Behavioral and cognitive development as well as family functioning of twins conceived by assisted reproduction: findings from a large population study

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Objective: To establish the nature and extent of difficulties in parenting and child development in families with twins conceived by assisted reproduction.

Design: Comparisons were carried out between a representative sample of 344 families with 2- to 5-year-old twins conceived by IVF/intracytoplasmic sperm injection (ICSI) and a matched comparison group of 344 families with singletons from IVF/ICSI. One twin was randomly selected for data analysis to avoid the bias associated with nonindependence of measures.

Setting: A general population sample of IVF/ICSI families.

Patient(s): Mothers and children.

Intervention(s): Mothers completed a questionnaire booklet.

Main Outcome Measure(s): Standardized measures of the mother's psychological well-being (parenting stress, depression, and quality of marriage) and standardized measures of the child's psychological development (emotional/behavioral problems and cognitive development).

Result(s): Mothers of twins showed significantly higher levels of parenting stress and depression than mothers of singletons and were significantly more likely to find parenting difficult and significantly less likely to obtain pleasure from their child. Regarding the children, there was no difference in the level of emotional or behavioral problems between twins and singletons. However, twins showed significantly lower levels of cognitive functioning.

Conclusion(s): Greater difficulties in parenting and child development were experienced by IVF/ICSI families with twins than by IVF/ICSI families with singletons. (Fertil Steril® 2005;84:725–33. ©2005 by American Society for Reproductive Medicine.)

Key Words: Twins, IVF/ICSI, parenting, child development

There has been growing concern in recent years about the escalating multiple birth rate arising from the increasing use of assisted reproduction procedures (1). In Europe, for example, 26.2% of births after IVF and intracytoplasmic sperm injection (ICSI) treatments in 1999 produced twins or triplets (2), and the multiple delivery rate was 26.4% for treatments initiated in 2000 (3). In the most recent report on assisted reproductive technologies in the United States, the incidence of multiple pregnancies was 42%, with 53% of children born in this way originating from IVF (4). This contrasts sharply with the multiple birth rate for naturally conceived pregnancies of around 1% (5). The problem is greatest in developing and newly industrialized regions such as Latin America, where the multiple birth rate for assisted reproduction pregnancies in 2000 was 50%, with over 13.5% of IVF and ICSI births involving triplets or quadruplets (6).

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A major effort has been made to reduce triplet pregnancies in European countries and also, to a lesser extent, in the United States (7). However, the incidence of twins remains very high and represents a clear public health concern (8). The risks associated with multiple births in terms of perinatal mortality, neonatal problems, and disability are high and have been well documented both for naturally conceived (9) and assisted reproduction children (10), and despite their lower overall rate of prematurity, twin pregnancies are the major contributors to severe prematurity (11). However, less is known about the consequences of multiple births for parent-child relationships or the psychological development of children as they grow up, and this is especially true of those born as a result of IVF and ICSI procedures.

Studies of naturally conceived twins have shown that parents of twins are faced with many stressors that can have a negative impact on family relationships (12). Raising two children of the same age places huge demands on parents' time, often resulting in exhaustion, lack of personal time, depression, and financial difficulties (13–15). As a consequence, twins have less involvement with their parents than do singleton children. In a study that observed the interac-

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tions of twins and singletons with their parents (16), it was found that twins experienced fewer verbal interchanges with their parents, less praise, and fewer overt expressions of affection because of the greater pressure on twins' parents' time.

With respect to the psychological well-being of the children themselves, it has been suggested that the lower levels of interaction with parents experienced by twins may have an adverse effect on both socioemotional and cognitive development. Regarding socioemotional development, it has been predicted that twins will be less likely to become securely attached to their mother and thus more at risk for psychological problems as they grow up (12). From the perspective of attachment theory, mothers who are sensitive to, and respond appropriately to, their infants are more likely to have securely attached infants (17, 18). Thus the greater pressure placed on mothers of twins may interfere with this process. In a study of the security of attachment of twins (19, 20), it was found that twins were no more likely than singletons to be insecurely attached. However, some twins were classified as "marginally secure," and mothers of these twins obtained lower ratings of responsiveness and sensitivity. In terms of psychological disorder, studies of general population samples have found no differences in emotional or behavioral problems between twins and singletons apart from a higher rate of attention problems in twins (21, 22).

