Introduction

The establishment of a pregnancy by IVF is quite different from that of a spontaneous pregnancy. It is therefore not surprising that the course and outcome of IVF pregnancies have been the subject of a considerable number of studies. In some of these studies, outcome of singleton IVF pregnancies was compared with that of a general obstetric population (Australian In-Vitro Fertilization Collaborative Group, 1985; Saunders and Lancaster, 1989; Beral et al., 1990; Fiedler et al., 1990; Rizk et al., 1991; Wennerholm et al., 1991; AIHW, 1992; Doyle et al., 1992; McFaul et al., 1993; Olivennes et al., 1993; Wang et al., 1994; FIVNAT, 1995; Gissler et al., 1995), whereas in others matching for age, parity and a number of other confounding factors was attempted (Tan et al., 1992; Tanbo et al., 1995; Verlaenen et al., 1995; Dhont et al., 1997; Reubinoff et al., 1997). In approximately two thirds of the studies an increased rate of preterm birth was found in the IVF group, and in half of them an increased incidence of small-for-gestational age (SGA) children was observed.

The aim of our study was to compare IVF pregnancies to spontaneously conceived pregnancies that fulfilled our matching requirements mentioned above. In this study, we present the results of a study in which four Dutch university centres participated. The course of pregnancy and perinatal outcome of singleton IVF pregnancies were compared with those of spontaneous singleton pregnancies after matching for maternal age, parity, ethnic origin, height, weight, smoking habit, obstetric and medical history, date of delivery as well as the hospital that provided the obstetric care (see also Table I).

Materials and methods

The IVF centres and the obstetric departments of the university hospitals of Amsterdam (Vrije Universiteit), Leiden, Nijmegen, and Utrecht participated in the study. The ethical committee of each hospital approved the study protocol. Only ongoing pregnancies of more than 16 weeks (IVF and control pregnancies) were entered into the study.

IVF pregnancies (cases)

IVF patients were included if their pregnancy was established before the end of 1992, and if the antenatal care was provided by the hospital that performed the IVF procedure. IVF pregnancies after transfer of frozen embryos and pregnancies in which embryo reduction was performed were excluded.

Control pregnancies (controls)

Control singleton pregnancies were selected from the registry of the same hospital if the following criteria were met: maternal age at the time of the last menstrual period (LMP) no more than 2 years apart from that of the case, same parity, same ethnic origin (Caucasian, Mediterranean, Asian and black), the date of parturition no more than 2 years apart from that of the case, comparable height (±10 cm) and...
weight (±10 kg), same smoking habit at the onset of pregnancy (non-smoking, 1–5, 5–10, 10–20, and >20 cigarettes a day), same obstetric and medical history for factors that might influence the outcome of a subsequent pregnancy. The control pregnancies had to have been conceived without any kind of infertility treatment, and the obstetric care had to be provided by the same clinic that provided the obstetric care for the IVF pregnancy. The gestation duration of controls had to be beyond reasonable doubt [regular menstrual cycle of normal length (28 ± 2 days), certain date of the LMP and ultrasound dating in early pregnancy, if performed, in accordance with the gestational age].

Matching procedure
Matching criteria and relevant medical and obstetric factors with regard to the IVF mother’s history were entered into a matching form. Potential control women were selected by scanning the obstetric register for women of suitable age, parity and date of delivery. The records of these women were retrieved and checked for all relevant medical and obstetric factors. For instance, when the IVF mother was known to have a uterine malformation, or to have suffered from pregnancy-induced hypertension (PIH) in a previous pregnancy, a control woman was sought with a similar problem. If no suitable match was available the IVF pregnancy was excluded. If several patients could serve as control the best matching patient with regard to maternal height and weight was chosen. If a match was found, the relevant data of the control woman were added to the matching form. All matching forms were reviewed by one investigator (J.K.) for approval. To avoid selection bias the outcome of potential control pregnancies remained unread until the choice was approved.

Definitions
Gestational age at delivery in IVF pregnancies was defined as the difference between the date of oocyte puncture and the date of delivery with 14 days added. In control pregnancies gestational age at delivery was defined as the number of days between the date of delivery and the date of the first day of the LMP.

