

Maternal adjustment, parenting and child behaviour in families of school-aged twins conceived after IVF and ovulation induction

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Background: Previous studies that have examined the long-term effects of infertility and assisted reproductive technology on parenting and child behaviour in families with twins have suffered from methodological problems. This study compared measures of parental adjustment, parenting and child behaviour in families with 5-year-old twins who were conceived after *in vitro* fertilisation (IVF) or ovulation induction (OI) with families whose twins were naturally conceived (NC). **Methods:** The families who conceived via IVF/OI ($N = 121$) were identified from an epidemiological study of twins and matched to families who were conceived naturally ($N = 121$) on the basis of eleven child and family variables. Mothers were interviewed in their homes for the study. **Results:** No significant differences were observed between the IVF/OI families and the NC families on measures of parental adjustment or parent and teacher ratings of the twins' behaviour. IVF/OI mothers and their partners agreed with each other about discipline more than NC couples, but otherwise no other differences in parenting were found. **Conclusions:** Overall, this study provides evidence that families who conceive twins following IVF/OI are functioning well and that the experience of fertility treatment does not lead to long-term difficulties for parents or children. **Keywords:** Assisted reproductive technology, *in vitro* fertilisation, ovulation induction, parental adjustment, parenting, twins, child behaviour. **Abbreviations:** IVF: *in vitro* fertilisation; OI: ovulation induction; IUI: Intra Uterine Insemination; GIFT: Gamete Intrafallopian Transfer.

Mothers who have endured a period of infertility followed by *in vitro* fertilisation (IVF), ovulation induction (OI) or other assisted reproductive technologies are more likely to be stressed than mothers who have not had fertility problems (Bernstein, 1990; Bernstein, Mattox, & Kellner, 1988). Stress associated with previous infertility and fertility treatment may lead mothers to have high levels of anxiety about their child (McMahon, Ungerer, Beaurepaire, Tennant, & Saunders, 1995), unrealistic expectations about their own parenting abilities and their child's behaviour (Lind, Pruitt, & Greenfield, 1989), and greater conflict with their partner (Cook, Parsons, Mason, & Golombok, 1989). Since parenting stress, unrealistic expectations and marital conflict are risk factors for dysfunctional parenting and child behaviour problems (Cowan & Cowan, 1992; Patterson, 1982, 1983; Rogosch, Cicchetti, Shields, & Toth, 1995), researchers have sought to determine whether there are differences between families who conceive naturally or via assisted techniques. The aim of this paper is to explore whether families who conceive twins after IVF and OI differ in parenting, child behaviour or parental adjustment when compared with families who conceive twins naturally.

In the US it has been estimated that about one in six couples have problems with fertility and half of

these couples will seek fertility treatment to become pregnant (Leiblum, 1997; Bernstein & Mattox, 1982). Assisted reproductive technologies are continuing to advance and the number of children, particularly twins and higher-order multiples, conceived by them is increasing. Natural conception has a twin birth rate of about 1% whereas about 26% of IVF births are twins (Human Fertilisation and Embryology Authority, 1996). As most forms of assisted reproduction are associated with a significantly higher incidence of multiple pregnancies than spontaneously conceived pregnancies, it is important to ascertain what impact IVF and OI has on families with twins as well as families with singletons.

A number of studies have compared families of singleton children conceived following IVF and other assisted techniques with those conceived naturally (Golombok et al., in press, 1996; Golombok, Cook, Bish, & Murray, 1995; Hahn & DiPetro, 2001; Levy-Shiff et al., 1998; van Balen, 1996; Weaver, Clifford, Gordon, Hay, & Robinson, 1993). Contrary to expectation, most of these studies found positive parenting outcomes for IVF families. When compared to parents of naturally conceived children, parents who conceived their child via assisted conception showed greater warmth, emotional involvement or protectiveness towards their child (Golombok et al., in press, 1995, 1996; Hahn &

DiPetro, 2001; van Balen, 1996), experienced fewer marital problems (Halasz et al., 1993) and less parenting stress (Golombok et al., 1995, 1996; Weaver et al., 1993). The higher levels of warmth and involvement of parents who conceived their child following IVF versus those who conceived naturally has been attributed to their greater desire for children and greater investment in their child's well-being.

In terms of children's behavioural outcomes, the research findings to date are contradictory. Some studies report that children conceived after IVF have more behavioural or emotional problems than children conceived naturally (Gibson, Ungerer, Leslie, Saunders, & Tennant, 1998; Levy-Shiff et al., 1998), whereas other studies report no differences between IVF and naturally conceived children (Golombok et al., in press, 1995, 1996; Hahn & DiPetro, 2001). On the other hand, one study found that IVF children were rated as more sociable and less obstinate than naturally conceived children (van Balen, 1996). These contradictory findings may be attributable to methodological difficulties in some studies, particularly the lack of well-matched control groups.

All of the above-mentioned studies have excluded twins from their comparisons since twins are known to be at greater 'biological risk' than singletons. When compared with singletons, twins are more often born prematurely, have lower birth weights and are more prone to neonatal complications (Botting, MacFarlane, & Price, 1990), all of which may have a lasting effect on their mental and physical development (Alin-Akerman & Fischbein, 1990). While there is a paucity of research into psychosocial risk factors in families of twins when compared with families of singletons, there is some evidence that the parents of twins may experience greater stress, depression and marital difficulties because of the burden of having two children simultaneously (Thorpe, Golding, MacGillivray, & Greenwood, 1991). It is possible that families who have given birth to twins following artificial reproductive procedures may find parenting more demanding than families who have had singletons following such procedures, which in turn may lead to poorer behavioural outcomes for children.

