Long-acting FSH versus daily FSH for women undergoing assisted reproduction (Review)

Pouwer AW, Farquhar C, Kremer JAM

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Long-acting FSH versus daily FSH for women undergoing assisted reproduction

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ABSTRACT

Background

Assisted reproduction techniques (ART) such as in vitro fertilisation (IVF) and intracytoplasmic sperm injection (ICSI) can help subfertile couples to create a family. It is necessary to induce multiple follicles; this is achieved by follicle stimulating hormone (FSH) injections. Current treatment regimens prescribe daily injections of FSH (urinary FSH with or without luteinizing hormone (LH) injections or recombinant FSH (rFSH)).

Recombinant DNA technologies have produced a new recombinant molecule which is a long-acting FSH, named corifollitropin alfa (Elonva) or FSH-CTP. A single dose of long-acting FSH is able to keep the circulating FSH level above the threshold necessary to support multi-follicular growth for an entire week. The optimal dose of long-acting FSH is still being determined. A single injection of long-acting FSH can replace seven daily FSH injections during the first week of controlled ovarian stimulation (COS) and can make assisted reproduction more patient friendly.

Objectives

To compare the effectiveness of long-acting FSH versus daily FSH in terms of pregnancy and safety outcomes in women undergoing IVF or ICSI treatment cycles.

Search methods

We searched the following electronic databases, trial registers and websites: the Cochrane Central Register of Controlled Trials (CENTRAL), the Menstrual Disorders and Subfertility Group (MDSG) Specialised Register, MEDLINE, EMBASE, PsycINFO, CINAHL, electronic trial registers for ongoing and registered trials, citation indexes, conference abstracts in the ISI Web of Knowledge, LILACS, Clinical Study Results (for clinical trial results of marketed pharmaceuticals), PubMed and OpenSIGLE (10 October 2011). We also carried out handsearches.

Selection criteria

All randomised controlled trials (RCTs) comparing long-acting FSH versus daily FSH in women who were part of a couple with subfertility and undertaking IVF or ICSI treatment cycles with a GnRH antagonist or agonist protocol were included.
Data collection and analysis

Data extraction and assessment of risk of bias was independently done by two review authors. Original trial authors were contacted in the case of missing data. We calculated Peto odds ratios for each outcome; our primary outcomes were live birth rate and ovarian hyperstimulation syndrome (OHSS) rate.

Main results

We included four RCTs with a total of 2335 participants. A comparison of long-acting FSH versus daily FSH did not show evidence of difference in effect on overall live birth rate (Peto OR 0.92; 95% CI 0.76 to 1.10, 4 RCTs, 2335 women) or OHSS (Peto OR 1.12; 95% CI 0.79 to 1.60, 4 RCTs, 2335 women). We compared subgroups by dose of long-acting FSH. There was evidence of reduced live birth rate in women who received lower doses (60 to 120 µg) of long-acting FSH compared to daily FSH (Peto OR 0.60; 95% CI 0.40 to 0.91, 3 RCTs, 645 women). There was no evidence of effect on live births in the medium dose subgroup (Peto OR 1.03; 95% CI 0.84 to 1.27) and no evidence of effect on clinical pregnancy rate, ongoing pregnancy rate, multiple pregnancy rate, miscarriage rate or ectopic pregnancy rate.

Authors’ conclusions

The use of a medium dose of long-acting FSH is a safe treatment option and equally effective compared to daily FSH. Further research is needed to determine if long-acting FSH is safe and effective for use in hyper- or poor responders and in women with all causes of subfertility.

PLAIN LANGUAGE SUMMARY

Long-acting FSH versus daily FSH for women undergoing assisted reproduction

For definitions of terminology see the Glossary

Assisted reproduction techniques such as in vitro fertilisation (IVF) and intracytoplasmic sperm injection (ICSI) can help subfertile couples to create a family. In a normal cycle only one egg will mature and is suitable for fertilisation. When IVF or ICSI are performed, the fertilisation of the egg takes place outside the woman's body. Multiple eggs are needed for IVF and ICSI to increase the number of suitable fertilised eggs for transfer to the woman. After the eggs are fertilised, they become embryos. One, two and sometimes three embryos are transferred; the other embryos can be cryopreserved and transferred in a later treatment cycle.

The development of multiple eggs is achieved by controlled ovarian stimulation (COS) with follicle stimulation hormone (FSH). Current treatment regimens prescribe daily injections of FSH during the first seven days of COS. A new treatment is available and one single injection of long-acting FSH, called corifollitropin alfa, can replace the first seven injections of FSH. The optimal dose of long-acting FSH is still being determined.

The aim of this review was to compare the effectiveness of long-acting FSH versus daily FSH in terms of pregnancy and safety outcomes in women undergoing IVF or ICSI treatment cycles. We included four trials involving a total of 2335 women. The results suggested that a medium dose of long-acting FSH provides similar numbers of live births as daily FSH. The serious adverse event ovarian hyperstimulation syndrome (OHSS) occurred equally with both treatments.

It can be concluded that medium dose long-acting FSH is a safe treatment option and is equally effective compared to daily FSH injections.
### Summary of Findings for the Main Comparison

**Long-acting FSH (all doses) versus daily FSH for women undergoing assisted reproduction**

**Patient or population:** women undergoing assisted reproduction  
**Settings:**  
**Intervention:** long-acting FSH (all doses) versus daily FSH

<table>
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<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
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<tr>
<td>Study population</td>
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<tr>
<td>Study population</td>
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<td>95% CI</td>
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The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

CI: Confidence interval; OR: Odds ratio;

<table>
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<th>Description</th>
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<tr>
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</tr>
<tr>
<td>Low quality</td>
<td>Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.</td>
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<tr>
<td>Very low quality</td>
<td>We are very uncertain about the estimate.</td>
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</tbody>
</table>

1 Open-label studies included
2 Total number of events is less than 300
3 Number of studies is not sufficient to assess publication bias
BACKGROUND

For definitions of terminology see the Glossary (Appendix 1).

Description of the condition

Infertility affects 10% to 15% of couples trying to conceive (Evers 2002; Gnoth 2005). Assisted reproduction techniques (ART) such as in vitro fertilisation (IVF) and intracytoplasmic sperm injection (ICSI) can help these couples to create a family. In ART it is necessary to induce multiple follicles. This is achieved by controlled ovarian stimulation (COS) with follicle stimulating hormone (FSH) injections.

Current treatment regimens prescribe daily injections of FSH (urinary FSH with or without luteinizing hormone (LH) injections or recombinant FSH (rFSH)). The FSH injections are usually started from cycle day two. Prevention of a premature ovulation due to a LH surge can be accomplished with gonadotropin-releasing hormone (GnRH) agonists or GnRH antagonists. Some clinicians consider antagonists to be the first choice in COS due to their immediate action, lack of side effects (for example lower incidence of ovarian hyperstimulation syndrome (OHSS)), the need for fewer injections and the same live birth rate as with agonists (Al-Inany 2011; Tarlatzis 2007). Other clinicians consider agonists as the first choice in COS due to a higher pregnancy rate (Maheshwari 2011). Antagonist injections start on day five or six (see Figure 1) whereas agonist injections start two to four weeks prior to the stimulation (see Figure 2).

Figure 1. Schematic representation of therapeutic interventions during ovarian stimulation with rFSH in a GnRH antagonist protocol (Source: De Greef 2010)
FSH and GnRH agonist or antagonist injections are continued up to and including the day the leading follicle reaches 18 to 20 mm (Heineman 2007). On this day, 34 to 36 hours prior to the ovum pick-up, human chorionic gonadotropin (hCG) is administered by injection leading to the final maturation necessary to produce the ovulation (see Figure 1; Figure 2). Two days (34 to 36 hours) later several oocytes are ready for ovum pick-up. After the pick-up, the oocytes are fertilised by IVF or ICSI. Two to five days after the fertilisation one, two or sometimes three embryos are transferred (Kovacs 2011).

Description of the intervention

Daily injections of rFSH are required to maintain steady state levels of FSH in the blood that are above the threshold for follicular development and ongoing maturation, due to its relatively short half-life and rapid metabolic clearance. The daily subcutaneous administration and side effects of the rFSH preparations can cause discomfort and be a physical burden to the patient. Many couples withdraw prematurely from IVF or ICSI due to emotional distress, which limits their chances of pregnancy. A German study showed withdrawal of 40% of non-pregnant couples after just one cycle of IVF due to emotional distress (Schroder 2004). For this reason, a patient friendly therapy regimen should be developed.

Recombinant DNA technologies have produced a new recombinant molecule which consists of the α-subunit of human FSH and a hybrid subunit consisting of the carboxyl-terminal peptide of the β-subunit of human chorionic gonadotrophin (hCG) coupled with the FSH β-subunit. This molecule is a long-acting FSH, named corifollitropin alfa (Elonva) or FSH-CTP (Fauser 2009; Koper 2008). A single injection of long-acting FSH on the first day of the stimulation can replace the first seven daily injections of rFSH and make assisted reproduction more acceptable to patients. The administration of long-acting FSH involves one subcutaneous injection on the first day of COS. The dose of long-acting FSH should be as low as possible to avoid ovarian hyperstimulation syndrome (OHSS) but high enough to support COS over the seven days. De Greef 2010 investigated 100 µg for women weighing < 60 kg and 150 µg for women weighing > 60 kg and the doses were proven to be adequate. The optimal dose of long-acting FSH is still under investigation. From day seven, the same treatment protocol as rFSH is used (see Figure 3; Figure 4).
Figure 3. Schematic representation of therapeutic interventions during ovarian stimulation with long-acting FSH (Corifollitropin alfa) in a GnRH antagonist protocol (Source: De Greef 2010)

Figure 4. Schematic representation of therapeutic interventions during ovarian stimulation with long-acting FSH (Corifollitropin alfa) in a GnRH agonist protocol (Source: De Greef 2010)
How the intervention might work
Long-acting FSH has, compared with rFSH, an approximately two-fold longer elimination half-life and an almost four-fold extended time to peak serum levels (Devroey 2009; Duijkers 2002). Due to this pharmacokinetic profile, a single dose of long-acting FSH is able to keep the circulating FSH level above the threshold necessary to support multi-follicular growth for an entire week (Devroey 2009; Koper 2008). As such, a single injection of long-acting FSH can replace seven daily rFSH injections during the first week of COS.

Why it is important to do this review
The development of this new treatment regimen may provide similar or better success rates with fewer injections. It may help to reduce the treatment burden and make the therapy more patient friendly. On the other hand it could also be more costly. This review considered the evidence from randomised controlled trials for the use of long-acting FSH on pregnancy and safety outcomes.

OBJECTIVES
To compare the effectiveness of long-acting FSH versus daily FSH in terms of pregnancy and safety outcomes in women undergoing IVF or ICSI treatment cycles.

METHODS
Criteria for considering studies for this review
Types of studies
Randomised controlled trials (RCTs) were included in this review. Only trials that were either clearly randomised or claimed to be randomised and did not have evidence of inadequate sequence generation, such as allocation by date of birth or hospital number, were included. We planned to include cross-over trials in the review but we did not find any cross-over trials comparing long-acting FSH with daily FSH.

Types of participants
Women with subfertility and undertaking IVF or ICSI treatment cycles with a GnRH antagonist or agonist protocol were included.

Types of interventions
Trials comparing long-acting FSH versus daily FSH were eligible for inclusion. Any dose was included.

Types of outcome measures
Primary outcomes
Effectiveness
• Live birth rate per woman randomised, defined as the delivery of one or more living babies after 20 completed weeks of gestation. When there were multiple live births (e.g. twins or triplets) these were counted as one live birth event

Adverse
• Ovarian hyperstimulation syndrome (OHSS) rate per woman randomised

Secondary outcomes
Effectiveness
• Ongoing pregnancy rate per woman randomised, defined as evidence of a gestational sac with fetal heart motion at 12 weeks, confirmed by ultrasound
• Clinical pregnancy rate per woman randomised, defined as the presence of a gestational sac with or without a fetal heart beat, confirmed by ultrasound

Adverse
• Multiple pregnancy rate per woman randomised, counted as one live birth event
• Miscarriage rate per woman randomised
• Any other adverse event per woman randomised (including ectopic pregnancy, fetal abnormalities, drug side effects and infection)

Process
• Patient satisfaction with the treatment

Search methods for identification of studies
All published and unpublished RCTs studying long-acting FSH versus daily FSH were sought. We used the following search strategy, without language restriction and in consultation with the Cochrane Menstrual Disorders and Subfertility Group (MDSG) Trials Search Co-ordinator.
Electronic searches

The following electronic databases, trial registers and websites were searched using Ovid software.

- Cochrane Central Register of Controlled Trials (CENTRAL), see Appendix 2.
- The Menstrual Disorders and Subfertility Group (MDSG) Specialised Register of controlled trials, see Appendix 3.
- MEDLINE, see Appendix 4.
- EMBASE, see Appendix 5.
- PsycINFO, see Appendix 6.
- CINAHL, see Appendix 7.

The MEDLINE search was combined with the Cochrane highly sensitive search strategy for identifying randomised trials that appears in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011). The EMBASE search was combined with trial filters developed by the Scottish Intercollegiate Guidelines Network (SIGN).

Other electronic sources of trials included the following.

- Trial registers for ongoing and registered trials: 'Current Controlled Trials' (http://www.controlled-trials.com/);
- Citation indexes (http://scientific.thomson.com/products/sci/).
- Conference abstracts in the ISI Web of Knowledge (http://iswbofknowledge.com/), see Appendix 8.
- Clinical Study Results, for clinical trials of marketed pharmaceuticals (http://www.clinicalstudyresults.org/).
- OpenSIGLE database for grey literature from Europe (http://opensigle.inist.fr/).

Searching other resources

The reference lists of articles retrieved by the search were hand-searched and personal contact was made with experts in the field and with the manufacturers of long-acting FSH in order to obtain any additional, relevant data.

Data collection and analysis

Data collection and analysis was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011).

Selection of studies

Two review authors independently scanned the titles and abstracts of articles retrieved by the search and removed those that were very clearly irrelevant. Full texts of all potentially eligible studies were retrieved. Two review authors independently examined the full text articles for compliance with the inclusion criteria and selected studies eligible for inclusion in the review. We discussed any disagreement or doubt as to whether a study was eligible for inclusion or not with a third review author and achieved consensus. A list of the excluded studies and the reasons for exclusion are provided in the ‘Characteristics of excluded studies’ table.