The situation is somewhat different with respect to cognitive and language development. In comparison with singletons, twins have consistently been found to show delayed language development and to obtain lower scores on verbal intelligence and reading tests (12, 23, 24). A recent study of a general population sample found that the language development of twins at age 3 years was 3 months behind that of singleton children after excluding the most premature twins and those with neurological damage and after adjusting for the gestational age of the twins at birth (25). As the language delay was found in nonhandicapped children and because the study took account of the twins' shorter gestation, it was concluded that the language delay was not a result of diagnosable brain damage or biological immaturity but instead reflected a real difference in language development between twins and singleton children.

The reason for the impairment in cognitive and language development shown by twins has been the subject of much debate. Whereas there is some evidence that prenatal and perinatal factors may be involved (12, 26), detailed information on obstetric and perinatal complications was obtained (25) and was not found to account for the slower language and cognitive development of twins. In contrast, differences in the quantity and quality of mother-child interaction between families with twins and families with singletons were shown to be important (25). The mothers of twins were compared with mothers of singletons with an older sibling of a similar age, thus controlling for the number of children present during the observed interaction. It was found that the mothers of twins were less responsive, less involved, and less likely to engage in an elaborated interaction with their children than were the mothers of singletons, and these differences in style of interaction were associated with the delay in language and cognitive development shown by twins.

Although much can be learned from existing studies of families with naturally conceived twins, parents who conceive their twins through IVF or ICSI differ in ways that may impact on outcomes for parenting and child development. First, they may be more accepting of a multiple birth. Although couples undergoing assisted reproduction may not fully acknowledge the possibility of a multiple birth, they will certainly have considered this outcome and made a decision to proceed. When embarking on assisted reproduction, the idea of having a multiple birth often appears preferable to childlessness. It has been found that 67% of infertile couples actively wished to have twins (27), and in a recent study it was reported that 94% of women attending a fertility clinic preferred twins as their treatment outcome (28). The prospect of twins is often viewed positively as a way of completing their family without the need for further stressful, risky, and expensive treatment (27, 29, 30). Second, parents of singletons conceived by assisted reproduction are more involved with their children than are their counterparts with naturally conceived children (31, 32, 33), and parents of twins conceived by assisted reproduction may similarly be more involved with their twin children than are parents who conceived their twins naturally and unexpectedly. To the extent that IVF/ICSI parents are more accepting of, and more involved with, their twins, fewer adverse effects may be predicted for parent-child relationships and children's psychological development.

The few existing studies of parenting in families with twins conceived by assisted reproduction have pointed to greater parenting difficulties than among parents of singleton children conceived by assisted reproduction (34, 35, 36). However, the samples studied were small, the focus was narrow, and no data were obtained on the consequences for children's psychological development. In the only study to focus on child development, the cognitive development of 24- to 28-month-old IVF/ICSI twins was compared with that of IVF/ICSI singletons using the Bayley Scales of Infant Development (37), and it was found that the twins obtained significantly lower scores than the singletons (38), although only 12% of the initial sample was assessed. The aim of the present investigation was to establish the nature and extent of difficulties in parenting and children's behavioral and cognitive development in a large representative sample of assisted reproduction families with twins in comparison with a matched group of assisted reproduction families with singletons.

MATERIALS AND METHODS

Participants

The families were recruited from Follow-Up, a national organization in France that was established to follow up

children conceived by assisted reproduction. At the time of study, the Follow-Up database included more than 10,000 families recruited from 18 IVF clinics with a cooperation rate of more than 95% and thus provided a highly representative sample of assisted reproduction families. The 12 clinics that had been participating for long enough to have children in the required age range were asked to take part in the present investigation. Of these, 10 clinics participated. One of the 12 clinics declined to take part, and the other had an insufficient number of children of the required age.

