Twins conceived using assisted reproduction: parent mental health, family relationships and child adjustment at middle childhood

Kayla N. Anderson1,*, Bibiana D. Koh2, Jennifer J. Connor3, Ascan F. Koerner4, Mark Damario5, and Martha A. Rueter1

1Department of Family Social Science, University of Minnesota, St Paul, MN, USA 2Department of Social Work, Augsburg College, Minneapolis, MN, USA 3Department of Counseling and Community Psychology, St. Cloud State University, St. Cloud, MN, USA 4Department of Communication Studies, University of Minnesota, Minneapolis, MN, USA 5Department of Obstetrics, Gynecology and Women’s Health, University of Minnesota, Minneapolis, MN, USA

*Correspondence address. 290 McNeal Hall, 1985 Buford Avenue, University of Minnesota, St Paul, MN 55108, USA.
E-mail: and02584@umn.edu

Submitted on April 1, 2014; resubmitted on June 10, 2014; accepted on July 2, 2014

STUDY QUESTION: Compared with singletons, what is the parent mental health, parent–child and couple relationship satisfaction, and child adjustment of 6- to 12-year-old assisted reproduction technology (ART) twins and their families?

SUMMARY ANSWER: There are no differences between 6- and 12-year-old ART twin and singleton families in parent mental health or family relationships; however, twins had significantly fewer behavior and attention problems than singletons in middle childhood.

WHAT IS KNOWN ALREADY: When ART twins are younger than 5 years old, parents have more mental health difficulties and poorer parent–child relationship quality, and no differences have been found in ART twin and singletons’ psychosocial adjustment. However, studies have only examined the implications of ART twin status in families with infant and toddler aged children.

STUDY DESIGN, SIZE, DURATION: A cross-sectional study of 300 6–12-year-old ART children (n = 124 twins and n = 176 singletons) from 206 families at a reproductive endocrinology clinic in the USA.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Patients from one clinic with a child born between 1998 and 2004 were invited to participate in an online survey (82% recruitment rate). Participants provided information on each 6- to 12-year-old ART child in the family, and responded to questions on parent mental health, family relationships and child adjustment.

MAIN RESULTS AND THE ROLE OF CHANCE: There were no differences in parent mental health or family relationships in families with 6- to 12-year-old ART twins versus singletons. However, twins (M = 2.40, SE = 0.35) had significantly fewer behavior problems than singletons (M = 3.47, SE = 0.36; f(1, 201) = 4.54, b = 1.08, P < 0.05). Twins (M = 1.86, SD = 0.23) also had fewer attention problems than singletons (M = 2.64, SD = 0.23; f(1, 156) = 5.75, b = 0.78, P < 0.05). Results also suggest that full-term twins had significantly fewer attention problems (M = 1.37, SE = 0.33; f(1, 222) = 2.65, P = 0.05) than premature twins (M = 2.32, SE = 0.32, b = 0.95, P < 0.05), full-term singletons (M = 2.25, SE = 0.21, b = 0.88, P < 0.05) and premature singletons (M = 2.84, SE = 0.49, b = 1.47, P = 0.01). There were no significant differences between the other groups.

LIMITATIONS, REASONS FOR CAUTION: Although the response rate is high (82%) and family demographics are representative of US ART patients, patients are from one US clinic. Responses also are from one family member and may be subject to social desirability biases. Additionally, our data did not include identification of monozygotic and dizygotic twins.

WIDER IMPLICATIONS OF THE FINDINGS: Studies on infant and toddler ART twins suggest these families have parents with more mental health difficulties and lower parent–child relationship quality than singleton families. This study indicates the negative effects of twin status may have ameliorated by middle childhood, and twins may even have more optimum psychosocial adjustment than singletons in this developmental period.
Introduction

Multiple births are considered a complication of assisted reproduction (ASRM, 2012). Despite calls for a reduction in multiple birth rates (Jones, 2003; Kalra and Barnhart, 2011; ASRM, 2012), the 30–32% US twin birth rate after assisted reproduction technology (ART) remains stable (CDC, 2010). The relative number of twins in the general population is on the rise (ASRM, 2012) due to increased ART utilization (CDC, 2013) and infertile patients’ continued desire for twins (Grobman et al., 2001; Child et al., 2004; Leese and Denton, 2010).