Only a few studies have examined differences in families with twins conceived via IVF/OI and those conceived naturally. Munro, Ironside, and Smith (1992) compared 80 families with pre-school age twins conceived naturally or after IVF and found that parents who conceived their twins after IVF showed poorer social support than non-IVF parents. Cook, Bradley, and Golombok (1998) compared 12 families with four- to eight-year-old twins conceived after IVF to 14 twin pairs naturally conceived and found that the IVF group reported greater parenting stress but no differences in parenting quality or child behaviour. Finally, Colpin, DeMunter, Nys, and Vandemeulebroecke (1999) compared a total of 103 families with one-year-old twins who were either

conceived naturally, after IVF or after OI and found no differences between groups in parenting stress or the psychosocial well-being of parents, although they did not investigate differences in children's behaviour.

It would appear that a different pattern of findings might be emerging for IVF families of twins versus singletons. While many studies with singletons have found parenting in IVF families to be superior to parenting in naturally conceived families, these findings have not been observed in the few studies that have been done with families with twins. The few studies which have examined the effects of IVF/OI in families of twins have suffered from methodological problems such as small sample sizes and control groups that are poorly matched for confounding variables, such as maternal age and number of older children (Colpin et al., 1999; Cook, Bradley, & Golombok, 1998; Munro et al., 1992). In addition, these studies have obtained eligible families from a select number of fertility programmes or hospitals, so it is possible that their samples are not representative of the population who have conceived twins after IVF and OI. Clearly, a large, well-matched, population-based sample is needed in order to explore the effects of IVF and OI in families with twins.

The aim of this study is to compare families of twins who have been conceived after IVF and OI with a matched sample of families of twins who have been naturally conceived (NC families). We address three questions: (1) do families who conceive twins after IVF and OI differ from NC families on measures of maternal adjustment, including maternal depression and social support, (2) do mothers who conceive twins after IVF and OI differ from NC mothers in their parenting behaviour, (3) does the behaviour of twins conceived after IVF and OI differ from the behaviour of twins conceived naturally? Due to the stress associated with the experience of infertility and fertility treatment, and the burden of having two children simultaneously, it is hypothesised that IVF/OI twins and their mothers will show poorer outcomes than the NC twins and their mothers on measures of maternal adjustment, parenting and children's behaviour.

Method

Sample

Participants are members of the Environmental Risk (E-risk) Longitudinal Twin Study, an epidemiological study of 1116 families which investigates how genetic and environmental factors influence children's development (Moffitt & The E-risk Study Team, 2002). This national probability sample was drawn from two consecutive birth cohorts (1994 and 1995) in the Twins' Early Development Study, a birth register of twins born in England and Wales (Dale et al., 1998). The full register is administered by the government's Office of National Statistics (ONS). Of the 15,906 twin pairs born

in 1994 and 1995, 71% joined the register. An initial list of 1210 families was drawn from the register to target for inclusion in the E-risk study (see Moffitt and The E-risk Study Team, 2002, for full description of sampling methods). Of the 1210 families targeted, 7 were discovered to be ineligible because the twins had moved overseas, did not speak English, were being reared by neither biological parent, or were opposite-sex. Of the 1203 eligible families, 1116 (93%) participated in home-visit assessments when the twins were age 5 years; 4% refused participation and 3% could not be traced.

In the E-risk sample, we identified 121 IVF/OI families and 121 NC families with 5-year-old same-sex twins. Families were identified as having undergone IVF/OI via a questionnaire that was completed by them when the twins were 12 months old. Three IVF/OI families were excluded from this study because one or both of their twins had cerebral palsy. Of the 121 families who indicated they had received fertility treatment at the time they became pregnant with their twins, 9 families (7.4%) did not specify the type of treatment they had received. Of the remaining families, 52 (43%) had IVF, 51 (42%) had OI, 6 (5.0%) had IUI (Intra Uterine Insemination) and 3 (2.5%) had GIFT (Gamete Intrafallopian Transfer). The four groups were combined into two: IVF and OI. The IUI families and GIFT families were included in the IVF group, since all procedures involved some type of transfer of eggs and sperm. Thus, overall there were 61 families (50.5%) in the combined IVF group and 51 families (42%) in the OI group.

The 121 families who received IVF/OI were matched with a sample of 121 NC families on the basis of family and child characteristics that may confound study results. The matching variables included gender, zygosity and ethnicity of twins; family income and occupation; relationship status of parents; whether or not the twins were the first birth in the family (twins' birth order); twins' birthweight; mother's age; and number of children in the family. To ensure that matching was effective in producing equivalent groups, the groups were compared on these variables. Independent samples *t*-tests were used for continuous variables and chi-square tests were used for categorical variables. Table 1 displays the percentages, means and standard deviations for family demographic and child variables for the IVF/OI group and NC group as well as *t*-values and chi-square values for differences between the two groups. No significant differences were found for any variable, indicating that the two groups were socio-demographically well matched.

