mountjoy, M.; Ackerman, K.E.; Bailey, D.M.; Burke, L.M.; Constantini, N.; Hackney, A.C.; Heikura, I.A.; Melin, A.; Pensgaard, A.M.; Stellingwerff, T.; et al. 2023 International Olympic Committee's (IOC) Consensus Statement on Relative Energy Deficiency in Sport (REDs). *British Journal of Sports Medicine* **2023**, *57*, 1073–1097, https://doi.org/10.1136/bjsports-2023-106994.
13. Rao, M.; Zeng, Z.; Tang, L. Maternal Physical Activity before IVF/ICSI Cycles Improves Clinical Pregnancy Rate and Live Birth Rate: A Systematic Review and Meta-Analysis. *Reproductive Biology and Endocrinology* **2018**, *16*, 11, https://doi.org/10.1186/s12958-018-0328-z.
14. Morris, S.N.; Missmer, S.A.; Cramer, D.W.; Powers, R.D.; McShane, P.M.; Hornstein, M.D. Effects of Lifetime Exercise on the Outcome of in Vitro Fertilization. *Obstetrics*

and Gynecology **2006**, *108*, 938–945, https://doi.org/10.1097/01.AOG.0000235704.45652.0b.
15. Evenson, K.R.; Calhoun, K.C.; Herring, A.H.; Pritchard, D.; Wen, F.; Steiner, A.Z. Association of Physical Activity in the Past Year and Immediately after in Vitro Fertilization on Pregnancy. *Fertility and Sterility* **2014**, *101*, 1047-1054.e5, https://doi.org/10.1016/j.fertnstert.2013.12.041.
16. Gaskins, A.J.; Williams, P.L.; Keller, M.G.; Souter, I.; Hauser, R.; Chavarro, J.E. Maternal Physical and Sedentary Activities in Relation to Reproductive Outcomes Following IVF. *Reproductive BioMedicine Online* **2016**, *33*, 513–521, https://doi.org/10.1016/j.rbmo.2016.07.002.
17. Deniss Sõritsa; Evelin Mäestu; Margit Nuut; Jarek Mäestu; Jairo H. Migueles; Siret Läänelaid; Aivar Ehrenberg; Aire Sekavin; Andrei Sõritsa; Andres Salumets; et al. Maternal Physical Activity and Sedentary Behaviour before and during in Vitro Fertilization Treatment: A Longitudinal Study Exploring the Associations with Controlled Ovarian Stimulation and Pregnancy Outcomes. *J Assist Reprod Genet* **2020**, *37*, 1869–1881, https://doi.org/10.1007/s10815-020-01864-w.
18. Ricci, E.; Noli, S.; Ferrari, S.; La Vecchia, I.; De Cosmi, V.; Castiglioni, M.; Somigliana, E.; Agostoni, C.; Cipriani, S.; Mauri, P.A.; et al. Pretreatment Maternal Lifestyle and Outcomes of Assisted Reproduction: An Italian Cohort Study. *BMJ Open* **2020**, *10*, e038837, https://doi.org/10.1136/bmjopen-2020-038837.
19. Läänelaid, S.; Ortega, F.B.; Kunovac Kallak, T.; Joelsson, L.; Ruiz, J.R.; Hreinsson, J.; Wånggren, K.; Stavreus-Evers, A.; Kalda, R.; Salumets, A.; et al. Physical and Sedentary Activities in Association with Reproductive Outcomes among Couples Seeking Infertility Treatment: A Prospective Cohort Study. *International Journal of Environmental Research and Public Health* **2021**, *18*, 2718, https://doi.org/10.3390/ijerph18052718.
20. Legro, R.S.; Hansen, K.R.; Diamond, M.P.; Steiner, A.Z.; Coutifaris, C.; Cedars, M.I.; Hoeger, K.M.; Usadi, R.; Johnstone, E.B. Effects of Preconception Lifestyle Intervention in Infertile Women with Obesity: The FIT-PLESE Randomized Controlled Trial. *PLoS Medicine* **2022**, *19*, e1003883, https://doi.org/10.1371/journal.pmed.1003883.
21. Wang, C.; Lv, H.; Ling, X. Association of Assisted Reproductive Technology, Germline de Novo Mutations and Congenital Heart Defects in a Prospective Birth Cohort Study. *Cell Research* **2021**, *31*, 919–928, https://doi.org/10.1038/s41422-021-00521-w.
22. Espinós, J.J.; Polo, A.; Sánchez-Hernández, J.; Bordas, R.; Pares, P.; Martínez, O.; Calaf, J. Weight Decrease Improves Live Birth Rates in Obese Women Undergoing IVF: A Pilot Study. *Reproductive BioMedicine Online* **2017**, *35*, 417–424, https://doi.org/10.1016/j.rbmo.2017.06.019.