Parents’ mental health and family relationships are a particular concern in families with ART twins. Parents of ART twins report higher levels of depression and anxiety (Ellison and Hall, 2003; Ellison et al., 2005; Olivennes et al., 2005; Vilska et al., 2009; Vilska and Unkila-Kallio, 2010; Ross et al., 2011), and lower quality parent–child relationships than parents of singletons (Garel and Blondel, 1992; Garel et al., 1997; Holditch-Davis et al., 1999; Baor et al., 2004; Glazebrook et al., 2004; Freeman et al., 2007). However, couple relationship quality may be similar across families with ART twins and singletons (Ellison et al., 2005; Olivennes et al., 2005; Freeman et al., 2007).

Concerns have also arisen about the health, development and psychosocial adjustment of twins. Children born as twins have less optimum perinatal health (Adamson and Baker, 2004; Pinborg, 2005; Zollner and Dietl, 2013) and poorer cognitive development than singletons (Bonduelle et al., 2003; Pinborg et al., 2003; Olivennes et al., 2005; Pinborg, 2005). The psychosocial adjustment of ART twins, including emotional and behavioral adjustment, has also been questioned, although research thus far suggests psychosocial adjustment is comparable across ART twins and singletons (Montgomery et al., 1999; Olivennes et al., 2005; Golombok et al., 2007).

A notable limitation to this research on parent mental health, family relationships and child psychosocial adjustment is that samples have been confined to ART twins and singletons younger than 5 years old (for an exception, see Montgomery et al., 1999). As parenting challenges change as children mature (Ford and Lerner, 1992) and psychosocial demands on children increase as they enter school (Masten and Coatsworth, 1998), it is necessary to monitor ART twins and their families as children age beyond 5 years. Thus, this study compared parent mental health, family relationships and children’s psychosocial adjustment across 6- to 12-year-old ART twins and singletons. Based on the research reviewed above, we expected:

Hypothesis (H): Parents of school-aged ART twins will report more mental health difficulties than parents of singletons.

H2: Parents of school-aged ART twins will have lower parent–child relationship satisfaction compared with parents of singletons.

H3: Parents of school-aged ART twins and singletons will have similar couple relationship satisfaction.

Materials and Methods

Participants

Eligible families had twins or singletons that were conceived using ART and born between 1998 and 2004. Although medically distinct procedures, this study includes families that have conceived a child via intratruine insemination (IUI), IVF or ICSI under the general ART heading. Participants were recruited from a metropolitan Midwestern US university reproductive endocrinology clinic. Most participants lived in the Midwest (94%), although families living across the country (e.g. New York to California) were included. Of eligible families (n = 306 families), 86% were located and 82% participated. This resulted in a sample of 214 families, which was further reduced by 8 families due to missing child data. This created a final study subsample of 206 families with 300 6–12-year-old ART children (53% were female; M child age = 8.49 years, SD = 1.42, min age = 6.05 years, max age = 12.94 years; n = 124 twins from 62 pairs, n = 176 singletons); 30.1% of families in this subsample had twins. Based on the parent report, 3.67% of the children were conceived via IUI, 43.6% via IVF, 51.33% via ICSI and 1.33% had missing data for parent-reported ART procedure.

On average, families included M = 2.21 children (SD = 0.90). Almost three-fourths (73.03%) of the singleton children had at least one sibling (M = 1.13 siblings, SD = 0.97, min = 0 siblings, max = 4 siblings). Approximately 40% (41.94%) of the twin children had at least one non-twin sibling (M = 0.58 non-twin siblings, SD = 0.80, min = 0 non-twin siblings, max = 3 non-twin siblings). Siblings may have included ART or non-ART children of any age; however, only data on ART children 6–12 years old were collected and utilized in this study. Table I and the Preliminary Analysis section provide additional demographic comparisons between 6- and 12-year-old ART twin and singleton children.

Within the 206 families, most participating parents (96.6%) and their partners (89.7%) were White. Most families were headed by a heterosexual couple (n = 198; 96.1%); however, seven families (3.4%) included a same-sex female couple and one family (0.5%) included a single parent by choice. Of the heterosexual couples, 184 (92.9%) remained married, 4 (2.0%) separated, 8 (4.0%) were divorced and 2 (1.0%) were widows. Consistent with ART user demographics (Katz et al., 2002; Nachtigall et al., 2012), families had above-average incomes and education. For example, incomes ranged from <$10,000 to >$200,000 (median = $100–149,999). Most participating parents (74%) and their partners (66%) held a bachelor’s degree or higher.