Data extraction and management

Data were extracted from eligible studies using a data extraction form designed and pilot-tested by the authors. Where studies had multiple publications, the main trial report was used as the reference and additional details were supplemented from secondary papers. The review authors corresponded with study investigators in order to resolve any data queries, as required. Two review authors independently extracted the data. Any disagreement between these review authors was resolved by a third review author.

Assessment of risk of bias in included studies

The included studies were assessed for risk of bias using the Cochrane risk of bias assessment tool, which recommends the explicit reporting of the following domains.

1. Random sequence generation (selection bias)
   - Adequate: use of central computer randomisation, independent central randomisation office, on-site computer from which assignment could only be determined after entering patient data, random number table or serially numbered and sealed opaque envelopes
   - Inadequate: use of non-opaque envelopes or systematic methods (e.g. date of birth, medical record number, day of the week presenting)
   - Unclear: insufficient information about the process of sequence generation

2. Allocation concealment (selection bias)
   - Adequate: sequentially numbered and identical drug containers were used
   - Inadequate: use of open random allocation (e.g. date of birth, medical record number, day of the week presenting)
   - Unclear: insufficient information about the process of allocation concealment

3. Blinding of participants, researchers and care providers (performance bias)
Dealing with missing data

In the case of missing data from the included studies, we contacted the original investigators to request the relevant missing data. We did not receive the requested data so we made an imputation of individual values for the primary outcomes only. Live births were assumed not to have occurred in participants without a reported outcome. For other outcomes, only the available data were analysed.

We analysed all data on an intention-to-treat (ITT) basis.

Assessment of heterogeneity

We considered whether the clinical and methodological characteristics of the included studies were sufficiently similar for meta-analysis to provide a meaningful summary. We used the I^2 statistic to assess the impact of the heterogeneity on the meta-analysis. We interpret the result of the I^2 statistic as follows:

- 0% to 40%, might not be important;
- 30% to 60%, may represent moderate heterogeneity;
- 50% to 90%, may represent substantial heterogeneity;
- 75% to 100%, considerable heterogeneity (Higgins 2011).

We did not find an I^2 statistic measurement greater than 50%, which means that there was no substantial heterogeneity (Higgins 2011). For this reason, we did not carry out any sensitivity analyses.

Assessment of reporting biases

We have taken care to search for within trial selective reporting, such as trials failing to report obvious outcomes or reporting them in insufficient detail to allow inclusion. We sought published protocols to look for any pre-planned outcomes that may not have been reported and compared the outcomes between the protocol and the final published study. We planned to undertake informal assessment if included studies failed to report the primary outcome of live birth, but all studies reported live birth.

In view of the difficulty of detecting and correcting for publication bias and other reporting biases, we aimed to minimise the potential impact by ensuring a comprehensive search for eligible studies. We were alert for duplication of data. To investigate the potential for publication bias, we planned to use a funnel plot if there were 10 or more studies in an analysis but due to the small number of studies per subgroup this was not possible.

Data synthesis

We carried out the statistical analysis using Review Manager version 5.1. We used a fixed-effect model to combine the data from primary studies. We planned to perform a random-effects meta-analysis in the case of substantial heterogeneity, but this was not necessary.
Subgroup analysis and investigation of heterogeneity
Data were analysed in the following subgroups.
Dose of long-acting FSH:
1. low dose (60 to 120 µg);
2. medium dose (150 to 180 µg);
3. high dose (240 µg).
We planned to do subgroup analyses on: women’s age; weight;
body mass index (BMI); day of starting GnRH antagonist; and
poor responders to ovarian stimulation. However, we were not
able to perform these subgroup analyses due to insufficient infor-
mation.

Sensitivity analysis
We planned to conduct sensitivity analyses for the primary out-
comes to determine whether the conclusions were robust regard-
ing the eligibility and analysis of studies. Because we did not find
substantial heterogeneity, we did not carry out the sensitivity anal-
yses.

RESULTS

Description of studies
See: Characteristics of included studies; Characteristics of excluded
studies; Characteristics of ongoing studies.
See: Characteristics of included studies, Characteristics of excluded
studies, Characteristics of ongoing studies

Results of the search
See: study flow diagram Figure 5
Figure 5. Study flow diagram

186 records identified through database searching

3 additional records identified through other sources

108 records after duplicates removed

58 records excluded

108 records screened

46 articles assessed for eligibility

9 articles excluded, with reasons

Devroye 2004: 1 full-text article, 1 protocol, 1 follow-up protocol, 2 clinical trial reports
ENGAGE 2009: 2 full-text articles (1 duplicate), 1 protocol, 2 follow-up protocols, 3 clinical trial reports, 4 conference abstracts (2 duplicates)
ENSURE 2010: 1 full-text article, 1 protocol, 2 follow-up protocols, 3 clinical trial reports, 1 conference abstract
Koper 2008: 1 full-text article, 1 protocol, 1 follow-up protocol, 2 clinical trial reports
2 ongoing trial reports with 1 conference abstract

4 studies included in quantitative synthesis (meta-analysis)
The search was done on 10 October 2011 (for our search strategy see Methods). The search strings as stated in Appendix 2; Appendix 3; Appendix 4; Appendix 5; Appendix 6; Appendix 7; Appendix 8 retrieved 107 articles. We also searched LILACS, metaRegister of Controlled Trials-active registers, WHO International Trials Registry Platform, clinicaltrials.gov, clinicalstudyresults.org, OpenSIGLE and PubMed (MeSH terms used) using the keywords ’corifollitropin’, ‘corifollitropin alfa’, ‘corifollitropin alpha’, ‘ORG 36286’, ‘Elonva’, ‘FSH-CTP’, ‘long-acting FSH’, ‘long acting FSH’. This search retrieved 79 reports, another three reports were found by using other methods such as handsearching. After removal of duplicates, 108 articles were screened, 53 records were found to be clearly irrelevant. The remaining 55 studies were retrieved in full-text or were conference abstracts, protocols or clinical study results. The reports that did not appear to meet our inclusion criteria were excluded (nine reports). Five trials met our inclusion criteria, and one study was a duplicate (Fausser 2010). We also found two ongoing trials and one conference abstract with preliminary results (Siristadis 2011), for details see Characteristics of ongoing studies.

We found on clinicaltrials.gov the protocols of the four included studies and six protocols of follow up studies of the original included studies. Clinical study reports of all protocols were found on clinicalstudyresults.org. We included four trials and the data of four conference abstracts, six protocols and six reports of clinical study results in our meta-analyses. Overall, we included four trials.

Included studies

Study design and setting

Four randomised controlled trials were included in the review. All were multi-center trials, conducted in Europe (Austria, Belgium, Czech Republic, Denmark, Finland, France, Norway, Poland, Spain, Sweden, The Netherlands, UK), North America (Canada, USA) and Asia (Korea, Taiwan). We included two four-arm trials (Devroey 2004; Koper 2008) and two two-arm trials (ENGAGE 2009; ENSURE 2010). As there were studies with four arms, three dosage arms and one control group, it was necessary to divide the control group by three. If the study did not report live births per dosage subgroup it was necessary to divide the intervention group by three. Where this number was even, then we made an arbitrary decision to increase or reduce the number of cases by one in one of the three groups.

Participants

A total of 2335 women participated in the included studies, 1348 women in the intervention groups and 987 women in the control groups. The age of the included participants ranged from 18 to 39 years, and the range of BMI was 17 to 32 kg/m².

The inclusion criteria differed slightly between the studies in age, BMI and weight. ENSURE 2010 included women with a body weight ≤ 60 kg and BMI of 18 to 32 kg/m², ENGAGE 2009 included women weighing > 60 kg and ≤ 90 kg with BMI 18 to 32 kg/m². The two other studies included women weighing 50 to 90 kg (Devroey 2004; Koper 2008).

There were differences for the inclusion and exclusion criteria between the protocols and the published articles. Koper 2008 reported an inclusion age range of 20 to 39 years in the article while they stated 18 to 39 years in the protocol. Devroey 2004 reported none of the exclusion criteria as stated in the protocol. All studies excluded poor responders, patients with a history of OHSS or polycystic ovary syndrome (PCOS) (hyper-responders) and women with explained subfertility.

A summary can be found in Table 1; for detail see table Characteristics of included studies.

Interventions

All included studies compared long-acting FSH with daily FSH and followed by a GnRH antagonist protocol. The studies varied in initial dose of long-acting FSH administered: 454 women received a low dose (60 to 120 µg) (Devroey 2004; ENSURE 2010; Koper 2008), 869 women received a medium dose (150 to 180 µg) (Devroey 2004; ENGAGE 2009; Koper 2008) and 25 women received a high dose (240 µg) (Devroey 2004). All studies used rFSH for the control group: three studies used 150 IU rFSH (Devroey 2004; ENSURE 2010; Koper 2008) and ENGAGE 2009 used 200 IU rFSH. ENSURE 2010 and ENGAGE 2009 used a bodyweight adjusted dose of long-acting and daily FSH. GnRH antagonist was administered subcutaneously. Devroey 2004 started on the day the leading follicle reached 14 mm, the three other studies (ENGAGE 2009; ENSURE 2010; Koper 2008) started on day 5. None of the studies used GnRH agonists. The number of transferred embryos varied from one or two embryos (ENGAGE 2009; ENSURE 2010) to three or fewer embryos (Devroey 2004; Koper 2008), see Table 1.

Outcomes

Primary outcomes

Effectiveness
Live birth rate was reported in four clinical trial reports with additional data obtained by follow-up studies of the original trial.

**Adverse**

Ovarian hyperstimulation syndrome (OHSS) was reported in all four included studies. We reported the total number of OHSS cases, including mild, moderate and severe cases.

**Secondary outcomes**

**Effectiveness**

Clinical pregnancy rate was reported in three studies (ENGAGE 2009; ENSURE 2010; Koper 2008). These three studies reported both the number of clinical pregnancies (defined as presence of gestational sac confirmed by ultrasound) and the number of vital pregnancies (defined as gestational sac and heartbeat confirmed by ultrasound). We decided to report the vital pregnancy rate per women randomised. Ongoing pregnancy rate was reported by all four studies. If results after both fresh and frozen embryo transfer were reported, we made the decision to report the ongoing pregnancy rate after fresh embryo transfer.

**Adverse**

Multiple pregnancy rate was reported in all four studies. Devroey 2004 reported three sets of twins in the intervention groups; we assumed that one twin pregnancy occurred in each intervention group. Miscarriage rate was reported in two studies (ENGAGE 2009; ENSURE 2010). Three studies reported ectopic pregnancy rate as an adverse event (Devroey 2004; ENGAGE 2009; ENSURE 2010). We had insufficient data to report any other adverse events.

**Process**

None of the included studies reported patient satisfaction with the treatment.

**Excluded studies**

Eleven studies were excluded from the review. Two studies (Boostanfar 2011; Fauser 2010) were duplicates of ENGAGE 2009. Nine studies did not meet our inclusion criteria, three studies were reviews (Croxtall 2011; Ledger 2009; Seyhan 2011), five studies (De Lartigue 2011; Fatemi 2010; Loutradis 2010; Norman 2011; Prados 2011) were not randomised controlled trials (RCTs) and one study (Balen 2004) was excluded because the women did not undergo IVF or ICSI after the stimulation.

See table of Characteristics of excluded studies for details.

**Risk of bias in included studies**

The risk of bias was assessed for each included trial in the ‘Risk of bias’ table, see Characteristics of included studies. We summarised our findings in the ‘Risk of bias’ summary (see Figure 6) and in the ‘Risk of bias’ graph (see Figure 7).
Figure 6. Risk of bias summary: review authors’ judgements about each risk of bias item for each included study.

<table>
<thead>
<tr>
<th></th>
<th>Random sequence generation (selection bias)</th>
<th>Allocation concealment (selection bias)</th>
<th>Blinding of participants and personnel (performance bias)</th>
<th>Blinding of outcome assessment (detection bias)</th>
<th>Incomplete outcome data (attrition bias)</th>
<th>Selective reporting (reporting bias)</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroy 2004</td>
<td>?</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>ENSURE 2010</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
We contacted the authors for supplementary information. All included studies had the same contact author; we did not receive the requested data.

**Allocation**

**Random sequence generation**

All four included studies were randomised. We judged three studies at low risk of selection bias as they used randomly permuted blocks with an undisclosed fixed block size (ENGAGE 2009; ENSURE 2010; Koper 2008). We judged one study at unclear risk of selection bias related to random sequence generation because the authors did not report the method of randomisation used (Devroey 2004).

**Allocation concealment**

The allocation was concealed by using central remote allocation in three studies and we judged the method to be at low risk of bias (ENGAGE 2009; ENSURE 2010; Koper 2008). One study did not describe the method of allocation concealment and we judged this to be unclear risk of bias (Devroey 2004).

**Blinding**

**Blinding of participants and personnel**

All four studies reported their method of blinding. Two studies were open-label trials (Devroey 2004; Koper 2008) and were judged at high risk of bias. Two studies were double-blind and described use of a double-dummy placebo and were thus we deemed them to be at low risk of performance bias (ENGAGE 2009; ENSURE 2010).

**Blinding of outcome assessment**

Two of the studies did not report the blinding of outcome assessors and we judged them to be at unclear risk of bias (ENGAGE 2009; ENSURE 2010). The other two studies were open-label trials and for this reason we judged them to be at high risk of detection bias (Devroey 2004; Koper 2008).

**Incomplete outcome data**

Two studies were found to be at high risk of attrition bias. Devroey 2004 did not report reasons for all withdrawals. They reported in their protocol six participants treated with long-acting FSH during this trial; these treated participants were not analysed in their publication. We decided to analyse 105 participants (99 participants analysed in the published paper and six participants treated as stated in the protocol) in our meta-analysis.
We found ENGAGE 2009 to be at high risk of bias because the trial had a high unexplained drop-out rate. Two studies were judged to be at low risk of bias because they reported all numbers and reasons for withdrawals (ENSURE 2010; Koper 2008). Across all studies, a total of 12.7% of participants in the intervention groups and 7.5% in the control groups withdrew during the treatment before embryo transfer.

Selective reporting

Protocols were available for all included studies and all pre-specified outcomes were reported in either the published articles or unpublished data on clinical study reports (clinicalstudyresults.gov). We judged all four studies to be at low risk of reporting bias.

