Age at first birth, mode of conception and psychological wellbeing in pregnancy: findings from the parental age and transition to parenthood Australia (PATPA) study

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Introduction

Older maternal age at first birth is now a well-established demographic trend in high-income countries. Older women are more likely to experience fertility problems and require assisted reproductive technology (ART) to conceive. Data from ART clinics in Australia (Wang et al., 2009), Europe (Ziebe and Devroey, 2008), the USA (Gleicher et al., 2007) and Canada (Reproductive Health Working Group, 2006) confirm increases in both the number and average age of women receiving ART. This paper presents the first report from a prospective Australian study that aims to provide contemporary evidence on the experience of first-time pregnancy and parenthood at an older age. An important contribution is the inclusion of both women who conceive spontaneously (SC women) and women conceiving through ART at different ages.
Definitions of ‘older’ mothers vary in the research literature. Some studies focus on chronological age and the social meanings and consequences of having a baby at different ages (Billari et al., 2010), whereas others focus on biological ageing and reproductive consequences. A cut-off of ≥35 years, when age-related infertility becomes more common, is used to define ‘older’ in many studies with a biological focus (Collins and Crosignani, 2005), whereas recent studies of psychological adjustment related to maternal age in women conceiving through ART have defined older mothers as 38 years or older (McMahon et al., 2007; Boivin et al., 2009). Gleicher et al. (2007) argue that ‘the age of 37–38 years, when the female fertility decline accelerates, would appear a more logical point of definition for the beginning of advanced reproductive age’ (p. 640). Mirowsky and Ross (2002) analysed age-related associations between depression in women and parenthood in a large sample (n = 2592) and found a parabolic association with higher depression scores reported by women who had first babies at younger and older ages, and optimal scores for those giving birth at 30 years. They noted that the psychosocial benefits of older maternal age may cease to apply after the age of 36 years.

In this prospective study, we used projected age at the expected date of delivery to derive age groups to enable comparisons with other large databases of published maternal age data in Australia (e.g. Births, Australia, 2009) and defined older mothers as 37 years or older and younger mothers as 20–30 years of age for descriptive purposes; however, we test our study hypotheses using age as a continuous variable.

The biological context of pregnancy changes with increasing maternal age. As they age, women are more likely to experience fertility difficulties and need ART to conceive (Collins and Crosignani, 2005). There is a linear decline in live birth rates per ART cycle with increasing age as well as greater likelihood of conception using donated eggs or embryos, and multiple pregnancies (Wang et al., 2009). Furthermore, rates of miscarriage and pregnancy complications, such as hypertension, diabetes, placental abruption and placenta previa, increase with older maternal age (Heffner, 2004, Joseph et al., 2005).

Understanding the impact of this biological risk context on general mood, specific anxiety about the pregnancy and feelings of attachment towards the unborn baby is important given growing research evidence of associations between anxiety in pregnancy and less optimal cognitive, temperamental and behavioural outcomes in infants during the first post-natal year (see Talge et al., 2007, for a review). A systematic review of psychological aspects of pregnancy after ART (Hammarberg et al., 2008) concludes that compared with SC women, women conceiving through ART consistently report fewer depressive and general anxiety symptoms, but higher anxiety about the pregnancy outcome and fetal health. Study findings regarding fetal attachment after ART are inconclusive with some studies reporting no differences compared with SC women from a similar socio-economic background (e.g. McMahon et al., 1997; Hjelmstedt et al., 2006) and others (Fisher et al., 2008) reporting higher scores on a measure of maternal–fetal attachment for women pregnant as a result of ART compared with data from a normative sample. Studies of women conceiving through ART typically control for maternal age, however, and most have not taken adequate account of the psychosocial and reproductive history factors associated with ART conception. Further, studies of women conceiving through ART frequently exclude women with multiple pregnancies and/or donated gametes (Hammarberg et al., 2008).

Few studies, to date, have focused explicitly on the impact of maternal age on psychological adjustment during pregnancy. Berrymann and Windridge (1996) reported that after controlling for parity, education and occupational status, older mothers (>35 years) reported lower levels of maternal–fetal attachment than did younger mothers (women in their 20s) at mid-pregnancy, but these differences were no longer apparent in late pregnancy. No measures of pregnancy-focused (P-F) anxiety, pregnancy complications or prior pregnancy loss were included in this study, and infertility history and mode of conception were not reported. More recently, McMahon et al. (2007) compared older (>38 years) and younger (≤35 years) women conceiving with ART on various indices of adjustment during pregnancy. There were no age differences for mood state and, contrary to prediction, no age differences were observed in anxiety about the pregnancy outcome or fetal attachment, assessed in the third trimester. This may have been related to limited statistical power in this small sample (n = 67) and the relatively small age difference between the age groups. Further, since all women in the McMahon et al. (2007) study conceived using ART, it is possible that the impact of infertility and ART outweighed any age differences. The current study therefore addresses a gap in the literature by examining maternal age effects in SC women as well as those who conceive through ART.