Procedure

Families were identified from patient clinic records and contacted to participate in this study using university Institution Review Board approved procedures. Letters introducing the study were sent from the clinic to eligible patients, asking one parent in the family to complete an online survey. In all families, the participating parent was the child’s primary caregiver (99%
mothers; 1% fathers). The survey included demographic questions, information on the participating parent’s mental health, parent–child relationship satisfaction, couple relationship satisfaction and children’s psychosocial adjustment. Participants received a $25 gift certificate for their time.

Measures

Parent’s mental health

The parent’s own mental health, including anxiety and depression, was assessed using the Adult Self-Report Anxious Depressed subscale (ASR; Achenbach and Rescorla, 2003). The ASR has strong test–retest reliability ($r = 0.88$) and demonstrated content and construct validity (Achenbach and Rescorla, 2003). To create the Anxious Depressed subscale, 18 items measured on a three-point scale ($0 = \text{not true to } 2 = \text{very true or often true}$) were summed, such that higher scores indicate more mental health difficulties.

Parent–child relationship satisfaction

Parents reported parent–child relationship satisfaction using an adaptation of the Huston Mantal Opinion Questionnaire (MOQ) (Huston and Vangelisti, 1991). This measure has been adapted previously with demonstrated reliability and validity in assessing parent–child relationship satisfaction (Caughlin et al., 2003). The adaptation consists solely of changing the introductory instructions from asking the participants to describe their relationship with their spouse or romantic partner to asking the participant to describe their relationship with their child. Following the introductory instructions, participants were presented with 11 semantic differential items, each beginning with the statement ‘I would describe my relationship as...’ The first 10 items give opposing adjectives for relationship satisfaction on a seven-point scale (e.g. 1 = hard to 7 = easy; 1 = rewarding to 7 = disappointing; 1 = free to 7 = tied down). The final item reflects global relationship satisfaction (1 = completely satisfied to 7 = completely dissatisfied). The first 10 scale items were reverse coded as necessary, summed and averaged; the mean of the first 10 items was then averaged with the global satisfaction item to create the parent–child relationship satisfaction scale. Higher scores indicate more parent–child relationship satisfaction.

Couple relationship satisfaction

For participants in partnered relationships at the time of data collection, couple relationship satisfaction was measured using the MOQ (Huston and Vangelisti, 1991). The MOQ has demonstrated validity and reliability for assessing couple relationship satisfaction (Graham et al., 2011). Constructed as described above (see parent–child relationship satisfaction), higher scores reflect higher quality couple relationship satisfaction.

Children’s psychosocial adjustment

Three dimensions of children’s psychosocial adjustment were tested in this study: emotional, behavioral and attention problems. Parents reported children’s emotional (CBCL Internalizing subscale), behavioral (CBCL Externalizing subscale) and attention problems (CBCL Attention Problems subscale) using the Child Behavior Checklist (CBCL; Achenbach and Rescorla, 2001). The CBCL has strong content and construct validity and high test–retest reliability ($r = 0.91–0.95$; Achenbach and Rescorla, 2001). Items were scored using a three-point scale ($0 = \text{not true to } 2 = \text{very true or often true}$), where the emotional problems (CBCL Internalizing subscale) measure consists of 32 items, the behavioral problems (CBCL Externalizing subscale) measure has 35 items and the attention problems (CBCL Attention Problems subscale) measure has 9 items. Items were summed such that higher scores indicate more problems.

Covariates

Preliminary data analyses (see Preliminary Analyses section and Table I) and evidence drawn from previous research led to the inclusion of several covariates. For example, parent and family characteristics, such as parent’s age, education (1 = did not complete high school to 7 = doctoral degree) and combined family income ($1 \leq \text{income to } 13 \geq \text{200,000}$), are known to relate to parent mental health (Rich-Edwards et al., 2006) and family relationships (Conger et al., 1994). Moreover, parent-reported children’s age, sex (1 = female, 2 = male) and gestational length ($0 = \text{full term}, 1 = \text{premature}$) are common predictors of child adjustment (Gjone and Novik, 1995; Bongers et al., 2003; Lung et al., 2009). Children born prior to 37 weeks of gestation were considered premature (ACOG, 2004; ASRM, 2012). Although twins were more likely to be premature (see Preliminary Analyses section), only a moderate relationship existed between twins and prematurity ($r = 0.39$; Cohen, 1992), suggesting prematurity could be included in the planned analyses without concerns for multicollinearity. Parent’s mental health was also included as a covariate when comparing family relationships and child psychosocial adjustment across school-aged ART twins and singletons. This covariate was included because research shows that when one parent provides all study information, parent’s mental health at the time of data collection can influence responses and artificially inflate associations between variables (Podsakoff et al., 2003). For example, parents who are depressed during data collection tend to report more negatively across all study measures (Najman et al., 2001; Chi and Hinshaw, 2002).

