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Antenatal paternal adjustment and paternal attitudes after infertility treatment

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STUDY QUESTION: Do mode of conception [ART versus Natural (NC)] and depression have an interactive effect on antenatal paternal adjustment and paternal attitudes?

SUMMARY ANSWER: Depression increased the negative effect of ART on antenatal paternal adjustment and paternal attitudes, specifically on antenatal marital relationship satisfaction.

WHAT IS KNOWN ALREADY: Research on antenatal paternal adjustment and paternal attitudes after ART is scarce and has produced inconsistent results.

STUDY DESIGN, SIZE, DURATION: This cross-sectional study assessed 197 primiparous men (71 ART and 126 NC) during their partner's second trimester of gestation.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Participants were derived from three larger longitudinal studies recruited at public Health Services in Northern Portugal. All men, for who this was their first child and had filled in a socio-demographic questionnaire, measures of depression and anxiety, and antenatal paternal adjustment and paternal attitudes were selected.

MAIN RESULTS AND THE ROLE OF CHANCE: An interaction effect of mode of conception and depression was found on antenatal paternal adjustment and paternal attitudes. ART men showing high depressive symptomatology had lower antenatal marital relationship satisfaction than ART men showing low depressive symptomatology and NC men showing high or low depressive symptomatology.

LIMITATIONS, REASONS FOR CAUTION: Due to the cross-sectional design of this study and the small sample size in the depression groups, the findings should be interpreted with caution.

WIDER IMPLICATIONS OF THE FINDINGS: Specialized psychological support should be available for ART men screened with high depressive symptomatology as part of routine prenatal care appointments.

STUDY FUNDING/COMPETING INTEREST(S): This study was conducted at Psychology Research Centre (UID/PSI/ 01662/2013), University of Minho, and at the Unidade de Investigação em Epidemiologia—Instituto de Saúde Pública da Universidade do Porto (EPIUnit) (UID/DTP/04750/2013). It was supported by the Foundation for Science and Technology (Portuguese Ministry of Education and Science) through National funds and co-financed by FEDER through COMPETE2020 under the PT2020 Partnership Agreement (POCI-01-0145-FEDER-007653) and through the Operational Programme Factors of Competitiveness–COMPETE within the project 'Health, Governance and Accountability in Embryo Research: Couples' Decisions About the Fates of Embryos' (FCOMP-01-0124-FEDER-014453), the FCT Investigator contract IF/01674/2015 and PhD grants (SFRH/BD/115048/2016, SFRH/BD/75807/2011 and SFRH/BD/40146/2007). The authors have no conflicts of interest.

Key words: infertility treatment / men / depression / anxiety / antenatal paternal adjustment and paternal attitudes

Introduction

The transition to parenthood is a major life stage that prompts both men and women to achieve several developmental tasks in order to adapt to the biological, psychological and social changes involved (Cowan and Cowan, 2000; Figueiredo, 2014). Although most prior studies have focused on women's psychological adjustment, there has been an increased interest in men's psychological adjustment in recent years, namely, during pregnancy (Figueiredo and Conde, 2011a, b; deMontigny et al., 2013; Cameron et al., 2016; Underwood et al., 2017; Vänskä et al., 2017). Antenatal paternal adjustment and paternal attitudes refer specifically to men's development as fathers and their adjustment to the transition to parenthood, and these factors can be assessed through the way in which the marital and sexual relationships, the partner's pregnancy and the baby are viewed (Marks et al., 1992).

Since the inception of infertility treatments (ART), a wide range of studies have examined maternal adjustment and maternal attitudes after ART (Hjelmstedt et al., 2003a,b; Ulrich et al., 2004; Łepecka-Klusek and Jakiel, 2007). However, research on antenatal paternal adjustment and paternal attitudes after ART is scarce and has produced inconsistent results. While some studies found lower antenatal marital relationship satisfaction in ART than in men whose partner conceived spontaneously (NC; Stanton and Golombok, 1993; Gibson et al., 2000; Klock and Greenfeld, 2000; Cohen et al., 2001), more recent studies have found similar levels of marital relationship satisfaction (e.g. Gameiro et al., 2010; Hjelmstedt et al., 2003a,b). Regarding attitudes toward sex, one study found that ART men reported lower sexual satisfaction during pregnancy and at 3 months postpartum than NC men (Ulrich et al., 2004). The few investigations exploring attitudes toward pregnancy and the baby reported that ART men had similar positive, ambivalent and negative attitudes about the growing baby as NC men (Ulrich et al., 2004) but also found that ART men held less ambivalent attitudes toward pregnancy than NC men, while general attitudes toward pregnancy and the baby were similar (Hjelmstedt et al., 2003a,b).

