

Psychological adjustment in adolescents conceived by assisted reproduction techniques: A systematic review

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ABSTRACT

Background: Adolescence is a transitional time for identity formation and relationships with parents. While people born through assisted reproduction techniques (ART) appear to be well adjusted in childhood, it is unclear whether these findings carry into adolescence, and whether diverse ART have different psychological outcomes. This review summarizes what is known about the psychological adjustment and family relationships of the growing number of children born through ART who are reaching adolescence.

Methods: The Pubmed, Web of Knowledge, PsycINFO, and Scopus databases were searched systematically for peer reviewed papers focusing on adolescent psychological adjustment and parent-adolescent relationships in families created by ART. Key search inclusion criteria included all papers published in English relating to adolescents aged between 11 and 18 years.

Results: Seventeen publications with varied methodologies were identified by this review. Only papers relating to in vitro fertilization (IVF), egg donation and donor insemination were identified. Results were categorized according to ART that used the parents' own gametes (IVF) and those that involved reproductive donation (egg donation, and donor insemination). Compared to naturally conceived adolescents and standardized normative samples, adolescents born through all ARTs seemed to be equally well adjusted, and to have positive parent-adolescent relationships. Some differences were however identified based on the type of ART used. In particular, the sex of the parent and child, along with age and process of disclosure of the adolescent's conception were identified as key mediators of parent-adolescent relationships in families created by donor insemination.

Conclusions: The studies in this review indicate that children born through ART have positive parent-adolescent relationships and are well adjusted, with some slight differences based on different ART. **The generalizability of findings may be limited by the general low level of disclosure to adolescents in some of the publications, the small sample sizes of studies in the field, along with the large age range that encompasses adolescence. Findings should also be interpreted in light of many publications' focus on singleton births.** Future studies should also focus on egg donation, surrogacy and embryo donation, as well as the disclosure processes, and adolescents born into non-traditional families (same-sex or single parents) or those born using different types of donor (anonymous, identity-release or known).

Key Words: IVF/ICSI outcome/ psychology/ child follow-up/ assisted reproduction/ gamete donation

INTRODUCTION

Assisted reproduction techniques (ART) have been increasingly used to help infertile couples conceive. ARTs encompass a variety of treatments including IVF (when the egg and sperm are fertilized in a petri dish), ICSI (when a single sperm is injected directly into an egg), donor insemination (DI, when donor sperm is used), egg donation (ED, when a donor egg is used), embryo donation (when both donor egg and sperm are used) and surrogacy (when another woman carries the pregnancy). The past few decades have seen a growing body of research on the medical outcomes of children born through ARTs. Some studies have also examined the psychological effects of ARTs on parents and children. However, very little data have been gathered beyond childhood. While multiple investigations have shown that people born through ARTs function well in childhood (for reviews see: Basatemur and Sutcliffe, 2008; Hahn, 2001; Wagenaar et al., 2008a), little is known about whether these findings carry over into adolescence and whether different types of ARTs have different psychological outcomes at adolescence.

Adolescent psychological adjustment refers to the mental health of the young person, and includes conduct and school problems, peer relationships and general social and emotional functioning. One reason why different ARTs might have different impacts on psychological adjustment and parent-adolescent relationships is the potential shock of finding out about the absence of a genetic relationship to one or both parents. In IVF and ICSI, the child is genetically related to both parents. However, in DI the child is genetically related to mother but not the father. In ED, the child is genetically related to the father, but not the mother, although the mother carries the pregnancy and so the child has a gestational link with her. Depending on the arrangement, children born through

surrogacy can either be genetically related to only one parent, both parents, or neither parent. In embryo donation, the child is not related to either parent but (unless surrogacy is used) has a gestational link with the mother. In cases where the child is genetically related to only one parent, it is important to establish how that information impacts upon the psychological well-being of the adolescent and the quality of the relationship between the adolescent and both the genetic and the social parent. This is especially important as adolescence is a time when issues to do with identity come to the fore and when parent-child disagreements are more likely to surface (Brown and Wright, 2001; Paikoff and Brooks-Gunn, 1991; Smetana, 1995; Steinberg, 1990; Steinberg and Silk, 2002).

The manner in which knowledge about genetic relatedness impacts upon psychological adjustment and parent-child relationships depends on how or whether this information is communicated. Previous studies have examined the process of disclosure in childhood but not how disclosure may affect adolescence (Daniels, 1997; Lycett et al., 2004; Lycett et al., 2005; McGee et al., 2001). These studies have looked at the effects of secrecy as well as early versus late disclosure on family functioning and psychological adjustment. It is vital to gather empirical data about adolescents' understanding and feelings about their ART conception, as it is a time when understanding of conception and biological inheritance becomes more complex.

Adolescence is also a critical time for identity formation and the development of autonomy from parents (Erikson, 1968). Identity formation is a normal stage of development that concerns how an individual constructs meaning about their life (Erikson, 1968) and involves addressing the question, "Who am I?" (Grotevant and Von Korff, 2011). This process synthesizes information that includes self-definition, a sense

of coherence and a sense of continuity and may be different for adolescents who were adopted or conceived through reproductive donation because they might not have access to all of this information. In relation to adoption, which is in some ways similar to reproductive donation in that children are raised apart from one or both genetic parents, Grotevant et al. (2000) have argued that different levels of openness provide different opportunities or resources to adopted persons and may necessitate different types of interactions as they construct their adoptive identities. For adolescents born through reproductive donation, the question of identity becomes similarly complex because they may or may not have access to some knowledge they may want from their donor.

It is important to note that identity development occurs in a broader context and is largely influenced by relationships, particularly a negotiation of relationships within the family (Grotevant et al., 2000; Phinney and Goossens, 1996). More specifically, during the process of autonomy and identity development, adolescence can signify a transition from a hierarchal parent-child relationship to one that is more egalitarian (Erikson, 1968; Smetana, 1994). Is this transition different for adolescents who are genetically related to only one of their parents, and is this influenced by whether and when they were told about their conception? Reproductive donation, like adoption (Grotevant, 2000), varies in the amount of openness about where the child comes from as well as the amount of potential contact with the donor. The different ages at which parents provide information to adolescents about their conception, and the amount of information they choose or are able to provide create different contexts in which adolescents negotiate their identity. Hence, the amount and manner in which parents communicate the story of a child's conception is likely to have an influence on the development of identity. Furthermore, a

late or accidental disclosure of the way they were conceived could greatly influence the identity coherence of an adolescent conceived through reproductive donation and may in turn impact upon parent-adolescent relationships.

Another factor thought to influence parent-child relationships in the case of ARTs is the experience of infertility. It has previously been speculated that parents who have used ARTs may be overprotective of their children because of the emotional, financial, and psychical obstacles they had to overcome in order to conceive (Hahn and DiPietro, 2001; Weaver et al., 1993). Does fertility treatment really lead to overprotective parents who hinder the emotional development of their children at adolescence? Or will the overcoming of infertility produce parents who are more resilient and who pass this along to their children at a time when they are becoming more autonomous? In order to answer these questions it is important to study these families at adolescence.