Preterm delivery was defined as a delivery before 37 completed weeks. SGA was defined as a birth weight below the 10th percentile of the national reference curve (Kloosterman, 1970). The Dutch reference curve is corrected for parity and sex of the infant. Low birth weight (LBW) was defined as a birth weight between 500 and 2500 g. Stillbirth was defined as the birth of a lifeless child weighing ≥500 g. Neonatal death was defined as the death of a live born child of ≥500 g during the first week after birth. Perinatal mortality was defined as the sum of stillbirths and neonatal deaths, divided by the total number of live and stillbirths. Placenta praevia was defined as the placenta covering the internal os and requiring delivery by Caesarean section. A Caesarean section was called elective if performed before the onset of labour, otherwise it was classified as an emergency Caesarean section. For PIH, as well as other complications of pregnancy, the classifications of the hospital concerned were used. All congenital malformations were registered unless mentioned in the list of exclusions of the European Registration of Congenital Anomalies (EUROCAT) (Zandwijken et al., 1997). The data of IVF and control pregnancies were entered into a database (SPSS data entry) and analysed by SPSS 7.5 statistical package (SPSS Inc., Chicago, IL, USA).

Statistics
Dichotomous variables were compared by the McNemar test. Ordinal variables were assessed by the Wilcoxon test and continuous variables by the paired t-test. For comparisons within a group multivariate regression analysis, analysis of variance (ANOVA) or χ² test was used. Significance level was set at 5%, two-tailed.

Results
A total of 377 singleton IVF pregnancies was eligible for matching. For 70 (19%) of the IVF pregnancies no suitable match was found. The causes were: uncommon ethnic origin (n = 11), medical disorders (n = 14), congenital uterine malformations (n = 10), previous uterine surgery (n = 2), previous Caesarean section (n = 6), poor obstetric history (n = 3), the presence of a condition that existed before the onset of pregnancy and necessitated delivery by Caesarean section (n = 5), diethylstilbestrol (DES) history (n = 3), and miscellaneous reasons (n = 16).

Maternal characteristics
A summary of maternal characteristics at the onset of pregnancy is presented in Table II. The average age, height, weight and

| Table I. Matching criteria in matched control studies (all exceeding 100 IVF pregnancies) |
|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| IVF pregnancies (n) | 494 | 355a | 140 | 311b | 260 | 307 |
| Control pregnancies (n) | 978 | 643 | 140 | 622 | 260 | 307 |
| Age | +c | + | + | + | + | + |
| Parity | ±d | + | + | + | + | + |
| Height | – | – | + | – | – | + |
| Weight | – | – | + | – | – | + |
| Ethnic origin | – | + | – | + | + | + |
| Smoking habit | – | – | – | – | – | + |
| Medical disorders | – | + | – | – | – | + |
| DES history | – | – | – | – | – | + |
| Obstetric history | – | – | – | – | – | + |
| Obstetric department | – | – | + | – | – | + |
| Date of delivery | – | + | + | + | + | + |

a281 IVF, 23 gamete intra-Fallopian transfer (GIFT), 51 other artificial reproduction techniques.
b131 IVF and 180 intracytoplasmic sperm injection (ICSI) pregnancies.
cStratum matched.
dAll controls were primiparous.

DES = diethylstilbestrol.
Table II. Maternal characteristics at the onset of pregnancy in IVF and control pregnancies. Values are mean (±SD)

<table>
<thead>
<tr>
<th></th>
<th>IVF group</th>
<th>Control group</th>
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<tbody>
<tr>
<td>(n = 307)</td>
<td>(n = 307)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>32.8 (±4.3)</td>
<td>32.7 (±4.4)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>64.2 (±9.8)</td>
<td>63.4 (±8.1)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167.9 (±6.5)</td>
<td>167.8 (±6.1)</td>
</tr>
<tr>
<td>BMI</td>
<td>22.8 (±3.3)</td>
<td>22.4 (±2.5)</td>
</tr>
<tr>
<td>Cigarettes (no. per day)</td>
<td>2.44 (±5.2)</td>
<td>2.46 (±5.1)</td>
</tr>
<tr>
<td>Alcohol (glasses per week)</td>
<td>0.25 (±1.3)</td>
<td>0.31 (±1.9)</td>
</tr>
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</table>

aBody mass index [BMI; weight (kg) divided by height (m) squared]. There were no significant differences between the two groups using the paired t-test.

body mass index [BMI; weight (kg) divided by height (m) squared] of IVF mothers was comparable to that of the control mothers. In both groups 233 (75.9%) women were non-smokers. The average number of cigarettes smoked and alcohol consumption was comparable in cases and controls: 80.8% of the cases did not consume alcohol, as did 79.8% of the controls. We have no information on smoking habit and alcohol consumption during the course of pregnancy.