Despite these inconsistent findings, the existing research suggests that ART men may experience antenatal paternal adjustment problems and negative paternal attitudes. Previous studies have reported lower antenatal self-esteem and higher anxiety about the security and safety of the pregnancy and fetal health in ART than in NC men (Cohen et al., 2001; Hammarberg et al., 2008). This experience could decrease sexual intimacy in ART couples and decrease men's marital relationship satisfaction and positive attitudes toward sex (Ulrich et al., 2004; Bracks-Zalloua et al., 2010). Moreover, increased anxiety about the security of the pregnancy and fetal health could delay the development of father-fetal/father-child attachment and decrease men's parenting self-efficacy, which may contribute to less positive attitudes toward pregnancy and the baby in ART men (Bracks-Zalloua et al., 2011; Hammarberg et al., 2008). Some possible explanatory pathways for the link between antenatal and postnatal paternal adjustment problems and negative attitudes in ART men include higher levels of child-related concerns, low parenting self-efficacy, female partners' criticism of men's parenting abilities, unequal sharing of domestic workload and responsibilities, and reduced opportunities for couple companionate activities (Bracks-Zalloua et al., 2010, 2011).

Studies that have analyzed men's psychological adjustment during their partner's pregnancy suggested that they are at risk for depression and anxiety (Hammarberg et al., 2008; Hjelmstedt and Collins, 2008; Figueiredo and Conde, 2011a, b; deMontigny et al., 2013; Cameron et al., 2016; Underwood et al., 2017; Vänskä et al., 2017). Depression has been systematically associated with men's adjustment problems in the transition to parenthood. Negative effects of depression have been found on paternal adjustment and paternal attitudes in different studies. NC men with higher depression symptoms were found to report lower marital relationship satisfaction during their partner's pregnancy (Ramchandani et al., 2011; Bower et al., 2012). Men with higher depression symptoms may experience lower proximity and communication and higher conflict and ambivalence, leading to lower marital relationship satisfaction (Kluwer and Johnson, 2007; Figueiredo et al., 2008). Depression can be a key element to understanding antenatal paternal adjustment problems and negative paternal attitudes after ART. One possible explanation for the inconsistent results found in the literature, namely, on antenatal paternal adjustment and paternal attitudes after ART, might be related to a previous association between mode of conception and depression that subsequently may have an effect on antenatal paternal adjustment and paternal attitudes.

This study aimed to explore the interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes. Exploring the role of depression on the relationship between mode of conception and antenatal paternal adjustment and paternal attitudes may contribute to the body of knowledge on the adjustment of ART men in the transition to parenthood. Additionally, this larger understanding can be particularly relevant in developing a more supportive antenatal psychological care that target the specific needs of ART men during their partners' pregnancies.

Materials and Methods

Participants

The sample comprised 197 primiparous men, 71 after ART and 126 NC, derived from three larger longitudinal studies with similar designs (Pinto et al., 2016; Samorinha et al., 2016; Tendais and Figueiredo, 2016). In the group of ART men, 68 couples used in vitro fertilization, one ovulation induction, and two had frozen embryo transfers in the last treatment cycle. Information about the use of couples' own gametes in treatment and the cause of infertility was known for 55 of 71 ART men (78%). Among these participants, all couples used their own gametes, and the causes of infertility were as follows: female (27%), male (20%), both female and male (25%), and unknown/unexplained causes (27%).

Study design

The present research was conducted in accordance with the Helsinki Declaration and received previous approval from the Ethical Commission of all institutions involved. Participants were recruited at public health services in northern Portugal. The aims and procedures were explained, and men who were willing to participate provided a written informed consent. A total of 214 primiparous men were contacted in the three longitudinal studies, and the majority ($n = 208$; 97.2%) agreed to participate and signed a consent form. To derive the subsamples to this study, all men ($n = 197$; 92.1%) who filled in a socio-demographic questionnaire, the measures of depression and anxiety (trait and state) using the same instruments (EPDS and STAI), and the PAPA-AN during the second trimester of gestation (20–28 gestational weeks) were selected.