All 488 IVF/ICSI families with twins born between July 1, 1998, and June 30, 2001, were invited to participate in the study in July 2003 to produce a sample of families with children aged 2–5 years old. Of the 426 families who could be traced, that is, whose questionnaire booklet was not returned because of an incorrect mailing address, 367 took part, representing a response rate of 86%. A comparison group of 1,143 IVF/ICSI families with singletons born between July 1, 1998, and June 30, 2001, were also invited to take part. These families were selected randomly from the database at an approximate ratio of two families for every twin family so that the total number of singleton children recruited to the study would be similar to the total number of twin children. Of the 1,100 families who could be traced, 958 participated in the investigation, representing a response rate of 87%. The families with twins and the families with singletons will be referred to as "twin families" and "singleton families," respectively, for the sake of simplicity, although many of the target children in each family type had older and/or younger siblings. Ethical approval for the study was obtained from the Scientific Committee of Follow-Up, which served as an Institutional Review Board.

In 21 of the twin families, one twin had a disability, and in a further two twin families, both twins were disabled. In the singleton families, 21 of the target children had a disability. All of these families were excluded from the analyses to avoid the potentially confounding effect of the child's disability on the outcome measures. The remaining 344 twin families were then matched to 344 of the singleton families on the basis of stratification according to the age of the child in months and the child's sex. In the twin families, one twin was randomly selected for data analysis to avoid the bias associated with nonindependence of measures.

As shown in Table 1, the age of the children did not differ between groups and there were similar proportions of boys and girls in the two family types. In addition, there was no difference in the educational level of the families as assessed by the father's or the mother's highest qualification. There was a significant group difference in the age of the mothers ($t = 2.82$, $P<.01$). The mothers of singletons were older, with a mean age of 36.9 years, whereas the mothers of twins had a mean age of 36.0 years. There was also a significant difference between groups for number of siblings ($\chi^2 = 55.01$, $P<.001$), reflecting a higher proportion of singleton children with siblings than twins. As significant differences between twin families and singleton families were found for mother's age and number of siblings in the family, these variables were entered into the statistical analyses as covariates.

Measures

A questionnaire booklet comprising structured questions on demographic and family characteristics, standardized measures of the mother's psychological well-being (parenting stress, depression, and quality of marriage), and standardized measures of the child's psychological development (emotional/behavioral problems and cognitive development) was sent to mothers by mail. Those mothers who had not returned the questionnaire booklet within 1 month received a reminder letter with a new questionnaire booklet.

Mothers' Psychological Well-Being. The short form (36 items) of the Parenting Stress Index (PSI/SF) (39) was used to assess stress associated with parenting. The PSI/SF produces a total score, with higher scores reflecting greater parenting stress, as well as subscale scores of parental distress, parent-child difficult interaction, and difficult child. A total score of 86 or above represents the 85th percentile. Test-retest reliability is .96 over a 1–3 month interval and .65 over 1 year. Concurrent and predictive validity have been demonstrated for the full-length questionnaire, and the short form has been reported to correlate very highly with the full-length version.

The Edinburgh Depression Scale (40) was used to assess depression. This 10-item instrument, for which a higher total score represents greater depression, has good reliability and discriminates between clinical and nonclinical groups. A score of 10 or more indicates possible depression. The 10-item short form of the Golombok Rust Inventory of Marital State (GRIMS) (41, 42) was administered to assess the quality of the marital relationship, with a higher total score representing poorer marital quality. Split-half reliability for the GRIMS is .87, and the GRIMS has been shown to discriminate significantly between couples who are about to separate and those who are not. In the present study, two additional items adapted from the Golombok Rust Inventory of Sexual Satisfaction (GRISS) (43) were included to assess sexual desire ("I am not interested in sex") and the frequency of sexual intercourse ("Since the birth of our child/ren we have sex less frequently"), respectively. These items were scored individually with a higher score representing greater sexual problems.

Children's Psychological Development. The presence of behavioral or emotional problems in the child was measured using the 25-item Strengths and Difficulties Questionnaire (SDQ) (44, 45). The SDQ produces a total score as well as subscale scores of emotional problems, conduct problems, hyperactivity, peer problems, and prosocial behavior. This questionnaire has been shown to have good inter-rater and

TABLE 1

Sociodemographic information by family type.