The role of psychosocial factors in attenuating the impact of biological risk for older mothers has not yet been empirically investigated. Although several studies of parenting have demonstrated that psychological maturity (generally conceptualized as adaptive competence and flexibility) is associated with more sensitive child-centred parenting (see Belsky and Barends, 2002, for a review), few have examined associations between maturity and maternal age, and studies have not yet explored whether psychological maturity influences the relationship between age and pregnancy adjustment. McMahon et al. (2007) found that compared with their younger counterparts (aged <35 years), older mothers (aged 38 years and older) conceiving through ART scored higher on psychological hardness (Maddi and Khoshaba, 2001), a measure that assesses adaptive flexible responsiveness to stress, characterized by commitment, a sense of control and enjoyment of challenge.

It is well recognized that stable supportive intimate relationships are advantageous during the transition to parenthood (Belsky and Barends, 2002). However, the relationship context of pregnancy, presumed to be more stable, may in fact be more complicated for older compared with younger women. Given trends to delay partnering (Birrell et al., 2004), older first-time parents may embark on pregnancy after a relatively short time together or while in a de facto relationship. Further, older women having first babies are more likely to be in a second marriage and/or have a partner who already has children, factors which may increase relationship tension during the transition to parenthood (Khesgi-Genovese and Genovese, 1997). One study notes that older mothers conceiving through ART and their partners (with children aged 4–9 years) reported less expressive warmth in their partner relationship compared with younger mothers and their partners (Boivin et al., 2009).

This paper is the first report from the Parental Age and Transition to Parenthood Australia (PATPA) study, a prospective study that...
seeks to examine the impact of maternal age and mode of conception on adjustment during the transition to parenthood. The study design acknowledges the complex interactions among age-related biological and socio-economic factors and their likely influence on the magnitude and nature of age effects on the outcomes of interest. First, we describe relationships between maternal age, mode of conception and demographic and psychosocial factors that may influence adjustment during pregnancy. Next, we test a model to investigate whether age and mode of conception effects are mediated by these contextual factors. Given considerable medical concern regarding delayed childbearing (e.g. Bewley et al., 2005), we have chosen to test the proposition that adjustment during pregnancy for older mothers will be more problematic.

Materials and Methods

Procedure

The ethics committees at Macquarie University, University of Melbourne, relevant hospitals and the participating ART clinics provided approval for the study. Our stratified sampling strategy involved recruiting approximately equal numbers of women who were in the third trimester of pregnancy and had either conceived through ART or SC across three age groups based on expected age at delivery: ‘younger’, 20–30 years; ‘middle’, 31–36 years; and ‘older’, ≥37 years. Inclusion criteria were intentionally broad (e.g. women with donor eggs, embryos, twin pregnancies, single women using donor sperm and ART were included) to ensure a representative sample of older mothers and women using ART to conceive. Nulliparous women aged 20 years or older in metropolitan Sydney and Melbourne were informed of the study through ART clinics and through antenatal clinics and classes in public and private hospitals co-located or associated with the ART clinics. Only women with inadequate English to complete the study measures were considered ineligible. Participation involved a computerized telephone interview and the completion of questionnaires in pregnancy (current paper) and at 4 months after the birth. A priori power calculations focused on group differences between age groups. For the present analyses, a power calculation using G*Power (Buchner et al., 1997) based on the regression effect size and 18 potential predictors (effect size $f^2 = 0.15, \alpha = 0.05$, power $= 0.95$) demonstrated a minimum total sample size of 213, which was exceeded.

Participants

The participation rate was 67% (793 of 1179 women approached), and 78% (619 of 793 consenting women) completed both interview and questionnaire measures during the third trimester of pregnancy. The 98 women who were interviewed and subsequently did not return questionnaires in pregnancy (current paper) and at 4 months after the birth. A priori power calculations focused on group differences between age groups. For the present analyses, a power calculation using G*Power (Buchner et al., 1997) based on the regression effect size and 18 potential predictors (effect size $f^2 = 0.15, \alpha = 0.05$, power $= 0.95$) demonstrated a minimum total sample size of 213, which was exceeded.

Any medical assistance. It should be noted that in Australia, ART is well subsidized by the national universal tax-payer funded Medicare and Pharmaceutical Benefit Schemes and therefore more affordable than in most other countries.

Materials

Interview: pregnancy context variables

Socio-economic and reproductive history variables. During a computer-assisted telephone interview conducted in the third trimester, participants provided information on education, current employment and occupational status, language spoken at home, marital status, whether previously married, whether they had stepchildren and home ownership. They were also asked about time to conceive, number of ART attempts, whether the pregnancy was intended, multiple pregnancy, prior miscarriages or induced abortions, and presence of gestational complications, such as hypertension, gestational diabetes and bleeding. Data regarding the use of donor gametes were collected from medical records at the ART clinics.