Procedures and measures

Research workers visited families' homes within 60 days of the twins' fifth birthday to conduct interviews with mothers. All data were collected via interview; no self-completion forms were used. Research workers visited each home in teams of two for a total of two to three hours. Families were given shopping vouchers for their participation, and children were given

Table 1 Percentages, means, standard deviations, *t*-values and chi-square values for comparison of IVF/OI and NC families on child variables and family socio-demographic characteristics

Child and family variables	NC group (<i>n</i> = 121) <i>n</i> (%)	IVF/OI group (<i>n</i> = 121) <i>n</i> (%)	χ^2 value	<i>P</i> value
Gender of twins				
Male	54 (44.6)	54 (44.6)	.00	1.00
Female	67 (55.4)	67 (55.4)		
Zygosity of twins				
Monozygotic	19 (15.7)	19 (84.3)	.00	1.00
Dizygotic	102 (15.7)	102 (84.3)		
Ethnicity of twins				
White	108 (89.3)	115 (95.0)	2.79	.24
Not white	13 (10.7)	6 (5.0)		
Family income				
Less than £20,000	38 (32.5)	29 (25.2)	1.80	.41
£20,000 to £34,999	42 (35.9)	42 (36.5)		
More than £35,000	37 (31.6)	44 (38.3)		
Occupations				
Professional/managerial	65 (56.5)	72 (62.1)	1.06	.59
Skilled manual and non-manual	41 (35.7)	38 (32.8)		
Partly skilled and unskilled	9 (7.8)	6 (5.2)		
Relationship status				
Living with biological father	110 (90.9)	111 (91.7)	.05	1.00
Not living with biological father	11 (9.1)	10 (8.3)		
Twins' birth order				
Twins first born to mother	61 (50.4)	68 (56.2)	.69	.24
Twins not first born to mother	60 (49.6)	53 (43.8)		
	Mean (SD)	Mean (SD)	T value	P value
Birthweight of elder twin	2381.30g (523.36)	2472.18g (546.69)	1.29	.20
Birthweight of younger twin	2355.20g (539.92)	2404.17g (582.50)	.66	.51
Mother's age at interview	35.6 (4.65)	36.0 (4.95)	.67	.51
Total number of children in family	2.94 (1.27)	2.85 (0.94)	-.63	.53

colouring books and stickers. All research workers had university degrees in the behavioural sciences, and experience in psychology, anthropology, or nursing. Research workers were blind to information concerning the method by which the twins were conceived. Interviews with the mothers included structured protocols and more qualitative, open-ended sessions that were audiotaped. Questions about each twin were separated by one hour of questions about other topics.

At the time of the home visit, parents were asked for permission to send a questionnaire to the twins' teachers. Parents were given an opportunity to view this questionnaire before giving consent. Of the 484 children (242 twin pairs) who participated in the study, questionnaires from teachers were returned for 450 children, giving a teacher response rate of 93%.

Family and child characteristics. The current (or last) *occupations* of mothers (and their spouses or partners) were coded using the Office of Population Censuses and Surveys (OPCS, 1991) Standard Occupational Classification. Occupational groups are arranged into 6 social classes (1 = professional occupations; 2 = managerial and technical occupations; 3N = skilled non-manual occupations; 3M = skilled manual occupations; 4 = partly skilled occupations; 5 = unskilled occupations). Families were assigned the higher of the occupations held by the mother or her spouse/partner. For analyses, the six occupation categories were divided into three: (1) professional and managerial, (2) skilled manual and non-manual, and (3) partly skilled and unskilled.

Household income was established by asking mothers to indicate how much total income the household received from all sources before tax in the previous 12 months. For analyses, income was divided into three categories: less than £20,000, between £20,000 and £34,999 and more than £35,000.

The *zygosity* of the twins was determined by a questionnaire administered to the parent about the physical similarities, differences and confusion between the twins (Rietveld et al., 2000). This questionnaire has been found to accurately classify the zygosity of 93% of twins (Rietveld et al., 2000). In the few cases where the zygosity of the twins was unclear from the questionnaire responses, cheek cells were collected from both children and sent to a laboratory for DNA analyses.

Parental adjustment. We assessed three features of partner relationships. The *quality of the mother's relationship* with her current partner was assessed by asking mothers questions about intimacy (e.g., 'We feel very close to each other'), trust (e.g., 'I feel I can trust my partner completely'), and communication (e.g., 'We discuss problems and feel good about the solutions') in the relationship. Mothers responded to all questions about partner relationship as not true (0), sometimes or somewhat true (1) and very true (2). Following Fincham's (1998) recommendation, we combined answers to these questions into a single, unidimensional index of relationship quality, which has an internal consistency reliability of .89.

Mothers were interviewed about quarrelling or physical abuse with any partner since the twins' birth (in the past five years) using items from the Conflict Tactics Scale (Straus, 1990) supplemented with additional items describing other physically abusive behaviours. *Quarrelling* was assessed by inquiring about three verbally aggressive acts (e.g., swearing at partner) and *physical partner abuse* was assessed by inquiring about 12 acts of physical violence (e.g., kicking a partner, threatening a partner with a knife). Mothers were asked about their own behaviour toward a partner, and about any partner's behaviour toward them. Mothers responded to all questions about self and partner violence as not true (0), sometimes or somewhat true (1) and very true (2). Mothers' self scores and partner scores were combined into one score. The internal consistency reliabilities of the quarrelling and physical abuse scales were .76 and .90, respectively. Additional methodological research using this measure shows that inter-partner agreement about verbal and physical relationship abuse is very high, with correlations between partners' independent reports $> .70$ (Moffitt et al., 1997).

Partner support was measured with four questions about the current partner (e.g., 'We support each other during difficult times', 'He helps me out with the children'). Mothers responded to each question as not true (0), somewhat or sometimes true (1), or very true or often true (2). The internal consistency reliability of this scale was .81.