Depression

The Edinburgh Postnatal Depression Scale (EPDS; Cox *et al.*, 1987) was used to assess men's depression. The EPDS is a 10-item self-report scale scored on a 4-point Likert-type scale designed to assess the intensity of depression symptoms within the previous 7 days. This instrument has been used in several studies with men during their partner's pregnancy (Figueiredo and Conde, 2011a,b; Pinto *et al.*, 2016; Tendais and Figueiredo, 2016). The Portuguese version of the EPDS showed good internal consistency in men during their partner's gestation ($\alpha = 0.85$) and an optimal clinical cutoff of 10 to screen for high depressive symptomatology (Figueiredo and Conde, 2011a, b). In the present sample, Cronbach's alpha coefficient was 0.80.

Anxiety

The State-Trait Anxiety Inventory (STAI; Spielberger *et al.*, 1983) was used to assess men's anxiety. The STAI consists of two 20-item scales scored on a 4-point Likert-type scale that measures individual differences in anxiety proneness as a personality trait (STAI-T) and the intensity of anxiety as an emotional state (STAI-S). When responding to the STAI-T scale, participants indicate how often they experienced anxiety-related feelings and cognitions. When responding to the STAI-S scale, participants report the intensity of their feelings of anxiety at the moment. Several studies have used this measure with men during their partner's gestation (Figueiredo and Conde, 2011a, b; Pinto *et al.*, 2016; Tendais and Figueiredo, 2016). The Portuguese version of the STAI showed good internal consistency in men ($\alpha = 0.89$ for the STAI-T and $\alpha = 0.93$ for the STAI-S; Silva, 2006) and an optimal clinical cutoff of 45 to screen for high anxiety (Figueiredo and Conde, 2011a, b). In the present sample, Cronbach's alpha coefficient was 0.88 for the STAI-T and the STAI-S.

Antenatal paternal adjustment and paternal attitudes

The Portuguese version of the Paternal Adjustment and Paternal Attitudes Questionnaire—Antenatal (PAPA-AN) was used to assess antenatal paternal adjustment and paternal attitudes. The PAPA-AN (Marks *et al.*, 1992; Pinto *et al.*, 2015) comprise 30 items scored on a 4-point Likert-type scale, ranging from one (never) to four (very often). PAPA-AN subscales are as follows: (i) attitudes toward sex (e.g. have you felt tense and unhappy at the thought of sexual intercourse?), (ii) marital relationship (e.g. have you felt that your partner was paying you too little attention?) and (iii) attitudes toward pregnancy and baby (e.g. have you been worrying about hurting your baby inside of your partner?). Each subscale has ten items. Higher scores on the PAPA-AN indicate better antenatal paternal adjustment and more positive paternal attitudes. The Portuguese of the PAPA-AN version showed good internal consistency ($\alpha = 0.91$) and an optimal clinical cutoff of 95 to screen for paternal adjustment problems and negative paternal attitudes (Pinto *et al.*, 2015). In the present sample, Cronbach's alpha coefficient was 0.82 for the attitudes toward sex subscale, 0.80 for the marital relationship subscale, 0.76 for the attitudes toward pregnancy and baby subscale, and 0.91 for the PAPA-AN total scale.

Data analysis

Fisher's exact tests and independent samples *t*-tests were used to analyze associations and differences between the mode of conception groups on socio-demographic characteristics and psychopathological symptoms.

A multivariate analysis of covariance (MANCOVA) and a univariate analysis of covariance (ANCOVA) were performed to analyze the interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes. The interaction between mode of conception (0 = ART, 1 = NC) and depression (0 = EPDS < 10, 1 = EPDS ≥ 10) was included both in the MANCOVA and the ANCOVA models as an independent variable. The PAPA-AN subscale scores (marital relationship, attitudes toward sex, and attitudes toward pregnancy and the baby) were included in the MANCOVA model as dependent variables. The PAPA-AN total score (antenatal paternal adjustment and paternal attitudes) was included in the ANCOVA model as a dependent variable. Men's age (0 = 18–29; 1 = 30–39; 2 = 40–46 years old), marital status (0 = cohabiting; 1 = married) and anxiety (trait: 0 = STAI-T < 45, 1 = STAI-T ≥ 45; state: 0 = STAI-S < 45, 1 = STAI-S ≥ 45) were included in both models as covariates.

Bonferroni corrections were applied in all models. Statistical analyses were performed using SPSS version 22.0 (SPSS Inc., USA). The effect size measure partial eta squared (η^2) was presented for the MANCOVA and the ANCOVA models.