Questionnaires

Anxiety. Anxiety was assessed with the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983). The STAI consists of two 20-item parts addressing current (state) and general (trait) feelings of anxiety and worry. Scores for each item range from 1 to 4 with higher total scores indicating greater anxiety. Cronbach’s $\alpha$ coefficients in this sample were 0.86 and 0.91 for the state and trait measures, respectively. Previous Australian research with pregnant women has confirmed that a score of >40 on the A-Trait and A-State measures is indicative of clinically significant anxiety (Grant et al., 2008).

Depression. Depression was assessed using the 10-item Edinburgh Postnatal Depression Scale (Cox et al., 1987). Scores for each item range from 0 to 3, yielding a possible total score between 0 and 30. Higher scores denote more depressive symptoms. The measure has also been validated for use in pregnancy, where scores ≥13 and ≥15 indicate minor and major depression, respectively (Murray and Cox, 1990). In pregnancy, and in this paper, the measure is referred to as the Edinburgh Depression Scale (EDS). Cronbach’s $\alpha$ in the current study was 0.86.

P-F anxiety. Participants completed the five-item ‘Anxiety concerning Health and Defects in the Child’ scale from the Baby Schema questionnaire (Gloger-Tippelt, 1983). Responses are rated on a six-point scale ranging from 1 (strongly disagree) to 6 (strongly agree), with higher scores indicating more anxiety. The scale has good reliability, with Cronbach’s $\alpha = 0.89$ in the current sample. Previous research shows a low but significant correlation with the A-state measure (McMahon et al., 2007).

Maternal–fetal attachment. The extent to which pregnant women engage in behaviours and thoughts that represent an affiliation with their unborn child was measured using the Maternal–Fetal Attachment Scale (MFAS; Cranley, 1981). Items are scored on a five-point Likert scale ranging from 0 (definitely no) to 4 (definitely yes) with higher scores indicating more intense attachment (but note transformation in data analysis). One item ‘I keep wondering what sex the baby is’ was removed as many contemporary mothers would know the sex of their baby. The Cronbach $\alpha$ coefficient for the amended scale was 0.81.

Proposed mediator variables

Hardiness. The Personal Views Survey (3rd edn, rev., or PVS-III-R; Maddi and Khoshaba, 2001) is an 18-item measure designed to assess
psychological hardiness, a construct similar to resilience which taps the ability of individuals to turn stressful circumstances into growth-inducing experiences. Items are rated on a four-point scale from 0 (not at all true) to 3 (very true). Higher scores indicate more hardiness (resilience). Reliability for the total questionnaire was 0.80 in the current sample.

Quality of intimate partner relationship. The 24-item Intimate Bonds Measure (IBM: Wilhelm and Parker, 1988) assesses two dimensions of the perceived quality of the partner relationship: the care dimension (IBM Care) gauges expressed warmth and affection, whereas the control dimension (IBM Control) assesses the extent to which the partner tends to control or criticize. Items are rated on a Likert scale (0–3) and higher scores indicate higher perceived care (more optimal) and control (less optimal), respectively (but see transformation in data analysis). The Cronbach’s alphas were 0.93 and 0.83 for IBM Care and IBM Control, respectively.

Statistical analyses
Less than 5% of questionnaire items were missing. We prorated when there were fewer than 10% of items missing and for the P-F anxiety measure where one-fifth of the items was missing; however, reliability for this scale was high (α = 0.89). As data screening revealed significant skewness (≥2.58, P < 0.001) towards more positive adjustment on EDS depression, STAI anxiety and MFAS attachment, a square root transformation was applied to these variables. IBM Care and IBM Control variables were more extremely skewed (also towards favourable adjustment) and a logarithmic transformation was applied. Because IBM Care and MFAS attachment were negatively skewed (most scores at the top end of distribution), scores were reflected before transformation such that higher scores on transformed variables indicate less favourable adjustment. These variables have been relabelled R-IBM Care and R-MFAS to remind the reader of reverse scoring. Three outliers (extreme low scores) detected on hardiness were changed to scores within three SDs of the mean (i.e. Winsorized). The A-State and A-Trait measures were highly correlated (r = 0.75) so analyses used only the state measure. P-F anxiety had a low but significant correlation with A-State (r = 0.28), P < 0.05. All data analyses are calculated on transformed scores. To allow cross-study comparisons, data values in tables were untransformed. For all analyses, probability values P ≤ 0.05 were considered significant.

Results
After recruitment, 27 women (8 aged 20–30 years; 10 aged 31–36 years and 9 aged ≥37 years) reported fertility treatment (ovulation induction or artificial insemination without IVF) and were excluded as they did not meet criteria for either ART (Zegers-Hochschild et al., 2006) or SC. Thus, the final sample for this paper comprised 592 women: 178 in the younger age group (mean = 28.4 years, SD = 2.0, range = 20–30); 218 in the middle age group (mean = 33.6 years, SD = 1.8, range = 31–36) and 196 in the older age group (mean = 39.4 years, SD = 2.2, range = 37–51). We had aimed to sample approximately equal numbers of ART and SC women in each age group. This objective was achieved for the middle age group (47% ART); however, the younger age group comprised 31% and the older age group 71% of women, respectively, who conceived through ART.