Table I Demographic differences between assisted reproduction families with 6- to 12-year-old singletons and twins.

<table>
<thead>
<tr>
<th></th>
<th>Singletons ($n = 176$)</th>
<th>Twins ($n = 124$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>Parent participant age (years)</td>
<td>43.18</td>
<td>0.28</td>
</tr>
<tr>
<td>Partner age (years)</td>
<td>44.51</td>
<td>0.38</td>
</tr>
<tr>
<td>Child age (years)</td>
<td>8.45</td>
<td>0.11</td>
</tr>
<tr>
<td>Participant education</td>
<td>4.87</td>
<td>0.08</td>
</tr>
<tr>
<td>Partner education</td>
<td>4.65</td>
<td>0.11</td>
</tr>
<tr>
<td>Family income</td>
<td>9.69</td>
<td>0.20</td>
</tr>
</tbody>
</table>

All means and standard errors reported for singletons and twins reflect marginal means after adjusting for shared family variance using individual nested independent samples t-tests for each demographic variable. Participant and partner education were both measured on a seven-point scale (1 = did not complete high school, 2 = high school diploma, 3 = Some college, 4 = Associate’s degree, 5 = Bachelor’s degree, 6 = Master’s or professional degree, 7 = Doctorate). Family income was measured on a 13-point scale (1 = $<10,000, 2 = $10,000–19,999, 3 = $20,000–29,999, 4 = $30,000–39,999, 5 = $40,000–49,999, 6 = $50,000–59,999, 7 = $60,000–69,999, 8 = $70,000–79,999, 9 = $80,000–89,999, 10 = $90,000–99,999, 11 = $100,000–149,999, 12 = $150,000–199,999, 13 = $200,000 or more).

**$P < 0.01$, ***$P = 0.001$. 

Demographic differences between assisted reproduction families with 6- to 12-year-old singletons and twins.
Missing data

All variables had fewer than 10% missing data. Participants with complete data on all variables were compared with participants missing data on any variable using t-tests and \( \chi^2 \) tests. While minimal, significant differences were found between participants with complete data and those missing data on any variable. Families with missing data had a lower family income \((t = 2.16, P < 0.05)\), although this difference was < 1 point apart on a 13-point family income scale. Additionally, families with missing data had more children than families without missing data \((t = -2.53, P = 0.01)\). Missing data were imputed using study and demographic variables with the expectation maximization function in SPSS 22.0. Imputation is preferred to traditional missing data analysis methods as it accounts for the effects of missing data on statistical inference during the imputation process and produces less biased results (Johnson and Young, 2011).

Data analysis plan

Testing hypotheses H1 – H4 in this study called for comparing means across two groups while controlling covariates. Hypotheses were tested using a series of analysis of covariance (ANCOVAs) tests. The first ANCOVA tested H1 by comparing the mental health of parents of ART school-aged twins and singletons, controlling for parent age and education, family income and child prematurity status. The second and third ANCOVAs tested H2 (comparison of parent–child relationship satisfaction) and H3 (comparison of couple relationship satisfaction), controlling for parent age, education and mental health, family income and child prematurity status. To test H4, the final three ANCOVAs compared school-aged ART twins and singletons’ psychosocial adjustment, including (ANCOVA 4) emotional problems, (ANCOVA 5) behavioral problems and (ANCOVA 6) attention problems, controlling for parent’s mental health and child sex, age and prematurity status.

These analyses were performed using a sample that included multiple children within the same family \((n = 300\) children from 206 families), suggesting the presence of shared family variance (Cook, 2012). Shared variance may be a particular concern in twin families because twins had a shared perinatal environment (Leonard, 2002) and tend to be treated similarly (Fraley and Tancredy, 2012). To account for the inflated F-values that occur because of shared variance, analyses were run using SPSS Mixed Models. Power analyses (Faul et al., 2007) suggest our sample of \( n = 300\) provided > 0.80 power to detect statistically significant effects using alpha \( \leq 0.05\) when the effect size was > 0.16, a small effect (Cohen, 1992).