Results

Participants' characteristics

Most participants were Portuguese (93.9%) and were employed (90.9%). More than half were married (71.7%), were aged between 30 and 39 years old (59.4%; *Mean* = 31.17, *SD* = 5.80), and belonged to a medium (medium-low to medium-high) socio-economic level (60.7%; measured using the Graffar scale or equivalent measure). Almost half had between nine and 12 years of education (41.8%). Differences/associations between the mode of conception groups were found on age [$t(196) = 6.72$, $P < 0.001$] and marital status [$Z = 6.00$, $P < 0.001$]. ART men were older and were more likely to be married than NC men (see Table I).

Associations between the mode of conception groups were found with depression, and no associations were found with anxiety (see Table II). The prevalence of men showing high depressive symptomatology (EPDS ≥ 10) was higher in the ART group than in the NC group [$Z = 3.20$, $P < 0.001$].

The interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes

Significant multivariate effects of the interaction between mode of conception and depression were found on antenatal paternal adjustment and paternal attitudes [*Wilks' lambda* = 0.43, $F(6,189) = 21.41$, $P < 0.001$, $\eta^2 = 0.25$]. Significant univariate effects were found in the marital relationship, attitudes toward sex, and attitudes toward pregnancy and the baby during the second trimester of gestation (all *P*s < 0.001). Additionally, significant univariate effects of the interaction between mode of conception and depression were found in the PAPA-AN total scale ($P < 0.001$).

Pairwise comparisons for the marital relationship during the second trimester of gestation revealed significant differences between ART men showing high depressive symptomatology and ART men showing low depressive symptomatology ($P = 0.020$), between ART and NC men showing high depressive symptomatology ($P = 0.009$) and showing low depressive symptomatology ($P < 0.001$), and between NC men showing high depressive symptomatology and NC men showing low depressive symptomatology ($P < 0.001$). ART men showing high depressive symptomatology had lower marital relationship satisfaction than ART men

Table I Men's socio-demographic characteristics.

		ART $n = 71$ n (%)	Natural conception $n = 126$ n (%)	Group comparisons 95% CI of difference
Age (years)	18–29	9 (13)	59 (47)	[20.51,45.36]***
	30–39	53 (75)	64 (51)	[9.24,37.14]**
	40–46	9 (13)	3 (2)	[2.98,21.23]**
Socio-economic level	High	18 (25)	30 (24)	[−11.71,14.71]
	Medium-high	12 (17)	12 (10)	[−3.29,18.73]
	Medium	16 (23)	25 (20)	[−9.20,16.27]
	Medium-low	17 (24)	38 (30)	[−8.00,18.84]
	Low	8 (11)	21 (17)	[−5.44,15.89]
Employed	Yes	69 (97)	110 (87)	[−1.56,16.08]
	No	2 (3)	16 (13)	[−1.56,16.08]
Education (in years)	<9	18 (25)	37 (29)	[−10.02,16.93]
	9–12	30 (42)	51 (41)	[−13.77,16.06]
	>12	23 (32)	38 (30)	[−11.76,16.45]
Marital status	Married	69 (97)	72 (57)	[28.72,49.48]***
	Cohabitation	2 (3)	54 (43)	[28.72,49.48]***

**$P < 0.01$; ***$P < 0.001$.

Table II Men's psychopathological symptoms.

		ART $n = 71$ n (%)	Natural conception $n = 126$ n (%)	Group comparisons 95% CI of difference
Depression	EPDS ≥ 10	16 (22)	9 (7)	[4.24, 27.02]***
Trait anxiety	STAI-T ≥ 45	5 (7)	12 (10)	[−6.78, 11.12]
State anxiety	STAI-S ≥ 45	7 (10)	16 (13)	[−7.84, 12.24]
		Mean (SD)	*Mean (SD)*	
Depression symptoms		5.8 (3.79)	4.3 (3.60)	[0.44, 2.58]**
Trait anxiety symptoms		33.9 (7.03)	32.4 (8.29)	[−0.78, 3.92]
State anxiety symptoms		35.4 (7.59)	33.6 (8.91)	[−0.70, 4.23]

EPDS, Edinburgh Postnatal Depression Scale; STAI, State-Trait Anxiety Inventory; -T, anxiety proneness as a personality trait; -S, intensity of anxiety as an emotional state.
**$P < 0.01$; ***$P < 0.001$.

showing low depressive symptomatology and NC men showing high or low depressive symptomatology. In addition, NC men showing high depressive symptomatology had lower marital relationship satisfaction than NC men showing low depressive symptomatology.

