



Research paper

Development of the paternal pregnancy-related anxiety scale (PPrAS) using Rasch analysis with Australian and USA samples of expectant fathers[☆]

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ABSTRACT

Up to 25 % of expectant fathers may experience anxiety symptoms, with potential adverse consequences for themselves and their families. This study developed a psychometrically sound measure of pregnancy-related anxiety for fathers, addressing a current gap in research and practice for psychological scales that specifically assess men's fears, worries, and concerns specific to pregnancy. An item pool encompassing men's pregnancy-related concerns and worries was generated based on findings from a systematic review (Dabb et al., 2023). Following expert panel review, 95 items were evaluated within the framework of the Rasch measurement model, using data from 292 expectant fathers ($M_{\text{age}} = 29.9$ years, $SD = 5.55$) from Australia ($N = 146$) and the USA ($N = 146$). The resultant 33-item unidimensional scale demonstrated good fit, no evidence for differential item functioning, sound levels of targeting, and excellent internal consistency reliability. The new Paternal Pregnancy-related Anxiety Scale (PPrAS) is a comprehensive measure of pregnancy-related anxiety for expectant fathers, with usefulness in both clinical and research contexts.

Pregnancy is a significant transitional period, during which parents often face multiple worries, predisposing them to experiencing anxiety symptoms (Biehle and Mickelson, 2011; Göbel et al., 2020). Systematic reviews indicate that up to 25 % of women (Dennis et al., 2017) and men (Philpott et al., 2019) experience anxiety symptoms during the pregnancy period, which are higher than the proportion of women and men in the general population who are affected by anxiety symptoms. The National Institute of Mental Health (2024) has reported that 21 % of women and 13 % of men experience anxiety over a 12-month period. Despite the comparable rates of women and men experiencing anxiety during pregnancy, the majority of pregnancy anxiety research has understandably focused on women and on the impact of maternal anxiety on maternal health, baby health, and birth outcomes. However, the higher rates of anxiety experienced by men during pregnancy, compared to the general male population, highlights the need for further research

into paternal anxiety during pregnancy and emphasizes the importance of supporting the wellbeing of expectant fathers. Moreover, researchers are increasingly recognizing that poor perinatal mental health in fathers not only adversely affects themselves, but also impacts the wellbeing of mothers, infants, and the family unit (Fisher et al., 2021); with anxiety in expectant fathers linked to multiple adverse outcomes (Philpott et al., 2019).

During pregnancy, the association between paternal anxiety and depressive symptoms is well established (e.g., Finnbogadóttir and Persson, 2019; Wee et al., 2015). Additionally, expectant fathers with anxiety are more likely to experience sleeping difficulties (Finnbogadóttir and Persson, 2019) and poorer quality of prenatal attachment to their unborn child (Vreeswijk et al., 2014). Following childbirth, prenatal¹ paternal anxiety is a predictor of paternal postnatal depression (Howarth and Swain, 2020; Ramchandani et al., 2008),

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¹ Period from gestation to birth.

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which is linked to psychiatric disorders and social difficulties in children at 7 years of age (Ramchandani et al., 2008). Other post-birth outcomes include lower paternal responsiveness to infants at three months (Parfitt et al., 2013), increased parenting stress, which in turn is associated with increased infant negative reactivity at three months (Prino et al., 2016), parenting stress at six months (Skjothaug et al., 2018), and reduced parental self-efficacy at six months (Pinto et al., 2016).

Anxiety in expectant fathers is also associated with a higher incidence of maternal anxiety and depression during pregnancy (Brandão et al., 2019; Canário and Figueiredo, 2017; Koh et al., 2015), and other psychosocial outcomes, potentially affecting the couple relationship and reducing the critical support provided to women during pregnancy. For example, fathers with prenatal anxiety are more likely to experience gender role stress, feeling that they are not measuring up to societal standards (Durkin et al., 2001). Additionally, they are vulnerable to feelings of anger (Durkin et al., 2001) and general hostility, such as hostile thoughts, annoyance, argumentative tendencies, and anger outbursts (Göbel et al., 2020). Not surprisingly, prenatal paternal anxiety is associated with reduced relationship satisfaction (Brandão et al., 2019; Cameron et al., 2021). These psychosocial outcomes may undermine the level of support provided by fathers to their partners, leading to an increased risk of maternal mental health difficulties during pregnancy (Cheng et al., 2016; Hyer et al., 2022) and after childbirth (Parfitt and Ayers, 2014; Pilkington et al., 2015). Moreover, women with low partner support are at increased risk of preterm birth (Ghosh et al., 2010) and having low birth-weight babies (Lee et al., 2018). Therefore, addressing anxiety in expectant fathers is likely to improve outcomes not only for fathers, but also for mothers, and their infants.

Despite growing evidence that anxiety in expectant fathers is associated with multiple adverse outcomes, research indicates that they often feel excluded from professional support during the perinatal² period (Rominov et al., 2018; Venning et al., 2020). Moreover, the diagnosis and treatment of anxiety in expectant fathers has been largely overlooked (Koh et al., 2015). To address this gap, clinical practice guidelines increasingly emphasize men's perinatal mental health (Fisher et al., 2021; Highet et al., 2023) and the need for routine mental health assessment of partners during the perinatal period (Darwin et al., 2021). However, to date, there are few psychometrically sound measures developed specifically for men, that assess their pregnancy-specific fears (Highet et al., 2023).