Results

Preliminary analyses

Prior to assessing the hypotheses, families with school-aged ART twins and singletons were compared on a number of demographic variables. As shown in Table I, parents of ART twins were younger \((F(1, 55) = 9.98, b = 1.16, P < 0.01)\) and less highly educated \((F(1, 161) = 11.19, b = 0.40, P = 0.001)\) than singleton parents. The distribution of children’s gender and prematurity status were also compared between twins and singletons. Of the 124 twins, 68 were female (54.8%) and 56 were male (45.2%); of the 176 singletons, 92 were female (52.3%) and 84 were male (47.7%). There was no difference in the proportion of male and female children by twin status \((\chi^2 = 0.19, P = 0.66)\). Of the twins, 65 were premature (52.4%) and 59 were full term (47.6%); of the singletons, 28 were premature (15.9%) and 148 were full term (84.1%). Twins were significantly more likely to be premature than singletons \((\chi^2 = 45.34, P < 0.001)\).

Results of hypothesis testing

Table II presents the study main effect results (e.g. differences between ART twins and singletons). Results of statistically significant main effects and covariates are reported below.

H1: Parent mental health. As shown in Table II, our expectation that school-aged ART twins would have parents with poorer mental health was not supported. There was no difference between the participating parent of ART twins and singletons on his/her mental health. Among the H1 covariates, increases in parent age \((\beta = 0.19, P = 0.04)\) and family income \((\beta = 0.20, P < 0.01)\) were associated with fewer parent mental health difficulties. Having demonstrated twin status and parent mental health were unrelated, we proceeded to test H2–H4, including parent mental health as a covariate in each ANCOVA to reduce method biases.

### Table II Effects of twin status on parent’s mental health, parent–child relationship satisfaction, couple relationship satisfaction and child psychosocial adjustment.

<table>
<thead>
<tr>
<th></th>
<th>Singletons ((n = 176))</th>
<th>Twins ((n = 124))</th>
<th>(F)</th>
<th>(b)</th>
<th>Effect size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participating parent’s mental health</td>
<td>3.98 0.24</td>
<td>3.94 0.25</td>
<td>0.11</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Family relationships</td>
<td>6.46 0.06</td>
<td>6.41 0.06</td>
<td>0.32</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Parent–child relationship satisfaction</td>
<td>5.84 0.11</td>
<td>5.78 0.13</td>
<td>0.17</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Child psychosocial adjustment</td>
<td>3.54 0.34</td>
<td>2.94 0.37</td>
<td>1.42</td>
<td>0.60</td>
<td>0.14</td>
</tr>
<tr>
<td>Emotional problems</td>
<td>3.47 0.36</td>
<td>2.40 0.35</td>
<td>4.54*</td>
<td>1.08</td>
<td>0.25</td>
</tr>
<tr>
<td>Behavioral problems</td>
<td>2.64 0.23</td>
<td>1.86 0.23</td>
<td>5.75*</td>
<td>0.78</td>
<td>0.28</td>
</tr>
<tr>
<td>Attention problems</td>
<td>3.54 0.34</td>
<td>2.94 0.37</td>
<td>1.42</td>
<td>0.60</td>
<td>0.14</td>
</tr>
</tbody>
</table>

All means and standard errors reported for singletons and twins reflect marginal means after adjusting for shared family variance and covariates.

*P < 0.05.

*Effect sizes were calculated with Wilson’s practical meta-analysis effect size calculator.
H2: Parent—child relationship satisfaction. Our expectation that parent—child relationship satisfaction would be lower in families with school-aged ART twins was also not supported (see Table II). Among H2 covariates, only parent mental health was related to parent—child relationship satisfaction (F(1, 203) = 27.36, b = −0.05, P < 0.001). Thus, parents who were more depressed reported lower parent—child relationship satisfaction than less depressed parents.

H3: Couple relationship satisfaction. Our expectation that couple relationship satisfaction would be similar between parents of school-aged ART twins and singletons was supported (see Table II). Among the H3 covariates, only parent’s mental health was associated with couple relationship satisfaction (F(1, 204) = 23.81, b = −0.11, P < 0.001), indicating that parents who were more depressed had poorer couple satisfaction than less depressed parents.