Pairwise comparisons for attitudes toward sex during the second trimester of gestation revealed significant differences between ART and NC men showing high depressive symptomatology ($P = 0.005$), between ART men showing high depressive symptomatology and NC men showing low depressive symptomatology ($P < 0.001$), and between ART and NC men showing low depressive symptomatology ($P < 0.001$). ART men showing high depressive symptomatology had less positive attitudes toward sex than NC men showing high depressive symptomatology and NC men showing low depressive symptomatology. Furthermore, ART men showing low depressive symptomatology had less positive attitudes toward sex than NC men showing low depressive symptomatology.

Pairwise comparisons for attitudes toward pregnancy and the baby during the second trimester of gestation revealed significant differences between ART and NC men showing high depressive symptomatology ($P < 0.001$), between ART men showing high depressive symptomatology and NC men showing low depressive symptomatology ($P < 0.001$), between ART men showing low depressive symptomatology and NC men showing high depressive symptomatology ($P = 0.018$), and between ART and NC men showing low depressive symptomatology ($P < 0.001$). ART men showing high depressive symptomatology had less positive attitudes toward pregnancy and the baby than NC men showing high depressive symptomatology and NC men showing low depressive symptomatology. Moreover, ART men showing low

depressive symptomatology had less positive attitudes toward pregnancy and the baby than NC men showing high depressive symptomatology and NC men showing low depressive symptomatology.

Additionally, significant univariate effects of the interaction between mode of conception and depression were found on the PAPA-AN total scale ($P < 0.001$). Pairwise comparisons for the PAPA-AN total scale during the second trimester of gestation revealed significant differences between ART men showing high depressive symptomatology and ART men showing low depressive symptomatology ($P = 0.025$), between ART and NC men showing high depressive symptomatology ($P < 0.001$), between ART men showing high depressive symptomatology and NC men showing low depressive symptomatology ($P < 0.001$), between ART and NC men showing low depressive symptomatology ($P < 0.001$), and between NC men showing high depressive symptomatology and NC men showing low depressive symptomatology ($P = 0.008$). ART men showing high depressive symptomatology had lower paternal adjustment and less positive paternal attitudes than ART men showing low depressive symptomatology and NC men showing high or low depressive symptomatology. Further, NC men showing high depressive symptomatology had lower paternal adjustment and less positive paternal attitudes than NC men showing low depressive symptomatology (see Table III).

Discussion

This study found an interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes. NC men showing high depressive symptomatology had lower antenatal marital relationship satisfaction than NC men showing low depressive symptomatology. ART men showing high depressive symptomatology had lower antenatal marital relationship satisfaction than both ART men showing low depressive symptomatology and NC men showing high or low depressive symptomatology. These results are congruent with those of previous studies (Stanton and Golombok, 1993; Klock and Greenfeld, 2000; Cohen *et al.*, 2001; Ulrich *et al.*, 2004) and contribute to the literature by suggesting that depression increases the negative effect of mode of conception on antenatal paternal adjustment and paternal attitudes, specifically on antenatal marital relationship satisfaction. Moreover, associations between mode of conception groups were found with depression, while no associations were found with anxiety. These findings indicate that depression, rather than anxiety, could be a key element to understanding antenatal paternal adjustment problems and negative paternal attitudes after ART.

These findings should be framed in the living experiences of men undergoing ART. Regardless of the treatment outcome, all ART men have passed through some burden. Many ART patients find it difficult to manage the usually lengthy diagnostic and treatment period and the uncertainty of achieving parenthood while experiencing some degree of emotional distress during treatment (Hammarberg *et al.*, 2008; Gameiro *et al.*, 2012; ESHRE, 2015). After achieving pregnancy, ART men may experience heightened emotional distress related to the safety of the pregnancy and fetal health (Cohen *et al.*, 2001; Hammarberg *et al.*, 2008), which could decrease men's parenting self-efficacy and increase depressive symptomatology. Thereafter, ART men showing high depressive symptomatology may experience more difficulties in adjusting to the transition to parenthood. Specifically, ART men showing high depressive symptomatology may experience lower proximity and communication and higher conflict and ambivalence (Kluwer and Johnson, 2007; Figueiredo *et al.*, 2008), which may contribute to decreased intimacy in ART couples and decrease men's satisfaction with their marital relationship.

These findings should also be framed in its social and cultural context. Previous studies have suggested that several stressful factors are associated with ART, namely, the economic cost and the social acceptance for family building (Abbey *et al.*, 1992; Cook *et al.*, 1997).