We asked the mothers the degree to which each of four different social relationships (i.e., parents, adult siblings, in-laws, friends) supplied each of three different types of *social support* (financial support, emotional support, and support with taking care of the twins) (Simons & Johnson, 1996). Mothers responded to each question as no (0), maybe (1), or definitely (2). The responses to these questions were combined into a single score. The internal consistency reliability of this scale was .75.

Maternal depression was assessed using the Diagnostic Interview Schedule (Robins, Cottler, Bucholz, & Compton, 1995). Mothers specified if and when they experienced any episodes of depression since the twins' birth and depression diagnoses were made following DSM-IV criteria (American Psychiatric Association, 1994). The Life History Calendar (Caspi et al., 1996) was used as a memory aid to help mothers specify when they experienced depression. We report the percentage of mothers who experienced a major depressive episode since the twins' birth.

Parenting. Inter-parental inconsistency of discipline was assessed with three questions about how the mother and her current partner handled child misbehaviour (e.g., 'We disagree about what to do when the children are naughty') (Vaughn, Block, & Block, 1988). Mothers responded to each question as not true (0), somewhat or sometimes true (1), or very true or often true (2). The internal consistency reliability of this scale was .57.

Mothers were asked how often they *physically disciplined* their twins in the last 5 years (Dodge, Pettit, & Bates, 1994). They were asked to respond yes (1) or no (0) to whether they smacked, hit or used other forms of

physical discipline in the last year and also in the four years prior to that. Total physical discipline scores ranged between 0 and 6. A score of 6 meant that mothers had smacked, hit and used other forms of physical discipline both in the last year and also in the previous four years.

As part of the parenting interview, we obtained a measure of maternal Expressed Emotion towards her twins using procedures adapted from the Five Minute Speech Sample (FMSS) method (Magana et al., 1986). Trained interviewers asked the mothers to describe their child ('For the next 5 minutes, I would like you to describe [child] to me, what is [child] like?'). Two trained raters coded the EE tapes according to guidelines set down by the FMSS scoring manual as modified for use with preschool children (Barnes-McGuire & Earls, 1994; Daley, Sonuga-Barke, & Thompson, in press). The raters underwent 2 weeks of training in coding procedures, and the same rater was used to code twins in the same family. Inter-rater reliability was established by having the raters individually code a test-standard audiotape describing 40 children. Two aspects of Expressed Emotion were coded from the speech sample for each twin: warmth and negativity.

Warmth is a global measure of the whole speech sample and was assessed by the tone of voice, spontaneity, sympathy and/or empathy towards the child. Warmth was coded on a six-point scale. (5) High warmth and (4) moderately high warmth were coded when there was a definite warmth, enthusiasm, interest in and enjoyment of the child. For example, 'She is a delight, she is so happy, I love taking her out, she is my ray of sunshine.' (3) Moderate warmth was coded when there was definite understanding, sympathy and concern but only limited warmth of tone. For example, 'I worried about her when she went to school, I thought she may have difficulty in mixing and I felt sorry for her.' (2) Some warmth was coded when there was a detached rather clinical approach with little or no warmth of tone, but moderate understanding, sympathy and concern. (1) Very little warmth was rated when there was only a slight amount of understanding, sympathy or concern or enthusiasm about or interest in the person. (0) No warmth was reserved for respondents who showed a complete absence of the qualities of warmth as defined. The inter-rater agreement rate was $r = .90$.

Negativity is a global measure of the whole speech sample and was also coded on a six-point scale. (0) No negativity was coded when the mother made no negative comments about the child. (1) A little negativity was coded when the mother made one minor criticism such as 'She can be a bully.' (2) Some negativity was coded when the mother made two criticisms that were stronger in tone than the former rating. (3) Negative – some dissatisfaction was coded when the mother repeatedly mentioned one or two particular traits of the child that she did not like and wished to change. For example, 'She is not very clever, I wish she would try more like her sister.' (4) Negative – makes disparaging remarks and finds fault with the child was coded when the mother had very little good to say about her child, and found fault in almost everything he/she did. (5) Resentful and hostile was coded when the mother gave the impression that she actively disliked the child. For example, 'I wish I had never had

her, I hate her.' The inter-rater agreement rate for negativity was $r = .84$.

Children's behaviour. Children's *externalising and internalising problems* were assessed with the Achenbach family of instruments: The Child Behaviour Checklist (CBCL; Achenbach, 1991a) and the Teacher Report Form (TRF; Achenbach, 1991b), respectively. The externalising syndrome reported in this article is the sum of items in the Delinquent Behaviour and Aggressive Behaviour scales; the internal consistency reliabilities of the parent and teacher reports of externalising problems were .88 and .93, respectively. The internalising syndrome reported in this article is the sum of items in the Withdrawn, Somatic Complaints, and Anxious/Depressed scales; the internal consistency reliabilities of the parent and teacher reports of internalising problems were .83 and .84, respectively.

Children's hyperactivity was measured with 17 items from the Rutter Child Scales (Sclare, 1997) and supplemented with items concerning inattention, impulsivity, and hyperactivity derived from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) diagnostic criteria for Attention Deficit Disorder (e.g., 'cannot settle to anything for more than a few moments, quickly moves from one thing to another', and 'fidgety or squirmy'). The internal consistency reliabilities of the parent and teacher reports were .88 and .94, respectively.