Socio-economic context
χ² analyses were used to compare the three age and two mode of conception groups for categorical variables and one-way analysis of variance and t-tests were used for continuous variables. There were few between-group differences and significant differences are summarized below.

Age group differences
Younger mothers were less likely to have purchased a home (61% compared with 75 and 77% in the middle and older age groups, respectively), and less likely to be employed in a professional occupation (65% compared with 76 and 83% in the middle and older groups, respectively). Older mothers differed from the other two age groups with regard to the relationship context: they were the least likely to be married (70% compared with 83% in the middle and 81% in the younger age groups). Forty per cent of mothers in the older age group had been previously married compared with 22% in the middle and 7% in the younger age groups. Mothers in both the middle and older age groups were more likely than younger mothers to have stepchildren [all χ² values (df = 2) were >10.0; all P < 0.025].

Mode of conception differences
Eighty-five per cent of women conceiving through ART had purchased a home compared with 63% of SC women. Women conceiving through ART were more likely than SC women to be married (85 versus 73%, respectively) and less likely to be in the paid workforce in the third trimester of pregnancy (70% ART versus 88% SC) [all χ² values (df = 1) were >4.0; all P < 0.025].

Reproductive history
Age group differences
Time to conceive the pregnancy increased across the young, middle and older maternal age groups, irrespective of mode of conception (SC: 3, 6 and 14 months, respectively; ART: 30, 35 and 39 months, respectively), F(2,591) = 10.7, P < 0.001. Older women were more likely to have experienced prior miscarriage compared with women in the middle and younger age groups (36% versus 22 and 19%, respectively) with similar results for termination (22% versus 12 and 10%, respectively). Among SC women, those from the younger (28%) and older age groups (26%) were more likely than those in the middle age group (16%) to have an unintended pregnancy [all χ² values (df = 2) were >6.0; all P < 0.025].

Among women conceiving through ART, those in the older age group required more treatment cycles to achieve a pregnancy (older: mean = 4.3 cycles, SD = 4.7; middle: mean = 3.1 cycles, SD = 2.8; younger: mean = 2.4 cycles, SD = 1.9), F(2,295) = 6.21, P < 0.001. Older mothers were also more likely than their younger counterparts to conceive using donor gametes (older 18%, middle 3% and younger 2%). All χ² values (df = 2) were >12.0; all P < 0.001.

Mode of conception differences
As expected, women conceiving through ART took longer (mean = 35.22 months, SD = 25.47) to conceive than SC women (mean = 25.47 months, SD = 15.60), t(590) = −5.80, P < 0.001.
Data from Supplementary data, Tables S1 and S2, for full details on demographics and reproductive history.

Pregnancy adjustment

Age group differences

Women conceiving through ART were more likely to have experienced a previous miscarriage (ART 32%, SC 17%) and to report at least one gynecological complication (e.g., bleeding, hypertension, gestational diabetes) in the current pregnancy (ART 36%; SC 27%); all values (df = 1) were P ≤ 0.025. As these differences in reproductive history may influence the overall experience of pregnancy, they were examined as potential mediators in multivariate analyses. See Supplementary data, Tables S1 and S2, for full details on age and mode of conception differences in demographic variables.

Women conceiving through ART had lower (more optimal) scores for P-F anxiety (Table I). Overall, 8% of women reported EDS depression scores ≥ 13. ART women differed, however, in reporting higher (less optimal) scores for hardiness compared with mothers in the middle age group reporting higher depression scores than those in the middle and younger age groups. It should be noted, however, that mean scores were well below the clinical cut-off, indicating marginally suggestive possible clinical depression and 15% reported A-State scores in the clinical range. There were no significant age group differences in the proportions of women with EDS and pregnancy-focused anxiety scores in the probable clinical range. There were no significant age group differences in reproductive history may influence the overall experience of pregnancy.

There was a significant age group difference on R-MFAS fetal attachment scores for perceiving their partner as controlling. Mode of conception differences

Table I Results from study of age at first birth, mode of conception and psychological wellbeing in pregnancy, showing mean (SD) values for dependent and mediator variables according to age group and mode of conception.