Table III The interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes from Paternal Adjustment and Paternal Attitudes Questionnaire—Antenatal (PAPA-AN) scores.

	(1) ART and EPDS ≥ 10 ($n = 16$)		(2) ART and EPDS < 10 ($n = 55$)		(3) NC and EPDS ≥ 10 ($n = 9$)		(4) NC and EPDS < 10 ($n = 117$)		Mode of conception		Mode of conception* EPDS	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	F^a	η^2	F^b	η^2
Marital relationship	23.9	2.78	27.2	4.99	28.8	4.58	34.9	3.03	143.67***	0.43	70.19***	0.52
Attitudes toward sex	24.1	2.26	26.8	5.47	30.1	4.20	34.7	3.83	112.29***	0.37	50.89***	0.44
Attitudes toward pregnancy and the baby	24.7	2.50	27.6	4.95	31.4	3.47	33.8	2.93	109.11***	0.36	47.56***	0.43
PAPA-AN total	72.6	5.82	81.6	14.53	90.3	10.55	103.4	7.08	169.85***	0.47	77.62***	0.55
	Pairwise comparisons 95% CI of difference											
	1 < 2		**1 < 3**		**1 < 4**		**2 < 3**		**2 < 4**		**3 < 4**	
Marital relationship	[−6.18,−0.34]*		[−9.70,−0.90]**		[−13.94,−8.33]***		[−6.05,1.97]		[−9.66,−6.10]***		[−9.52,−2.16]***	
Attitudes toward sex	[−5.72,0.95]		[−11.44,−1.39]*		[−13.63,−7.23]***		[−8.61,−0.55]		[−10.07,−6.01]***		[−8.22,−0.19]	
Attitudes toward pregnancy and the baby	[−5.51,0.12]		[−11.31,−2.83]***		[−11.76,−6.36]***		[−8.24,−0.51]*		[−8.08,−4.65]***		[−5.54,1.56]	
PAPA-AN total	[−15.99,−0.68]*		[−30.32,−7.24]***		[−37.98,−23.27]***		[−20.97,−0.82]		[−26.95,−17.63]***		[−21.50,−2.19]**	

Notes. NC, Natural conception; EPDS, Edinburgh Postpartum Depression Scale; EPDS ≥ 10 = men showing high depressive symptomatology; EPDS < 10 = men showing low depressive symptomatology. Men's age, marital status and anxiety (trait and state) were included as covariates; [a] $df = 1,192$; [b] $df = 3,191$;
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

This study was conducted in Portugal with men attending public health services, where the state pays for ART treatments, embryo freezing, and storage for up to three cycles per couple and covers 69% of the total cost of ART medication (Silva and Barros, 2012). Moreover, past studies have reported that the use of ART for family building is more socially acceptable in Western than in Eastern European countries (Cook *et al.*, 1997). These findings might strengthen those of the present study, accounting for an 'ART effect' on men's antenatal adjustment problems, when public regulations and society can possibly contribute to a reduction in the stress associated with the costs and social acceptance of ART.

Some limitations should be considered. Specifically, due to the cross-sectional design of this study and the small sample size of the depression groups, the findings should be interpreted with caution. The cross-sectional design of this study does not allow for the determination of the direction of depression effect on antenatal paternal adjustment and paternal attitudes. The small sample size of depression groups could increase the Type I error in the results found. Men's age and marital status could have influenced the findings, as associations were found between ART and NC men. However, these variables were controlled in the statistical analysis, and no covariate effects of either were found when analyzing the effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes.

This study provides contributions to clinical practice. Our findings suggested that ART men showing high depressive symptomatology are at high risk of antenatal paternal adjustment problems and negative paternal attitudes. The differences found on the antenatal paternal adjustment and paternal attitudes of ART men seem to be clinically significant, as the mean scores of ART men on the PAPA-AN, and specifically the scores of those showing high depressive symptomatology, were below the optimal clinical cutoff of 95 proposed to identify antenatal paternal adjustment problems and negative paternal attitudes (Pinto *et al.*, 2015). These findings suggest that specialized psychological support should be available for ART men screened with high depressive symptomatology as part of routine prenatal care appointments. The early screening for depression as part of routine prenatal care appointments may allow identifying ART men at risk of antenatal paternal adjustment problems and negative paternal attitudes. The PAPA-AN is a useful tool to assess the specific problems on dimensions of antenatal paternal adjustment and paternal attitudes and to develop new aims in psychological counseling according to the specific needs of ART men during their partner's gestation.