Children's *prosocial behaviour* was measured with 10 items from the Revised Rutter Scale for School-Age Children (Sclare, 1997; Goodman, 1994), including items such as 'tries to be fair in games' and 'considerate of other people's feelings'. Parents and teachers each rated the items as not true (0), somewhat or sometimes true (1), or very true or often true (2). The internal consistency reliabilities of the parent and teacher reports were .73 and .92, respectively.

Data analysis

To compare the combined IVF/OI group with the NC group on measures of family adjustment, parenting and child behaviour, independent samples *t*-tests were performed on all measures except maternal depression. Chi-square analyses were used to compare the proportion of mothers who reported depression in the two groups.

Statistical analyses of data about the study children (e.g., measures of child-specific parenting and measures of the twins' behaviour) was complicated by the fact that our twin study contained two children from each family, leading to non-independent observations. As such, we analysed data about the study children using standard regression techniques but with all tests based on the sandwich variance estimator, a method which is available in the statistical package STATA 6.0 (StataCorp, 1999). Application of this technique allows for the relaxation of the assumption of independence of observations by penalising estimated standard errors and therefore accounting for the dependence in the data due to analysing sets of twins.

Results

Table 2 shows the means, standard deviations and *t* values for the parental adjustment, parenting and child behaviour measures for the combined IVF/OI group and NC group.

No significant differences between the two groups were identified on any measure of parental adjustment. For measures of parenting, the only significant difference between the groups was obtained for mothers' reports of inconsistency with partner over discipline. NC mothers reported significantly more inconsistency with partner over discipline than IVF/OI mothers. No significant differences were found between the two groups on any parent-rated or teacher-rated measure of child behaviour.

In order to ascertain whether or not there were any differences between the IVF, OI and NC groups separately on all measures, additional analyses were performed but not reported here in detail. Using analysis of variance for independent variables and chi-square analyses for categorical variables, the only significant difference between the groups was again found for mothers' ratings of inconsistency with partner over discipline. Post-hoc comparisons revealed that mothers in the NC group reported higher levels of inconsistency with their partner over discipline than mothers in the IVF group, but mothers' mean scores in the NC group were not significantly different to mothers in the OI group. No significant differences were found between the three groups for any other measure of parenting, parental adjustment or parent and teacher ratings of child behaviour.

Discussion

The findings of the present study do not support the hypotheses that families with twins conceived after IVF/OI would show poorer outcomes than families with twins conceived naturally. In fact, the findings indicate that families of twins conceived after IVF/OI have similar parenting styles and maternal adjustment when compared with families of twins conceived naturally. In addition, children conceived after IVF/OI do not differ from NC children in terms of their behaviour, whether reported by mothers or teachers. The results of this study are reassuring for professionals, parents and couples considering IVF/OI and indicate that the experience of infertility and undergoing fertility treatment does not have any long-term negative consequences for mothers, children or mother-child relationships.

This study aimed to avoid the methodological problems associated with previous research into IVF and family functioning in families with twins. It is the first study to include a population-based sample of IVF/OI families rather than families selected from specific fertility clinics. Therefore, it is less likely that there are selection biases operating in this study when compared to previous studies. As far as the authors are aware, this is also the largest study on IVF/OI to be done with twins and it is the first to use a control group that has been matched on several potentially confounding child and family variables. Finally, the present study interviewed mothers in their homes, rather than using postal questionnaires, and used state-of-the-art measurement of parent and child functioning

Table 2 Means, standard deviations, *t*-values and significance levels for differences between the IVF/OI and NC groups on measures of parental adjustment, parenting and children's behaviour

Variable	NC group Mean (SD)	IVF/OI group Mean (SD)	<i>t</i> value	<i>P</i> value
Parental adjustment ^a				
Quality of relationship	22.87 (5.29)	23.35 (4.49)	.73	.46
Quarrelling	5.01 (2.79)	4.75 (2.65)	-.73	.47
Partner violence	2.09 (4.46)	1.79 (3.82)	-.55	.58
Social support	15.64 (5.59)	15.05 (4.76)	-.79	.43
Depression	61 (52.1%)	56 (47.9%)	.34	.33
Parenting ^b				
Inconsistency in discipline	2.11 (1.57)	1.58 (1.26)	-2.76	.01
Use of physical discipline	1.66 (0.81)	1.61 (0.74)	.60	.55
Maternal warmth - EE	3.35 (0.88)	3.27 (0.88)	.76	.45
Maternal negativity - EE	1.42 (0.87)	1.37 (0.94)	.57	.57
Child behaviour - parent ^b				
Externalising behaviour	11.76 (7.95)	11.07 (8.85)	.77	.44
Internalising behaviour	8.93 (6.58)	7.97 (5.98)	1.49	.14
ADHD scale	10.61 (7.11)	9.72 (7.82)	1.30	.20
Prosocial behaviour	16.47 (3.18)	16.15 (3.51)	.90	.37
Child behaviour - teacher ^b				
Externalising behaviour	4.33 (6.17)	4.66 (8.05)	-.41	.68
Internalising behaviour	5.82 (5.94)	6.86 (6.36)	-1.66	.10
ADHD scale	4.66 (6.13)	5.02 (6.89)	-.49	.62
Prosocial behaviour	12.06 (4.77)	12.49 (4.75)	-.77	.44

^a *n* = 242 (121 IVF and 121 NC/OI) - one score for each family included in *t*-tests.