Different family types can also influence parent-adolescent relationships and psychological adjustment. In particular, ARTs may not be used solely by infertile couples, but also by either same-sex couples or single people. This may present different contexts for understanding the importance of conception through ARTs on identity. For example, are adolescents born through DI to single women affected by their lack of a father figure, or do they have an especially good relationship with their mothers because they know they were really wanted? Same-sex and single parent families are more likely to be open about the use of fertility treatments, which may influence psychological adjustment and parent-adolescent relationships. Given that the majority of heterosexual coupled families that use ARTs still choose not to be open about their use of reproductive donation (Readings et al., 2011), it is important to examine how being open from an early

age impacts upon adolescent psychological adjustment and parent-adolescent relationships in same-sex and single parent families. Furthermore, it is important to examine how the potential stigma of same-sex or single parenting affects adolescents conceived through ARTs.

Previous reviews of families conceived through ARTs have mainly examined outcomes at childhood. Moreover, the majority of these have focused mainly on medical outcomes (Alukal and Lipshultz, 2008; Basatemur and Sutcliffe, 2008; Ceelen et al., 2008b; Hart and Norman, 2012; Kamphuis et al., 2014; Middelburg et al., 2008; Wagenaar et al., 2008a; Steel and Stutcliffe, 2009; Sutcliff, 2009; Wennerholm et al., 2009). Of the reviews that have focused on psychosocial adjustment, the majority of the findings show that children conceived by ARTs have comparable family functioning, and cognitive and behavioural development, to naturally conceived children. However, given the unique developmental stage presented by adolescence and the increasing population of people born through ARTs that are now reaching adolescence, it is important to establish whether these findings carry over into later stages of life.

The review by Hart and Norman (2012) includes some papers that examine medical and psychological outcomes of adolescents born through IVF, alongside studies of young children and is thus not specific to the unique psychological changes at adolescence. Only one systematic review has focused specifically on outcomes of ARTs at adolescence but this comprehensive review had a large focus on physical rather than psychological outcomes (Wilson et al., 2011). Ten publications on the psychological adjustment of ART adolescents were identified, and it was concluded that there were no differences in adjustment between ART and naturally conceived adolescents (Wilson et

al., 2011). However, while it did focus specifically on adolescence, this review did not differentiate between different types of ARTs or different family types (heterosexual coupled, same-sex coupled, or single parents) and donor type (known, anonymous, or identity-release) in the case of reproductive donation. Furthermore, it did not address whether the adolescents in these studies had been told of their conception. As disclosure has been increasingly encouraged in several countries, it is important to elucidate the consequences for psychological adjustment and relationships with parents. The present review builds on that of Wilson et al., (2011) by addressing these issues. It is also the first review to assess adolescent psychological adjustment in the context of parent-adolescent relationships in families that have used ARTs.

Aims and Objectives:

The current paper aims to provide an updated systematic review of published studies of parent-adolescent relationships, and the psychological adjustment of adolescents who were born using ARTs. Synthesizing the literature on the topic will help summarize what is known about the well-being of adolescents in these families and the quality of their relationships with their parents, while also identifying gaps in the literature for future research. It will focus specifically on differences between families that used their own gametes and those that used donor gametes in order to examine the role of genetic relatedness and the role of disclosure in mediating psychological adjustment and family relationships

METHODS

An updated systematic review of 1) parent-adolescents relationships, and 2) the psychological adjustment of adolescents in families created by ARTs, was carried out.

Search Strategy

The systematic search followed PRISMA guidelines (Moher, 2009). A literature search was conducted in PubMed 2.0 (National Library of Medicine), Web of KnowledgeSM version 4.7 (©Thomson Reuters 2009), PsycINFO and SciVerse Scopus in May of 2014 (see Table 1). Search terms were updated from the Wilson et al. (2011) review and included all potential key words relating to assisted reproduction technologies, and psychological adjustment and family relationships. The search terms are listed in Table 1 and MeSH terms were used where applicable.

Study Selection

Given that reproductive donation (the donation of a gamete or embryo, or surrogacy) is a fairly recent practice, no filters were used to limit the search by publication dates. Only papers in English were included. In line with the aim of this search to synthesize all available data on the topic, no results were excluded on the basis of study design. An understanding of the psychological adjustment of adolescents also depends on the psychological well-being of the parents and the family as a whole so papers that focused on these topics were not excluded. The definition of adolescence was the same as in the previous review, which identified the period as 11 to 18 years of age (Wilson et al., 2011). Papers that only focused on fertility, pregnancy, or younger

children were outside the scope of this review and were accordingly excluded. Additional exclusion criteria are summarized in Table 1.

Screening and Quality Assessment

All results (n= 1042) were reviewed based on the inclusion and exclusion criteria. Following an initial screening, 958 papers were excluded based on the title alone (see Figure 1). After applying the exclusion criteria to these abstracts, 20 studies were further evaluated for inclusion (see Figure 1). Additional studies were included from snowballing the references of studies found through the review. A total of 17 studies were included in the present review.

The studies judged to be irrelevant included studies that focused only on ethics or legislation, pregnancy and fertility, or medical conditions of these children (as opposed to psychological state). Evidence from experimental and exploratory studies was included to obtain a comprehensive review of adolescents born using ART. ART were defined as IVF, ICSI, donor insemination, egg donation, embryo donation and surrogacy.

RESULTS

Study design, measures and main outcomes of the results are outlined in Tables 2 and 3. Publications largely came from different phases of five longitudinal studies and two cross-sectional studies. Table 2 is organized to include the longitudinal studies by first author and year of publication, with alternating shading to indicate different longitudinal studies. Only the phases of the study that involved adolescent children were included. The two cross-sectional studies are presented following the longitudinal studies (Table 3). Measures included face-to-face interviews, standardized questionnaires, and

open response questionnaires. Data were generally collected from parents, adolescents and occasionally from teachers. Participants were often recruited from fertility clinics, or online websites for donor conceived children. Comparison groups for the studies were usually couples that had experienced a period of infertility before natural conception (NC), or from normative national samples. The following section summarizes the results obtained by this review.

The results presented below are separated into ARTs where the child is genetically related to both parents (IVF), and ARTs that involve reproductive donation (DI, ED, and surrogacy). As no results relating to ICSI, surrogacy or embryo donation were found, the first section refers solely to IVF and the second to ED and DI. It is of note that all of the findings related to IVF families only refer to adolescents born from a singleton birth. Four of the papers that include families born through reproductive donation include one set of twins (Bos and Gartrell, 2011; Gartrell and Bos, 2010; Gartrell et al., 2012; van Gelderen et al., 2012), and two of the papers focused on DI do not specify whether the study was restricted to singletons (Jadva et al., 2009; Scheib et al., 2005). The following results should be interpreted in light of these sample criteria.