Implications for clinical research can also be noted. This study provides novelty to ART literature by analyzing the interaction effect of mode of conception and depression on antenatal paternal adjustment and paternal attitudes. Future longitudinal studies could explore the effect of mode of conception and depression on the trajectories of paternal adjustment and paternal attitudes. Repeated assessments from early pregnancy to the postpartum period could help to clarify if the effect of the interaction between mode of conception and depression on antenatal paternal adjustment and paternal attitudes remains the same over the postnatal period.

Authors' roles

All authors participated in the study design and T.M.P., C.S. and I.T. collected the data. T.M.P. undertook the statistical analysis, interpreted the results and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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Conflict of interest

None declared.

References

Abbey A, Halman LJ, Andrews FM. Psychosocial, treatment, and demographic predictors of the stress associated with infertility. *Fertil Steril* 1992;**57**:122–128.

Bower D, Jia R, Schoppe-Sullivan S, Mangelsdorf S, Brown G. Trajectories of couple relationship satisfaction in families with infants: the roles of parent gender, personality, and depression in first-time and experienced parents. *J Soc Pers Relatsh* 2012;**30**:389–409.

Bracks-Zalloua P, Gibson F, McMahon C. Age and gender differences in relationship and psychological adjustment to parenthood in couples conceiving through in-vitro fertilisation (IVF). *Edu Develop Psychol* 2010;**27**:90–103.

Bracks-Zalloua P, McMahon C, Gibson F. IVF-conceiving fathers' experiences of early parenthood. *J Relat Resear* 2011;**2**:1–9.

Cameron EE, Sedov ID, Tomfohr-Madsen LM. Prevalence of paternal depression in pregnancy and the postpartum: an updated meta-analysis. *J Affec Disord* 2016;**206**:189–203.

Cohen J, McMahon C, Tennant C, Saunders D, Leslie G. Psychosocial outcomes for fathers after IVF conception: a controlled prospective investigation from pregnancy to four months postpartum. *Repr Techn* 2001;**10**:126–131.

Cook R, Vatev I, Michova Z, Golombok S. The European study of assisted reproduction families: a comparison of family functioning and child development between Eastern and Western Europe. *J Psychosom Obstet Gynecol* 1997;**18**:203–212.

Cowan CP, Cowan PA. *When Partners Become Parents: The Big Life Change for Couples*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers, 2000.

Cox J, Holden JM, Sagovsky R. Detection of postnatal depression development of the 10-item Edinburgh postnatal depression scale. *Br J Psychiatry* 1987;**150**:782–786.

deMontigny F, Girard ME, Lacharité C, Dubeau D, Devault A. Psychosocial factors associated with paternal postnatal depression. *J Affect Disord* 2013;**150**:44–49.

ESHRE Psychology and Counselling Guideline Development Group Routine. Psychosocial care in infertility and medically assisted reproduction – A guide for fertility staff. ESHRE, 2015.

Figueiredo B. Mother and father-to-infant emotional involvement. In: Pariante CM, Conroy S, Dazzan P, Howard L, Pawlby S, Seneviratne T (eds). *Perinatal Psychiatry: The Legacy of Channi Kumar*. London, England: Oxford University Press, 2014.

Figueiredo B, Conde A. Anxiety and depression symptoms in women and men from early pregnancy to 3-months postpartum: parity differences and effects. *J Affect Disord* 2011a;**132**:146–157.

Figueiredo B, Conde A. Anxiety and depression in women and men from early pregnancy to 3-months postpartum. *Arch Womens Ment Health* 2011b;**14**:247–255.

Figueiredo B, Field T, Diego M, Hernandez-Reif M, Deeds O, Ascencio A. Partner relationships during the transition to parenthood. *J Reprod Infant Psychol* 2008;**26**:99–107.

Gameiro S, Boivin J, Peronace L, Verhaak C. Why do patients discontinue fertility treatment? A systematic review of reasons and predictors of discontinuation in fertility treatment. *Hum Reprod Update* 2012;**18**:652–669.

Gameiro S, Moura-Ramos M, Canavarro MC, Soares I. Psychosocial adjustment during the transition to parenthood of Portuguese couples who conceived spontaneously or through assisted reproductive technologies. *Res Nurs Health* 2010;**33**:207–220.

Gibson F, Ungerer J, Tennant CC, Saunders D. Parental adjustment and attitudes to parenting after in vitro fertilization. *Fertil Steril* 2000;**73**:565–574.