	Singletons		Twins			
	Mean	SD	Mean	SD	*t*	*P*
Age of child (y)	3.45	.93	3.43	.89	0.33	NS
Age of mother (y)	36.93	4.14	36.06	3.92	2.82	<.01
Age of father (y)	39.75	6.21	38.95	5.63	1.76	NS
	N	%	N	%	χ^2	*P*
Child's sex						
Boy	186	54	186	54	0	NS
Girl	158	46	158	46		
Father's educational level						
Primary	7	2	8	2	5.12	NS
Intermediate	87	25	90	27		
Baccalauréat	29	9	44	13		
Higher education <2 y	51	15	54	16		
Higher education >2 y	168	49	144	42		
Mother's educational level						
Primary	8		3		8.09	NS
Intermediate	60		62			
Baccalauréat	42		43			
Higher education <2 y	66		88			
Higher education >2 y	167		138			
No. of siblings						
None	155	45	250	73	55.01	<.001
One	168	49	87	25		
Two	21	6	7	2		

Note: SD = standard deviation; NS = not significant.

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test-retest reliability and to discriminate well between children with and without psychiatric disorder.

The parental completion version of the Denver Developmental Screening Test (Denver II) (46, 47) was administered to provide an assessment of the child's cognitive functioning. The questionnaire comprised 20 items, of which 11 assessed language development (combines words, names one picture, body parts, points to four pictures, speech half-understandable, names four pictures, knows two actions, knows two adjectives, names one color, use of two objects, and counts one), three assessed gross motor skills (jumps up, broad jumps, and balances), three assessed fine motor skills (makes tower of eight cubes, imitates vertical line, and wiggles thumb), and three assessed personal/social skills (puts on clothing, washes and dries hands, and names friend). For each question, the mother reported whether or not her child was able to perform the task described, and a higher total score represented a higher level of cognitive ability. The Denver II items have been demonstrated to have satisfactory inter-rater and test-retest reliability and good validity at different ages. In the present investigation, internal consistency was found to be .90.

RESULTS

Group comparisons of the questionnaire scores were conducted using one-way analyses of covariance (ANCOVAs). For questionnaires that produced subscale scores, multivariate analyses of covariance (MANCOVAs) were used to correct for inflated significance. ANCOVAs were then performed on the individual subscale scores. The covariates were mother's age and number of siblings.

Mothers' Measures

As shown in Table 2, a significant difference between twin and singleton families was found for the mother's total score on the PSI ($F = 10.04$, $P<.01$), reflecting higher levels of parenting stress among the mothers of twins. The subscale scores of parental distress, parent-child difficult interaction, and difficult child were entered into a MANCOVA. Wilks's λ was

TABLE 2

Means, SD, F, and *P* values for comparisons of mothers' psychological well-being between family types.

	Singletons		Twins			
	Mean	SD	Mean	SD	*F*	*P*
PSI: total score	67.76	15.13	70.94	16.82	10.04	<.01
PSI: parental distress	24.29	7.05	26.71	7.92	26.14	<.001
PSI: dysfunctional interaction	17.98	4.57	18.25	4.62	.82	NS
PSI: difficult child	25.49	6.88	25.97	7.17	1.36	NS
Edinburgh Depression Scale	6.94	4.14	7.52	4.43	5.30	<.05
GRIMS	10.36	4.62	10.36	5.03	.01	NS
Interest in sex	2.29	.84	2.29	.85	.57	NS
Frequency of sex	2.37	.93	2.74	.94	26.56	<.001

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significant ($F = 10.34$, $P<.001$). One-way ANCOVAs showed a significant difference between family types for the parent distress subscale ($F = 26.14$, $P<.001$), indicating a higher level of parent distress among the mothers of twins than among the mothers of singletons. There was no group difference for the parent-child difficult interaction or the difficult child subscales.