23. Palomba, S.; Falbo, A.; Valli, B.; Morini, D.; Villani, M.T.; Nicoli, A.; La Sala, G.B. Physical Activity before IVF and ICSI Cycles in Infertile Obese Women: An Observational Cohort Study. *Reproductive BioMedicine Online* **2014**, *29*, 72–79, https://doi.org/10.1016/j.rbmo.2014.03.006.
24. Lo Giudice, A.; Asmundo, M.G.; Cimino, S.; Morgia, G.; Cocci, A.; Falcone, M.; Sokolakis, I.; Capogrosso, P.; Morgado, A.; Russo, G.I. Effects of Physical Activity on Fertility Parameters: A Meta-Analysis of Randomized Controlled Trials. *World Journal of Men's Health* **2024**, *42*, 555–562, https://doi.org/10.5534/wjmh.230106.
25. Matorras, R.; Navarro, A.; Ramos, D.; Malaina, I.; Irazusta, J.; Vendrell, A.; Fernández, A.; Ferrando, M.; Quintana, F. Physical Activity and Sperm Quality: Influence in Sperm Donors. *Reproductive Biology and Endocrinology* **2022**, *20*, 83, https://doi.org/10.1186/s12958-022-00946-x.
26. Donato, F.; Rota, M.; Ceretti, E.; Viola, G.C.V.; Marullo, M.; Zani, D.; Lorenzetti, S.; Montano, L. Intensity and Type of Physical Activity and Semen Quality in Healthy

Young Men. *Fertility and Sterility* **2025**, *123*, 88–96, https://doi.org/10.1016/j.fertnstert.2024.09.005.
27. Sharqawi, M.; Hantisteanu, S.; Bilgory, A.; Aslih, N.; Shibli Abu Raya, Y.; Atzmon, Y.; Estrada, D.; Limonad, O.; Meisel-Sharon, S.; Shalom-Paz, E. The Impact of Lifestyle on Sperm Function, Telomere Length, and IVF Outcomes. *American Journal of Men's Health* **2022**, *16*, https://doi.org/10.1177/15579883221119931.
28. Humaidan, P.; Haahr, T.; Povlsen, B.B.; Kofod, L.; Laursen, R.J.; Alsbjerg, B.; Elbaek, H.O.; Esteves, S.C. The Combined Effect of Lifestyle Intervention and Antioxidant Therapy on Sperm DNA Fragmentation and Seminal Oxidative Stress in IVF Patients: A Pilot Study. *International Braz J Urol* **2022**, *48*, 131–156, https://doi.org/10.1590/S1677-5538.IBJU.2021.0604.
29. Hamoda, H. The Management of Ovarian Hyperstimulation Syndrome. Green-Top Guideline No. 5. *BJOG: An International Journal of Obstetrics & Gynaecology* **2026**, https://doi.org/10.1111/1471-0528.70195.
30. Olaso, F.; Mendoza, R.; Echeverria, I.; Malaina, I.; Ibañez, J.; Irazusta, J.; Matorras, R. Impact of Physical Activity on Ovarian Response: A Prospective Study Among In Vitro Fertilization Patients. *Cureus* **2025**, *17*, e98640, https://doi.org/10.7759/cureus.98640.
31. Shapiro, M.; Kaing, A.; Christ, J.P.; Huddleston, H.G. Physical Activity During Fertility Care (PACE): A Randomized Controlled Trial of Exercise During Ovarian Stimulation. *Fertility and Sterility* **2024**, *122*, e119–e120, https://doi.org/10.1016/j.fertnstert.2024.07.391.
32. Jorge Rodriguez-Purata; Maitane Alonso-de Mendieta; Maria Jose Gomez-Cuesta; Enrique Cervantes-Bravo Live Birth Rate Following Bed Rest Versus Early Mobilization After Embryo Transfer: A Systematic Review And Meta-Analysis. *JBRA* **2022**, *26*, 547–553, https://doi.org/10.5935/1518-0557.20220003.
33. Remy, C.; Vinsonneau, L.; Stout, S.; Dupont, C.; Selleret, L.; Monnet, M.; Hours, A.; Sermondade, N.; Bardet, L.; Touboul, C.; et al. Impact of Physical Activity on Frozen Embryo Transfer Outcomes. *Journal of Gynecology Obstetrics and Human Reproduction* **2026**.
34. Jacobs, E.; Summers, K.; Van Voorhis, B. The Impact of Physical Activity and Stress on Frozen Embryo Transfer Cycles: The Step and Stress Tracking to Estimate Pregnancy (SSTEP) Trial. *Fertility and Sterility* **2026**, *125*, 401–410, https://doi.org/10.1016/j.fertnstert.2025.08.039.
35. Wang, W.; Yang, F.; Bai, Y.; Lu, Y.; Mao, X. Association between Domain-Specific Physical Activity and Mental Health Status after Embryo Transfer in IVF-ET-Assisted Pregnancy Patients. *Scientific Reports* **2024**, *14*, 4928, https://doi.org/10.1038/s41598-024-55097-3.