Obstetric history

In both groups 231 (72.2%) women were primiparous; 157 (51.1%) of the cases and 158 (51.5%) of the controls had not been pregnant before. The average number of previous spontaneous abortions was higher in controls (0.42 range 0–4 versus 0.32 range 0–4, P = 0.04). Previous ectopic pregnancies were more frequently found in the IVF group (0.22 range 0–3 versus 0.05 range 0–2, P < 0.001). The rate of preterm delivery, congenital malformations, stillbirth and neonatal mortality, instrumental delivery and Caesarean section, PIH, and gestational diabetes in previous pregnancies showed no differences.

Pregnancy

In the IVF and control groups ultrasound examination in early pregnancy was performed in 100 and 73.0% respectively of the pregnancies. A vanishing twin was more frequently reported in the IVF group (11.1 versus 1.6%, P < 0.01). In the IVF group, pregnancies with and without vanishing twins were compared. No significant effects were noted on neonatal birth weight, SGA rate, gestational age at birth, preterm rate and the incidence of bleeding in the second and third trimester. First trimester bleeding tended to occur more often in association with vanishing twins (32 versus 20%) but this was not significant (P = 0.08).

Invasive prenatal diagnostic tests were less common in the IVF group (24.1 versus 30.3%, P = 0.02) and this was due to a lower incidence of chorionic villus biopsies (3.9 versus 10.1%, P = 0.003); amniocentesis was performed in an equal number in both groups (n = 62; 20.2%).

Vaginal blood loss throughout pregnancy occurred more often in the IVF group (first trimester 21.2 versus 13.7%, P = 0.02; second trimester 7.8 versus 2.0%, P = 0.002; third trimester 8.6 versus, 3.9%, P = 0.03). The incidence of PIH in IVF and control pregnancies was comparable (13.7 versus 11.1%) and in each group the severity of PIH required admission in 25 patients. No differences were found in the occurrence of hyperemesis, gestational diabetes, polyhydramnios, placental abruption, and preterm rupture of membranes. Intrauterine growth retardation was more frequently suspected in the IVF group (3.6 versus 1.0%) but this difference was not significant (P = 0.06). Seven placenta praevia (2.3%) were recorded in the IVF group versus one (0.3%) in controls (not significant, P = 0.07). In both groups two pregnancies were terminated because of severe congenital malformations. During their pregnancies, IVF patients spent more days on admission in hospital than control patients (4.6 ± 10.2 versus 2.5 ± 5.4, P = 0.001).

Delivery

Data on pregnancy and neonatal outcome are summarized in Table III. On average, the IVF child was born 5.1 days earlier. In the IVF group more pregnancies ended preterm. The elective Caesarean section rate was higher in IVF patients, while the rate of induced labour was similar in both groups (11.7 versus 9.8%). The gestational age at delivery of pregnancies with spontaneous onset of labour in the four participating centres for IVF and control pregnancies was compared after correction for confounding factors by linear regression analysis. In the control group no difference was found between the centres, while in the IVF group the greatest difference between two centres was 9 days (271 versus 280 days, P = 0.03).

No difference was noted between the IVF and control groups in the rate of normal vaginal deliveries and emergency Caesarean sections. Instrumental vaginal deliveries were more frequent in the control group. Sixteen per cent of all IVF pregnancies ended in a Caesarean section versus 13% in the control group (not significant). Breech presentation at term was not significantly different between IVF and control pregnancies (6.6 versus 4.2%).