Other potential sources of bias

We judged all studies to be at high risk of other bias because the included studies were funded by Schering-Plough (NV Organon). ENGAGE 2009 also received fees and grants from: Ferring, Bessins, Serono, Merck Serono, IBSA, Wyeth, Schering, Ardana, Andromed, Pantrhei Bioscience and Preglem.

Effects of interventions

See: Summary of findings for the main comparison Long-acting FSH (all doses) versus daily FSH for women undergoing assisted reproduction

We did not conduct all the subgroup analyses as stated in our protocol. We had insufficient data to be able to conduct the analyses, see Table 1. We compared long-acting FSH (all doses) versus daily FSH with the following subgroups.

Dose of long-acting FSH:
1. low dose (60 to 120 µg);
2. medium dose (150 to 180 µg);
3. high dose (240 µg).

Primary outcomes

1.1 Live birth rate

All four trials reported the numbers of live births. There was no evidence of effect comparing long-acting FSH versus daily FSH. Moderate heterogeneity was detected but there was no indication of substantial heterogeneity (Peto OR 0.92; 95% CI 0.76 to 1.10, 4 RCTs, 2335 women, $I^2 = 46\%$).

1.1.1 Low dose

There was evidence of a reduced live birth rate in women who received lower doses (60 to 120 µg) of long-acting FSH compared to daily FSH (Peto OR 0.60; 95% CI 0.40 to 0.91, 3 RCTs, 645 women, $I^2 = 0\%$).

1.1.2 Medium dose

There was no evidence of difference in effect; heterogeneity was detected but there was no indication of substantial heterogeneity (Peto OR 1.03; 95% CI 0.84 to 1.27, 3 RCTs, 1647 women, $I^2 = 17\%$).

1.1.3 High dose

No data were available to conduct high dose subgroup analysis. See Figure 8 for details.
The primary adverse effect was reported in all four trials. There was no evidence of effect for this adverse outcome and no heterogeneity detected. (Peto OR 1.12; 95% CI 0.79 to 1.60, 4 RCTs, 2335 women, I² = 0%).

### 1.2.1 Low dose

There was no evidence of difference in effect (Peto OR 1.22; 95% CI 0.55 to 2.72, 3 RCTs, 645 women, I² = 0%).

### 1.2.2 Medium dose

There was no evidence of difference in effect; heterogeneity was detected but there was no indication of substantial heterogeneity (Peto OR 1.08; 95% CI 0.72 to 1.61, 3 RCTs, 1657 women, I² = 49%).

### 1.2.3 High dose

There was no evidence of difference in effect (Peto OR 3.91; 95% CI 0.15 to 104.40, 1 RCT, 33 women).

### 1.2 Ovarian hyperstimulation syndrome (OHSS)

The primary adverse effect was reported in all four trials. There was no evidence of effect for this adverse outcome and no heterogeneity detected. (Peto OR 1.12; 95% CI 0.79 to 1.60, 4 RCTs, 2335 women, I² = 0%).

### 1.2.1 Low dose

There was no evidence of difference in effect (Peto OR 1.22; 95% CI 0.55 to 2.72, 3 RCTs, 645 women, I² = 0%).

### 1.2.2 Medium dose

There was no evidence of difference in effect; heterogeneity was detected but there was no indication of substantial heterogeneity (Peto OR 1.08; 95% CI 0.72 to 1.61, 3 RCTs, 1657 women, I² = 49%).

### 1.2.3 High dose

There was no evidence of difference in effect (Peto OR 3.91; 95% CI 0.15 to 104.40, 1 RCT, 33 women).

See Figure 9 for details.
### Figure 9. Forest plot of comparison: 1 Long-acting FSH (all doses) versus daily FSH, outcome: 1.2 Ovarian hyperstimulation syndrome.

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Events</td>
<td>Total</td>
</tr>
<tr>
<td>1.2.1 Low dose (60-120 µg)</td>
<td>2</td>
<td>27</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Enovay 2004</td>
<td>18</td>
<td>226</td>
<td>6</td>
<td>128</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>2</td>
<td>158</td>
<td>1</td>
<td>55</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>454</td>
<td>191</td>
<td>19.7%</td>
<td>1.22 (0.95, 2.72)</td>
</tr>
<tr>
<td>Total events</td>
<td>22</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Ch² = 8.67, df = 2 (P = 0.014); P* = 49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.37 (P = 0.71)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.2 Medium dose (150-180 µg)</td>
<td>0</td>
<td>29</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Enovay 2004</td>
<td>55</td>
<td>757</td>
<td>47</td>
<td>752</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>2</td>
<td>83</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>869</td>
<td>788</td>
<td>79.1%</td>
<td>1.08 (0.72, 1.61)</td>
</tr>
<tr>
<td>Total events</td>
<td>56</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Ch² = 8.94, df = 2 (P = 0.014); P* = 49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.37 (P = 0.71)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.3 High dose (240 µg)</td>
<td>2</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>25</td>
<td>8</td>
<td>12.2%</td>
<td>3.94 (0.05, 104.40)</td>
</tr>
<tr>
<td>Total events</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.01 (P = 0.99)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1348</td>
<td>987</td>
<td>100.0%</td>
<td>1.12 (0.79, 1.60)</td>
</tr>
<tr>
<td>Total events</td>
<td>76</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Ch² = 0.25, df = 6 (P = 0.81); P* = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.04 (P = 0.96)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for subgroup differences: CH² = 0.01, df = 2 (P = 0.93); P* = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Secondary outcomes

#### 1.3 Ongoing pregnancy rate

All four included studies reported ongoing pregnancy rate. There was no evidence of effect; heterogeneity was detected but no indication for substantial heterogeneity (OR 0.93; 95% CI 0.78 to 1.11, 4 RCTs, 2334 women, I² = 29%).

#### 1.4.2 Medium dose

There was no evidence of difference in effect and no heterogeneity detected. (Peto OR 1.02; 95% CI 0.83 to 1.25, 3 RCTs, 1656 women, I² = 0%).

#### 1.4.3 High dose

There was no evidence of difference in effect (Peto OR 0.30; 95% CI 0.06 to 1.67, 1 RCT, 33 women).

See Figure 10 for details.
Figure 10. Forest plot of comparison: 1 Long-acting FSH (all doses) versus daily FSH, outcome: 1.3 Ongoing pregnancy rate.

1.3.1 Low dose (60-120 µg)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Events</th>
<th>Total FSH</th>
<th>Total Daily FSH</th>
<th>Peto Odds Ratio Peto, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroye 2004</td>
<td>4</td>
<td>27</td>
<td>3</td>
<td>0.0% 0.25 [0.04, 1.76]</td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>86</td>
<td>268</td>
<td>44</td>
<td>14.9% 0.64 [0.40, 1.02]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>24</td>
<td>159</td>
<td>7</td>
<td>4.3% 1.21 [0.51, 2.88]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>454</td>
<td>191</td>
<td>20.1% 0.71 [0.47, 1.16]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 2.71, df = 2 (P = 0.28), I² = 28%
Test for overall effect: Z = 1.09 (P = 0.29)

1.3.2 Medium dose (150-180 µg)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Events</th>
<th>Total FSH</th>
<th>Total Daily FSH</th>
<th>Peto Odds Ratio Peto, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroye 2004</td>
<td>5</td>
<td>29</td>
<td>3</td>
<td>0.0% 0.31 [0.05, 1.94]</td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>294</td>
<td>757</td>
<td>26</td>
<td>75.7% 1.03 [0.84, 1.27]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>11</td>
<td>83</td>
<td>4</td>
<td>2.1% 0.92 [0.66, 1.30]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>310</td>
<td>293</td>
<td>78.8% 1.02 [0.83, 1.25]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 1.97, df = 2 (P = 0.40), I² = 0%
Test for overall effect: Z = 0.16 (P = 0.87)

1.3.3 High dose (240 µg)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Events</th>
<th>Total FSH</th>
<th>Total Daily FSH</th>
<th>Peto Odds Ratio Peto, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroye 2004</td>
<td>6</td>
<td>25</td>
<td>4</td>
<td>11% 0.30 [0.08, 1.67]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>25</td>
<td>8</td>
<td>1.1% 0.30 [0.06, 1.67]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.0, df = 1 (P = 0.97)
Test for overall effect: Z = 1.37 (P = 0.17)

Total (95% CI)

<table>
<thead>
<tr>
<th>Events</th>
<th>Total FSH</th>
<th>Total Daily FSH</th>
<th>Peto Odds Ratio Peto, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1348</td>
<td>1987</td>
<td>100.0% 0.93 [0.78, 1.12]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.47, df = 6 (P = 0.88), I² = 28%
Test for overall effect: Z = 0.76 (P = 0.45)
Test for subgroup differences: Chi² = 3.15, df = 2 (P = 0.21), I² = 52.2%

(1) This study only recruited women with a body weight of less than 80 kg.

1.4 Clinical pregnancy rate

Clinical pregnancy rate was reported in three trials (ENGAGE 2009; ENSURE 2010; Koper 2008). There was no evidence of effect, heterogeneity was detected but no indication for substantial heterogeneity (Peto OR 0.96; 95% CI 0.80 to 1.15, 3 RCTs, 2230 women, I² = 21%).

1.3.2 Medium dose

There was no evidence of difference in effect and no heterogeneity detected. (Peto OR 1.03; 95% CI 0.84 to 1.26, 2 RCTs, 1620 women, I² = 0%).

1.3.3 High dose

No data were available to conduct high dose subgroup analysis.

See Figure 11 for details.
1.5 Multiple pregnancy rate

The adverse event multiple pregnancy rate was reported in all four studies. There was no evidence of effect (Peto OR 1.24; 95% CI 0.92 to 1.68, 4 RCTs, 2335 women, I² = 0%).

1.5.1 Low dose

There was no evidence of difference in effect. Moderate heterogeneity detected, but no indication for substantial heterogeneity (Peto OR 1.05; 95% CI 0.51 to 2.17, 3 RCTs, 645 women, I² = 34%).

1.5.2 Medium dose

There was no evidence of difference in effect and no heterogeneity detected (Peto OR 1.28; 95% CI 0.92 to 1.79, 3 RCTs, 1657 women).

1.5.3 High dose

There was no evidence of difference in effect (Peto OR 3.74; 95% CI 0.04 to 362.67, 1 RCT, 33 women).

See Figure 12 for details.
1.6.1 Low dose
There was no evidence of difference in effect (Peto OR 1.19; 95% CI 0.38 to 3.73, 1 RCT, 396 women).

1.6.2 Medium dose
There was no evidence of difference in effect (Peto OR 1.29; 95% CI 0.72 to 2.28, 1 RCT, 1509 women).

1.6.3 High dose
Not data were available to conduct high dose subgroup analysis.

See Figure 13 for details.
1.7 Ectopic pregnancy rate

Three studies reported the adverse event ectopic pregnancy rate (Devroey 2004; ENGAGE 2009; ENSURE 2010). There was no evidence of effect and no heterogeneity was detected (Peto OR 0.91; 95% CI 0.43 to 1.92; 3 RCTs, 2004 women, I² = 0%).

1.7.1 Low dose

There was no evidence of effect difference and no heterogeneity was detected (Peto OR 1.05; 95% CI 0.32 to 3.42, 2 RCTs, 429 women, I² = 0%).

1.7.2 Medium dose

There was no evidence of difference in effect and no heterogeneity was detected (Peto OR 0.83; 95% CI 0.32 to 2.17, 2 RCTs, 1542 women, I² = 0%).

1.7.3 High dose

There were no events in both the intervention group and the control group.

See Figure 14 for details.
DISCUSSION

Summary of main results

This review evaluated the effectiveness of long-acting FSH versus daily FSH on pregnancy and safety outcomes in women undergoing IVF or ICSI treatment cycles. There was evidence of a reduced live birth rate in women who received lower doses (60 to 120 µg) of long-acting FSH compared to daily FSH but no evidence of difference in effect on live birth rate in women receiving a medium dose (150 to 180 µg). Only one small study used a high dose (240 µg) of long-acting FSH and at present this is of no clinical value. The meta-analyses of effectiveness for the outcomes of clinical pregnancy and ongoing pregnancy did not show evidence of a difference of effect between long-acting and daily FSH. Similarly, there was no evidence of a difference in adverse events for OHSS rate, multiple pregnancy rate, miscarriage rate and ectopic pregnancy rate between long-acting and daily FSH. We can conclude that medium dose long-acting FSH is a safe treatment option, with no difference in benefits or harm.

See Summary of findings for the main comparison for a complete overview.

Overall completeness and applicability of evidence

All randomised clinical trials comparing long-acting FSH with daily FSH were included in this review. Our primary outcomes, live birth rate and OHSS rate, were reported in all four trials. Women at high risk of OHSS (hyper-responders) were excluded; this provides an explanation for the poor effect of long-acting FSH on the OHSS rate and the low number of OHSS cases in both treatment groups. Also, poor responders were excluded in all trials. For this reason, trials did not provide outcome data on the use of long-acting FSH in poor responders. All studies excluded women with explained subfertility. Therefore,
our meta-analyses were based on women with unexplained subfertility. Our outcomes do not apply to long-acting FSH in women with explained subfertility.

Quality of the evidence
We included four studies with a total of 2335 participants in our meta-analyses. The number of participants in each study varied between 99 and 1509. Both two-arm (one intervention and one control group) and four-arm (three intervention groups and one control group) studies were included. All studies reported their outcomes per woman. Only one study performed an intention-to-treat analysis but we had sufficient data to perform intention-to-treat analyses. We found differences between the inclusion and exclusion criteria as stated in the protocol and those published in the article, see Characteristics of included studies for details. These differences were minor and did not tend to be relevant.

The included studies differ in the dose of long-acting FSH. ENGAGE 2009 and ENSURE 2010 used a dose adjusted for participant body weight. ENGAGE 2009 only included women with a body weight above 60 kg and they used a medium dose of long-acting FSH. ENSURE 2010 recruited women weighing less than 60 kg and used a low dose of long-acting FSH for these women. Both Devroey 2004 and Koper 2008 also used a low dose but they included women weighing 50 to 90 kg. This may influence the overall effect in the low dose, long-acting FSH subgroup in favour of long-acting FSH.

Only one trial (Devroey 2004) studied a high dose of long-acting FSH and this treatment subgroup contained only 25 participants. This information is insufficient to make accurate conclusions about the treatment with high dose, long-acting FSH.