<table>
<thead>
<tr>
<th>Age group at expected date of delivery (range)</th>
<th>≤30 years, M = 28.4, SD = 2.0 (20–30)</th>
<th>31–36 years, M = 33.6, SD = 1.8 (31–36)</th>
<th>&gt;37 years, M = 39.4, SD = 2.2 (37–51)</th>
<th>ART (total)</th>
<th>SC (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
</tr>
<tr>
<td>Dependent variables</td>
<td></td>
<td></td>
<td></td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
</tr>
<tr>
<td>STAI state anxiety (n = 590)</td>
<td>31.0 (7.0)</td>
<td>33.1 (8.6)</td>
<td>32.4 (8.0)</td>
<td>30.0 (7.0)</td>
<td>32.7 (9.6)</td>
</tr>
<tr>
<td>EDS depression‡ (n = 591)</td>
<td>5.3 (4.0)</td>
<td>6.3 (4.7)</td>
<td>6.0 (4.5)</td>
<td>4.4 (4.1)</td>
<td>4.6 (4.1)</td>
</tr>
<tr>
<td>P-F anxiety‡ (n = 582)</td>
<td>18.1 (6.1)</td>
<td>17.6 (6.3)</td>
<td>17.7 (6.1)</td>
<td>18.8 (6.5)</td>
<td>17.8 (6.3)</td>
</tr>
<tr>
<td>MFAS‡ (n = 592)</td>
<td>71.1 (8.7)</td>
<td>68.6 (9.9)</td>
<td>69.4 (9.6)</td>
<td>66.4 (11.6)</td>
<td>66.9 (10.3)</td>
</tr>
<tr>
<td>Psychosocial mediator variables (mean, SD)</td>
<td></td>
<td></td>
<td></td>
<td>ART, SC, Total</td>
<td>ART, SC, Total</td>
</tr>
<tr>
<td>Hardiness‡ (n = 583)</td>
<td>38.4 (5.8)</td>
<td>39.0 (5.3)</td>
<td>38.8 (5.5)</td>
<td>41.6 (7.2)</td>
<td>41.5 (6.0)</td>
</tr>
<tr>
<td>IBM Care‡,1 (n = 581)</td>
<td>32.6 (4.7)</td>
<td>32.6 (4.4)</td>
<td>32.6 (4.5)</td>
<td>30.9 (6.6)</td>
<td>30.6 (7.7)</td>
</tr>
<tr>
<td>IBM Control‡,1 (n = 572)</td>
<td>3.9 (4.4)</td>
<td>4.8 (5.3)</td>
<td>4.6 (5.0)</td>
<td>4.1 (4.8)</td>
<td>3.7 (3.8)</td>
</tr>
</tbody>
</table>

ART, assisted reproduction techniques; SC, spontaneous conception; STAI, State-Trait Anxiety Inventory; EDS, Edinburgh Postnatal Depression Scale; P-F anxiety, pregnancy-focused anxiety; MFAS, Maternal Fetal Attachment Scale.

†Analyses were conducted using transformed values but means are from untransformed data.
‡Women without a partner did not complete IBM Care (n = 581) and IBM Control (n = 572).
*Women without a partner did not complete IBM Control.

1Age groups differ at P < 0.05; cells with different superscripts are significantly different.
Multivariate analyses

Next, we examined relationships between age (as a continuous variable) and the dependent variables (i.e. EDS, STAI, P-F anxiety and R-MFAS attachment), as well as the potential mediator variables (demographic variables, reproductive history variables, hardiness, R-IBM Care and IBM Control). In order to test for mediation, predicted age at birth should be related to the dependent variables and to the potential mediators (i.e. mode of conception and other demographic, psychosocial and reproductive history variables) and these mediators should be significantly related to the dependent measures (Baron and Kenny, 1986).

Mediation and moderation

As we wanted to disaggregate the effects of predicted age at birth from mode of conception as well as from the more generic mediators, we built a hierarchical regression model using the following sequence of entry: predicted age at first birth (Step 1), mode of conception (Step 2), interaction between age at birth and mode of conception (Step 3a) and mediators (Step 3b). Only mediators that showed marginal or significant associations with the dependent measure at the univariate level were included. Table II shows correlations between predicted age at first birth (column one) and mode of conception (column two) and proposed mediator variables, as well as summary results for the hierarchical regression analyses. Age at first birth was significantly correlated with all mediators except twin pregnancy and the presence of one or more gestational complications. Mode of conception was significantly correlated with a subset of mediators: marital status, previous marriage, home ownership, prior miscarriage, time to fall pregnant, likelihood of multiple pregnancy and gestational complications.

All regression models were significant with 7.2–22.6% of variability in the psychosocial adjustment measures explained by study variables. Expected age at birth was correlated with all dependent variables except for P-F anxiety as shown by significant standardized coefficients for the main effect of age (Step 1). Specifically, older maternal age was associated with lower scores on the measures of depression symptoms, state anxiety and maternal–fetal attachment. When mode of conception was entered into the model (Step 2), it attenuated the association between age and state anxiety, but not the associations between maternal age and depression or between maternal age and fetal attachment, both of which remained significant. Mode of conception was significantly related to all dependent variables and was associated with more favourable adjustment in all cases except for P-F anxiety, where using ART was associated with higher P-F anxiety. The interaction between age and mode of conception (Step 3a) was not significant for any dependent measure.

The final step of the model (Step 3b) shows changes in associations related to contextual factors. Overall, the main effects of age and mode of conception were attenuated, with maternal age and mode of conception effects becoming non-significant after entry of these variables. The only exception was for maternal–fetal attachment, where the association with mode of conception emerged as significant after entering mediator variables. After controlling for contextual factors, women who used ART reported a more intense emotional attachment to the fetus than SC women.