H4: Children’s psychosocial adjustment. Our expectation that there would be no differences in school-aged ART twins and singletons’ psychosocial adjustment was partially supported (see Table II). While there were no differences in ART twins and singletons’ emotional adjustment, twins (M = 2.40, SE = 0.35) had significantly fewer behavior problems than singletons (M = 3.47, SE = 0.36; F(1, 201) = 4.54, b = 1.08, P < 0.05) (reference: twins). Twins (M = 1.86, SD = 0.23) also had fewer attention problems than singletons (M = 2.64, SD = 0.23; F(1, 156) = 5.75, b = 0.78, P < 0.05) (reference: twins). Although twins had fewer problems than singletons, both twins and singletons were within the normal CBCL score range for children’s emotional (boys: M = 5.10, SD = 4.80; girls: M = 6.00, SD = 5.00), behavioral (boys: M = 6.60, SD = 6.00; girls: M = 6.10, SD = 5.60) and attention problems (boys: M = 3.80, SD = 3.4; girls: M = 3.20, SD = 2.70; Achenbach and Rescorla, 2001).

Several H4 covariates were significant. An increase in parent mental health difficulties was related to greater emotional (F(1, 176) = 23.90, b = 0.30, P < 0.001), behavioral (F(1, 194) = 17.71, b = 0.25, P < 0.001) and attention problems in children (F(1, 160) = 11.96, b = 0.14, P = 0.001). Older children were more likely to have emotional problems (F(1, 274) = 4.27, b = 0.32, P < 0.05). Boys (M = 2.66, SE = 0.23) were more likely to have attention problems than girls (M = 1.84, SE = 0.21; F(1, 281) = 7.83, b = −0.82, P < 0.01) (reference: male). Finally, children born prematurely had higher rates of attention problems (M = 2.64, SD = 0.28) than children born at full term (M = 1.86, SD = 0.19; F(1, 177) = 5.04, b = −0.78, P < 0.05) (reference: prematurity).

Post hoc analyses
To further examine the combined effect of twin status and prematurity on children’s attention problems, children were assigned to one of four groups: 1 = premature singleton, 2 = full-term singleton, 3 = premature twin and 4 = full-term twin. Level of attention problems was then compared across the groups (reference group: full-term twins). Full-term twins had significantly fewer attention problems (M = 1.37, SE = 0.33; F(1, 222) = 2.65, P = 0.05) than premature twins (M = 2.32, SE = 0.32, b = 0.95, P < 0.05), full-term singletons (M = 2.25, SE = 0.21, b = 0.88, P < 0.05) and premature singletons (M = 2.84, SE = 0.49, b = 1.47, P = 0.01). There were no significant differences between the other groups. These findings show that full-term twins averaged the fewest attention problems and premature singletons averaged the most attention problems.

Discussion
Twins are considered a negative outcome of assisted reproduction (Kalra and Barnhart, 2011; ASRM, 2012), and research on families with young ART children suggests there should be concern for twins (Adamson and Baker, 2004; Zollner and Dietl, 2013) and their families (Holditch-Davis et al., 1999; Glazebrook et al., 2004; Olivennes et al., 2005; Vilska and Unkila-Kallio, 2010; Ross et al., 2011). This study indicates that by the time children reach school age, no differences exist between families with ART twins and singletons for parent’s mental health, family relationships or children’s emotional problems. School-aged ART twins also had fewer behavioral and attention problems than singletons. In the upcoming sections, we discuss how ART twins’ adjustment findings relate to the adjustment of school-aged twins born without medical assistance, the effects of twin status and prematurity on child adjustment and how developmental periods may influence the adjustment of twin families.

Comparisons with school-aged twins born without medical assistance
Although our twin psychosocial adjustment results are somewhat surprising given the perinatal and other risks for families with young ART twins (c.f., Olivennes et al., 2005; ASRM, 2012), studies on school-aged twins born without medical assistance bolster confidence in this study’s findings. With one exception (Hay and O’Brien, 1987), 6- to 12-year-old twins and singletons born without medical assistance often have similar psychosocial adjustment (Lyttton et al., 1987; Gjone and Novik, 1995; Moilanen et al., 1999; Pulkkinen et al., 2003; Robbers et al., 2010, 2011) or twins have more positive adjustment, including more pro-social behavior and fewer internalizing, behavioral or attention problems than singletons (Moilanen et al., 1999; Pulkkinen et al., 2003; Robbers et al., 2010). Although results for 6- to 12-year-old twins conceived via ART and without medical assistance suggest twins may have similar or more positive psychosocial adjustment, studies have yet to identify mechanisms for these findings. Future studies should examine the environments of twin families to identify variables related to more positive twin adjustment in middle childhood, especially considering known and hypothesized risks for twins and their families (c.f., Rutter and Redshaw, 1991; Baor and Blickstein, 2005; Olivennes et al. 2005). It is important to note, however, that twins and singletons typically function within normal ranges (Achenbach and Rescorla, 2001).