A significant difference between groups was also found for the Edinburgh Depression Scale ($F = 5.30$, $P<.05$), with the mothers of twins experiencing higher levels of depression than the mothers of singletons. There was no difference in marital satisfaction between the mothers of twins and the mothers of singletons as assessed by the GRIMS. With respect to the sexual relationship, no difference was identified between mothers of twins and mothers of singletons in their level of interest in sex. However, the mothers of twins had sexual intercourse less frequently than did the mothers of singletons ($F = 26.56$, $P<.001$).

Children's Measures

There was no difference in the level of emotional or behavioral problems shown by twins and singletons as assessed by the total score of the SDQ, and there was no difference between family types in the proportion of children who obtained scores above cutoff for psychological disorder, with 10.7% of twins and 7.3% of singletons obtaining scores above cutoff. These proportions are in line with the expected rate of 10% for the general population and were not significantly different from each other. The subscale scores of emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial behavior were entered into a MANCOVA. Wilks's λ was not significant. One-way ANCOVAs showed no difference between family types for any of the individual subscales (see Table 3).

With respect to cognitive functioning as assessed by the Denver Developmental Questionnaire, a significant difference was found between groups ($F = 5.20$, $P<.05$), reflecting lower scores among the twins than among the singletons. The individual item scores were entered into a MANCOVA, and Wilks's λ was significant ($F = 2.94$, $P<.01$). One-way ANCOVAs showed a significant difference between twins and singletons for seven items, each reflecting lower scores, that is, poorer performance, among twins than among singletons. Of these seven items, four were language items: combines words ($F = 4.49$, $P<.05$), speech half-understandable ($F = 8.39$, $P<.01$), names four pictures ($F = 9.67$, $P<.01$), and counts one ($F = 4.09$, $P<.05$). Two were fine motor–adaptive items: imitates vertical line ($F = 4.06$, $P<.05$) and wiggles thumb ($F = 4.13$, $P<.05$). One was a personal-social item: names friend ($F = 16.10$, $P<.001$).

Experiences of Motherhood

In both twin and singleton families, the large majority of children (97%) lived with both parents. However, a significantly lower proportion of mothers of twins (59%) than mothers of singletons (77%) were in paid employment ($\chi^2 = 23.85$, $P<.001$). In terms of help with childcare, there was no difference between mothers of twins and mothers of singletons in the amount of assistance received from family members, with only 22% of mothers of twins and 19% of mothers of singletons receiving regular help. Of the families where the child had not yet started school, significantly fewer mothers of twins than mothers of singletons received paid help with childcare such as a daycare or nanny in the home ($F = 6.08$, $P<.05$) (see Table 4).

Regarding the mothers' experiences of parenting, a significantly higher proportion of mothers of twins than mothers of singletons found parenting difficult ($\chi^2 = 107.73$, $P<.001$), with only 12% of mothers of twins reporting no difficulties, compared with 33% of mothers of singletons. Similarly, there was a significant difference between mothers of twins and mothers of singletons in the amount of pleasure

TABLE 3

Means, SD, *F*, and *P* values for comparisons of children's psychological development between family types.