^b *n* = 484 (242 IVF and 242 NC/OI) - scores for each twin included in *t*-tests.

Note. Depression is a categorical variable. The number and percentage of mothers who experienced depression are reported in the table along with the chi-square value.

across different domains and raters (parent and teachers).

The findings of the present study with IVF/OI families of twins are similar to many studies with singletons, suggesting that the effects of IVF/OI are no greater in families of twins. As there is some evidence that parents of naturally conceived twins may experience greater stress, depression and marital difficulties when compared with families of naturally conceived singletons (Thorpe et al., 1991), researchers assume that the demands of twins can lead to adjustment problems for families. However, it is possible that the experience of IVF/OI is a protective factor for coping with twins. In other words, parents' knowledge of the increased risk of multiple births due to assisted conception (Gleicher et al., 1995) and their strong desire to have children may result in very positive attitudes towards twins and enhanced coping skills to deal with the demands of twins. In support of this, Leiblum, Kemmann, and Taska (1990) reported that infertile women showed significantly more positive attitudes towards multiple gestation when compared with fertile women. However, there is presently no evidence to demonstrate that a positive attitude towards twins at pre-conception leads to greater resilience after twins are conceived and born.

The present study found no differences between IVF/OI families and NC families in terms of use of physical discipline and expressed warmth and negativity towards their twins. This is the first study to compare mothers' use of physical discipline and expressed negativity in families who conceive naturally or after assisted conception and indicates that the experience of infertility and undergoing assisted conception does not result in greater maternal negativity, either physical or emotional. The finding that IVF/OI mothers did not differ from NC mothers in levels of warmth towards their twins supports Cook's (1998) small study with parents of IVF twins. However, there are a number of studies with singletons that have found that IVF families show greater warmth towards their child when compared with NC families (Golombok et al., in press, 1996; Hahn & Pietro, 2001; van Balen, 1996). It is possible that parents of twins conceived after IVF do not show enhanced levels of warmth that are observed in parents of singletons because they are required to share their feelings of warmth between two children.

There were no significant differences between the IVF/OI and NC twins in their internalising, externalising, hyperactive or prosocial behaviour whether rated by parents or teachers. This finding is not surprising given that no differences between the groups were identified for measures of parenting or parental adjustment. The findings of the present study support previous studies with twins (Cook et al., 1998) and singletons (Golombok et al., in press, 1996; Golombok, Cook, Bish, & Murray,

1995; Hahn & Pietro, 2001; van Balen, 1996). However, they do not support the findings of two other studies (Gibson et al., 1998; Levy-Shiff et al., 1998) which found higher levels of behaviour problems in IVF children compared with NC children. While it is likely that conflicting results of these studies reflect different methodologies, it is also possible that cultural factors may mediate the effects of infertility and assisted conception on parenting and children's behaviour (Hahn & DiPietro, 2001). Different countries throughout the world have different eligibility criteria and costs for IVF, as well as different cultural expectations regarding child bearing, so it is imperative to consider cultural factors when interpreting the results of assisted conception studies. Notwithstanding the need to investigate these cultural factors further, the present study demonstrates that twins conceived following IVF and OI are functioning well in both the home and school environments at 5 years of age.

The present study found only one significant difference between IVF/OI families and NC families. IVF/OI mothers reported lower levels of inconsistency with their partner over discipline when compared with NC mothers. While it is possible that this finding may be due to chance given the number of statistical analyses that were performed, it is also possible that couples who have experienced IVF/OI are better at discussing and agreeing upon parenting issues, due to their strong desire to have children. Alternatively, IVF/OI fathers may simply be more involved in and committed to the task of parenting their twins than NC fathers. It is interesting to find that no differences were observed on measures of partner support, intimacy, and conflict (physical or verbal), which indicates that IVF/OI parents of twins do not have a better partner relationship overall when compared with NC parents of twins.

While the present study found no negative outcomes for families who conceive after IVF/OI, it is possible that the long-term effects of infertility and fertility treatment are mediated by other factors that were not assessed in the present study. For example, couples who have had long-term fertility problems and have undergone several fertility treatments may be more likely to experience difficulties in the transition to parenthood than couples who have conceived after a brief period of infertility. Future research should collect information about the duration and experience of infertility in order to elucidate possible mediating factors. As there is evidence that infertility is stressful for couples at least in the short term, it may be helpful for clinicians delivering parenting interventions to request information about the child's mode of conception and the parents' experience of infertility and fertility treatment. For some families, this information may provide clinicians with a better understanding about factors affecting parenting and children's behaviour.

There are two important limitations that must be kept in mind when interpreting the results of the study. First, we did not ask the IVF mothers about donated gametes, so we are unaware of the exact genetic relationship between the twins and their parents in this study. While it is important to obtain this information in future studies in order to accurately describe the sample, previous research has found that assisted conception using gamete donation does not result in poorer outcomes for families or children (Golombok et al., 1995). Second, we interviewed only mothers and did not have the opportunity to interview fathers. Some studies have found different results for IVF fathers of singletons versus NC fathers of singletons, but not for mothers on the same measures (Cook et al., 1998). Therefore, it is possible that parenting and parental adjustment of fathers of IVF and OI twins may be different when compared with fathers of NC twins. It is imperative that future research into the effects of assisted conception on parenting and child behaviour includes measures for both mothers and fathers.