Hardiness/resilience and perceived care (IBM Care) in the partner relationship were significantly related to better adjustment on all dependent variables, whereas greater reported partner control (IBM Control) in the relationship was associated with more depression. Of the demographic and reproductive history variables, only three were significant. Living in rented accommodation was associated with more depression, having stepchildren was associated with more P-F anxiety and a short time to fall pregnant was associated with less P-F anxiety.

Discussion

The results of this study show that personality and context factors (mainly the quality of the relationship with the intimate partner) are more important than age in predicting pregnancy mood (both depression and anxiety symptoms) and also pregnancy-specific adjustment (P-F anxiety, fetal attachment). The favourable factors are having a hardy (resilient/adaptive) personality and a less controlling partner, and together these attenuate most age effects on global emotional adjustment during pregnancy.

ART conception, however, sets the stage for a more complex experience of pregnancy with women conceiving through ART simultaneously experiencing more P-F anxiety and more intense feelings of attachment to the growing fetus. Although P-F anxiety was no longer significantly higher for ART women when reproductive history factors were controlled for, the association between ART conception and more intense fetal attachment can be attributed directly to having required fertility treatment to conceive rather than to personality, contextual or age factors. Despite reporting higher P-F anxiety, women conceiving by ART reported lower symptoms of depression and anxiety than did SC women. Taken together, these results indicate that if a pregnancy is achieved, childbearing at an older age (whether using ART or not) is not associated with more problematic anxiety and depression symptoms during pregnancy and therefore unlikely to lead to adverse effects reported in association with effects of maternal mood on the developing fetus (Talge et al., 2007).

The relatively low correlation between P-F anxiety and state anxiety in this study confirms that P-F anxiety needs to be considered as a separate construct from more generalized anxiety. Indeed, women conceiving through ART reported higher P-F anxiety alongside more positive mood, a finding consistent with previous research suggesting that the experience of pregnancy is qualitatively different in this context (Hammarberg et al., 2008). Further research on the implications of P-F anxiety in women conceiving through ART is needed. As noted earlier, associations between anxiety in pregnancy and less optimal cognitive, temperamental and behavioural outcomes in infants during the first post-natal year have been reported in a number of studies and these effects are hypothesized to result from physiological influences of maternal stress hormones on the developing fetus (see Talge et al., 2007, for a review). However, the mixed emotions (low depression and state anxiety, but high P-F anxiety) characterizing ART pregnancies and the fact that P-F anxiety may be based on a particular reproductive history rather than intrapsychic (trait) factors may differentiate these pregnancies from other stressful pregnancy contexts.