	Singletons		Twins			
	Mean	SD	Mean	SD	*F*	*P*
SDQ: total score	9.50	5.00	9.79	5.41	1.20	NS
SDQ: emotional problems	1.91	1.68	2.02	1.90	1.43	NS
SDQ: conduct problems	2.63	1.98	2.63	2.02	.34	NS
SDQ: hyperactivity	3.21	2.38	3.21	2.35	.02	NS
SDQ: peer problems	1.73	1.60	1.91	1.70	2.69	NS
SDQ: prosocial behavior	7.74	1.79	7.83	1.72	.02	NS
Denver II: total score	16.15	4.16	15.04	4.93	5.20	<.05
Language						
Combines words	.99	.09	.96	.19	4.49	<.05
Names one picture	.99	.12	.97	.17	2.08	NS
Body parts	.97	.16	.97	.17	.01	NS
Points to four pictures	.98	.15	.96	.20	3.46	NS
Speech half-understandable	.92	.26	.85	.36	8.39	<.01
Names four pictures	.95	.21	.89	.31	9.67	<.01
Knows two actions	.82	.38	.75	.43	2.40	NS
Knows two adjectives	.71	.45	.63	.48	1.46	NS
Names one color	.77	.41	.70	.45	1.77	NS
Use of two objects	.67	.46	.60	.49	2.12	NS
Counts one	.68	.46	.58	.49	4.09	<.05
Gross motor skills						
Jumps up	.85	.35	.84	.36	.01	NS
Broad jump	.66	.47	.59	.49	1.00	NS
Balances	.58	.49	.52	.50	.64	NS
Fine motor skills						
Makes tower of eight cubes	.88	.32	.85	.36	1.60	NS
Imitates vertical line	.60	.49	.49	.50	4.06	<.05
Wiggles thumb	.72	.45	.63	.48	4.13	<.05
Personal/social skills						
Puts on clothing	.88	.32	.85	.36	.06	NS
Washes and dries hands	.67	.47	.68	.46	2.36	NS
Names friend	.88	.32	.75	.43	16.10	<.001

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they obtained from their child ($\chi^2 = 20.91$, $P<.001$), with fewer mothers of twins (76%) than mothers of singletons (89%) reporting feelings of enormous pleasure. A significantly lower proportion of mothers with twins (32%) than mothers of singletons (48%) wished to have more children ($\chi^2 = 18.44$, $P<.001$).

DISCUSSION

In spite of the general acceptance of the possibility of having twins by couples embarking upon infertility treatment, the findings of the present study showed that the outcomes of a twin pregnancy for both parents and children were in line with those of families with naturally conceived twins in that greater difficulties were experienced by families with twins than families with singletons. The mothers of IVF/ICSI twins showed raised levels of stress associated with parenting and raised levels of depression in comparison with mothers of IVF/ICSI singletons. Interestingly, rearing twins did not appear to have a negative effect on the quality of the marital relationship, although sexual intercourse was less frequent among parents of twins than among their counterparts with a singleton child. In terms of their experiences of parenting, mothers of twins were less likely to receive help with childcare from their family, were less likely to have paid help with childcare, and were less likely to be employed than mothers of singletons, suggesting that mothers of twins are more likely to give up work to look after their children. In addition, mothers of twins found parenting more difficult

TABLE 4

Experiences of motherhood by family type.

	Singletons		Twins			
	N	%	N	%	χ^2	P
Mother working						
No	80	23	139	41	23.85	<.001
Yes	264	77	203	59		
Help from family						
None	95	28	97	28	2.89	NS
A little	31	9	40	12		
Occasional	151	44	132	38		
Regular	66	19	74	22		
Paid help preschool						
No	36	24	55	37	6.08	<.05
Yes	114	76	91	63		
Parenting difficulties						
None	114	33	42	12	107.7	<.001
No more than others	212	62	187	55		
More than others	14	4	99	29		
Many difficulties	2	1	14	4		
Pleasure from child						
None	0	0	1	0	20.91	<.001
A little	2	1	6	2		
A lot	34	10	74	22		
Enormous	304	89	262	76		
Wish for more children						
Yes	162	48	111	32		
Not sure	51	15	77	23	18.44	<.001
No	122	37	154	45		

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and obtained less pleasure from their children than did mothers of singletons. Although mothers of twins were less likely to want to increase their family, it is interesting to note that one-third did report a wish to have more children.

Regarding the psychological development of the children themselves, there was no evidence that the twins were more at risk for emotional or behavioral problems than were the singletons. This finding is consistent with previous studies of twins born in the absence of assisted reproduction techniques. However, the IVF/ICSI twins in the present study showed delayed cognitive development in comparison with the comparison group of IVF/ICSI singletons. This finding is of particular interest in view of earlier investigations of spontaneously conceived twins that showed a similar developmental delay, particularly in relation to language development (25), and replicates the findings of the only other study of the cognitive development of IVF/ICSI twins (38). In the present study, twins showed significantly poorer performance in one-third of the language items and in two-thirds of the items designed to assess fine motor skills. The significantly lower score for one of the personal/social items reflected the twins' greater difficulty in naming friends, a finding that is not surprising given the tendency of preschool twins to play with each other.