None of the studies reported patient satisfaction for long-acting FSH versus daily FSH treatment so we are not able to determine if long-acting FSH treatment is more patient friendly than daily FSH.

All included trials were sponsored by the same pharmaceutical company and have the same contact author, from the company. This may have introduced a bias in favour of long-acting FSH treatment.

Two studies (Devroey 2004; Koper 2008) did not blind the participants, personnel and outcome assessment and this caused a high risk of bias. Two studies (Devroey 2004; ENGAGE 2009) did not report all the reasons for withdrawals and Devroey 2004 did not report six treated participants in their published article, constituting a high risk of bias. We detected some moderate heterogeneity between the studies and subgroups. This can be explained by differences between the inclusion and exclusion criteria for participants, participant characteristics and the small differences between the treatment after the first seven days of COS. There was no indication for substantial heterogeneity, therefore we did not perform sensitivity analyses.

Potential biases in the review process
We stated in our protocol that we would perform different subgroup analyses. Due to insufficient data, we performed only the subgroup analysis for dose of long-acting FSH. We included a small number of studies and for this reason we did not construct a funnel plot. Therefore, we were not able to estimate the existence of publication or other reporting biases.

The method we adopted to deal with data from four-arm studies (discussed in detail in Included studies) may have introduced bias. All data were extracted by two review authors (AWP and CF). AWP compared the extracted data and discussed disagreements and doubts with CF. AWP entered the data into RevMan and wrote the review. These authors’ methods may have introduced bias.

Agreements and disagreements with other studies or reviews
Our results are in agreement with both previous reviews (Croxtall 2011; Seyhan 2011).

Authors’ Conclusions
Implications for practice
The use of a medium dose of long-acting FSH is a safe treatment option and equally effective compared to daily FSH.

Implications for research
All current trials excluded poor- and hyper-responders to ovarian stimulation and women with explained subfertility. Therefore, further research is needed to determine if long-acting FSH can be used in all women with subfertility. There is one ongoing trial about long-acting FSH in combination with a GnRH agonist treatment. More research is needed to determine the pregnancy and safety outcomes in this treatment combination. There are no studies about patient satisfaction with the treatment and further research should examine this to determine whether the new treatment is more patient friendly than the daily injections regimen.

Acknowledgements
We would like to thank the Cochrane Menstrual Disorders and Subfertility Group. In particular we thank Marian Showell (Trials Search Co-ordinator) for writing and running the search, Vanessa Jordan (NZ Cochrane Fellow), Helen Nagels (Managing Editor of MDSG) and Julie Brown (systematic reviewer) for answering our questions.
REFERENCES

References to studies included in this review

Devroey 2004  [published and unpublished data]
A phase III, open-label, prospective, randomized, comparative clinical trial to investigate the appropriate dose of a single injection of Org 36286 (corifollitropin alfa) to initiate multiple follicular growth in a controlled ovarian hyperstimulation protocol for IVF or IVF/ICSI. clinicaltrials.gov 18 June 2008.


ENGAGE 2009  [published and unpublished data]
A phase III, non-inferiority clinical trial to investigate the efficacy and safety of a single injection of 150 µg Org 36286 (corifollitropin alfa) to induce multifollicular development for ovarian stimulation using daily recombinant FSH as reference. clinicaltrials.gov 11 June 2008.


A phase II, open label, randomized trial to investigate the dose-response relationship of a single injection of 100 µg Org 36286 (corifollitropin alfa) to induce multifollicular development for ovarian stimulation using daily recombinant FSH as a reference. A phase III, equivalence clinical trial to investigate the efficacy and safety of a single injection of 100 µg Org 36286 (corifollitropin alfa) to induce multifollicular development for ovarian stimulation during clinical trial 107012. 

References to studies excluded from this review


Evers 2002

Fauser 2009

Gnoth 2005

Heineman 2007

Higgins 2011

Kovacs 2011

Maheshwari 2011

MDSG module 2008

Schroder 2004

Tarlatzis 2007
## Characteristics of included studies [ordered by study ID]

### Devroey 2004

| Methods | Randomised controlled trial, open-label four-arm trial  
|         | Academic multi-center trial; Belgium and The Netherlands  
|         | Timing: July 2001 to October 2002 (15 months)  
|         | Ethical approval and informed consent obtained  
|         | Power calculation carried out (dose of FSH-CTP)  
|         | No intention-to-treat analysis performed  |

| Participants | Number of participants as stated in their protocol (unpublished data): 104 (6 subjects treated during stage I part of this trial)  
|              | Number of participants as stated in published article: 99 (75 intervention, 24 control treated during phase II part of the trial)  
|              | All treated subjects (104) during the trial (phase I and II) are analysed in the follow-up study. We decided to analyse 105 subjects (99 subjects analysed in the published paper and 6 subjects treated stated in the protocol)  
|              | **Inclusion criteria as stated in the article**  
|              | Women between 18 and 39 years of age and a regular menstrual cycle (24-35 d) and normal body weight (BMI 18-29 kg/m\(^2\))  
|              | **Inclusion criteria as stated in the protocol**  
|              | Women of couples with an indication for COH before IVF or ICSI, between 18 and 39 years, regular menstrual cycle (24-35d), BMI 18-29 kg/m\(^2\), couples have availability of ejaculatory sperm, willing and able to sign informed consent  
|              | **Exclusion criteria as stated in the article**  
|              | Not reported  
|              | **Exclusion criteria as stated in the protocol**  
|              | History of/or current endocrine abnormality such as PCOS, or polycystic ovaries according to USS, (treated) hyper-prolactinemia or evidence of ovarian dysfunction, > 3 unsuccessful COH cycles for IVF since last established ongoing pregnancy, history of non- or low ovarian response to FSH/hMG treatment, any clinically relevant hormone value outside the reference range during the early follicular phase as measured by the local laboratory (FSH, LH, E2, P, total T, TSH and prolactin), any clinically relevant abnormal laboratory value, any ovarian and/or abdominal abnormality interfering with ultrasound examination, contraindications for the use of gonadotropins, epilepsy, diabetes, cardiovascular, gastro-intestinal, hepatic, renal, pulmonary, or abdominal disease, history of alcohol or drug abuse within 12 months prior to signing informed consent, hypersensitivity to Orgalutran® or any of its compounds, administration of investigational drugs within three months prior to screening, use of hormonal preparations within one month prior to the start of Org 36286 with the exception of thyroid medication  
| Mean age (years) and SD | intervention 120 µg: 30.4 ± 3.8  
|                        | intervention 180 µg: 31.5 ± 3.8  
|                        | intervention 240 µg: 33.4 ± 4.1  
|                        | control: 32.1 ± 4.3  
| Mean weight (kg) and SD | not reported  
| Mean BMI (kg/m\(^2\)) and SD |
intervention 120 µg: 23.2 ± 2.8
intervention 180 µg: 22.9 ± 3.5
intervention 240 µg: 22.6 ± 2.7
control: 23.4 ± 2.8

Mean duration of subfertility (years) and SD
intervention 120 µg: 4.2 ± 3.1
intervention 180 µg: 4.9 ± 3.6
intervention 240 µg: 5.6 ± 4.3
control: 4.6 ± 3.2

Withdrawals

Intervention
Total 16% of participants in intervention groups withdrawn before embryo transfer
120 µg: two subjects who received hCG did not continue with oocyte pick-up, because absence of sperm and too few pre-ovulatory follicles
180 µg: one randomised subject dropped-out before the treatment started, no reason reported. One subject did not receive hCG because an excessive response. Before oocyte pick-up one subject discontinued because too few preovulatory follicles
240 µg: two subjects did not receive hCG because an excessive response or a too-low response
Six subjects in the intervention groups who had oocyte retrieval did not proceed with embryo transfer because of fertilisation failure or the recovery of too few or no embryos

Control
Total 4.2% of participants in control group withdrawn before embryo transfer
One subject in the control group did not receive hCG because a too-low response

Interventions

Intervention: 120 µg, 180 µg or 240 µg long-acting FSH
Control: 150 IU rFSH
GnRH antagonist was administered sc starting on the day the leading follicle reached 14 mm, until at least 3 follicles ≥ 17 mm
No more than 3 embryos were transferred

Outcomes

Primary
Live birth rate
OHSS

Secondary
Ongoing pregnancy rate
Multiple pregnancy rate
Adverse events: ectopic pregnancy

Notes
They report in their protocol six subjects treated with long-acting FSH during the phase I stage of this trial. Two subjects are treated with 120 µg and four subjects are treated with 180 µg of long-acting FSH. These six subjects are not reported in their published article. We made the decision to analyse all participants of this trial instead of the 99 as reported in their article
Devroey 2004  (Continued)

| Random sequence generation (selection bias) | Unclear risk | "Randomised" Method of randomisation not reported |
| Allocation concealment (selection bias) | Unclear risk | "Randomised" No reference to allocation concealment |
| Blinding of participants and personnel (performance bias) All outcomes | High risk | Open-label trial |
| Blinding of outcome assessment (detection bias) All outcomes | High risk | Open-label trial |
| Incomplete outcome data (attrition bias) All outcomes | High risk | Reason for one withdrawal not reported, other numbers and reasons reported, for details see Characteristics of included studies |
| Selective reporting (reporting bias) | Low risk | All planned protocol outcomes reported |
| Other bias | High risk | Funded by pharmaceutical |

ENGAGE 2009

| Methods | Randomised controlled trial, double-blind two-arm trial Multicenter trial; 14 centres in North America (USA, Canada), 20 centres in Europe (Spain, UK, Belgium, Czech Republic, Finland, France, Norway, Sweden, Denmark, The Netherlands) Timing June 2006 to January 2008 (20 months) Ethical approval and informed consent obtained Power calculation carried out (total no. of participants) No intention-to-treat analysis performed |
| Participants | Number of participants: 1509 (757 intervention, 752 control) Inclusion criteria as stated in the article Women aged 18-36 years with a body weight > 60kg and ≤ 90 kg, a BMI 18-32 kg/m², a menstrual cycle 24-35 d, access to ejaculatory sperm and an indication for COS before IVF or ICSI Inclusion criteria as stated in the protocol Women of a couple with an indication for COS before IVF or ICSI, between 18 and 36 years with a regular menstrual cycle (24-35d), body weight > 60 kg an ≤ 90 kg, BMI 18-32 kg/m², couples have availability of ejaculatory sperm (donated and/or cryopreserved sperm is allowed), willing and able to sign informed consent Exclusion criteria as stated in the article Patients who had a (history of) an endocrine abnormality, an abnormal outcome of blood biochemistry or hematology, an abnormal cervical smear, a chronic disease, relevant ovarian, tubal or uterine pathology that could interfere with the COS treatment (e.g.
endometrioma $>0$ mm or fibroids $\geq 5$ cm), embryo implantation or pregnancy were not to be included in the trial. Patients who had a history of ovarian hyperresponse (more than 30 follicles $\geq 11$ mm) or OHSS, PCOS or a basal antral follicle count of more than 20 on ultrasound ($<11$ mm, both ovaries combined). Other exclusion criteria included a previously low ovarian response to FSH or hMG treatment (i.e. cycle cancelled due to insufficient ovarian response or less than four oocytes obtained), an FSH or LH over 12 IU/L in the early follicular phase, more than three consecutive unsuccessful IVF cycles since the last ongoing pregnancy, a history of recurrent miscarriage (three or more), or currently smoking more than five cigarettes per day

**Exclusion criteria as stated in the protocol**

History of/or any current (treated) endocrine abnormality, history of ovarian hyper-response or ovarian hyperstimulation syndrome (OHSS), history of/or current polycystic ovary syndrome (PCOS), more than 20 basal antral follicles $<11$ mm (both ovaries combined) as measured on USS in the early follicular phase (menstrual cycle day 2-5) , less than 2 ovaries or any other ovarian abnormality (including endometrioma $>10$ mm; visible on USS), presence of unilateral or bilateral hydrosalpinx (visible on USS) , presence of any clinically relevant pathology affecting the uterine cavity or fibroids $\geq 5$ cm, more than three unsuccessful IVF cycles since the last established ongoing pregnancy (if applicable), history of non- or low ovarian response to FSH/hMG treatment, history of recurrent miscarriage (3 or more, even when unexplained), FSH $>12$ IU/L or LH $>12$ IU/L as measured by the local laboratory (sample taken during the early follicular phase: menstrual cycle day 2-5), any clinically relevant abnormal laboratory value based on a sample taken during the screening phase, contraindications for the use of gonadotropins (e.g. tumors, pregnancy/lactation, undiagnosed vaginal bleeding, hypersensitivity, ovarian cysts), recent history of/or current epilepsy, HIV infection, diabetes, cardiovascular, gastro-intestinal, hepatic, renal or pulmonary disease, abnormal karyotyping of the patient or her partner (if karyotyping is performed), smoking more than 5 cigarettes per day, history or presence of alcohol or drug abuse within 12 months prior to signing informed consent, previous use of Org 36286, use of hormonal preparations within 1 month prior to randomisation, hypersensitivity to any of the concomitant medication prescribed as part of the treatment regimen in this protocol, administration of investigational drugs within three months prior to signing informed consent

**Mean age (years) and SD**

- Intervention: $31.5 \pm 3.3$
- Control: $31.5 \pm 3.2$

**Mean weight (kg) and SD**

- Intervention: $68.8 \pm 7.6$
- Control: $68.4 \pm 7.3$

**Mean BMI (kg/m2) and SD**

- Intervention: $24.8 \pm 2.8$
- Control: $24.8 \pm 2.7$

**Mean duration of subfertility (years) and SD**

- Intervention: $3.3 \pm 2.4$
- Control: $3.2 \pm 2.2$

**Withdrawals**

Total intervention group: 11.2% withdrew before embryo transfer
Total control group: 6.4% withdrew before embryo transfer
A total of 187 patients failed screening or dropped out due to personal reasons prior to
treatment allocation. Three patients (one in the intervention and two in the comparison group) were discontinued prior to the start of treatment (one for personal reasons and two were found to violate entry criteria after randomisation but before commencing treatment). During the treatment, but before the embryo transfer, a total of 130 patients (84 interventional, 46 control) discontinued the treatment, no reason reported.

### Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Control</th>
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<tbody>
<tr>
<td>150 µg FSH-CTP</td>
<td>200 IU rFSH</td>
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</tbody>
</table>

GnRH antagonist was administered sc starting on day 5 up to and including the day of hCG (at least 3 follicles ≥ 17 mm)

One or two embryos were transferred

Drugs provided by patient itself, partner or medical staff

### Outcomes

**Primary**
- Live birth rate
- OHSS

**Secondary**
- Clinical (vital) pregnancy rate
- Ongoing pregnancy rate
- Multiple pregnancy rate
- Miscarriage rate
- Adverse event: ectopic pregnancy

### Notes

**Risk of bias**

<table>
<thead>
<tr>
<th>Bias</th>
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<th>Support for judgement</th>
</tr>
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<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>Quote: &quot;Randomisation to one of the two arms (1:1 ratio) was done per centre and stratified by age (&lt;32 or ≥ 32 years) by using randomly permuted blocks with a 'undisclosed' fixed block size of four.”</td>
</tr>
<tr>
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<td>Low risk</td>
<td>Quote: &quot;central remote allocation&quot;</td>
</tr>
<tr>
<td>Blinding of participants and personnel (performance bias) All outcomes</td>
<td>Low risk</td>
<td>Double-blind (subject, investigator) Quote: &quot;The double-dummy approach guaranteed the blinding of medication during the trial and prevented any bias in terms of treatment decisions”</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias) All outcomes</td>
<td>Unclear risk</td>
<td>Not reported</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias) All outcomes</td>
<td>High risk</td>
<td>High unexplained drop out rate, for details see Characteristics of included studies</td>
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</table>
ENGAGE 2009  (Continued)

<table>
<thead>
<tr>
<th>Selective reporting (reporting bias)</th>
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<th>All planned protocol outcomes reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other bias</td>
<td>High risk</td>
<td>Funded by pharmaceuticals</td>
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</table>

ENSURE 2010

**Methods**
Randomised controlled trial, double-blind two-arm trial
Multicentre trial; 14 centres in Europe (Austria, Czech republic, France, Spain, Poland, Sweden, Denmark) and 5 centres in Asia (Korea, Taiwan)
Timing: January 2007 to December 2007 (12 months)
Ethical approval and informed consent obtained
Power calculation carried out (total no. participants)
Intention-to-treat analysis performed

**Participants**
Number of participants: 396 (268 intervention, 128 control)

**Inclusion criteria as stated in the article**
Women aged 18-36 years, weighing ≤ 60 kg and BMI 18-32 kg/m², normal menstrual cycle (25-34d), have an indication for ovarian stimulation before IVF or ICSI, access to ejaculatory spermatozoa

**Inclusion criteria as stated in the protocol**
Women aged 18-36 years, weighing ≤ 60 kg and BMI 18-32 kg/m², normal menstrual cycle (25-34d) and have an indication for IVF or ICSI, couples have availability of ejaculatory sperm (donated and/or cryopreserved sperm allowed), willing and able to sign informed consent

**Exclusion criteria as stated in the article**
Same as those reported in Devroey 2009; History of ovarian hyperresponse to ovarian stimulation (more than 30 follicles >11 mm) or OHSS, PCOS or more than 20 basal antral follicles on ultrasound (<11 mm, both ovaries combined), history of no or low ovarian response (i.e. cycle cancelled due to insufficient response of less than four oocytes obtained) or more than three unsuccessful ovarian stimulation cycles since the last established ongoing pregnancy

**Exclusion criteria as stated in the protocol**
History of/or any current (treated) endocrine abnormality, history of ovarian hyper-response or OHSS, history of/or current PCOS, more than 20 basal antral follicles <11 mm (both ovaries combined) as measured on USS in the early follicular phase (menstrual cycle day 2-5), less than 2 ovaries or any other ovarian abnormality (including endometrioma > 10 mm; visible on USS), presence of unilateral or bilateral hydrosalphinx (visible on USS), presence of any clinically relevant pathology affecting the uterine cavity or fibroids ≥ 5 cm, more than three unsuccessful IVF cycles since the last established ongoing pregnancy (if applicable), history of non- or low ovarian response to FSH/hMG treatment, history of recurrent miscarriage (3 or more, even when unexplained), FSH > 12 IU/L or LH > 12 IU/L as measured by the local laboratory (sample taken during the early follicular phase: menstrual cycle day 2-5), any clinically relevant abnormal laboratory value based on a sample taken during the screening phase, contraindications for the use of gonadotropins (e.g. tumors, pregnancy/lactation, undiagnosed vaginal bleeding, hypersensitivity, ovarian cysts), recent history of/or current epilepsy, HIV infection, diabetes, cardiovascular, gastro-intestinal, hepatic, renal or pulmonary disease, abnormal
ENSURE 2010  (Continued)
karyotyping of the patient or her partner (if karyotyping is performed), smoking more than 5 cigarettes per day, history or presence of alcohol or drug abuse within 12 months prior to signing informed consent, previous use of Org 36286, use of hormonal preparations within 1 month prior to randomisation, hypersensitivity to any of the concomitant medication prescribed as part of the treatment regimen in this protocol, administration of investigational drugs within three months prior to signing informed consent

Mean age (years) and SD
Intervention: 30.9 ± 3.2
Control: 31.1 ± 3.0

Mean weight (kg) and SD
Intervention: 54.1 ± 4.2
Control: 54.4 ± 4.2

Mean BMI (kg/m^2) and SD
Intervention: 20.5 ± 1.5
Control: 20.6 ± 1.6

Mean duration of subfertility (years) and SD
Intervention: 3.2 ± 2.2
Control: 3.3 ± 2.1

Withdrawals
Intervention
Total 8.2% of participants in intervention group
All the randomised patients started stimulation, two subjects cancelled the treatment before hCG because of insufficient ovarian response and a patients decision. All hCG treated patients underwent oocyte retrieval, twenty subjects cancelled before embryo transfer, one because the risk of OHSS, one suspicious for tuberculosis, too high ovarian response (5 subjects), no/too few/bad quality oocytes retrieved (2 subjects), no or abnormal fertilisation (4 subjects), no/too few/bad quality embryos for transfer (7 subjects)

Control
Total 6.3% of participants in control group
All the randomised subjects started stimulation, one cancelled before the hCG treatment because too high ovarian response. All hCG treated patients underwent oocyte retrieval, a total of seven subjects discontinued before embryo transfer. The reasons are: no/too few/bad oocytes retrieved (2 subjects), one subject because of too high ovarian response, in one subject no fertilisation was possible, one had no/too few/bad quality embryos, no or abnormal fertilisation (2 subjects)

Interventions
Intervention: 100 µg long-acting FSH
Control: 150 IU rFSH
GnRH antagonist was administered sc starting on day 5 up to and including the day of hCG (at least 3 follicles ≥ 17 mm)
One ore two embryos were transferred

Outcomes
Primary
Live birth rate
Cumulative live birth rate
OHSS
Secondary
Clinical pregnancy rate
Ongoing pregnancy rate
<table>
<thead>
<tr>
<th>Risk of bias</th>
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<td></td>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>Quote: &quot;Randomisation to one of the two treatment groups in a 2:1 ratio (investigational:reference group) was performed at each centre and stratified by age (&lt;32 or ≥ 32 years) and planned fertilisation procedure (IVF or ICSI) by central remote allocation using randomly permuted blocks with an 'undisclosed' fixed block size of three.&quot;</td>
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<td>Allocation concealment (selection bias)</td>
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<td>Quote: &quot;Randomisation by central remote allocation&quot;</td>
</tr>
<tr>
<td></td>
<td>Blinding of participants and personnel (performance bias)</td>
<td>Low risk</td>
<td>Double-blind &quot;To conceal the allocation all patients also started daily sc injection of rFSH or placebo on the same day, daily active or placebo rFSH injections were continued through the first seven days of stimulation.&quot;</td>
</tr>
<tr>
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<td>Unclear risk</td>
<td>Not reported</td>
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<tr>
<td></td>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td>Numbers and reasons for withdrawal reported, for details see Characteristics of included studies</td>
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</tbody>
</table>

Multiple pregnancy rate
Miscarriage rate

Notes
### Methods

Randomised controlled trial, open-label four-arm trial  
Multicentre trial; 14 centres in Europe  
Timing: May 2003 to May 2004 (12 months)  
Ethical approval and informed consent obtained  
Power calculation carried out (no. participants per group)  
No intention-to-treat analyses performed

### Participants

Number of participants: 325 (242 intervention, 83 control)  
**Inclusion criteria as stated in the article**  
Women aged 20-39 years with a normal menstrual cycle (24-35d) and a BMI 17-31 kg/m² with an indication for COS before IVF or ICSI  
**Inclusion criteria as stated in the protocol**  
Women of couples with an indication for COH and IVF or ICSI, aged 18-39 years, normal menstrual cycle (24-35d), BMI 17-31 kg/m², with an indication for IVF or ICSI, couples have availability of ejaculatory sperm (donated or frozen sperm is allowed), able and willing to sign informed consent  
**Exclusion criteria as stated in the article**  
Women with a history of OHSS, PCOS, any endocrine abnormality, previous poor response to FSH or hCG, more than three unsuccessful COS cycles since last ongoing pregnancy, fewer than two ovaries, abnormal hormone levels during days 2-7 of the menstrual cycle, use of hormonal preparations within 1 month before treatment or previous use of Corifollitropin alfa, were excluded  
**Exclusion criteria as stated in the protocol**  
History of/or any current (treated) endocrine abnormality, history of ovarian hyperstimulation syndrome (OHSS), history of/or current polycystic ovary syndrome (PCOS) or current polycystic ovaries according to USS (at least 10 follicles of 2-8 mm in each ovary), more than three unsuccessful COH cycles since the last established ongoing pregnancy (if applicable), history of non- or low ovarian response to FSH/hMG treatment, any clinically relevant hormone value outside the reference range during the early follicular phase (menstrual cycle day 2-7) as measured by the local laboratory (FSH, LH, E₂, P, total T, TSH and prolactin), any clinically relevant abnormal laboratory value, less than 2 ovaries, any ovarian and/or abdominal abnormality interfering with ultrasound examination, contraindications for the use of gonadotropins (e.g. tumors, pregnancy/lactation, breastfeeding, hypersensitivity, ovarian cysts), epilepsy, diabetes, cardiovascular, gastro-intestinal, hepatic, renal, pulmonary, or abdominal disease, history of presence of alcohol or drug abuse within 12 months prior to signing informed consent, previous use of Org 36286, use of hormonal preparations within 1 month prior to randomisation, hypersensitivity to Org 32489 (Puregon®) and/or Org 37462 (Orgalutran®) and/or Pregnyl® or any of their components, administration of investigational drugs within three months prior to signing informed consent

#### Mean age (years) and SD

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Mean Age (years)</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>60 µg</td>
<td>32.0 ± 3.5</td>
<td></td>
</tr>
<tr>
<td>120 µg</td>
<td>32.0 ± 4.1</td>
<td></td>
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<tr>
<td>180 µg</td>
<td>32.4 ± 3.5</td>
<td></td>
</tr>
<tr>
<td>Control rFSH</td>
<td>32.1 ± 3.8</td>
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</table>

#### Mean weight (kg) and SD

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<th>Mean Weight (kg)</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>60 µg</td>
<td>63.8 ± 9.0</td>
<td></td>
</tr>
<tr>
<td>120 µg</td>
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<td></td>
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<tr>
<td>180 µg</td>
<td>64.0 ± 9.3</td>
<td></td>
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</tbody>
</table>
control rFSH: 65.2 ± 9.3
Mean BMI (kg/m2) and SD
intervention 60 µg: 22.7 ± 3.2
intervention 120 µg: 23.5 ± 3.2
intervention 180 µg: 22.7 ± 2.6
control rFSH: 23.1 ± 3.0
Mean duration of subfertility (years) and SD
intervention 60 µg: 3.2 ± 1.8
intervention 120 µg: 3.3 ± 1.9
intervention 180 µg: 3.1 ± 2.5
control rFSH: 3.1 ± 2.2

**Withdrawals**

58 subject are excluded before randomisation, reasons not reported

**Interventions**

Total 21.1% of participants in intervention groups withdrew before embryo transfer

**60 µg:** One subject excluded before stimulation because PCOS. 23 Subjects did not received hCG because insufficient ovarian response (22 subjects) and one (serious) adverse event. Five subjects are excluded before oocyte retrieval, two because insufficient ovarian response, and two inadequate oocytes retrieved (none, too few or poor quality). Before embryo transfer six subjects withdrew because no fertilisation (2 subjects, inadequate embryos (3 subjects) and one because ICSI not possible (dead sperm))

**120 µg:** Three subjects excluded before start stimulation because personal reasons, five did not underwent hCG treatment because insufficient ovarian response (2 subjects), risk of hyperstimulation (2 subjects) and one for personal reasons. After oocyte retrieval two excluded before transfer because no fertilisation or inadequate embryos

**180 µg:** Before the start of treatment four subjects are excluded because spontaneous pregnancy (2 subjects) and personal reasons (2 subjects). After oocyte retrieval 4 subjects did not underwent embryo transfer because risk of hyperstimulation, no fertilisation and inadequate embryos (2 subjects)

**Control**

Total of 20.5% in control group withdrawn before embryo transfer

Two Subjects did not started stimulation because a menstrual disorder and personal reasons, six subjects discontinued before the hCG treatment because insufficient ovarian response (5 subjects) and one because personal reasons. Two subjects are excluded before oocyte retrieval because an insufficient ovarian response and inadequate oocytes retrieved. After oocyte retrieval seven subjects dropped-out because inadequate oocytes retrieved (5 subjects) and in two subjects no fertilisation take place

### Interventions

- **Intervention:** 60 µg, 120 µg or 180 µg long-acting FSH
- **Control:** 150 IU rFSH
- GnRH antagonist was administered sc starting on day 5 up to and including the day of hCG (at least 3 follicles ≥ 17 mm)
- No more than 3 embryos were transferred

### Outcomes

**Primary**
- Live birth rate
- OHSS

**Secondary**
- Clinical (vital) pregnancy rate
### Risk of bias

<table>
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<tr>
<th>Bias</th>
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<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>Quote: &quot;Randomisation to one of the four arms (1:1:1:1) was stratified by age (&lt;32 or ≥ 32 years) and by centre using a fixed block size of four and a minimization algorithm combined with randomly permuted blocks.&quot;</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Low risk</td>
<td>Quote: &quot;Randomisation by using a central remote allocation procedure&quot;</td>
</tr>
<tr>
<td>Blinding of participants and personnel (performance bias)</td>
<td>High risk</td>
<td>Open-label</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>High risk</td>
<td>Open-label</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td>Numbers and most reasons for withdrawals reported, for details see Characteristics of included studies</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low risk</td>
<td>All planned protocol outcomes reported</td>
</tr>
<tr>
<td>Other bias</td>
<td>High risk</td>
<td>Funded by pharmaceutical</td>
</tr>
</tbody>
</table>