Table III. Outcome of pregnancy in IVF and control pregnancies

<table>
<thead>
<tr>
<th></th>
<th>IVF group</th>
<th>Control group</th>
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<tbody>
<tr>
<td>(n = 307)</td>
<td>(n = 307)</td>
<td></td>
</tr>
<tr>
<td>Mean gestational age at birth:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All pregnancies (days ±SD)</td>
<td>272 ± 24</td>
<td>277 ± 19</td>
</tr>
<tr>
<td>P value</td>
<td>0.005</td>
<td></td>
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<tr>
<td>Pregnancies with spontaneous onset of labour only (days ±SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preterm deliveries:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All pregnancies (%)</td>
<td>15</td>
<td>5.9</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Pregnancies with spontaneous onset of labour only (%)</td>
<td></td>
<td></td>
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<tr>
<td>Mode of delivery:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal vaginal delivery (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrumental vaginal delivery (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective Caesarean section (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Caesarean section (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant birth weight:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight &lt;2500 g (%)</td>
<td>13.8</td>
<td>6.9</td>
</tr>
<tr>
<td>P value</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Birth weight &lt;10th percentile (%)</td>
<td>16.2</td>
<td>7.9</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;0.001</td>
<td></td>
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</tbody>
</table>

aPaired t-test.

bMcNemar test.
Figure 1. Birth weight percentiles in IVF and control children (%). There was a significant shift towards lower birth weight among IVF children ($P < 0.001$, Wilcoxon signed ranks test).

Neonatal outcome

The male:female ratio was 1.05 in IVF and 0.9 in controls (not significant). Two IVF children were stillborn, both after termination of the pregnancy because of a severe congenital malformation (thanatophoric dwarfism and trisomy 18). There were three neonatal deaths in the IVF group. One child, born at 41 weeks, died 6 days after birth because of ventricular tachycardia. The second child was born at 30 weeks and died 2 days later of respiratory insufficiency and the third child, born at 29 weeks, died 3 days later due to a pulmonary haemorrhage. In the control group one neonatal death occurred; this child was born at 28 weeks and died 6 days later of an intracranial haemorrhage. Perinatal mortality in the IVF group was 17 per 1000 and in the control group 3 per 1000 (not significant).

Meconium staining of the amniotic fluid (cerebral presentations only) was noted less often in IVF pregnancies (12.6 versus 19.8%, $P = 0.04$). Neonatal condition at birth, either expressed as the proportion of children with umbilical cord arterial pH < 7.1, or Apgar score < 7 at 5 min after birth, was not significantly different between the two groups.

The mean birth weight in the IVF group was lower than that of the control group (3112 ± 759 versus 3326 ± 639 g, $P < 0.001$). The histogram of the weight percentiles of the IVF children in comparison to control children showed a distinct shift to the left (Figure 1) with over-representation in the lower percentiles ($P < 0.001$). Significantly more IVF children were SGA but placental weight in the IVF and control group was comparable (534 ± 148 versus 531 ± 132 g). Consequently, the placenta/birth weight ratio was higher in the IVF group (0.18 ± 0.05 versus 0.17 ± 0.06, $P = 0.01$).

On average IVF children needed longer neonatal care (5.6 range 0–92 versus 2.3 range 0–73 days, $P = 0.04$) as well as longer neonatal intensive care (0.4 range 0–31 versus 0.02 range 0–7 days). No significant differences were found in the incidence of neonatal problems such as respiratory distress syndrome, intracranial bleeding, hyperbilirubinaemia, gastrointestinal disorders and infections. In both groups seven children (2.3%) had congenital malformations. In both groups one child with trisomy 18 was born. In the IVF group one child was born with Beckwith–Wiedemann syndrome, one child with multiple congenital malformations, one thanatophoric dwarf, one child with a cleft palate, one child with hip dysplasia, and one child had an extra thumb. In the control group there was one trisomy 21, one multicystic dysplasia of one kidney, one tethered cord, one Hirschsprung’s disease, one large haemangioma, and one child with a foot with four missing toes.

Puerperium

When deliveries by Caesarean section were excluded, post partum blood loss in IVF and control deliveries was comparable (428 ± 338 versus 455 ± 351 ml), as was the number of admission days after delivery (2.7 range 0–20 versus 2.5 range 0–14 days).

Discussion

In our study we found a number of differences between IVF and control pregnancies, the most important of which were a decrease in gestational age at delivery and an increased SGA rate in IVF pregnancies. Several comparable studies on IVF pregnancies have been published. In none of these studies was the matching as elaborate as in our study (Table 1). Our matching did not include social class or economic status; however this cannot explain our results. According to Lang et al. (1996) maternal education is the most important demographic factor and more highly educated women had a better pregnancy outcome. In the Netherlands the educational level of IVF women is higher than that of women who conceive naturally (Buitendijk et al., 1999).