Conclusion

In summary, this study found no evidence to suggest that families who conceived their twins via IVF or OI had any more difficulties in terms of parenting, maternal adjustment and child behaviour problems when compared with NC families. While some researchers have recommended that families who conceive their children via assisted conception should be provided with additional help and support to assist them in their transition to parenthood, we found no evidence to support this recommendation. The findings of the present study should reassure parents, researchers and fertility experts that families who conceive twins via IVF and OI function well and appear to suffer no adverse effects as a result of their experience of infertility. Given that 1 in 6 couples have fertility problems and that an increasing number of children, especially twins, are conceived via assisted conception, this area of research is an important one and deserves continued investigation.

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References

- Achenbach, T.M. (1991a). *Manual for the child behaviour checklist/4-18 and 1991 profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Achenbach, T.M. (1991b). *Manual for the teacher's report form and 1991 profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Alin-Akerman, B.A., & Fischbein, S. (1990). Twins: are they are risk? A longitudinal study of twins and nontwins from birth to 18 years of age. *Acta Geneticae Medicae et Gemellologiae*, 40, 29–40.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th edn). Washington, DC: Author.
- Barnes-McGuire, J., & Earls, F. (1994). The test retest stability of the five minute speech sample in parents of disadvantaged minority children. *Journal of Child Psychology and Psychiatry*, 35, 971–979.
- Bernstein, J. (1990). Parenting after infertility. *Journal of Perinatal Neonatal Nursing*, 4, 11–23.
- Bernstein, J., & Mattox, J.H. (1982). An overview of infertility. *Journal of Obstetric, Gynaecologic, and Neonatal Nursing*, 9–10, 309–314.
- Bernstein, J., Mattox, J.H., & Kellner, R. (1988). Psychological status of previously infertile couples after a successful pregnancy. *Journal of Obstetric Gynaecological Neonatal Nursing*, 14, 404–408.
- Botting, B.J., MacFarlane, A.J., & Price, F.V. (1990). *Three, four and more. A study of triplet and higher order births*. London: HMSO.
- Caspi, A., Moffitt, T.E., Thornton, A., Freedman, D., Amell, J.W., Harrington, H.L., Smeijers, J., & Silva, P.A. (1996). The life history calendar: A research and clinical assessment method for collecting retrospective event-history data. *International Journal of Methods in Psychiatric Research*, 6, 101–114.
- Cook, R., Bradley, S., & Golombok, S. (1998). A preliminary study of parental stress and child behaviour in families with twins conceived by in-vitro fertilisation. *Human Reproduction*, 13, 3244–3246.
- Cook, R., Parsons, J., Mason B., & Golombok, S. (1989). Emotional, marital and sexual functioning in patients embarking on IVF and AID treatment for infertility. *Journal of Reproductive and Infant Psychology*, 7, 87–93.
- Colpin, H., DeMunter, A., Nys, K., & Vandemeulebroecke. (1999). Parenting stress and psychosocial well-being among parents with twins conceived naturally or by reproductive technology. *Human Reproduction*, 14, 3133–3137.
- Cowan, C.P., & Cowan, P.A. (1992). *When partners become parents*. New York: Basic Books.
- Dale, P.S., Simonoff, E., Bishop, D.V.M., Eley, T.C., Oliver, B., Price, T.S., Purcell, S., Stevenson, R., & Plomin, R. (1998). Genetic influence of language delay