### Characteristics of excluded studies [ordered by study ID]

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balen 2004</td>
<td>This trial is excluded because no IVF or ICSI performed after stimulation</td>
</tr>
<tr>
<td>Croxtall 2011</td>
<td>Not a RCT (review)</td>
</tr>
<tr>
<td>De Lartigue 2011</td>
<td>Not a RCT</td>
</tr>
<tr>
<td>Fatemi 2010</td>
<td>Not a RCT</td>
</tr>
</tbody>
</table>
Pursue 2010

**Trial name or title**  
Efficacy and safety of a single injection of SCH 900962 versus daily recFSH injections in women undergoing controlled ovarian stimulation (Study P06029)

**Methods**  
Randomised controlled trial, double-blind (Subject, Caregiver, Investigator, Outcomes Assessor), double-dummy, two-arm trial

**Participants**  
Estimated enrolment: 1400 participants

**Inclusion criteria**  
Willing and able to provide written informed consent for trial P06029 as well as for the Frozen-Thawed Embryo Transfer (FTET) follow-up trial P06031, and for the pharmacogenetic analysis (if applicable), female and ≥35 to ≤42 years of age with indication for COS and IVF/ICSI, body weight ≥50.0 kg, BMI ≥18.0 to ≤32.0 kg/m², regular spontaneous menstrual cycle with variation not outside the 24-35 days, ejaculatory sperm must be available (donated and/or cryopreserved sperm is allowed), results of clinical laboratory tests, cervical smear, physical examination within normal limits or clinically acceptable to the investigator, adhere to trial schedule

**Exclusion criteria**  
A recent history of/or any current endocrine abnormality, a history of ovarian hyper-response or ovarian hyperstimulation syndrome, a history of/or current polycystic ovary syndrome, more than 20 basal antral follicles <11 mm (both ovaries combined) in the early follicular phase, less than 2 ovaries or any other ovarian abnormality, unilateral or bilateral hydrosalpinx, intraterine fibroids ≥5 cm or any clinically relevant pathology, which could impair embryo implantation or pregnancy continuation, more than three unsuccessful COS cycles for IVF/ICSI since the last established ongoing pregnancy (if applicable), a history of non- or low ovarian response to FSH/hMG treatment, a history of recurrent miscarriage, FSH >15.0 IU/L or LH >12.0 IU/L, during the early follicular phase, positive for HIV or Hepatitis B, contraindications for the use of gonadotropins or GnRH antagonists, a recent history of/or current epilepsy, thrombophilia, diabetes, cardiovascular, gastro-intestinal, hepatic, renal or pulmonary or auto-immune disease requiring regular treatment, smoking or recently stopped smoking (ie, within the last 3 months prior to signing informed consent), a recent history or presence of alcohol or drug abuse, the subject or the sperm donor has known gene defects, genetic abnormalities, or abnormal karyotyping, relevant for the current indication or for the health of the offspring, prior or concomitant medications disallowed by protocol

**Interventions**  
Intervention: corifollitropin alfa, 100 µg for women weighing ≤60 kg, and 150 µg for women weighing >60 kg

---

**Characteristics of ongoing studies [ordered by study ID]**

<table>
<thead>
<tr>
<th>Study</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ledger 2009</td>
<td>Not a RCT (review)</td>
</tr>
<tr>
<td>Loutradis 2010</td>
<td>Not a RCT</td>
</tr>
<tr>
<td>Norman 2011</td>
<td>Not a RCT</td>
</tr>
<tr>
<td>Prados 2011</td>
<td>Not a RCT</td>
</tr>
<tr>
<td>Seyhan 2011</td>
<td>Not a RCT (review)</td>
</tr>
</tbody>
</table>
Pursue 2010  (Continued)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Control: recombinant FSH 150-300 IU daily until &gt;2 follicles are &gt;18 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting date</td>
<td>June 2010</td>
</tr>
<tr>
<td>Contact information</td>
<td>No contacts provided</td>
</tr>
<tr>
<td>Notes</td>
<td>Estimated study completion date: September 2012</td>
</tr>
</tbody>
</table>

Siristatidis 2011

<table>
<thead>
<tr>
<th>Trial name or title</th>
<th>Corifollitropin alfa versus recombinant follicle stimulating hormone (FSH) in ovarian stimulation of women undergoing in vitro fertilisation</th>
</tr>
</thead>
</table>
| Methods             | Randomised controlled trial  
|                     | Single-blind (participant), two-arm trial  
|                     | One-centre trial |
| Participants        | Estimated enrolment: 100  
|                     | **Inclusion criteria**  
|                     | Women aged 18-36 years old with a body weight of more than 60 kg up to 90 kg, BMI of 18-32 kg/m², menstrual cycle length of 23-35 days, an indication for controlled ovarian stimulation for IVF or ICSI  
|                     | **Exclusion Criteria**  
|                     | History of an endocrine abnormality, abnormal outcome of blood biochemistry or hematology, abnormal cervical smear, chronic disease, uterine pathology that interfering with the COS treatment (e.g. fibroids ≥ 5 cm) |
| Interventions       | Intervention: corifollitropin alfa 150 µg  
|                     | Control: recombinant FSH 300 IU  
|                     | Both GnRH agonists (long) and antagonists protocols will be used. Final oocyte maturation will be induced by the administration of hCG on the day that 2 follicles >18 mm were recognized on the transvaginal ultrasound scan  
|                     | One or two embryos will be transferred |
| Outcomes            | **Primary:** Ongoing pregnancy rate, defined as the presence of fetal heart at ultrasound after 12 gestational weeks  
|                     | **Secondary:** Clinical pregnancy rate, defined as the presence of fetal heart at transvaginal ultrasound at 6+2 gestational weeks  
|                     | Cancellation rate  
|                     | Miscarriage rate  
<p>|                     | Ectopic pregnancy rate |</p>
<table>
<thead>
<tr>
<th>Starting date</th>
<th>January 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact information</td>
<td>Siristatidis CS, MD, PhD; <a href="mailto:harrysiri@yahoo.gr">harrysiri@yahoo.gr</a>, 6932294994 ext 0030</td>
</tr>
<tr>
<td>Notes</td>
<td>Estimated completion date: January 2013</td>
</tr>
</tbody>
</table>
## DATA AND ANALYSES

### Comparison 1. Long-acting FSH (all doses) versus daily FSH

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Live birth rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Low dose (60-120 µg)</td>
<td>4</td>
<td>2335</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.92 [0.76, 1.10]</td>
</tr>
<tr>
<td>1.2 Medium dose (150-180 µg)</td>
<td>3</td>
<td>645</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.60 [0.40, 0.91]</td>
</tr>
<tr>
<td>1.3 High dose (240 µg)</td>
<td>1</td>
<td>33</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.29 [0.04, 1.95]</td>
</tr>
<tr>
<td>2 Ovarian hyperstimulation syndrome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Low dose (60-120 µg)</td>
<td>3</td>
<td>645</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.22 [0.55, 2.72]</td>
</tr>
<tr>
<td>2.2 Medium dose (150-180 µg)</td>
<td>3</td>
<td>1657</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.08 [0.72, 1.61]</td>
</tr>
<tr>
<td>2.3 High dose (240 µg)</td>
<td>1</td>
<td>33</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>3.91 [0.15, 104.40]</td>
</tr>
<tr>
<td>3 Ongoing pregnancy rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Low dose (60-120 µg)</td>
<td>4</td>
<td>2335</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.93 [0.78, 1.12]</td>
</tr>
<tr>
<td>3.2 Medium dose (150-180 µg)</td>
<td>3</td>
<td>645</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.71 [0.47, 1.06]</td>
</tr>
<tr>
<td>3.3 High dose (240 µg)</td>
<td>1</td>
<td>33</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.02 [0.83, 1.25]</td>
</tr>
<tr>
<td>4 Clinical pregnancy rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Low dose (60-120 µg)</td>
<td>3</td>
<td>2230</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.96 [0.80, 1.15]</td>
</tr>
<tr>
<td>4.2 Medium dose (150-180 µg)</td>
<td>2</td>
<td>610</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.71 [0.47, 1.06]</td>
</tr>
<tr>
<td>5 Multiple pregnancy rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1 Low dose (60-120 µg)</td>
<td>3</td>
<td>645</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.05 [0.51, 2.17]</td>
</tr>
<tr>
<td>5.2 Medium dose (150-180 µg)</td>
<td>3</td>
<td>1657</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.28 [0.92, 1.79]</td>
</tr>
<tr>
<td>5.3 High dose (240 µg)</td>
<td>1</td>
<td>33</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>3.74 [0.04, 362.67]</td>
</tr>
<tr>
<td>6 Miscarriage rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 Low dose (60-120 µg)</td>
<td>2</td>
<td>1905</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.27 [0.76, 2.12]</td>
</tr>
<tr>
<td>6.2 Medium dose (150-180 µg)</td>
<td>1</td>
<td>396</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.19 [0.38, 3.73]</td>
</tr>
<tr>
<td>7 Ectopic pregnancy rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1 Low dose (60-120 µg)</td>
<td>3</td>
<td>2004</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.91 [0.43, 1.92]</td>
</tr>
<tr>
<td>7.2 Medium dose (150-180 µg)</td>
<td>2</td>
<td>429</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>1.05 [0.32, 3.42]</td>
</tr>
<tr>
<td>7.3 High dose (240 µg)</td>
<td>1</td>
<td>33</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.83 [0.32, 2.17]</td>
</tr>
</tbody>
</table>
Analysis 1.1. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 1 Live birth rate.

Review: Long-acting FSH versus daily FSH for women undergoing assisted reproduction

Comparison: 1 Long-acting FSH (all doses) versus daily FSH

Outcome: 1 Live birth rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>4/27</td>
<td>3/8</td>
<td>0.9 %</td>
<td>0.25</td>
<td>0.25 [0.04, 1.76]</td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>63/268</td>
<td>45/128</td>
<td>15.2 %</td>
<td>0.56</td>
<td>0.35 [0.05, 0.89]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>20/159</td>
<td>7/55</td>
<td>4.0 %</td>
<td>0.99</td>
<td>0.39 [0.24, 2.48]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>454</strong></td>
<td><strong>191</strong></td>
<td>20.1 %</td>
<td>0.60</td>
<td>0.40 [0.20, 0.91]</td>
</tr>
<tr>
<td>Total events: 87 (long-acting FSH), 55 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Heterogeneity: \( \chi^2 = 1.98, df = 2 (P = 0.37) \); \( I^2 = 0.0 \%

Test for overall effect: \( Z = 2.42 (P = 0.015) \)

2 Medium dose (150-180 g)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>4/29</td>
<td>3/8</td>
<td>0.9 %</td>
<td>0.22</td>
<td>0.03 [1.60]</td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>269/757</td>
<td>258/752</td>
<td>75.9 %</td>
<td>1.06</td>
<td>0.85 [1.30]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>11/83</td>
<td>4/28</td>
<td>2.2 %</td>
<td>0.92</td>
<td>0.26 [3.19]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>869</strong></td>
<td><strong>788</strong></td>
<td>78.9 %</td>
<td>1.03</td>
<td>0.84 [1.27]</td>
</tr>
<tr>
<td>Total events: 284 (long-acting FSH), 265 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Heterogeneity: \( \chi^2 = 2.41, df = 2 (P = 0.30) \); \( I^2 = 17 \%

Test for overall effect: \( Z = 0.31 (P = 0.76) \)

3 High dose (240 g)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>4/25</td>
<td>3/8</td>
<td>0.9 %</td>
<td>0.29</td>
<td>0.04 [1.95]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>25</strong></td>
<td><strong>8</strong></td>
<td>0.9 %</td>
<td>0.29</td>
<td>0.04 [1.95]</td>
</tr>
<tr>
<td>Total events: 4 (long-acting FSH), 3 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Heterogeneity: not applicable

Test for overall effect: \( Z = 1.27 (P = 0.20) \)

**Total (95% CI)**

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>225/623</td>
<td>173/612</td>
<td>100.0 %</td>
<td>0.92</td>
<td>0.76 [1.10]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>1348</strong></td>
<td><strong>987</strong></td>
<td>100.0 %</td>
<td>0.92</td>
<td>0.76 [1.10]</td>
</tr>
<tr>
<td>Total events: 375 (long-acting FSH), 323 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Heterogeneity: \( \chi^2 = 11.10, df = 6 (P = 0.09) \); \( I^2 = 46 \%

Test for overall effect: \( Z = 0.93 (P = 0.35) \)

Test for subgroup differences: \( \chi^2 = 6.71, df = 2 (P = 0.03) \); \( I^2 = 70 \%

---

(1) This study only recruited women with a body weight of less than 60kg.
Analysis 1.2. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 2 Ovarian hyperstimulation syndrome.