Twin status and perinatal factors
Perinatal factors, such as prematurity and low birthweight, are a primary concern related to twins (Adamson and Baker, 2004; Zollner and Dietl, 2013). Furthermore, studies on twins born without medical assistance suggest that the social implications of being a twin (e.g., twin status) and perinatal factors both have direct effects on child psychosocial adjustment (Lyttton et al., 1987; Alin Akerman and Fischbein, 1991; Rutter et al., 2003; Feldman and Eidelman, 2004; Feldman et al., 2004; Brouwer et al., 2006; Christensen et al., 2006; Lung et al., 2009), suggesting perinatal factors should be included as study covariates. However, studies on the adjustment of ART twins have not assessed twins’ psychosocial adjustment after accounting for perinatal factors (c.f. Montgomery et al., 1999). The present study did account for both variables and in doing so found twin status was associated with fewer behavior and
attention problems. Prematurity was associated only with children’s attention problems.

Closer examination of the effects of twin status and prematurity on attention problems suggested that full-term twins had significantly fewer attention problems than premature twins, full-term singletons and premature singletons. Although we cannot know from this study’s findings, it is possible that adverse perinatal factors in twins and singletons have unique causes that differentially affect child adjustment (Phillips et al., 2001). Research is needed to test the joint effects of twin status and prematurity in ART twins on children’s attention problems, with emphasis on understanding why premature singletons have the highest rate of attention problems.

Developmental change: will stressors and adjustment change over time?

The literature on ART families with infant and toddler-aged twins is clear: twin families have less adaptive parent mental health and parent–child relationships quality (Holditch-Davis et al., 1999; Baor et al., 2004; Ellison et al., 2005; Olivennes et al., 2005; Freeman et al., 2007; Vilska and Unkila-Kallio, 2010; Ross et al., 2011). However, this study suggests school-aged ART twins and their families are doing well. To explain this phenomenon, we draw from developmental systems theory (DST; Ford and Lerner, 1992). As children grow and mature through developmental periods, DST suggests parents’ well-being and family relationships are constantly changing in response to children’s developmental stressors. For example, in middle childhood, children have entered full-day school programmes (Entwisle et al., 1988; Perry and Weinstein, 1998) and are increasingly more self-reliant (Masten and Coatsworth, 1998). These changes could result in fewer direct caregiving demands (Blau and Currie, 2006), which may allow stay-at-home parents to return to work or rekindle relationships within their social networks. In turn, this may reduce social isolation through improved social support, which serves as a protective factor in parent mental health and family relationships (Robertson et al., 2004; Baor and Soskolne, 2012). Additional research is needed to test these developmental explanations for why families with ART twins are functioning well in middle childhood.

Moreover, DST recognizes that developmental changes will continue to affect families with twins into adolescence, the next developmental period, which may bring different stressors to families with ART twins (Ford and Lerner, 1992). For example, it is possible the financial stress of simultaneously contributing to two college saving programmes may again alter the adjustment of ART twins and their families. For this reason, we emphasize the importance of continuing to monitor the lives of ART twins so we may provide guidance to couples considering the implications of twin births.

Study strengths and limitations

This study has a number of strengths increasing confidence in results. Results were based on a large sample of ART families (N = 206 families, n = 300 children) with a strong recruitment rate (82%). Thus, statistical power was adequate to detect small significant effects when they did exist (Cohen, 1992). This study also accounted for demographic covariates that are known influences of parent mental health, family relationships and child psychosocial adjustment (c.f., Conger et al., 1994; Bongers et al., 2003; Rich-Edwards et al., 2006; Lung et al., 2009). Inclusion of these covariates ensures that significant results were due to the influence of raising multiple same-aged children instead of to variables spuriously related to dependent variables.