Parent-Adolescent Relationships in IVF Families

The majority of the studies showed that parent-adolescent relationships in IVF families did not differ from NC families in terms of parental control (Golombok et al., 2001), warmth and conflict (Golombok et al., 2002b; Golombok et al., 2009), or parental dependability and sensitivity towards the child (Golombok et al., 2002b). More specifically, IVF adolescents reported high levels of warmth and low levels of conflict in their relationships with their parents, and this level was no different from adolescents in

naturally conceived families. In addition, longitudinal findings from early adolescence carried over to age 18 years (Golombok et al., 2009; Owen and Golombok, 2009). These findings were supported by a different study of 15 to 16 year olds (Colpin and Bossaert, 2008). Additionally, no differences were found in parental self-reports, or adolescent reports of parenting style or stress between IVF and natural conception parents (Colpin and Bossaert, 2008). These findings suggest that the positive relationships between parents who used IVF and their children persist into adolescence.

While parent-adolescent relationships in IVF families are generally comparable to NC families, some slight differences were found. Adolescents from IVF families reported that their parents reasoned with them less than adolescents in NC families although the parents reports did not differ, indicating that parents perceived themselves to reason the same amount (Golombok et al., 2001). One study did however report increased disciplinary indulgence (Owen and Golombok, 2009), and another reported less sensitive responding by mothers who conceived through IVF (Golombok et al., 2001). However, more often than not, differences between IVF and NC families actually reflected a particularly warm relationship between parents and adolescents following IVF (Golombok et al., 2001). Examples of these differences indicate greater overt affection of parents towards their adolescents and IVF adolescents' perceptions of their mothers as more dependable than **naturally conceived** adolescents (Golombok et al., 2001). Additionally, both mothers and fathers who used IVF to conceive showed greater emotional involvement with their adolescent child and reported that they enjoyed parenthood more than parents who conceived naturally (Golombok et al., 2002b).

Overall, 6 out of 9 papers reported no differences in parent-adolescent

relationships between families that conceived through IVF and those who conceived naturally. When differences were reported, they tended to be positive, indicating more enjoyment of parenting by IVF parents and more warmth in their relationships with their adolescent children (Golombok et al., 2001; Golombok et al., 2002b). While these findings warrant further investigation, in most cases multiple respondents do not confirm these findings. In general, the results indicate that adolescents born through IVF have a good relationship with their parents that, for the most part, does not differ from that of adopted or naturally conceived adolescents.

Parent-Adolescent Relationships in Reproductive Donation Families

All but one of the papers relating to reproductive donation focus on DI. Papers identified by this review indicate that families that used DI were functioning well at adolescence with positive parent-adolescent relationships that did not differ from NC families in terms of parental warmth and control (Golombok et al., 2002a; Owen and Golombok, 2009). Additionally, one longitudinal study reported no differences in parental dependability, disputes, disciplinary control and parental sensitivity in DI families when compared to **families who have naturally conceived** (Golombok et al., 2002b; Owen and Golombok, 2009).

Similar to parent-adolescent relationships in IVF families, the only differences found between DI and NC parent-adolescent relationships tended to reflect more positive relationships in DI families, such as increased warmth and emotional involvement (Golombok et al., 2002a; Golombok et al., 2002b; Owen and Golombok, 2009), greater enjoyment of parenthood (Golombok et al., 2002b), and parents who are seen by their adolescent children as more dependable, more lenient and less critical (Golombok et al.,

2002a). These findings were also true for lesbian coupled and single mothers (Gartrell et al., 2012). The only potentially negative findings were greater emotional over involvement with their children among DI parents, a higher level of disciplinary aggression shown by DI mothers, and less disciplinary involvement shown by DI fathers, when compared to NC families (Golombok et al., 2002b; Owen and Golombok, 2009). While there is reason to think that differences may exist between parent-adolescent relationships in ED and DI families because children in ED families share a gestational connection with their genetically-unrelated mother whereas children in DI families have no genetic link with their father, only one study comparing these two reproductive donation groups was identified. When comparing DI and ED families, the only difference found was a tendency towards lower levels of sensitive responding from ED mothers towards their children (Murray et al., 2006), suggesting that for mothers the absence of a genetic link to their child may be more significant than is the absence of a genetic link for fathers.

It is, however, of note that less than 10% of the children in the majority of these studies with heterosexual coupled parents were aware of their donor conception. Thus, it is important to investigate how these findings may vary in families that have told their child about their conception. Nevertheless, the existing studies reported no difficulties in mother-adolescent relationships in families that had not disclosed (Owen and Golombok, 2009). Of the two adolescents who had been told about their donor conception, both were told in middle school (Owen and Golombok, 2009). While they reported feeling upset at the time of disclosure, neither of them was distressed about it at age 18 years (Owen and Golombok, 2009). Additionally neither felt that their relationship with their mother or

536 father had been affected by knowledge of their donor conception (Owen and Golombok,
537 2009).

538 Recently, openness about donor conception has been increasingly recommended.
539 One study found that families who were open about DI conception reported lower levels
540 of conflict between mothers and adolescent sons when compared to mothers and
541 adolescent daughters (Freeman and Golombok, 2012). The link between disclosure and
542 lower levels of mother-child conflict was also found at earlier phases of this longitudinal
543 study as well as in other studies (Golombok et al., 2002a; Lycett et al., 2004). However,
544 at adolescence, this difference is specific to the relationship between mothers and sons.
545 Additionally, in this same study, adolescents who knew about their donor conception
546 reported less warm father-adolescent interactions than those in families that had not
547 disclosed (Freeman and Golombok, 2012). Sex specific findings like these suggest that
548 the sex of the adolescent and the parent are important mediators when examining the
549 effect of disclosure on parent-adolescent relationships (Freeman and Golombok, 2012).
550 In relation to the finding that father-adolescent relationships were less warm in disclosed
551 families, this may indicate the possibility that adolescents who are aware that their father
552 is not their genetic parent may distance themselves at adolescence. Alternatively, it is
553 also possible that fathers may distance themselves at adolescence, a finding that might be
554 corroborated by the lower disciplinary involvement of DI fathers in a different study
555 (Golombok et al., 2002a). However, it must be emphasized that these studies still have a
556 small sample size and that the findings have not yet been replicated.

557 Disclosure may also have different outcomes for parent-adolescent relationships
558 in different family types. For example, single mothers and lesbian couples are more likely

to disclose their use of reproductive donation than heterosexual couples who do not have to explain the lack of a father. The timing of disclosure may also affect adolescents' feelings towards their parents, with disclosure earlier in life associated with less distress for (Scheib et al., 2005). Adolescents with identity-release donors who were told about their conception early in life reported that learning about their conception had a neutral to positive impact on their relationship with their parents (Scheib et al., 2005). Adolescents from heterosexual-coupled families also appear to feel angry at being lied to by their mothers rather than by their fathers, reflecting another sex-specific difference in parent-adolescent relationships in families that are open about their use of reproductive donation (Jadva et al., 2009). In this study, the general feeling of adolescents conceived through DI towards their fathers was sympathetic (Jadva et al., 2009).