The delayed cognitive development shown by twins in the present investigation indicates that the greater desire for twins among couples embarking upon assisted reproduction does not ameliorate the cognitive impairment associated with being a twin. Although the mechanisms that result in delayed cognitive development in naturally conceived twins have not been fully established, the existing evidence suggests that reduced levels of mother-child interaction may be involved (25). Whereas it may be expected that mothers who conceive twins through assisted reproduction may be more involved with their children than are mothers who conceive twins naturally, the findings of the present study suggest that assisted reproduction twins, like naturally conceived twins, may experience less one-to-one interaction with their mother than their singleton counterparts, thus producing similar cognitive delay.

An alternative explanation is that biological factors may be involved. As discussed above, twins are more at risk than singletons for obstetric and perinatal problems (9). More-

over, IVF and ICSI procedures in combination with a multiple pregnancy may produce increased risks for the child possibly stemming from the infertility itself (10). Although these factors cannot be ruled out, a recent national cohort study in Denmark showed comparable neonatal outcomes between IVF/ICSI and naturally conceived twins (48), as did a systematic review of 25 controlled studies (49). Similarly, a comparison of parental adjustment, parenting, and child behavior between IVF twins and naturally conceived twins aged 5 years old found no additional problems associated with assisted reproduction (50). However, no data on children's cognitive development were obtained.

Whatever mechanisms are involved, the results of the present investigation indicate that preschool twins born as a result of IVF/ICSI are at a disadvantage in terms of cognitive development in comparison with preschool IVF/ICSI singletons. This is the first study to produce systematic data on the quality of parent-child relationships and the psychological development of children in a large sample of twins conceived by IVF/ICSI. The sample was highly representative because the families were recruited from the general population of assisted reproduction families and the response rate was high (86% and 87% for twins and singletons, respectively).

An advantage of the use of a large, general population sample was that the comparison group of IVF/ICSI families with singletons could be carefully matched to the target group. Moreover, the size of the target and comparison group samples provided sufficient statistical power to identify significant effects were they to exist. Although the large number of families and the large geographical area involved meant that it was not possible for assessments of children's development to be administered directly, the use of a measure designed for completion by mothers (47) produced findings that matched those of earlier investigations of spontaneously conceived twins as well as those of a sample of 24- to 28-month-old IVF/ICSI twins, thus increasing confidence in their validity. Direct testing of the children by qualified psychologists would be expected to identify even greater differences between twin and singleton samples.

It should be mentioned that some of the twins in the earlier investigations of naturally conceived twins many have been born as a result of assisted reproduction as the method of their conception was not reported. However, many of these studies were conducted before IVF, and especially ICSI, became widely available, and had some of these children been conceived by assisted reproduction this would not detract from the findings of the present investigation. A follow-up of the children in the present investigation will be of interest to establish whether the difference in cognitive development between twins and singletons persists over time.

A major policy issue in recent years has been the number of embryos that should be transferred in an IVF/ICSI cycle and whether regulation should be introduced to limit the number of embryos that may be transferred. As the ESHRE Task Force (51) has pointed out, the decision about the number of embryos to be transferred in IVF or ICSI cycles can lead to conflict between the professional autonomy of the physician, who has a responsibility toward the well-being of the prospective mother and her future children, and the reproductive autonomy of the prospective parents, who may request the transfer of a high number of embryos due to a strong desire for a child, the inability to pay for repeated IVF/ICSI cycles, and lack of information on the consequences of multiple births. A recent study in the United States has shown that the rate of multiple pregnancies after IVF has decreased as a result of fewer embryos being transferred (7). However, this decrease reflects a reduction in the number of triplet and higher-order births rather than a decrease in the number of twins.

By examining the experiences of parents and the socioemotional and cognitive development of children in IVF and ICSI families with twins, it is hoped that the findings of this study will inform the decision making of couples embarking on infertility treatment, as well as that of physicians, by providing them with a greater understanding of the psychological consequences of multiple births.

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