A third study strength is related to our use of data on all children within the same family. In families with twins, the influence and adjustment of multiple same-aged children is paramount. Without utilizing data on each child, unintended biases are created. For example, including only the most difficult twin may inflate the negative adjustment of twins by not including data on well-functioning twins. Of course, the utilization of multiple children within the same family requires that statistical methods accounting for shared family variance be used (Cook, 2012). We consider it a strength of this study to utilize data on all 6- to 12-year-old ART children in the family while statistically accounting for shared variance.

Of course, assessing all eligible children meant we also assessed children across the length of middle childhood, and children at the ends of this age range may be developmentally distinct. Concerns about the effect of developmental differences are partially mitigated by our inclusion of children’s age as a covariate. For example, we found that, as one might expect from general population research (Bongers et al., 2003), children’s emotional problems are positively associated with child age. This finding suggests future research should more closely examine the influence of age on ART children’s adjustment.

Limits to generalizability and clarifications for future research should also be considered. Although a sample representative of the clinic from which it was drawn, this study drew data from one clinic in the USA. However, the percentage of twins in this study is similar to the US twin birth rate for families using ART (CDC, 2010), and demographic information mirrors the population of US ART patients: high income and highly educated White families (Katz et al., 2002; Nachitagil et al., 2012). While caution should be taken when generalizing results, examination of demographic data suggests that families in this study are similar to other families that use ART in the USA. Finally, maternal reports of highly wanted children’s psychosocial adjustment may be prone to social desirability bias. Despite this, previous studies on ART children have shown consistent findings between parent and teacher reports (c.f., Golombok et al., 1996; Tully et al., 2003), and parents of ART twins do report socially undesirable traits such as mental health difficulties (c.f. Olivennes et al., 2005). To further minimize biases occurring because of single informant data (Podsakoff et al., 2003), this study accounted for parent’s mental health at the time of data collection in ANCOVAs assessing family relationships and child psychosocial adjustment.

However, this study only included information about the mental health of one parent, but twins and singletons may differentially affect mother’s and father’s mental health (Vilska and Unkila-Kallio, 2010). Thus, future research should examine the mental health of both parents with ART twins and singletons in middle childhood. Additionally, our data did not include identification of monozygotic and dizygotic twins. Because monozygotic twins and their parents may experience more marital and child adjustment difficulties than dizygotic twins or singletons and their parents (Lytton et al., 1987; Sandbank, 1988; van den Oord et al., 1995), twin zygosity is an important covariate to consider in future studies. Finally, future research should consider the influence of siblings who may be present in a family. For example, parenting twins and a singleton child simultaneously may bring additional family challenges (Ellison and Hall, 2003). Moreover, families with singleton siblings closely spaced in age may have different family relationship patterns and adjustment compared with twin children (Thorpe et al., 2003). While
this study provides vital information about differences in parent’s mental health, family relationships and child adjustment between twin and singleton children, future research should examine the influence of various child configurations in a family on ART child and family adjustment.

**Conclusion**

Although concerns about young ART twins and their families are persistent in the literature (Holditch-Davis et al., 1999; Glazebrook et al., 2004; Baor and Blickstein, 2005; Olivennes et al., 2005; Freeman et al., 2007; Vilska and Unkila-Kallo, 2010), this first study of 6- to 12-year-old ART twins suggests that families with school-aged twins are doing well. Consistent with the literature on twins born without medical assistance (Moilanen et al., 1999; Pulkkinen et al., 2003; Robbers et al., 2010; Barnes and Boutwell, 2013), middle childhood appears to be a period of relative stability for ART twins and their families. Continued monitoring of ART twin families as they move through subsequent developmental periods will ensure couples considering the implications of assisted reproduction have adequate information about parenting twins.

**Authors’ roles**

K.N.A., M.A.R. and B.D.K. were responsible for data analysis and interpretation. M.A.R., J.J.C., A.F.K. and M.D. were responsible for conception, design and acquisition of data. K.N.A. and M.A.R. were responsible for primary article content; B.D.K., J.J.C. and A.F.K. revised the article critically for important content. All authors approved this article.

**Funding**

This research is based on a collaborative research effort supported by University of Minnesota Agriculture Experiment Station Project Number MN-52-107, a University of Minnesota Grant-in-Aid of Research, Artistry and Scholarship grant, a University of Minnesota College of Education and Human Development Research Development Investment Grant and the M. Janice Hogan Fellowship from the Department of Family Social Science at the University of Minnesota.

**Conflict of interest**

The authors of this article have no commercial or corporate interests to declare.

**References**