- in two-year-old children. *Nature Neuroscience*, 1, 324–328.
- Daley, B.M., Sonuga-Barke, E.J.S., & Thompson, M. (in press). Assessing expressed emotion in preschool: The psychometric properties of a modified speech sample in a clinical group. *British Journal of Clinical Psychology*.
- Dodge, K.A., Petit, G.S., & Bates, J.E. (1994). Effects of physical maltreatment on the development of peer relations. *Development and Psychopathology*, 6, 43–55.
- Fincham, F. (1998). Child development and marital relations. *Child Development*, 69, 543–574.
- Gibson, F.L., Ungerer, J.A., Leslie, G.I., Saunders, D.M., & Tennant, C.C. (1998). Development, behavior and temperament: A prospective study of infants conceived through in-vitro fertilization. *Human Reproduction*, 13, 1727–1732.
- Gleicher, N., Campbell, D.P., Chan, C.L., Karande, V., Rao, R., Balin, M., & Pratt, D. (1995). The desire for multiple births in couples with infertility problems contradicts present practice patterns. *Human Reproduction*, 10, 1079–1084.
- Goodman, R. (1994). A modified version of the Rutter Parent Questionnaire including extra items on children's strengths: A research note. *Journal of Child Psychology and Psychiatry*, 35, 1483–1494.
- Golombok, S., Brewaeys, A., Giavazzi, M.T., Guerra, D., MacCallum, R., & Rust, J. (in press). The European study of assisted reproduction families: The transition to adolescence. *Human Reproduction*.
- Golombok, S., Brewaeys, A., Cook, R., Giavazzi, M.T., Guerra, D., Mantovani, A., van Hall, E., Crosignani, P.G., & Dexeus, S. (1996). The European study of assisted reproduction families: Family functioning and child development. *Human Reproduction*, 10, 2324–2331.
- Golombok, S., Cook, R., Bish, A., & Murray, C. (1995). Families created by the New Reproductive Technologies: Quality of parenting and social and emotional development of the children. *Child Development*, 66, 285–298.
- Hahn, C., & DiPetro, J. A. (2001). In vitro fertilisation and the family: Quality of parenting, family functioning, and child psychosocial adjustment. *Developmental Psychology*, 37, 37–48.
- Halasz, G., Munro, J., Saunders, K., Astbury, J., & Spensley, J. (1993). *The growth and development of children conceived by IVF*. Report to Commonwealth Department of Health, Housing, Local Government and Community Services, Research and Development Grants Advisory Committee, and Victorian Health Promotion Foundation.
- Human Fertilisation and Embryology Authority. (1996). *Fifth Annual Report – July 1996*. Annex 3.
- Leiblum, S.R. (1997). Introduction. In S.R. Leiblum (Ed.), *Infertility: Psychological issues and counseling strategies* (pp. 3–19). New York: Wiley.
- Leiblum, S.R., Kemmann, E., & Taska, L. (1990). Attitudes towards multiple births and pregnancy concerns in infertile and non-infertile women. *Journal of Psychosomatic Obstetrics and Gynaecology*, 11, 197–210.
- Levy-Shiff, R., Vakil, E., Dimitrovksy, L., Abramovitz, M., Shahar, N., Har-Even, D., Gross, S., Lerman, M., Levy, I., Sirota, L., & Fish, B. (1998). Medical, cognitive, emotional, and behavioral outcomes in school-age children conceived by in-vitro fertilization. *Journal of Clinical Child Psychology*, 27, 320–329.
- Lind, R., Pruitt, R.L., & Greenfeld, D. (1989). Previously infertile couples and the newborn intensive care unit. *Health and Social Work*, 14, 127–133.
- Magana, A.B., Goldstein, M.J., Karno, M., Miklowitz, D., Jenkins, J., & Falloon, I.F. (1986). A brief method for assessing expressed emotion in relatives of schizophrenic patients. *Psychiatry Research*, 17, 203–212.
- McMahon, C.A., Ungerer, J.A., Beaurepaire, J., Tennant, C., & Saunders, D. (1995). Psychosocial outcomes for parents and children after in vitro fertilization: A review. *Journal of Reproductive and Infant Psychology*, 13, 1–16.
- Moffitt, T.E., & The E-risk Study Team. (2002). Contemporary teen-aged mothers in Britain. *Journal of Child Psychology and Psychiatry*, 43, 727–742.
- Moffitt, T.E., Caspi, A., Krueger, R.F., Magdol, L., Margolin, G., Silva, P.A., & Sydney, R. (1997). Do partners agree about abuse in their relationship? A psychometric evaluation of interpartner agreement. *Psychological Assessment*, 9, 47–5.
- Munro, J.M., Ironside, W., & Smith, G.C. (1992). Successful parents of in vitro fertilization (IVF): The social repercussions. *Journal of Assisted Reproduction and Genetics*, 9, 170–176.
- Office of Population Censuses and Surveys. (1991). *Standard Occupational Classification (vols 1–3)*. London: HMSO.
- Patterson, G.R. (1982). *Coercive family process*. Eugene, OR: Castalia.
- Patterson, G.R. (1983) Stress: A change agent for family process. In N.Garmezy & M. Rutter (Eds.), *Stress, coping and development in children* (pp. 235–264). New York: McGraw-Hill.
- Rietveld, M.J.H., der Valk, J.C., Bongers, I.L., Stroet, T.M., Slagboom, P.E., & Boomsma, D.I. (2000). Zygosity diagnosis in young twins by parental report. *Twin Research*, 3, 134–141.
- Robins, L.N., Cottler, L., Bucholz, K., & Compton, W. (1995). *Diagnostic Interview Schedule for DSM-IV*. St. Louis, Washington University Press.
- Rogosch, F.A., Cicchetti, D., Shields, A., & Toth, S.L. (1995) Parenting dysfunction in child maltreatment. In M. Bornstein (Ed.), *Handbook of parenting (volume 4), Applied and practical parenting* (pp. 127–157). New Jersey: Lawrence Erlbaum Associates.
- Sclare, I. (1997). *The child psychology portfolio*. Windsor, Berkshire: NFER-Nelson Publishing Company.
- Simons, R.L., & Johnson, C. (1996). The impact of marital and social network support on quality of parenting. In G.R. Pierce, B.R. Sarason, & I.G. Sarason (Eds.), *Handbook of social support and the family* (pp. 269–287). New York: Plenum Press.
- StataCorp (1999). *Stata statistical software: Release 6.0*. College Station, TX: Stata Corporation.
- Straus, M.A. (1990). Measuring intrafamily conflict and violence: The Conflict Tactics (CT) Scales. In M.A. Straus & R.J. Gelles (Eds.), *Physical violence in American families: Risk factors and adaptations to violence in 8,145 families* (pp. 403–424). New Jersey: Transaction.

- Thorpe, K., Golding, J., MacGillivray, I.M., & Greenwood, R. (1991). Comparison of prevalence of depression in mothers of twins and mothers of singletons. *British Medical Journal*, *302*, 875–878.
- van Balen, F. (1996). Child-rearing following in vitro fertilization. *Journal of Child Psychology and Psychiatry*, *37*, 687–693.
- Vaughn, B.E., Block, J.H., & Block, J. (1988). Parental agreement on child rearing during early childhood and the psychological characteristics of adolescents. *Child Development*, *59*, 1020–1033.
- Weaver, S.M., Clifford, E., Gordon, A.G., Hay, D.M., & Robinson, J. (1993). A follow-up study of 'successful' IVF/GIFT couples: Social-emotional well-being and adjustment to parenthood. *Journal of Psychosomatic Obstetrics and Gynaecology*, *14*, 5–16.

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