**Comparison:** 1 Long-acting FSH (all doses) versus daily FSH

**Outcome:** 2 Ovarian hyperstimulation syndrome

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio Peto,Fixed 95% CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>2/27</td>
<td>1/8</td>
<td>1.6 % 0.53 [0.03, 8.55]</td>
<td></td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>18/268</td>
<td>6/128</td>
<td>16.2 % 1.43 [0.59, 3.44]</td>
<td></td>
</tr>
<tr>
<td>Koper 2008</td>
<td>2/159</td>
<td>1/55</td>
<td>1.9 % 0.67 [0.05, 9.01]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>454</strong></td>
<td><strong>191</strong></td>
<td>19.7 % 1.22 [0.55, 2.72]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Medium dose (150-180 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>0/29</td>
<td>1/8</td>
<td>0.6 % 0.01 [0.00, 1.15]</td>
<td></td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>53/757</td>
<td>47/752</td>
<td>76.7 % 1.13 [0.75, 1.69]</td>
<td></td>
</tr>
<tr>
<td>Koper 2008</td>
<td>2/83</td>
<td>1/28</td>
<td>1.8 % 0.65 [0.05, 8.95]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>869</strong></td>
<td><strong>788</strong></td>
<td>79.1 % 1.08 [0.72, 1.61]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 High dose (240 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>2/25</td>
<td>0/8</td>
<td>1.2 % 3.91 [0.15, 104.40]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>25</strong></td>
<td><strong>8</strong></td>
<td>1.2 % 3.91 [0.15, 104.40]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>1348</strong></td>
<td><strong>987</strong></td>
<td>100.0 % 1.12 [0.79, 1.60]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 22 (long-acting FSH), 8 (daily FSH)

Heterogeneity: Chi² = 0.67, df = 2 (P = 0.72); I² = 0%

Test for overall effect: Z = 0.50 (P = 0.62)

Total events: 55 (long-acting FSH), 49 (daily FSH)

Heterogeneity: Chi² = 3.94, df = 2 (P = 0.14); I² = 49%

Test for overall effect: Z = 0.37 (P = 0.71)

Total events: 2 (long-acting FSH), 0 (daily FSH)

Heterogeneity: not applicable

Test for overall effect: Z = 0.81 (P = 0.42)

Total events: 79 (long-acting FSH), 57 (daily FSH)

Heterogeneity: Chi² = 5.25, df = 6 (P = 0.51); I² = 0%

Test for overall effect: Z = 0.64 (P = 0.53)

Test for subgroup differences: Chi² = 0.64, df = 2 (P = 0.73), I² = 0%

(1) This study only recruited women with a body weight of less than 60 kg.

---

Long-acting FSH versus daily FSH for women undergoing assisted reproduction (Review)

Copyright © 2012 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.
### Analysis 1.3. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 3 Ongoing pregnancy rate.

**Review:** Long-acting FSH versus daily FSH for women undergoing assisted reproduction

**Comparison:** 1 Long-acting FSH (all doses) versus daily FSH

**Outcome:** 3 Ongoing pregnancy rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH n/N</th>
<th>daily FSH n/N</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Low dose (60-120 g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>4/27</td>
<td>3/8</td>
<td>0.9 %</td>
<td>0.25 [ 0.04, 1.76 ]</td>
<td></td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>68/268</td>
<td>44/128</td>
<td>14.9 %</td>
<td>0.64 [ 0.40, 1.02 ]</td>
<td></td>
</tr>
<tr>
<td>Koper 2008</td>
<td>24/159</td>
<td>7/55</td>
<td>4.3 %</td>
<td>1.21 [ 0.51, 2.88 ]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>454</td>
<td>191</td>
<td>20.1 %</td>
<td>0.71 [ 0.47, 1.06 ]</td>
<td></td>
</tr>
<tr>
<td>Total events: 96 (long-acting FSH), 54 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi² = 2.71, df = 2 (P = 0.26); I² = 26%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.69 (P = 0.091)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 Medium dose (150-180 g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>5/29</td>
<td>3/8</td>
<td>0.9 %</td>
<td>0.31 [ 0.05, 2.04 ]</td>
<td></td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>294/757</td>
<td>286/752</td>
<td>75.7 %</td>
<td>1.03 [ 0.84, 1.27 ]</td>
<td></td>
</tr>
<tr>
<td>Koper 2008</td>
<td>11/83</td>
<td>4/28</td>
<td>2.1 %</td>
<td>0.92 [ 0.26, 3.19 ]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>869</td>
<td>788</td>
<td>78.8 %</td>
<td>1.02 [ 0.83, 1.25 ]</td>
<td></td>
</tr>
<tr>
<td>Total events: 310 (long-acting FSH), 293 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi² = 1.57, df = 2 (P = 0.46); I² = 0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.16 (P = 0.87)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>3 High dose (240 g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>6/25</td>
<td>4/8</td>
<td>1.1 %</td>
<td>0.30 [ 0.06, 1.67 ]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>25</td>
<td>8</td>
<td>1.1 %</td>
<td>0.30 [ 0.06, 1.67 ]</td>
<td></td>
</tr>
<tr>
<td>Total events: 6 (long-acting FSH), 4 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.37 (P = 0.17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>1348</td>
<td>987</td>
<td>100.0 %</td>
<td>0.93 [ 0.78, 1.12 ]</td>
<td></td>
</tr>
<tr>
<td>Total events: 412 (long-acting FSH), 351 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi² = 8.47, df = 6 (P = 0.21); I² = 29%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.76 (P = 0.45)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Test for subgroup differences: Chi² = 4.19, df = 2 (P = 0.12), I² = 52%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

(1) This study only recruited women with a body weight of less than 60kg.
### Analysis 1.4. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 4 Clinical pregnancy rate.

Review: Long-acting FSH versus daily FSH for women undergoing assisted reproduction

Comparison: 1 Long-acting FSH (all doses) versus daily FSH

Outcome: 4 Clinical pregnancy rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio</th>
<th>Weight</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>Peto</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>69/268</td>
<td>45/128</td>
<td>15.3 %</td>
<td>0.63</td>
<td>[ 0.40, 1.01 ]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>26/159</td>
<td>9/55</td>
<td>4.8 %</td>
<td>1.00</td>
<td>[ 0.44, 2.28 ]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>427</strong></td>
<td><strong>183</strong></td>
<td><strong>20.1 %</strong></td>
<td><strong>0.71</strong></td>
<td><strong>[ 0.47, 1.06 ]</strong></td>
</tr>
<tr>
<td>Total events: 95 (long-acting FSH), 54 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi$^2$ = 0.89, df = 1 (P = 0.34); I$^2$ =0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.69 (P = 0.092)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Medium dose (150-180 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>302/757</td>
<td>293/752</td>
<td>77.5 %</td>
<td>1.04</td>
<td>[ 0.85, 1.28 ]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>12/83</td>
<td>5/28</td>
<td>2.4 %</td>
<td>0.77</td>
<td>[ 0.24, 2.52 ]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>840</strong></td>
<td><strong>780</strong></td>
<td><strong>79.9 %</strong></td>
<td><strong>1.03</strong></td>
<td><strong>[ 0.84, 1.26 ]</strong></td>
</tr>
<tr>
<td>Total events: 314 (long-acting FSH), 298 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi$^2$ = 0.24, df = 1 (P = 0.63); I$^2$ =0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.29 (P = 0.77)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>1267</strong></td>
<td><strong>963</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>0.96</strong></td>
<td><strong>[ 0.80, 1.15 ]</strong></td>
</tr>
<tr>
<td>Total events: 409 (long-acting FSH), 352 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi$^2$ = 3.81, df = 3 (P = 0.28); I$^2$ =21%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.50 (P = 0.62)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for subgroup differences: Chi$^2$ = 2.68, df = 1 (P = 0.10), I$^2$ =63%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) This study only recruited women with a body weight of less than 60kg.
### Analysis 1.5. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 5 Multiple pregnancy rate.

**Review:** Long-acting FSH versus daily FSH for women undergoing assisted reproduction

**Comparison:** 1 Long-acting FSH (all doses) versus daily FSH

**Outcome:** 5 Multiple pregnancy rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio</th>
<th>Weight</th>
<th>Peto,Fixed,95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>1/27</td>
<td>1/8</td>
<td>0.8%</td>
<td>0.20</td>
<td>[0.01, 5.84]</td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>19/268</td>
<td>10/128</td>
<td>14.0%</td>
<td>0.90</td>
<td>[0.40, 2.02]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>6/159</td>
<td>0/55</td>
<td>2.7%</td>
<td>3.97</td>
<td>[0.62, 25.31]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>454</strong></td>
<td><strong>191</strong></td>
<td><strong>17.5%</strong></td>
<td><strong>1.05</strong></td>
<td><strong>[0.51, 2.17]</strong></td>
</tr>
</tbody>
</table>

Total events: 26 (long-acting FSH), 11 (daily FSH)

Heterogeneity: Chi^2 = 3.03, df = 2 (P = 0.22); I^2 = 34%

Test for overall effect: Z = 0.14 (P = 0.89)

2 Medium dose (150-180 g)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio</th>
<th>Weight</th>
<th>Peto,Fixed,95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroey 2004</td>
<td>1/29</td>
<td>0/8</td>
<td>0.4%</td>
<td>3.58</td>
<td>[0.03, 418.61]</td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>83/757</td>
<td>66/752</td>
<td>79.9%</td>
<td>1.28</td>
<td>[0.91, 1.79]</td>
</tr>
<tr>
<td>Koper 2008</td>
<td>3/83</td>
<td>1/28</td>
<td>1.7%</td>
<td>1.01</td>
<td>[0.10, 9.98]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>869</strong></td>
<td><strong>788</strong></td>
<td><strong>82.1%</strong></td>
<td><strong>1.28</strong></td>
<td><strong>[0.92, 1.79]</strong></td>
</tr>
</tbody>
</table>

Total events: 87 (long-acting FSH), 67 (daily FSH)

Heterogeneity: Chi^2 = 0.22, df = 2 (P = 0.90); I^2 = 0.0%

Test for overall effect: Z = 1.44 (P = 0.15)

3 High dose (240 g)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio</th>
<th>Weight</th>
<th>Peto,Fixed,95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devroey 2004</td>
<td>1/25</td>
<td>0/8</td>
<td>0.4%</td>
<td>3.74</td>
<td>[0.04, 362.67]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>25</strong></td>
<td><strong>8</strong></td>
<td><strong>0.4%</strong></td>
<td><strong>3.74</strong></td>
<td><strong>[0.04, 362.67]</strong></td>
</tr>
</tbody>
</table>

Total events: 1 (long-acting FSH), 0 (daily FSH)

Heterogeneity: not applicable

Test for overall effect: Z = 0.57 (P = 0.57)

| Total (95% CI) | 1348 | 987 | 100.0% | 1.24 | [0.92, 1.68] |

Total events: 114 (long-acting FSH), 78 (daily FSH)

Heterogeneity: Chi^2 = 3.71, df = 6 (P = 0.72); I^2 = 0.0%

Test for overall effect: Z = 1.40 (P = 0.16)

Test for subgroup differences: Chi^2 = 4.46, df = 2 (P = 0.04), I^2 = 0.0%

(1) This study only recruited women with a body weight of less than 60kg.
Analysis 1.6. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 6 Miscarriage rate.

Review: Long-acting FSH versus daily FSH for women undergoing assisted reproduction

Comparison: 1 Long-acting FSH (all doses) versus daily FSH

Outcome: 6 Miscarriage rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Peto Odds Ratio</th>
<th>Weight</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENSURE 2010 (1)</td>
<td>10/268</td>
<td>4/128</td>
<td>1.19 [0.38, 3.73]</td>
<td>20.3 %</td>
<td>1.19 [0.38, 3.73]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>268</td>
<td>128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20.3 %</td>
<td>1.19 [0.38, 3.73]</td>
<td></td>
</tr>
<tr>
<td>Total events:</td>
<td>10 (long-acting FSH), 4 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity:</td>
<td>not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.31 (P = 0.76)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2 Medium dose (150-180 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGAGE 2009</td>
<td>27/757</td>
<td>21/752</td>
<td>1.29 [0.72, 2.28]</td>
<td>79.7 %</td>
<td>1.29 [0.72, 2.28]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>757</td>
<td>752</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>79.7 %</td>
<td>1.29 [0.72, 2.28]</td>
<td></td>
</tr>
<tr>
<td>Total events:</td>
<td>27 (long-acting FSH), 21 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity:</td>
<td>not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.86 (P = 0.39)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1025</td>
<td>880</td>
<td>100.0 %</td>
<td>1.27 [0.76, 2.12]</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total events:</td>
<td>37 (long-acting FSH), 25 (daily FSH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity:</td>
<td>Ch² = 0.01, df = 1 (P = 0.91); I² = 0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.90 (P = 0.37)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Test for subgroup differences: Ch² = 0.01, df = 1 (P = 0.91), I² = 0.0%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

(1) This study only recruited women with a body weight of less than 60kg.
## Analysis 1.7. Comparison 1 Long-acting FSH (all doses) versus daily FSH, Outcome 7 Ectopic pregnancy rate.

Review: Long-acting FSH versus daily FSH for women undergoing assisted reproduction

Comparison: 1 Long-acting FSH (all doses) versus daily FSH

Outcome: 7 Ectopic pregnancy rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>long-acting FSH</th>
<th>daily FSH</th>
<th>Odds Ratio</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>Peto, Fixed; 95% CI</td>
<td>Peto, Fixed; 95% CI</td>
</tr>
<tr>
<td>1 Low dose (60-120 g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devroey 2004</td>
<td>1/25</td>
<td>0/8</td>
<td>3.74 [0.04, 362.67]</td>
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<td><strong>1.05 [0.32, 3.42]</strong></td>
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<td><strong>Subtotal (95% CI)</strong></td>
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<td><strong>8</strong></td>
<td><strong>0.0 [0.0, 0.0]</strong></td>
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<tr>
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<td><strong>904</strong></td>
<td><strong>0.91 [0.43, 1.92]</strong></td>
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Heterogeneity: Chi² = 0.32, df = 1 (P = 0.57); I² = 0.0%
Test for overall effect: Z = 0.07 (P = 0.94)

Test for subgroup differences: Chi² = 0.09, df = 1 (P = 0.76), I² = 0.0%

(1) This study only recruited women with a body weight of less than 60kg.

---

Long-acting FSH versus daily FSH for women undergoing assisted reproduction (Review)

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ADDITIONAL TABLES

Table 1. Summary of characteristics of included studies

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<th>Participant BMI (kg/m²)</th>
<th>Participant weight (kg)</th>
<th>Start GnRH antagonist</th>
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<th>Poor responders</th>
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APPENDICES

Appendix 1. Glossary

Assisted reproductive technology (ART)

All treatments or procedures that include the in vitro handling of human oocytes and sperm or embryos for the purpose of establishing a pregnancy. This includes, but is not limited to, in vitro fertilization and transcervical embryo transfer, gamete intrafallopian transfer, zygote intrafallopian transfer, tubal embryo transfer, gamete and embryo cryopreservation, oocyte and embryo donation, and gestational surrogacy. ART does not include assisted insemination (artificial insemination) using sperm from either a woman’s partner or a sperm donor.

Cancelled cycle

an ART cycle in which ovarian stimulation or monitoring has been carried out with the intent of undergoing ART but which did not proceed to follicular aspiration or, in the case of a thawed embryo, to transfer.