36. Urata, Y.; Harada, M.; Komiya, S.; Akiyama, I.; Tuchida, C.; Nakaoka, Y.; Fukuda, A.; Morimoto, Y.; Kawahara, T.; Ishikawa, Y.; et al. Lifestyle and Fertility-Specific Quality of Life Affect Reproductive Outcomes in Couples Undergoing in Vitro Fertilization. *Frontiers in Endocrinology* **2024**, *15*, 1346084, https://doi.org/10.3389/fendo.2024.1346084.
37. Steegers-Theunissen, R.; Hoek, A.; Groen, H.; Bos, A.; van den Dool, G.; Schoonenberg, M.; Smeenk, J.; Creutzberg, E.; Vecht, L.; Starmans, L.; et al. Pre-Conception Interventions for Subfertile Couples Undergoing Assisted Reproductive Technology Treatment: Modeling Analysis. *JMIR mHealth and uHealth* **2020**, *8*, e19570, https://doi.org/10.2196/19570.
38. Malekpour, P.; Hasanzadeh, R.; Javedani Masroor, M.; Chaman, R.; Motaghi, Z. Effectiveness of a Mixed Lifestyle Program in Couples Undergoing Assisted

Reproductive Technology: A Study Protocol. *Reproductive Health* **2023**, *20*, 112, https://doi.org/10.1186/s12978-023-01652-6.
39. Sunyach, C.; Courbiere, B.; Simon, N.; Delva, F.; Garlantezec, R.; Bretelle, F.; Leandri, R.; Gehanno, J.F.; Esquirol, Y.; Loubiere, S.; et al. PREVENIR-IVF: Study Protocol for a Prospective Multicentre Randomized Open Comparative Trial. *Trials* **2025**, *26*, 575, https://doi.org/10.1186/s13063-025-09208-8.
40. Dupont, C.; Aegerter, P.; Foucaut, A.M.; Reyre, A.; Lhuissier, F.J.; Bourgain, M.; Chabbert-Buffet, N.; Cédrin-Durnerin, I.; Selleret, L.; Cosson, E.; et al. Effectiveness of a Therapeutic Multiple-Lifestyle Intervention Taking into Account the Periconceptional Environment in the Management of Infertile Couples: Study Design of a Randomized Controlled Trial - the PEPCI Study. *BMC Pregnancy and Childbirth* **2020**, *20*, 322, https://doi.org/10.1186/s12884-020-2855-9.
41. Boedt, T.; Dancet, E.; Lie Fong, S.; Peeraer, K.; De Neubourg, D.; Pelckmans, S.; van de Vijver, A.; Seghers, J.; Van der Gucht, K.; Van Calster, B.; et al. Effectiveness of a Mobile Preconception Lifestyle Programme in Couples Undergoing in Vitro Fertilisation (IVF): The Protocol for the PreLiFe Randomised Controlled Trial (PreLiFe-RCT). *BMJ Open* **2019**, *9*, e029665, https://doi.org/10.1136/bmjopen-2019-029665.
42. Boedt, T.; Matthys, C.; Lie Fong, S.; De Neubourg, D.; Vereeck, S.; Seghers, J.; Van der Gucht, K.; Weyn, B.; Geerts, D.; Spiessens, C.; et al. Systematic Development of a Mobile Preconception Lifestyle Programme for Couples Undergoing IVF: The PreLiFe-Programme. *Human Reproduction* **2021**, *36*, 2493–2505, https://doi.org/10.1093/humrep/deab166.
43. Ying, L.; Chen, X.; Wu, L.H.; Shu, J.; Wu, X.; Loke, A.Y. The Partnership and Coping Enhancement Programme for Couples Undergoing in Vitro Fertilization Treatment: The Development of a Complex Intervention in China. *Journal of Assisted Reproduction and Genetics* **2017**, *34*, 99–108, https://doi.org/10.1007/s10815-016-0817-y.
44. You, R.; Huang, W.; Luo, J. The Dose-Response Effect of Aerobic Exercise on Neuroplasticity: An Analysis of The Mechanism of Drug Relapse Intervention Based on RCTs. *Pedagogy and Psychology of Sport* **2025**, *26*, 66394, https://doi.org/10.12775/PPS.2025.26.66394.
45. Kakargia, E.; Mamalakis, E.; Frountzas, M.; Anagnostou, E.; Siristatidis, C. The Role of Maternal Physical Activity on in Vitro Fertilization Outcomes: A Systematic Review and Meta-Analysis. *Archives of Gynecology and Obstetrics* **2023**, *307*, 1667–1676, https://doi.org/10.1007/s00404-022-06606-0.
46. Dai, H.; He, Q.; Liu, Y.; Wu, L.; Wang, H. Effect of Weight Loss Intervention on Assisted Reproductive Outcomes in Women with Obesity and Infertility: A Retrospective Cohort Study. *Frontiers in Endocrinology* **2026**, *17*, 1829965, https://doi.org/10.3389/fendo.2026.1829965.