The current findings indicate the quality of parent-adolescent relationships in families that used reproductive donation, albeit mainly DI, is similar to that of naturally conceived families. However, there appears to be greater warmth in DI families. Furthermore, whether, how and when families disclose their use of ARTs seem to be important factors in how adolescents interact with their parents. Some exploratory findings indicate there may be a sex-specific difference in parent-adolescent relationships at adolescence and these findings warrant further investigation.

Adolescent Psychological Adjustment in IVF Families

Nine studies relating to IVF and adolescent psychological adjustment were identified by this review. Despite concerns that parents who underwent fertility treatment might have a negative influence on the development of their children because of over involvement (Burns, 1990; Covington and Burns, 2006), most of the studies showed that

IVF adolescents did not differ in measures of psychological adjustment when compared to naturally conceived or adopted controls (Colpin and Bossaert, 2008; Golombok et al., 2001; Golombok et al., 2002b; Golombok, 2009; Murray et al., 2006; Wagenaar et al., 2008b; Wagenaar et al., 2009; Wagenaar et al., 2011). Both parental and adolescent self-reports found no differences in behavioral problems (Colpin and Bossaert, 2008), peer problems (Golombok et al., 2009), emotional functioning (Wagenaar et al., 2009), or school performance (Wagenaar et al., 2008b).

One exception is a longitudinal study that found 18-year old adolescents born through IVF to show more physical aggression and school problems than a naturally conceived comparison group but these findings reflected two extreme outliers and disappeared when the outliers were removed from the analysis (Golombok et al., 2009). Another study using parent and teacher assessments found fewer externalizing behaviours and more withdrawn and depressive behaviours in IVF adolescents (mean age 13.6 years) when compared to naturally conceived adolescents (Wagenaar et al., 2011). These findings were, however, not supported by the adolescents' self-reports and were not present at later ages (15 years) indicating that any problems were transient in nature. This is supported by another study that found no behavioural differences between IVF adolescents and a natural conception control group at ages 15-16 years (Colpin and Bossaert, 2008).

When looking at peer relationships, the IVF adolescents at age 18 years reported greater confidence in their relationships when compared to naturally conceived adolescents (Golombok et al., 2009). In regards to disclosure of how they were conceived, the same study showed that no adolescent aged 18 years reported any distress

about being conceived through IVF (Golombok et al., 2009). All of the data came from heterosexual coupled families and no data were available on differences in functioning based on family type.

Overall, these findings indicate that adolescents conceived through IVF do not show any greater difficulties in psychological adjustment when compared to naturally conceived adolescents. Only two studies reported some differences in behaviour of adolescents conceived through IVF but these differences were either the result of outliers, not confirmed by multiple observers, or did not appear at other phases of the longitudinal studies indicating that they were transient in nature. While no differences are apparent between IVF adolescents and comparison groups, it is important to note that all of these adolescents were genetically related to both of their parents so it is unclear whether these findings can be generalized to children born through reproductive donation.

Adolescent Psychological Adjustment in Reproductive Donation Families

Eleven studies looking at ARTs involving reproductive donation and adolescent psychological adjustment were included in this review. Of these, three included IVF adolescents in addition to naturally conceived adolescents as a comparison group (Golombok et al., 2002b; Murray et al., 2006; Owen and Golombok, 2009). Only one study involved adolescents conceived by ED (Murray et al., 2006). No differences in psychological adjustment were found between DI and either IVF or NC, suggesting that the absence of a genetic link between fathers and their children does not interfere with adolescent psychological adjustment (Gartrell et al., 2012; Golombok et al., 2002a; Golombok et al., 2002b; Murray et al., 2006). Additionally, the only study of ED

adolescents found them to be well adjusted in terms of social and emotional development (Murray et al., 2006). As previously mentioned, less than 10% of heterosexual coupled families in most of these studies had disclosed donor conception to their children. Despite concerns about the effects of secrecy, no negative outcomes were identified in the psychological adjustment of these DI and ED adolescents (Murray et al., 2006). These findings should be interpreted with caution as many of the parents in this study had told other people about their child's donor conception, and accidental disclosure could later have a negative effect (Golombok et al., 1996; Jadva et al., 2009).

Is the psychological adjustment of adolescents different when they do know about the use of donated gametes in their conception? One study found that disclosure of conception through DI did not affect the psychological adjustment of adolescents (Freeman and Golombok, 2012). Some studies have reported that adolescents who were told about their DI conception earlier in life had a more positive reaction than people who were told about their conception in adolescence or adulthood (Jadva et al., 2009; Scheib et al., 2005). Data in support of this comes from a questionnaire study of 29 DI adolescents who were told about their conception early in life and who were comfortable with the way they were conceived (Scheib et al., 2005). Conversely, there is some evidence that people who found out about their donor conception later in life reported feeling shocked and betrayed (Turner and Coyle, 2000).

Further data comes from same-sex and single parents who are more likely to disclose their use of reproductive donation (Jadva et al., 2009). Adolescents born through DI to lesbian coupled mothers are well adjusted psychologically, with mothers' and adolescents' scores reflecting higher social, academic and total competence when

653 compared to a normative sample (Gartrell and Bos, 2010). While all of these adolescents
654 knew about their donor conception, psychological adjustment did not seem to be
655 negatively affected by this knowledge (Bos and Gartrell, 2011; Gartrell and Bos, 2010,
656 Gartrell et al, 2012). Furthermore no differences in psychological stability and
657 development were found between adolescents conceived by a not-yet-known donor
658 (anonymous and identity-release), and a known donor (Bos and Gartrell, 2011). In the
659 Scheib et al. (2005) study, all of the adolescents had an identity-release donor, a factor
660 that may relieve some of the feelings of frustration adolescents with anonymous donors
661 may have when trying to gain information about their biological background.

662 Taken together, these studies indicate that adolescents born through DI and ED
663 are well adjusted psychologically. Age and process of disclosure are likely to impact
664 upon the psychological adjustment of adolescents, with disclosure earlier in life
665 associated with more neutral or positive reactions (Jadva et al., 2009). Donor status and
666 knowledge about conception does not seem to affect the adjustment of adolescents born
667 to same-sex couples, who are also functioning well (Gartrell and Bos, 2011).

668 **DISCUSSION**

670 The studies identified by this review indicate that adolescents conceived through
671 different ARTs (IVF, DI, and ED) are in general psychologically well adjusted. This
672 review was unique in separating out the effects of different forms of ARTs on parent-
673 adolescent relationships and adolescent psychological adjustment. At the time of this
674 review there were only two other reviews (Hart and Norman, 2012; Wilson et al., 2011)
675 of the effects of ARTs on the medical and psychosocial development of adolescents,
676 although one of these reviews did not focus solely on adolescents (Hart and Norman,

2012). However, both of these reviews treated all ARTs as one category rather than acknowledging differences between ARTs where children share a genetic link with one or both parents, and those where they do not. Examining differences based on different ARTs did indeed bring to light variations in psychological well-being and parent-adolescent relationships based on the specific fertility treatment used.