Clinical pregnancy

Evidence of pregnancy by clinical or ultrasound parameters (ultrasound visualization of a gestational sac). It includes ectopic pregnancy. Multiple gestational sacs in one patient are counted as one clinical pregnancy.

Controlled ovarian stimulation (COS)

Medical treatment to induce the development of multiple ovarian follicles to obtain multiple oocytes at follicular aspiration

Cryopreservation or cryostorage

Freezing and storage of gametes, zygotes, or embryos.
Ectopic pregnancy
A pregnancy that occurs outside of the uterus.

Embryo
Product of conception from the time of fertilization to the end of the embryonic stage eight weeks after fertilization (the term pre-embryo or dividing conceptus, has been replaced by embryo).

Embryo transfer (ET)
Procedure in which embryos are placed in the uterus or fallopian tube.

Fertilisation
The penetration of the ovum by the spermatozoon and fusion of genetic materials resulting in the development of a zygote.

Fetus
The product of conception starting from completion of embryonic development (at eight completed weeks after fertilisation) until birth or abortion.

Follicle
The sac in which an egg develops in the ovary.

Follicle-stimulating hormone (FSH)
A hormone produced and released from the pituitary gland. In women it stimulates the production of oestrogen and follicles in the ovary ready for ovulation. In men it stimulates the production of sperm.

Gestational age
Age of an embryo or foetus calculated by adding 14 days (2 weeks) to the number of completed weeks since fertilisation.

Gestational sac
A fluid-filled structure containing an embryo that develops early in pregnancy usually within the uterus.

Gonadotrophin releasing hormone (GnRH)
A substance produced by the hypothalamus (part of the brain) to enable the pituitary gland to secrete LH and FSH.

Gonadotropins
Pituitary hormones FSH and LH which stimulate the testes and ovaries.

Human chorionic gonadotrophin (hCG)
A hormone produced by placental tissue that can be measured in the blood and urine of pregnant women.
**Hyper-responder**
A women who produce a large number of oocytes (women with PCOS, see polycystic ovary syndrome, or a history of OHSS, see ovarian hyperstimulation syndrome).

**Implantation**
The attachment and subsequent penetration by the zona-free blastocyst (usually in the endometrium) which starts five to seven days following fertilization.

**Intracytoplasmic sperm injection (ICSI)**
When an egg is surgically removed from a woman and injected with a single spermatozoon is injected through the zona pellucida into the oocyte. If fertilisation is successful the embryo is placed into the woman's uterus. This technique is used when a male partner has a low sperm count or other sperm related problem.

**Intrauterine**
Inside the uterus.

**In vitro fertilization (IVF)**
An ART procedure which involves extracorporeal fertilization.

**Live birth**
A birth in which a fetus is delivered with signs of life after complete expulsion or extraction from its mother, beyond 20 completed weeks of gestational age. Live births are counted as birth events (e.g., a twin or triplet live birth is counted as one birth event).

**Luteinising hormone (LH)**
A hormone produced and released by the pituitary gland. In women it is responsible for ovulation and progesterone production. In men it stimulates the production of testosterone and is involved with the production of sperm cells.

**Miscarriage**
Spontaneous end of a pregnancy at prior to 20 weeks of gestation.

**Oocyte**
The egg from a woman's ovary.

**Ova**
A woman's reproductive cell, also known as egg or oocyte.

**Ovarian hyperstimulation syndrome (OHSS)**
A condition that occurs from fertility drugs when a large number of follicles in the ovary are stimulated to develop and ovulate. This stimulation causes an enlargement of the ovaries.

**Ovulation**
The release of an egg/ova from an ovarian follicle.
Ovulation Induction
Medical treatment to produce ovulation.

Ovulatory hCG (human chorionic gonadotrophin)
Hormone given to trigger ovulation in assisted reproduction.

Polycystic ovary syndrome (PCOS)
When a woman has enlarged ovaries with multiple cysts and the surface of the ovary is thickened. The woman may ovulate infrequently or not at all.

Poor responder
A women who require large doses of medication to stimulate the ovary but produce less than an optimal number of oocytes.

Premature LH-surge
In a normal menstrual cycle an increase in LH-levels (LH-surge) is needed to start ovulation. In IVF/ICSI cycles it is important that the ovulation does not start before the oocytes are mature enough to be retrieved. A LH-surge that occurs too early is called premature and is an unwanted event in IVF/ICSI cycles.

Recombinant (as in recombinant FSH)
Is a naturally occurring hormone which has been made in the laboratory with the use of DNA technology. Recombinant technology examines the DNA sequence of a hormone. The sequence is then placed inside certain bacteria (bacterial factories), which produce a protein from the DNA sequence. This protein is then taken from the bacteria and packaged as a hormone.

Semen
A thick white fluid produced in the reproductive organs of men that usually contains the sperm cells produced in the testicles.

Spermatozoa/sperm
Male reproductive cells found in semen.

Subfertility
Failure to achieve pregnancy after at least one year of unprotected coitus.

Subcutaneous
Under the skin.

Ultrasound
Radiology sounds waves of a high frequency used to examine the inside of the body. Ultrasound is also used to visualise the developing foetus in the uterus to check size, growth and the presence of abnormalities. Most of the definitions were achieved from the glossary of the MDSG module 2008.
Appendix 2. CENTRAL search strategy

EBM Reviews - Cochrane Central Register of Controlled Trials (CENTRAL)

Date of search: 10-10-2011

1 exp embryo transfer/ or exp fertilization in vitro/ or exp sperm injections, intracytoplasmic/ (1533)
2 embryo transfer$.tw . (853)
3 in vitro fertilization.tw . (1282)
4 ivf-et.tw . (244)
5 (ivf or et).tw . (5804)
6 icsi.tw . (626)
7 intracytoplasmic sperm injection$.tw . (389)
8 (blastocyst adj2 transfer$).tw . (63)
9 exp reproductive techniques, assisted/ or exp insemination, artificial/ or exp ovulation induction/ (2133)
10 assisted reproduction$.tw . (373)
11 artificial insemination.tw . (53)
12 iui.tw . (270)
13 intrauterine insemination$.tw . (373)
14 ovulation inducing$.tw . (414)
15 ovarian hyperstimulation.tw . (524)
16 COH.tw . (117)
17 (ovari$ adj2 stimulat$).tw . (702)
18 superovulation$.tw . (127)
19 infertility.tw . (1688)
20 subfertility.tw . (127)
21 (ovari$ adj2 induction).tw . (25)
22 or/1-21 (8905)
23 corifollitropin alfa.tw . (12)
24 corifollitropin alpha.tw . (1)
25 org 36286.tw . (2)
26 org36286.tw . (0)
27 FSH carboxy terminal peptide.tw . (1)
28 FSH-CTP.tw . (5)
29 FSH CTP.tw . (5)
30 long acting follitropin.tw . (0)
31 Elonva$.tw . (0)
32 sustained follicle stimulating hormone.tw . (0)
33 long acting fsh.tw . (3)
34 long acting follicle stimulating hormone.tw . (0)
35 or23-34 (14)
36 22 and 35 (7)

Appendix 3. MDSG search strategy

Date of search: 10-10-2011

Keywords CONTAINS "IVF"or"ICSI" or "subfertility" or "in vitro fertilisation" or "in vitro fertilization" or "intracytoplasmic sperm injection" or "assisted conception" or "assisted reproduction" or "ART" or "infertility" or "IUI" or "Intrauterine Insemination" or "artificial insemination" or "ovarian hyperstimulation" or "ovarian stimulation" or "ovulation induction"or"COH" or "controlled ovarian " or "insemination" or "insemination-intrauterine" or Title CONTAINS "IVF"or"ICSI" or "subfertility" or "in vitro fertilisation" or "in vitro fertilization" or "intracytoplasmic sperm injection" or "assisted conception" or "assisted reproduction" or "ART" or "infertility" or "IUI" or "Intrauterine Insemination" or "artificial insemination" or "ovarian hyperstimulation" or "ovarian stimulation" or "ovulation induction"or"COH" or "controlled ovarian " or "insemination" or "insemination-intrauterine" AND

Keywords CONTAINS "corifollitropin alfa" or Title CONTAINS "corifollitropin alfa"
Appendix 4. MEDLINE search strategy

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE (1948 to present)

Date of search: 10-10-2011

1 exp embryo transfer/ or exp fertilization in vitro/ or exp sperm injections, intracytoplasmic/ (29168)
2 embryo transfer$.tw. (7138)
3 in vitro fertilization.tw. (14924)
4 ivf-et.tw. (1669)
5 (ivf or et).tw. (154947)
6 icsi.tw. (4487)
7 intracytoplasmic sperm injection$.tw. (4173)
8 (blastocyst adj2 transfer$).tw. (424)
9 exp reproductive techniques, assisted/ or exp insemination, artificial/ or exp ovulation induction/ (47003)
10 assisted reproduct$.tw. (7212)
11 artificial insemination.tw. (4355)
12 iui.tw. (1012)
13 intrauterine insemination$.tw. (1571)
14 ovulation induc$.tw. (3109)
15 ovarian hyperstimulation.tw. (3292)
16 COH.tw. (894)
17 (ovari$ adj2 stimulat$).tw. (4178)
18 superovulat$.tw. (2718)
19 infertil$.tw. (36915)
20 subfertil$.tw. (2981)
21 (ovari$ adj2 induction).tw. (200)
22 or/1-21 (227905)
23 corifollitropin alfa.tw. (22)
24 corifollitropin alpha.tw. (1)
25 org 36286.tw. (4)
26 org36286.tw. (0)
27 FSH carboxy terminal peptide.tw. (2)
28 FSH-CTP.tw. (7)
29 FSH CTP.tw. (7)
30 long acting follitropin.tw. (1)
31 Elonva$.tw. (3)
32 sustained follicle stimulat$.tw. (5)
33 long acting fsh.tw. (13)
34 long acting follicle stimulating hormone.tw. (5)
35 or/23-34 (40)
36 22 and 35 (28)
37 randomized controlled trial.pt. (319965)
38 controlled clinical trial.pt. (83743)
39 randomized.ab. (234955)
40 placebo.tw. (137503)
41 clinical trials as topic.sh. (158838)
42 randomly.ab. (172143)
43 trial.ti. (100880)
44 (crossover or cross-over or cross over).tw. (52403)
45 or/37-44 (783234)
46 exp animals/ not humans.sh. (3701210)
47 or/45 not 46 (723312)
48 36 and 47 (11)
Appendix 5. EMBASE search strategy

**Embase.com** (1980 to current)

Date of search: 10-10-2011

1 exp embryo transfer/ or exp fertilization in vitro/ or exp intracytoplasmic sperm injection/ (42896)
2 embryo$ transfer$.tw . (9711)
3 in vitro fertilization.tw . (17136)
4 ivf-et.tw . (2023)
5 icsi.tw . (6900)
6 intracytoplasmic sperm injection$.tw . (5013)
7 (blastocyst adj2 transfer$).tw . (667)
8 (ivf or et).tw . (299448)
9 exp infertility therapy/ or exp artificial insemination/ or exp intrauterine insemination/ or exp ovulation induction/ (63983)
10 artificial insemination.tw . (4135)
11 intrauterine insemination.tw . (1904)
12 assisted reproduct$.tw . (9674)
13 iui.tw . (1423)
14 ovulation induc$.tw . (3738)
15 (ovari$ adj2 stimulat$).tw . (5358)
16 ovarian hyperstimulation.tw . (4173)
17 COH.tw . (1095)
18 superovulat$.tw . (2637)
19 infertil$.tw . (43284)
20 subfertil$.tw . (3494)
21 (ovari$ adj2 induction).tw . (236)
22 or/1-21 (385118)
23 exp corifollitropin alfa/ (35)
24 corifollitropin alfa.tw . (46)
25 corifollitropin alpha.tw . (5)
26 FSH carboxy terminal peptide.tw . (1)
27 FSH-CTP.tw . (12)
28 FSH CTP.tw . (12)
29 long acting follitropin.tw . (1)
30 Elonva$.tw . (23)
31 sustained follicle stimulat$.tw . (9)
32 long acting fsh.tw . (16)
33 long acting follicle stimulating hormone.tw . (5)
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36 or/23-35 (82)
37 Clinical Trial/ (819367)
38 Randomized Controlled Trial/ (290224)
39 exp randomization/ (54690)
40 Single Blind Procedure/ (14260)
41 Double Blind Procedure/ (100996)
42 Crossover Procedure/ (30997)
43 Placebo/ (185441)
44 Randomized controlled trial$.tw . (64940)
45 Rct.tw . (7766)
46 random allocation.tw . (1056)
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Appendix 6. PsycINFO search strategy

PsycINFO (1980 to current)
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1 exp reproductive technology/ (1093)
2 in vitro fertilization.tw. (433)
3 ivf-et.tw. (16)
4 (ivf or et).tw. (78691)
5 icst.tw. (37)
6 intracytoplasmic sperm injection$.tw. (30)
7 (blastocyst adj2 transfer$).tw. (2)
8 assisted reproductive.tw. (379)
9 artificial insemination.tw. (202)
10 iui.tw. (17)
11 intrauterine insemination$.tw. (12)
12 ovulation induc$.tw. (13)
13 (ovari$ adj2 stimulat$).tw. (42)
14 superovulat$.tw. (5)
15 ovarian hyperstimulation.tw. (8)
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24 org36286.tw. (0)
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26 FSH-CTP.tw. (0)
27 FSH CTP.tw. (0)
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29 Elonva$.tw. (0)
30 sustained follicle stimulation$.tw. (0)
31 long acting fsh.tw. (0)
32 long acting follicle stimulating hormone.tw. (0)
33 exp Follicle Stimulating Hormone/ (71)
34 Follicle Stimulating Hormone$.tw. (406)
35 FSH.tw. (329)
36 rFSH.tw. (0)
37 or/21-36 (520)
38 20 and 37 (27)
39 random.tw. (33464)
40 control.tw. (261118)
41 double-blind.tw. (15184)
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45 or/39-44 (748851)
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### Appendix 7. CINAHL search strategy

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Timespan=All Y ears |
| #5  | 96      | #4 AND #3  
Timespan=All Y ears |
| Protocol first published: Issue 1, 2012 |
| Review first published: Issue 6, 2012 |

**CONTRIBUTIONS OF AUTHORS**

AWP and CF extracted data. AWP entered data and wrote the review. CF helped to draft the review, acted as a clinical expert and commented on the review. JK acted as a clinical expert and commented on the review.

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