In the current study, it should be noted that once reproductive history factors were included as control variables, the difference
### Table II Summary statistics for hierarchical regression testing mediation and moderation in adjustment to pregnancy.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age at first birth, zero-order correlation</th>
<th>Mode of conception, zero-order correlation</th>
<th>EDS depression (n = 569)</th>
<th>STAI anxiety (n = 573)</th>
<th>P-F anxiety (n = 574)</th>
<th>R-MFAS attachment (n = 580)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$R^2 \Delta = 0.02^{***}$</td>
<td>$R^2 \Delta = 0.01^{*}$</td>
<td>$R^2 \Delta = 0.00$</td>
<td>$R^2 \Delta = 0.01^{*}$</td>
</tr>
<tr>
<td>Step 1: Main effect age</td>
<td>Predicted age at first birth</td>
<td>$-0.15^{***}$</td>
<td>$-0.09^{*}$</td>
<td>0.07</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mode of conception (0 = ART, 1 = SC)</td>
<td>0.33^{***}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2: Main effect age in presence of ART</td>
<td>Predicted age at birth</td>
<td>$(-0.12^{**})$</td>
<td>(-0.06)</td>
<td>(0.03)</td>
<td>(0.13^{**})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mode of conception (0 = ART, 1 = SC)</td>
<td>$-0.11^{**}$</td>
<td>$-0.11^{**}$</td>
<td>0.11</td>
<td>$-0.10^{*}$</td>
<td></td>
</tr>
<tr>
<td>Step 3a: Interaction of age and mode of conception</td>
<td>Predicted age at birth</td>
<td>$R^2 \Delta = 0.01$</td>
<td>$R^2 \Delta = 0.01$</td>
<td>$R^2 \Delta = 0.01$</td>
<td>$R^2 \Delta = 0.01$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mode of conception</td>
<td>$-0.03$</td>
<td>$-0.05$</td>
<td>$-0.02$</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Step 3b: Age and ART in presence of mediators</td>
<td>Predicted age at birth</td>
<td>$R^2 \Delta = 0.15^{***}$</td>
<td>$R^2 \Delta = 0.22^{***}$</td>
<td>$R^2 \Delta = 0.07^{*}$</td>
<td>$R^2 \Delta = 0.06^{***}$</td>
<td></td>
</tr>
<tr>
<td>University education (0 = no, 1 = yes)</td>
<td>0.09^{*}</td>
<td>$-0.05$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language spoken in home (0 = mixed, 1 = English only)</td>
<td>0.10^{*}</td>
<td>0.07</td>
<td>$-0.02$</td>
<td>$-0.01$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status (0 = not married, 1 = married)</td>
<td>$-0.11^{***}$</td>
<td>0.09^{*}</td>
<td>$-0.04$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous marriage (0 = no, 1 = yes)</td>
<td>0.34^{***}</td>
<td>0.11^{**}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stepchild(ren) (0 = no, 1 = yes)</td>
<td>0.11^{***}</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational status (1 = professional, 2 = other)</td>
<td>$-0.19^{***}$</td>
<td>$-0.06$</td>
<td>$-0.01$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased home (0 = no, 1 = yes)</td>
<td>0.16^{***}</td>
<td>0.29^{***}</td>
<td>$-0.11^{**}$</td>
<td>$-0.05$</td>
<td>0.07^{**}</td>
<td></td>
</tr>
<tr>
<td>Psychosocial</td>
<td>Hardiness/resilience</td>
<td>0.17^{***}</td>
<td>0.08</td>
<td>$-0.26^{***}$</td>
<td>$-0.35^{***}$</td>
<td>$-0.14^{***}$</td>
</tr>
<tr>
<td>R-IBM Care†</td>
<td>0.08^{*}</td>
<td>0.02</td>
<td>0.09*</td>
<td>0.16^{***}</td>
<td>0.09*</td>
<td>0.11^{**}</td>
</tr>
<tr>
<td>R-IBM Control†</td>
<td>$-0.11^{***}$</td>
<td>$-0.06$</td>
<td>0.14^{***}</td>
<td>0.07^{**}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproductive history</td>
<td>Previous miscarriage (0 = no, 1 = yes)</td>
<td>0.18^{***}</td>
<td>0.17^{***}</td>
<td></td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Previous termination (0 = no, 1 = yes)</td>
<td>0.14^{***}</td>
<td>$-0.03$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time to pregnancy (months)*</td>
<td>0.32^{***}</td>
<td>0.57^{***}</td>
<td>0.02</td>
<td>$-0.00$</td>
<td>$-0.10^{*}$</td>
</tr>
<tr>
<td></td>
<td>Twin pregnancy (0 = singleton, 1 = twins)</td>
<td>0.06</td>
<td>0.14^{***}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more gestational complications</td>
<td>0.07</td>
<td>0.11^{***}</td>
<td></td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td>Overall model significance</td>
<td>$R^2 = 0.17^{***}$</td>
<td>$R^2 = 0.23^{***}$</td>
<td>$R^2 = 0.08^{***}$</td>
<td>$R^2 = 0.07$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(—) indicates variable not meeting the threshold for inclusion in model in bivariate analyses.

*Women with unplanned pregnancies assigned a time to pregnancy = 0. Sample size varies owing to missing data.

†Because IBM Care and MFAS attachment were negatively skewed, scores were reflected before transformation such that higher scores on transformed variables indicate less favourable adjustment. These variables have been relabelled R-IBM Care and R-MFAS, as a reminder of reverse scoring.

*P < 0.05.

**P < 0.01.

***P < 0.001.
between ART and SC women was no longer significant for P-F anxiety. Oates (2002) cautions against making pregnant women worry about worrying, and this may be particularly pertinent for women conceiving through ART. These women often have complex histories of pregnancy loss and may need to be reassured by health-care providers as their pregnancy progresses that most pregnancy losses occur in the first trimester of pregnancy and that the risk of pregnancy loss is low in later pregnancy.

Empirical evidence, to date, regarding maternal–fetal attachment in women pregnant after ART conception is equivocal (Hammarberg et al., 2008). In the current study, although univariate analyses showed no differences in fetal attachment according to the mode of conception, the multivariate analysis revealed that when the impact of age was taken into account, a robust association between mode of conception and more intense maternal–fetal attachment emerged.

Fisher et al. (2008) have reported intense protective and affectionate preoccupation with the fetus in women conceiving through ART compared with normative community data and suggested that the combination of high fetal attachment and positive mood noted in their sample (pregnancy-specific anxiety was not assessed) may indicate elation about the prospect of parenthood after a long period of anticipation and effort to conceive. They caution that idealized expectations in pregnancy may contribute to vulnerability in adjusting to early parenthood in women conceiving through ART. Assessing mother to fetus attachment is important because it is associated with self-care in pregnancy and also predicts quality of parent to infant attachment (Van den Bergh and Simons, 2009). Identification of groups who might be vulnerable to either delayed or overly idealized fetal attachment has implications for targeted clinical care in pregnancy. Longitudinal data from the current prospective study may more fully elucidate the relationship between a high intensity of fetal attachment in pregnancies conceived using ART, later parent–infant relationships and the experience of parenthood.