In IVF families, adolescents showed no differences in emotional, behavioural or conduct problems compared to naturally conceived adolescents (Colpin and Bossaert, 2008; Wagenaar et al., 2011). Adolescents born through IVF seem to be well adjusted and to have good relationships with both parents (Golombok et al., 2002b). These findings indicate that the stress or stigma of infertility do not negatively impact family functioning in IVF families with an adolescent child. It has been suggested that the increasing use of IVF likely removes the early stigma associated with the procedure and normalizes it (Colpin and Bossaert, 2008). Congruent with previous findings, it seems that adolescents conceived by IVF can integrate knowledge of their conception without much difficulty (Siegel et al., 2008).

In reproductive donation (DI and ED) families, it has been thought that the absence of genetic relatedness between one parent and the child may have differential effects on psychological adjustment of adolescents and on parent-adolescent relationships. Although the data on ED are much more limited than those on DI, studies identified by this review indicated that adolescents born through DI and ED are psychologically well adjusted and that they have positive relationships with their parents. Although very few studies included single parent families, family type (heterosexual coupled, same-sex coupled or single parent families) did not seem to affect adolescent

psychological adjustment or parent-adolescent relationships.

While all the results were within the normal range, some factors that were identified as impacting the parent-adolescent relationship in reproductive donation families are the sex of the parents and the child, and the age and process of disclosure of the method of their conception. The findings of lower father-adolescent warmth in DI families may indicate that knowledge about the absence of a genetic link may become more important in parent-child relationships at adolescence (Freeman and Golombok, 2012). This finding is supported by data that DI fathers are less involved in discipline at adolescence (Golombok et al., 2002b), however the sample sizes of these studies are still small and these findings have yet to be replicated or investigated in ED families. It is also of note that adolescence is a time during which parent-child conflict tends to increase regardless, and that these differences may return to normal levels later in life. Increasing the sample sizes and the number of studies that follow up parent-child relationships in disclosed families is important in determining whether these are genuine effects. It is also of interest to examine whether this finding is seen in regards to the social parent in families with same-sex partnered parents.

This review also identified age of disclosure as an important factor mediating the effect of disclosure on the well-being of adolescents conceived through reproductive donation. Disclosure is a complex ongoing process and as more data become available, it is important to further clarify its differential impacts throughout the life course. Two studies in this review suggested that openness about the use of reproductive donation from an early age may allow an adolescent to incorporate their conception into their identity formation and hence lead to a more accepting and positive attitude (Jadva et al.,

2009; Rumball and Adair, 1999; Scheib et al., 2005). Indeed, adolescents who found out about their conception earlier in life seemed to have a less negative reaction to the information (Jadva et al., 2009; Scheib et al., 2005). Furthermore, early disclosure may support healthy parent-adolescent relationships by fostering trust in the relationship. It is also possible that the positive parent-adolescent relationships seen in families that have disclosed their use of reproductive donation may result from a more open communication style in the family. To further elucidate this, the process of disclosure should be studied within the greater context of family communication. While families that had not disclosed their use of reproductive donation also had positive parent-adolescent relationships, it is important to remember that disclosure prevents the risk of unintended disclosure, which may have more negative consequences (Freeman and Golombok, 2012).

Despite the few differences outlined above, families that have used ARTs have largely comparable levels of psychological adjustment and parent-adolescent relationships. There are many possible reasons to explain the lack of difficulties predicted for ART families. One suggested interpretation is that the gap previously thought to exist between ART and NC families has been lessened in recent years due to more planning of naturally conceived children (Colpin, 2002). It has also been postulated that after a period of infertility parents might appreciate the value of their child, and parent more consciously (Colpin, 2002). In addition, parents who use ARTs are on average older than parents who conceive naturally, allowing them time to fulfill personal ambitions and develop more of a foundation for their relationships – all factors that may overshadow the stresses of infertility (Colpin, 2002).

As of now however, comparison studies between ART and NC families tend to have small sample sizes that are possibly biased to include people who are functioning well. Additionally, differences in measures, recruitment, sample inclusion and exclusion criteria, and theoretical concepts are an impediment to drawing conclusions across studies (Colpin, 2002; Hammarberg et al., 2008). Future studies would benefit from larger, more inclusive samples with more interview data from multiple informants including the adolescents themselves. It would also be beneficial to gather more data from adolescents conceived through ARTs in different family types, particularly single parents. Four publications did look at families with same-sex parents, but all of these publications came from one longitudinal study with lesbian mothers so the findings may not be generalizable to same-sex male parents (Bos and Gartrell, 2011; Gartrell and Bos, 2010; Gartrell et al., 2012; van Geleren et al., 2012). The same longitudinal study also included data from single lesbian mothers with adolescents conceived through DI, although the sample sizes were small. The large age range that encompasses adolescence further complicates the current review due to the variation individual children have in undergoing puberty and maturation. As more data become available, it may be useful to compare early versus late adolescence.

Most of the studies in this review have also restricted their samples to singleton births (Colpin and Bossaert, 2008; Freeman and Golombok, 2012; Golombok et al., 2001; Golombok et al., 2002a; Golombok et al., 2002b; Golombok et al., 2009; Murray et al., 2006; Owen and Golombok, 2009; Wagenaar et al., 2008; Wagenaar et al., 2009; Wagenaar et al., 2011). Of the remaining six papers, four of them include only one set of twins (Bos and Gartrell, 2011; Gartrell and Bos, 2010;

Gartrell et al., 2012; van Gelderen et al., 2012) and two of the papers do not mention whether or not the participants were singletons (Jadva et al., 2009; Scheib et al., 2005). Despite the focus of many of these studies on singleton births, the current rate for multiple births following the use of ARTs is about 24% (Murray and Norman, 2014). Along with multiple pregnancies there is an increase in intrapartum and postpartum complications for both mother and child (Murray and Norman, 2014). Accordingly, the findings of this review may not be generalizable to adolescents born through ARTs from multiple pregnancies. New single embryo transfer policies in Europe have, however, restricted the number of twin rates, which will continue to decline. As the number of multiple pregnancies continues to decline and the number of singletons rises, the findings of this review will be increasingly relevant and valid.

One limitation to take into account while interpreting the findings of this review is the complexity of calculating retention rates for longitudinal studies. Some of the studies report multiple retention rates based on people that could not be traced, and those that actively declined to participate, while other papers do not make this distinction. It is important for future papers to note these differences in order to make biases in the samples apparent. Another limitation of the findings of this review is the varied participation of fathers across different comparison groups and studies. The only study that reported the participation rates of fathers in different groups indicated that a lower number of fathers participated in the DI group (23%) when compared to IVF (83%), adoptive (81%) and NC (81%) fathers (Owen and Golombok, 2009). While none of the other studies report participation rates for fathers between

groups, Golombok et al. (2001) do report that only 67% of fathers were interviewed. Without this information from the remaining papers, it is possible that the findings related to father-child relationships may be systematically impaired due to lower participation of fathers in these studies. In order to examine these potential biases, future publications should report both participation rates for fathers, and how retention rates are calculated.