In each of the previous published studies, the IVF pregnancies were the result of the work of a single IVF centre and local (laboratory) procedures may have influenced the outcome of the pregnancies. Our series comprises IVF pregnancies from four IVF centres.

We noted a lower utilization of chorionic villus biopsy in IVF pregnancies. A comparable finding was previously reported (Beral et al., 1990). This might reflect the women’s desire to avoid the risk of an iatrogenic abortion in these, highly wanted, pregnancies. IVF mothers experience a higher fear of pregnancy loss than controls (McMahon et al., 1997).

In IVF pregnancies, antenatal surveillance usually starts earlier than in naturally conceived pregnancies. This might explain the higher incidence of first trimester bleeding in IVF since blood loss in early pregnancy is more likely to be recorded in these cases. Accordingly, the first ultrasound examination in the IVF group was performed at a younger gestational age than in control pregnancies (data not shown). This might, at least in part, be the cause of the higher incidence of vanishing twin syndrome in our IVF pregnancies. Tanbo et al. (1995) excluded IVF patients with vanishing twins. We included these cases in our study and found no significant influence on pregnancy outcome.

The higher incidence of second and third trimester bleeding can partly be explained by the higher incidence of placenta praevia and preterm uterine contractions in IVF pregnancies; however, if these cases were excluded the difference remained significant ($P = 0.05$).

We found comparable rates of PIH in IVF and control pregnancies. This is in accordance with two earlier studies (Verlaenen et al., 1995; Reubinoff et al., 1997) but contradict-
ory to the studies in which pregnancies in cases and controls were not attended by the same obstetric staff (Tan et al., 1992; Tanbo et al., 1995). There are three accepted definitions of PIH (Franx, 1997), and possibly the reported difference in PIH rate between IVF and control pregnancies in the latter two studies reflects differences in definition rather than differences in the incidence of PIH. This illustrates the necessity of matching by obstetric department.

During pregnancy IVF women spent more days in the hospital than women in the control group. This may, in part, reflect greater anxiety by physicians and patients in these ‘precious’ pregnancies. A ‘safety first’ approach might also explain the higher rate of elective Caesarean sections. The difference in the rate of obstetric interventions resulting in delivery has to be taken into account when gestational age at birth in IVF and control pregnancies is compared. In our study, gestational age at birth in pregnancies with spontaneous onset of labour was 3 days lower in the IVF group. In the literature, several methods are used to compute gestational age in IVF pregnancies. Dhont et al. (1997), Reubi et al. (1997), and Tanbo et al. (1995) applied the same, or a comparable, method to that which we utilized. Verlaenen et al. (1995) determined gestation duration in both IVF and control pregnancies by first trimester sonographic measurements. Tan et al. (1992) calculated gestational age from the LMP. These different methods may yield different results. Mean gestational age in our IVF group decreased by 1.3 days if we used the LMP and the preterm rate increased to 16.3%. As there is no gold standard, it is impossible to say which method is the best. The importance of a difference of a few days on preterm rate has been demonstrated (Olivennes et al., 1992). However, when the preterm rate decreases, the SGA rate will increase and vice versa (Rufat et al., 1994). In other words, the combination we found in our IVF group of a shortened gestational duration and an increased SGA rate denotes a distinct difference between IVF and control pregnancies.

Preterm delivery has been associated with young maternal age, low pre-pregnancy weight, nulliparity, previous preterm birth, a history of two or more induced abortions, spontaneous abortions or stillbirths, intrauterine exposure to DES, incompetent cervix, uterus anomaly, pyelonephritis and low weekly weight gain (Lang et al., 1996). Two of these factors (low weekly weight gain and pyelonephritis) are pregnancy complications. All other factors were included in our matching procedure with the exception of the number of (induced) abortions. This does not explain the reduced gestational age at delivery in our IVF group as the previous abortion rate was lower in this group.