Older maternal age was associated with socio-demographic factors likely to contribute to optimal adjustment (home ownership, professional occupation), but associations between age and relationship status were more complex. Although older mothers were less likely to be married, more likely to be in a second marriage and more likely to have stepchildren, all variables that may be presumed to make relationship adjustment more challenging, they perceived their partners as less controlling (more optimal) than women in the other age groups. Expected age-related reproductive history factors were confirmed, with older mothers taking longer to conceive and having a history of more pregnancy loss, irrespective of mode of conception.

Of particular interest was the finding that psychological hardiness (an index of adaptive personality functioning) was positively associated with maternal age, confirming in this larger more representative sample earlier findings reported by McMahon et al. (2007) that were specific to women conceiving through ART. Further, hardiness was the variable most strongly associated with positive indices of pregnancy adjustment. This finding provides the first direct empirical support for largely speculative comments across a range of studies that psychological maturity may be an advantage for older parents (e.g. Berryman et al., 1999; Bornstein et al., 2006). The hardiness construct has been shown to be closely related to ego resilience (Gramzow et al., 2000), previously identified as a predictor of positive adaptation across the transition to parenthood (Heinicke, 1984). Further longitudinal research is needed to better understand the complex psychological construct of maturity and implications for adjustment to parenting.

Study strengths and limitations

This large prospective study represents a significant advance in examining both age and ART effects on adjustment during pregnancy, while taking account of the many confounding variables that are associated with but not caused by age. The sample was recruited systematically from a range of clinical services in two Australian states and was of sufficient size to allow us to take account of a large number of potential age-related confounds, most notably mode of conception. Importantly, our sampling strategy allowed us to consider separate and combined effects of maternal age and ART conception.

The step-wise approach in multivariate analyses showed that mode of conception explained some but not all of the age effects and there was no evidence that the effect of age differed according to mode of conception, nor that their effects were additive. This lack of interaction between age and mode of conception may be attributable to the fact that those contextual factors that may make the transition to parenthood easier (e.g. high socio-economic status) or more difficult (e.g. time to conceive, pregnancy complications) are present for both older women and those conceiving through ART, and therefore, joint effects are minimal.

Nonetheless, some limitations need to be acknowledged. First, the participants were for the most part highly educated and well resourced financially. Although this may be typical of samples of older mothers and those using ART (Hammarberg et al., 2008), the women having a first baby in their 20s who participated in this study are unlikely to be representative of younger mothers in the population. This suggests that findings regarding overall positive adjustment in older mothers may be conservative, as they were compared for the most part with younger mothers with similar socio-demographic advantages. However, the comparability of the age groups in this regard allowed a more robust test of pure age effects. We acknowledge that our sample spanned a broad age range with very small numbers of women in their early 20s and mid-late 40s, respectively. Future studies may like to consider a more detailed analysis of the socio-economic and psychological characteristics of women in their early versus late 20s, or late 40s versus late 30s, but meaningful comparisons would require sampling adequate numbers of women in these more ‘atypical’ age groups for childbearing.

We also note as a limitation that our sampling goals regarding comparable numbers of young women conceiving through ART and older SC women were not achieved, as these are both relatively rare phenomena in the community. Nevertheless, this sample represents the largest prospective cohort, to date, of older and ART mothers. Finally, we included women expecting twins, women conceiving using donor gametes, single women and women with same sex partners, to accurately reflect the diverse pregnancy context for older first-time mothers. However, the sample sizes for these subgroups were small and did not allow detailed analysis of the impact of these characteristics on adjustment during pregnancy.

Conclusions

Our study findings are reassuring regarding the psychosocial wellbeing of older mothers once a pregnancy is achieved and suggest that the
greater psychological hardness among older women may be protective. Results confirm previous reports that women conceiving through ART may have a qualitatively different experience of pregnancy: with higher pregnancy-specific anxiety juxtaposed with more intense maternal–fetal attachment and lower levels of depression and general anxiety symptoms. More research on the implications of mixed emotions in pregnancy is needed using instruments that capture both the highs and the lows of pregnancy and the fact that these may co-occur (DiPietro et al., 2004). Finally, given the demographic shift to older first-time parenthood, it is also important to acknowledge that this study has assessed wellbeing only in those women who successfully achieved a pregnancy that survived until the third trimester. Bearing in mind the compelling evidence of age-related declines in fertility (Collins and Crosignani, 2005), it is also important, therefore, to study psychosocial wellbeing in those women who, having delayed parenthood for a variety of reasons, are not able to achieve a pregnancy.

Authors’ roles

C.A.M. contributed to conceptualization, study design, to the first draft and revisions of the manuscript and supervised data collection in North South Wales; J.B. contributed to the conceptualization, study design, data analysis and interpretation, first draft and revisions; F.L.G. contributed to conceptualization and study design, drafting and revisions; K.H. contributed to conceptualization and study design, drafting and revisions; K.W. contributed to data analysis and interpretation, drafting and revisions; D.S. contributed to conceptualization, study design, drafting and revisions; J.F. contributed to conceptualization and study design, drafting and revisions of the paper and supervised data collection in Victoria.

Supplementary data

Supplementary data are available at http://humrep.oxfordjournals.org/.

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