If possible, future studies should also examine differences based on adolescents who have a known, anonymous, or identity-release donor. It is conceivable that adolescents with an identity-release donor would have a less negative reaction to finding out about their conception than those with an anonymous donor because they would have the possibility to find out more information about their biological background at a time when genetic knowledge is becoming increasingly important. Additionally, it would be informative to gain more data from adolescents that found out about their conception at different time points to examine the long-term effects of disclosure at different ages. More in-depth exploratory research on how the process of disclosure occurs and what the adolescents themselves understand is also important for informing future families created through IVF. Lastly, this review included only one family that used ED, and no families that used ICSI, embryo donation or surrogacy. It is important to conduct studies on how these families are doing psychologically as children go through adolescence, especially as some of these ARTs are becoming increasingly popular.

CONCLUSION

This is the first review of adolescent psychological adjustment and parent-adolescent relationships to examine outcomes based on different ARTs. The findings have implications for policy related to children born through ARTs, and single or same-sex parenting, by showing that adolescents born through different ARTs into different family types are generally psychologically well adjusted. While some differences in family functioning were identified in relation to the type of ART, the disclosure process, and the sex of both parent and adolescent, it is important to note that despite some variation all of the families were functioning within the normal range and the differences indicated variations within a continuum of positive psychological adjustment. The follow-up of people conceived using ARTs as they progress through adolescence and into adulthood would further elucidate what factors affect the psychological adjustment of families created through fertility treatment.

Authors' roles:

All authors meet the following qualifications:

- 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data,
- 2) drafting the article or revising it critically for important intellectual content, and
- 3) final approval of the version to be published.

ECI and SG contributed significantly to all stages of the preparation of this manuscript. ECI designed and conducted the literature search. SG and ECI both contributed to preparation, editing and reviewing of the manuscript. SG is the principal investigator.

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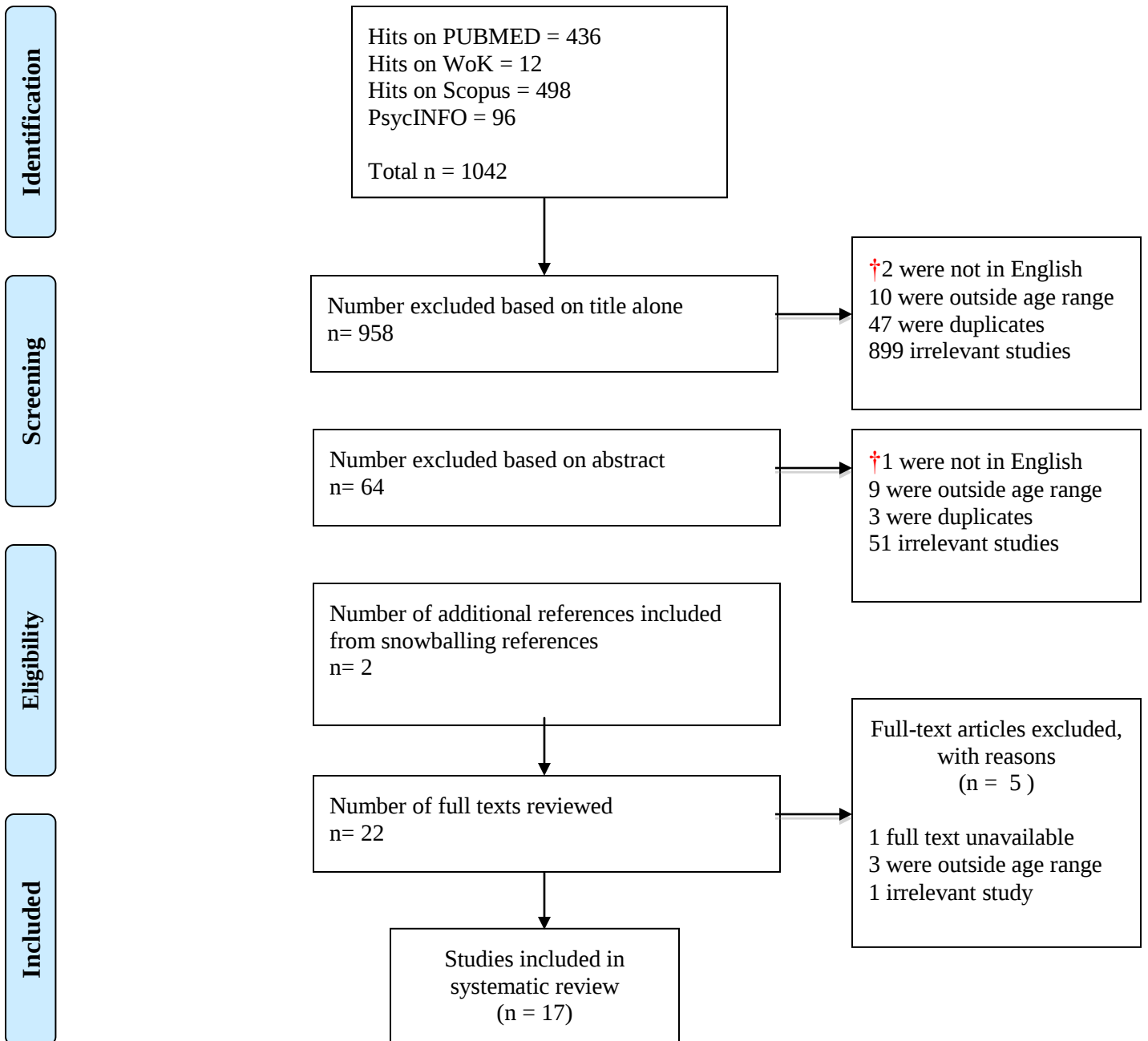
FIGURES AND TABLES

Table 1: Search and selection strategy for systematic review of psychological adjustment in adolescents conceived by assisted reproduction techniques (ART)

Databases searched	Pubmed, Web of Science, Scopus, PsycINFO
Search key words (all in Title/Abstract; MeSH terms were used where appropriate)	Exposure: [Assisted reproduction OR assisted reproductive technolog* OR In-vitro fertilization OR in-vitro fertilisation OR IVF OR sperm donor OR egg-donor OR egg donation OR sperm donation OR insemination OR gamete donation OR embryo donation OR ICSI OR intra-cytoplasmic sperm donation surrogacy* OR surrogate] AND Outcome: [(Adolescen* OR teen* OR teenager* OR young adult*) AND (psycholog* OR adjustment OR well-being OR disclosure OR telling OR open OR behaviour OR socioemotional OR parent-child OR parent-adolescent)] NOT organ donation OR blood donation OR organ OR kidney OR transplant OR heart
Other sources checked	Additional studies were identified through references of included studies.
Inclusion criteria	1. Published in English in peer reviewed journals 2. Studies focusing on ARTs as defined in the search 3. Studies focusing on psychological well being
Exclusion criteria	1. Papers not in English 2. Full article not available 3. Papers that only focus on fertility, pregnancy, or laws 4. Papers that do not focus on adolescence (11-18 years)[†]
Categories of studies	Parent-adolescent relationships Psychological adjustment of adolescents

[†]Note: While the Wilson et al. (2011) review defined adolescence as above or equal to 12 years, they included several papers where the age of participants was 11 years. We based our definition of adolescence on theirs but adjusted it to include children of 11 years of age or above.