One may wonder whether the reduced pregnancy duration in IVF pregnancies may be caused by the IVF technique per se, the ovarian stimulation, or the infertility. Ovarian stimulation increases circulating relaxin concentrations (Johnson et al., 1991). In IVF pregnancies, high serum relaxin concentrations have been found which were correlated with the number of growing follicles in the preceding treatment cycle (Kristiansson et al., 1996). A relationship has been demonstrated between serum relaxin concentrations following ovarian stimulation and preterm delivery (Weiss et al., 1993). Thus, ovarian stimulation might be the causative factor instead of the IVF procedure as such. This would be in line with a study (Olivennes et al., 1993) in which no difference in preterm rate was found between a group of 162 IVF patients and 263 infertile patients treated with ovarian stimulation. In another study, 160 singleton pregnancies, after transfer of cryopreserved embryos (in a cycle without ovarian stimulation), were compared with equal numbers of singleton pregnancies after standard IVF and spontaneous pregnancies (Wennerholm et al., 1997). The preterm rate in the spontaneous and ‘cryo’ pregnancies was equal (5.6%), whereas this rate was considerably higher in IVF pregnancies (11.3%), although the difference was not significant. A lower preterm rate after transfer of frozen embryos in natural cycles has been reported elsewhere as well (AIHW, 1990). It is tempting to ascribe the shorter duration of IVF pregnancies to abnormally elevated relaxin concentrations caused by the ovarian stimulation. However, the role of relaxins in human reproduction remains to be clarified, and there appears to be no simple relationship between the relaxin concentrations in the circulation and the duration of the pregnancy (Bryant-Greenwood and Schwabe, 1994). Infertility per se has been associated with preterm delivery (Ghazi et al., 1991) although other studies found no such relationship (Tuck et al., 1988; Li et al., 1991). Review of the literature revealed insufficient evidence to link a history of infertility to preterm delivery (Kramer, 1987; Berkowitz and Papiernik, 1993).

When perinatal mortality in IVF and control pregnancies is compared, it should be noted that the two stillbirths in the IVF group resulted from termination of pregnancy, performed because of severe congenital malformations. In the control group two pregnancies were also terminated for this reason, but this occurred earlier in the pregnancy, the (stillborn) children weighed <500 g at birth, and were therefore not included in the perinatal mortality figures.

The higher rate of LBW in IVF pregnancies may in part be due to the higher preterm rate in this group. However, the two-fold increased incidence of SGA shows that IVF children were smaller than control children when corrected for gestational age, parity, and infant sex. The explanation remains elusive. A history of infertility has been associated with an increased SGA risk (Ghazi et al., 1991; Williams et al., 1991) but others dispute such a relationship (Tuck et al., 1988; Li et al., 1991). An interesting finding is that IVF in domestic animals (cows and sheep) resulted in unusually large offspring and prolongation of the duration of pregnancy (Kruip and den Daas, 1997). It has been shown that with IVF in sheep, birth weight can be influenced by changes in culture conditions (Thompson et al., 1995). IVF in livestock, however, differs from IVF in humans (i.e. in livestock IVF is preceded by in-vitro maturation of the oocytes), and whether culture conditions in human IVF influence infant birth weight is unknown. However, one might speculate that in human IVF, factors such as culture conditions may also play a role, as we found a difference in gestation duration in IVF pregnancies between two centres.

We found no difference in placental weight between the IVF and the control group whereas the placental:fetal weight
ratio was significantly higher in the IVF group. Similar results have been reported (Daniel et al., 1999) and it was noted that no differences in morphological or histopathological features existed between IVF and control placentae. These findings suggest that the increased incidence of SGA is not due to placental insufficiency. In IVF pregnancies, elevated concentrations of human chorionic gonadotrophin (HCG) have been found during the first trimester (Ribbert et al., 1996). It could be speculated that in IVF there is an alteration in distribution of blastocyst cells forming fetus and placenta in early pregnancy. The relatively low birth weight in association with a normal placental weight resulted in an increased placenta/birth weight ratio. According to the ‘Barker hypothesis’, these infants are possibly at risk for cardiovascular and other diseases in later life (Barker et al., 1990, 1993); however, this relationship is disputed (Joseph and Kramer, 1996).

We conclude that in comparison to their naturally conceived counterparts, IVF children were born at younger gestational age. They weighed less at birth than they should according to their gestational age, although their placental weight was comparable to that of controls. They needed more neonatal (intensive) care. Whether these adverse outcomes are the result of the IVF procedure per se, ovarian stimulation, or parental factors like infertility, remains to be elucidated.

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Obstetric outcome of singleton pregnancies after IVF


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