Hammarberg K, Fisher JR, Wynter KH. Psychological and social aspects of pregnancy, childbirth and early parenting after assisted conception: a systematic review. *Hum Reprod Update* 2008;**14**:395–414.

Hjelmstedt A, Collins A. Psychological functioning and predictors of father–infant relationship in IVF fathers and controls. *Scand J Caring Sci* 2008;**22**:72–78.

Hjelmstedt A, Widström A-M, Wramsby H, Matthiesen A-S, Collins A. Personality factors and emotional responses to pregnancy among IVF couples in early pregnancy: a comparative study. *Acta Obstet Gynecol Scand* 2003a;**82**:152–161.

Hjelmstedt A, Widström AM, Wramsby H, Collins A. Patterns of emotional responses to pregnancy, experience of pregnancy and attitudes to parenthood among IVF couples: a longitudinal study. *J Psychosom Obstet Gynecol* 2003b;**24**:153–162.

Klock S, Greenfeld DA. Psychological status of in vitro fertilization patients during pregnancy: a longitudinal study. *Fertil Steril* 2000;**73**:1159–1164.

Kluwer ES, Johnson MD. Conflict frequency and relationship quality across the transition to parenthood. *J Marriage Fam* 2007;**69**:1089–1106.

Łepecka-Klusek C, Jakiel G. Difficulties in adaptation to pregnancy following natural conception or use of assisted reproduction techniques: a comparative study. *Eur J Contracept Reprod Health Care* 2007;**12**:51–57.

Marks MN, Wieck A, Checkley SA, Kumar R. Contribution of psychological and social factors to psychotic and non-psychotic relapse after childbirth in women with previous histories of affective disorder. *J Affect Disord* 1992;**29**:253–264.

Pinto TM, Samorinha C, Tendais I, Nunes-Costa R, Figueiredo B. Paternal adjustment and paternal attitudes questionnaire: antenatal and postnatal Portuguese versions. *Assessment* 2015:1–11.

Pinto TM, Figueiredo B, Pinheiro LL, Canário C. Fathers' parenting self-efficacy during the transition to parenthood. *J Reprod Infant Psychol* 2016:1–13.

Ramchandani PG, Psychogiou L, Vlachos H, Iles J, Sethna V, Netsi E, Lodder A. Paternal depression: an examination of its links with father, child and family functioning in the postnatal period. *Depress Anxiety* 2011;**28**:471–477.

Samorinha C, Severo M, Machado H, Figueiredo B, Freitas C, Silva S. Couples' willingness to donate embryos for research: a longitudinal study. *Acta Obstet Gynecol Scand* 2016;**95**:912–919.

Silva D. O inventário de estado-traço de ansiedade. In: Gonçalves M, Almeida L, Machado C, Simões M (eds). *Avaliação Psicológica—Instrumentos Validados para a População Portuguesa*. Coimbra: Quarteto Editora, 2006.

Silva S, Barros H. Perspectives on access to in vitro fertilization in Portugal. *Rev Saude Publ* 2012;**46**:344–350.

Spielberger CD, Gorsuch RL, Lushene RE. *The State-Trait Anxiety Inventory: Test Manual*. Palo Alto, CA, USA: Consulting Psychologists Press, 1983.

Stanton F, Golombok S. Maternal-fetal attachment during pregnancy following in vitro fertilization. *J Psychosom Obstet Gynaecol* 1993;**14**:153–158.

Tendais I, Figueiredo B. Parents' anxiety and depression symptoms after successful infertility treatment and spontaneous conception: does singleton/twin pregnancy matter? *Hum Rep* 2016;**31**:2303–2312.

Ulrich D, Gagel DE, Hemmerling A, Parstor V-S, Kentenich H. Couples becoming parents: something special after IVF? *J Psychosom Obstet Gynaecol* 2004;**25**:99–113.

Underwood L, Waldie KE, Peterson E, D'Souza S, Verbiest M, McDaid F, Morton S. Paternal depression symptoms during pregnancy and after childbirth among participants in the growing up in New Zealand study. *JAMA Psychiatry* 2017;**74**:1–10.

Vänskä M, Punamäki RL, Tolvanen A, Lindblom J, Flykt M, Unkila-Kallio L, Tiitinen A. Paternal mental health trajectory classes and early fathering experiences: prospective study on a normative and formerly infertile sample. *Int J Behav Dev* 2017;**41**:570–580.