Figure 1: PRISMA Information Flow Diagram for the Systematic Review of Adolescent Psychological Adjustment in Families Created by Assisted Reproduction



†Note: at all levels of analysis, studies may have been excluded for more than one reason.

Table 2: Summary of longitudinal studies on parent-adolescent relationships and psychological adjustment of adolescents conceived by ART

Longitudinal Studies

Authors, Year, Location, Singleton or Multiple Pregnancies Study	Research design, Study groups (retention rate), Initial response rates at Phase I † Age (mean age) Family type, Disclosure	Outcome measures	Key Findings
(Colpin and Bossaert, 2008) Belgium First-born singletons	Prospective longitudinal 24 IVF (77.4%), and 21 NC (67.7%) families Initial phase one response rate for IVF- 88.6% 15 - 16 year olds (mean age 16.05) Heterosexual coupled parents	Louvain Adolescent Perceived Parenting Scale; Children's Report on Parent Behaviour; Perceptions of Parents Scale; Responsiveness scale, Behavioural control scale, Psychological control scale, Autonomy Support scale; Parenting Stress Index; Child Behaviour Checklist; Youth Self-Report	Adolescent psychological well-being did not differ between IVF and naturally conceived families.
(Freeman, and Golombok 2012) UK Singletons	Prospective longitudinal cohort 30 DI (86%) families Initial phase one response rate for DI- 77% 12 - 13 year olds (mean age 12.5) Heterosexual coupled parents	Parent interviews; Child and Adolescent Functioning and Environment Schedule; Golombok Rust Inventory of Marital State; Strengths and Difficulties Questionnaire	All families, including families that used donor insemination (DI) were functioning well. In families that were open about their use of DI, there was a lower level of conflict between mothers and sons. Adolescents in these families also reported lower levels of warmth in their relationships with their fathers.
(Gartrell and Bos, 2010) USA	Prospective longitudinal 78 DI (93%) families, and Achenbach normative sample for	Telephone interview with mother; Child Behaviour Checklist (mother and child)	Adolescents born through DI to lesbian coupled mothers are psychologically well adjusted. Lesbian mothers that used DI reported their adolescents to score higher in social, school/academic, and total competence when compared to

Not limited to singletons, one set of twins	comparison Initial phase one response rate unavailable, as interested participants contacted study administrator 16 - 18 years old (mean age: 17.05) Lesbian families (coupled and single)		Achenbach's normative sample of American youth of the same age. Mothers also rated their children to show less social problems, rule-breaking, aggressive and externalizing problem behaviors.
(Bos and Gartrell, 2011) USA Not limited to singletons, one set of twins	Prospective longitudinal 78 DI (93%) families, and Achenbach normative sample for comparison 16 - 18 years old (mean age: 17.05) Lesbian families (coupled and single)	Child Behaviour Checklist (mother and child); Online questionnaire	No differences were found between psychological adjustment between adolescents conceived by a known, and a not-yet-known donor. This suggests that donor type does not influence adolescent psychological adjustment. The majority (67%) of adolescents with an identity-release donor plan on contacting him when they turn 18 years. No differences were found between adolescents with different types of donors in relation to their psychological development and stability.
(Gartrell et al., 2012) USA Not limited to singletons, one set of twins	Prospective longitudinal 77 DI families (93%) 16 - 18 years old (mean age: 17.05) Lesbian families (coupled and single)	Descriptive online questionnaire on 1) academics, extracurriculars and aspirations, 2) friendship, family interaction and role models, 3) health problems, psychotherapy and wellbeing.	Adolescents born through DI to lesbian mothers reported themselves to be academically successful, with active friendship networks, strong family bonds, and overall high ratings of wellbeing. Over 80% of the adolescents felt they could confide in their mothers, and almost all described their mothers as good role models.
(van Gelderen et al, 2012) USA Not limited to singletons, one set of twins	Prospective longitudinal 77 DI (93%) families, and Washington Healthy Youth Survey for control 16 - 18 years old (mean age: 17.05)	Online questionnaire (children) with sections on 1) quality of life, 2) donor status 3) maternal relationship continuity and 4) stigmatization	Self-ratings of adolescents conceived by DI to lesbian mothers showed they had comparable ratings of quality of life when compared to controls. No correlation was found between quality of life rating and donor status. There was also no relation found between the mothers' relationship continuity and the quality of life rating of the adolescents.

	Lesbian families (coupled and single)		
(Golombok et al., 2001): UK Healthy singletons	Prospective longitudinal 34 IVF (83%), 49 adoptive (89%), 38 (NC) (88%) families Initial phase one response rate for IVF- 95%, for DI-62%, for adoptive-76%, and for NC-62% 67% of all fathers interviewed, and 76% of all fathers completed questionnaires 11 - 12 years old (mean age: 11.92) Heterosexual coupled parents	Quality of Parenting Interview; Child and Adolescent Functioning and Environment Schedule; Expression of Affection Inventory; Conflict Tactics Scale; Strengths and Difficulties Questionnaire; Social Adjustment Inventory for Children and Adolescents	All families were functioning within a normal range. Slight differences between groups included lower sensitive responding of IVF mothers compared to NC mothers, higher ratings of dependability of IVF children towards their mothers, and higher scores of affection of both IVF mothers and fathers. No differences related to parental control were found between the families.
(Golombok et al., 2002a) UK Healthy singletons	Prospective longitudinal 37 DI (82%), 49 adoptive (89%), 91 (77%) NC families 11 - 12 years old (mean age: DI 11.89, Adopted 11.96, NC 12.45 years) Heterosexual coupled parents	Golombok Rust Inventory of Marital State; State-Trait Anxiety Inventory; Beck Depression Inventory; Quality of parenting interview; Child and Adolescent Functioning and Environment Schedule; Expression of Affection Inventory; Conflict Tactics Scale; Strengths and Difficulties Questionnaire (mothers and teachers)	All families were well adjusted psychologically. Few differences between groups included greater expressed warmth of DI mothers when compared to adoptive mothers, and the perception of DI adolescents of their mothers as more dependable. DI fathers were less involved in disciplining their adolescent when compared to NC and adoptive fathers. No differences in adolescent wellbeing were found between groups.
(Golombok et al., 2002b): UK, The Netherlands, Italy and Spain Healthy singletons	Prospective longitudinal 102 IVF (88%), 94 DI (85%), 102 adopted (89%), 102 (85%) NC families 11-12 years old (mean age: 11.9 in UK, 11.1 in The Netherlands, and the rest fall within that range)	Golombok Rust inventory of Marital State; State-Trait Anxiety Inventory; Beck Depression Inventory; Quality of Parenting Interview; Child and Adolescent Functioning and Environment Schedule; Expression of Affection Inventory; Conflict Tactics Scale; Strengths and Difficulties Questionnaire	No differences were found in mother-child warmth, dependability, and sensitivity towards the child between any groups. Slight differences indicated that IVF and DI mothers showed greater emotional involvement with their child, and they enjoyed motherhood more than NC mothers. IVF and DI fathers expressed more warmth and emotional involvement than adoptive and NC fathers and enjoyed fatherhood more. Some of the IVF and DI parents were over involved with their children. No differences were found in disputes, and

	Heterosexual coupled parents		disciplinary control or adolescent's psychological wellbeing.
(Murray et al., 2006) UK Healthy singletons	Prospective longitudinal 17 egg donation (ED) (84%), 35 DI (82%), 34 (83%) IVF families 11 - 12 years old (mean age: ED 11.60, DI 11.87, IVF 11.97) Heterosexual coupled parents	Mother interview, child interview, Golombok Rust inventory of Marital State; State-Trait Anxiety Inventory; Beck Depression Inventory; Quality of Parenting Interview; Child and Adolescent Functioning and Environment Schedule; Expression of Affection Inventory; Strengths and Difficulties Questionnaire	No differences between ED and IVF families. Few differences found between groups showed lower levels of sensitive responding towards children in ED mothers when compared to DI mothers, while DI mothers were more likely to be emotionally over involved with children than ED mothers. All of the children were well adjusted.
(Golombok et al., 2009): UK Healthy singletons	Prospective longitudinal 26 IVF (79%), 27 adopted (79%), 56 NC (77%) families 18 years old (mean age: IVF 18.83, Adopted 18.83, NC 18.17) Heterosexual coupled parents	Child and Adolescent Functioning and Environment Schedule; Inventory of Peer and Parent Attachment; SCL-90-R; Self-Perception Profile for college students; semi-structured questions about feelings related to ART or adoption	Parent-adolescent relationships did not differ between the groups in terms of warmth or conflict. Adolescents born through IVF showed slightly more physical aggression and reported themselves to do more poorly in school (but differences disappeared when 2 outliers were removed). No difference in psychological or peer problems was reported. The adolescents who knew about their conception reported that this did not cause them distress.
(Owen and Golombok, 2009): UK Healthy singletons	Prospective longitudinal 26 IVF (83%), 26 DI (71%), 38 adoptive (81%), 63 NC (81%) families Participation Rates for fathers: 54%, 23%, 61% and 56% 17 - 18 years old (mean age: 17.33) Heterosexual coupled parents	Golombok Rust Inventory of Marital State; Trait Anxiety Inventory; Beck Depression Inventory; Quality of Parenting Interview; face to face interview (maternal only); Parents of Adolescents Separation Anxiety Scale; Conflict Behaviour Questionnaire	Few differences indicated lower levels of anxiety in mothers that had used DI. Mothers that used ART (IVF and DI) also showed a higher degree of warmth to their children, with the highest level of warmth in DI mother-child dyads. IVF mothers showed higher levels of disciplinary indulgence and DI mothers showed higher levels of disciplinary aggression when compared to NC mothers. No differences were found between fathers in regard to either warmth or conflict.
(Wagenaar et al., 2008b): The Netherlands	Prospective longitudinal 246 IVF (69%), 233 NC (51%) families	Education level; general cognitive ability (Dutch CITO test); school performance; learning and developmental disorders via parental report	The school performance of adolescents born through IVF was no different from that of adolescents conceived spontaneously. No differences were found in ability/performance nor in the number of children with developmental disorders in comparison with the control group.

Singletons	Initial phase one response rate for IVF-72% and for NC-55% 8 - 18 years old (mean age: IVF 12.2, NC 12.21) Heterosexual coupled parents		
Wagenaar et al., 2009): The Netherlands Singletons	Prospective longitudinal 139 IVF, 143 NC families 9 - 18 years old (mean age: IVF 13.6, NC 13.51) Heterosexual coupled parents	Child Behaviour Checklist (parents); Teacher Report Form	All of the children in the study were within a normal range of behavioural and emotional functioning. Parents of adolescents born through IVF reported their child to have less problem behaviour than controls, although teachers reported no differences between the groups. There was a trend towards less externalizing behaviour in the IVF adolescents and teachers also reported a trend towards more withdrawn and depressive behaviour in adolescents born through IVF.
Wagenaar et al., 2011 The Netherlands Singletons	Prospective longitudinal 86 IVF (67%), 97 NC (70%) families 11-18 years old (mean age: IVF 15.71, NC 15.07) Heterosexual couples parents	Youth Self-Report	Behaviour and socioemotional functions as reported by IVF adolescents and controls were found to be within normal range, with no significant differences between groups.

Table 3: Summary of cross-sectional studies on parent-adolescent relationships and psychological adjustment of adolescents conceived by ART

Cross Sectional Studies

Authors, Year, Location, Singletons or Multiple Pregnancies	Research design, Sample groups, Response rate, Age (mean age), Family type	Outcome measures	Key Findings
(Scheib et al., 2005) USA Unspecified if singletons or not	Retrospective cohort 29 DI adolescents, 60.4% response rate (from people already participating in another study) † 12-17 years old (mean age: 14.7) Lesbian (41.4%), single mother (37.9%), and heterosexual coupled	Mail-back questionnaires about disclosure and donor	Most adolescents were very comfortable with their conception and they reported knowing about their conception had a neutral to positive impact on their relationship with their parents. The majority of adolescents also reported wanting to know the donor's identity, although not necessarily at age 18 years, and not necessarily to have a relationship with him. All adolescents had an identity release donor.
(Jadva et al., 2009) USA Unspecified if singletons or not	Retrospective cohort 165 people conceived through DI, response rate 19% for first phase of recruitment and 22% for second phase of recruitment (Members of the Donor-Sibling Registry in the USA) 13-61 years old (mean age: 22) 58% heterosexual coupled parents, 23% single mother, 15% lesbian coupled	Online questionnaire about experiences of donor conception and feelings towards parents. The questionnaire included questions about disclosure as well.	Disclosure in adulthood led to more negative experiences, especially feelings of anger at being lied to by their mother. Those told later did however also report more positive feelings and sympathy towards their mother. People conceived through DI benefit from being disclosed to earlier in childhood. Single mothers and lesbian couples parents were more likely to disclose from a young age. DI conceived people in heterosexual coupled families were more likely to find out about their disclosure from a third party.

†Note: For the longitudinal studies described in Table 2, retention rates (how many people participate as compared to the people involved in the first phase of the study) are reported in parentheses following each study group. Response rates (number of people out of those contacted in the initial phase of the study who participated) are reported in the same column, but only once for each longitudinal study. For the cross-sectional studies in Table 3 only response rates are reported.