1. Assessing anxiety in expectant fathers in clinical practice and research

Current clinical practice guidelines provide limited recommendations for the assessment and treatment of fathers experiencing prenatal anxiety (Leach et al., 2016). In the United States of America (USA), antenatal mental health screening of fathers is largely seen as optional (Fisher et al., 2021). The Australian guidelines, outlined by the Centre of Perinatal Excellence (COPE; Highet et al., 2023), recommend routine perinatal mental health screening of fathers. However, given the absence of male-specific measures of prenatal anxiety, COPE does not recommend any specific screening tools for fathers (Highet et al., 2023). The current consensus-based recommendation is for clinicians to select a screening tool in accordance with which tools are available, and their professional competencies (Highet et al., 2023). Within perinatal health settings, the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) is readily available and has been validated for fathers with a lower cut-off score of 5/6 (Matthey et al., 2001). When administering the EPDS to men, the Australian guidelines recommend that practitioners examine responses to individual items rather than solely relying on total scores (Highet et al., 2023). Responses to EPDS items 3, 4, and 5 would provide clinicians with some information about men's general anxiety

symptoms. Otherwise, clinicians may choose to administer a generic measure of anxiety (e.g., Hospital Anxiety Depression Scale [HADS; Zigmond and Snaith, 1983]; or the Generalized Anxiety Disorder-7 scale [GAD-7; Spitzer et al., 2006]; or the anxiety subscale of the Depression Anxiety Stress Scale-21 [DASS-21; Lovibond and Lovibond, 1995]). These generic measures of anxiety are similarly used in research examining anxiety in expectant fathers (e.g., Brandão et al., 2019; Göbel et al., 2019; Sartori et al., 2018; Wee et al., 2015), along with the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970; e.g., Finnbo-gadóttir and Persson, 2019; Pinto et al., 2016; Vreeswijk et al., 2014).

2. Assessing pregnancy-related anxiety

Although clinical practice and research have largely relied on generic measures of anxiety to assess anxiety in expectant fathers, this assessment approach is unlikely to adequately identify fathers with problematic anxiety specifically related to their partner's pregnancy (Cameron et al., 2021). Research with women indicates that in addition to experiencing specific and generalized anxiety disorders during pregnancy (Leach et al., 2017), women may also experience pregnancy-related anxiety (Huizink et al., 2004), also known as pregnancy anxiety or pregnancy specific anxiety (Dunkel Schetter and Ponting, 2022). Pregnancy-related anxiety is characterized by multiple worries and fears regarding the pregnancy, childbirth, infant health, and the transition to parenthood (Bayrampour et al., 2016). There is increasing evidence that pregnancy-related anxiety is a different construct to general anxiety or depression in both expectant mothers (Anderson et al., 2018; Brunton et al., 2019; Huizink et al., 2004) and fathers (Cameron et al., 2021). Reliance on generic measures of anxiety may not adequately identify individuals with pregnancy-related anxiety (Anderson et al., 2018; Brunton et al., 2019; Cameron et al., 2021; Huizink et al., 2004), nor reliably predict outcomes commonly associated with pregnancy-related anxiety (Cameron et al., 2021; Lobel et al., 2008; Nolvi et al., 2016). Considering the limitations of using generic measures of anxiety during pregnancy, researchers have directed increased attention to developing psychometrically sound measures of pregnancy-related anxiety for women (e.g., Brunton et al., 2021; Dryer et al., 2022). However, no pregnancy-related anxiety measure has yet been specifically developed for expectant fathers.

In the absence of pregnancy-related anxiety measures for fathers, researchers have relied on adaptations of existing maternal scales in research with fathers, such as the Pregnancy Outcome Questionnaire (POQ; Theut et al., 1988; e.g., Armstrong, 2002, 2004; Franche and Mikail, 1999; Theut et al., 1988) and the Pregnancy-Related Anxiety Measure³ (PRAM; Rini et al., 1999; e.g., Cameron et al., 2021; Saxbe et al., 2018). Adaptations of a Pregnancy-Related Anxiety Questionnaire (PRAQ; Van den Bergh, 1990; e.g., Winter et al., 2016); or the revised 10-item or 7-item versions of this scale (i.e., PRAQ-R; Huizink et al., 2004; e.g., Skjothaug et al., 2015, 2018; Skjothaug et al., 2020; Tolvanen et al., 2013) have also been used. These researchers have brought the relevancy of paternal pregnancy-related anxiety to the forefront, within a historical context of men being overlooked in perinatal mental health research, or research focusing on paternal depression or non-specific anxiety.

However, there are limitations with adapting maternal scales for fathers. This approach assumes that items originally designed for women are equally effective at capturing the construct of pregnancy-related anxiety in men. While maternal scales, such as the PRAM (Rini et al., 1999), address concerns about fetal health, childbirth, and

³ Note, the measure of maternal pregnancy-related anxiety developed by Rini et al. (1999) was referred to as the Pregnancy-Related Anxiety Measure (PRAM) by Stevenson et al. (2019), the Pregnancy Anxiety Scale (PAS) by Saxbe et al. (2018), and the Pregnancy Related Anxiety Scale (PRAS) by Cameron et al. (2021).

² Period from gestation to one year post birth.

parenting, that are also shared by men (Pilkington and Rominov, 2017), expectant mothers and fathers also worry about different things and prioritize their concerns differently (Biehle and Mickelson, 2011). For example, men are more likely to worry about security, such as finances, than women (Biehle and Mickelson, 2011). Consequently, the pregnancy-related anxiety experienced by men would differ from that experienced by women because of their unique concerns, worries, and fears during pregnancy. Qualitative research indicates that frequently reported concerns among expectant fathers include issues which are unique to the non-birthing parent, such as feeling excluded from antenatal care, worrying about their ability to adequately support their partner during labor and delivery, and feeling unprepared for parenthood (Dabb et al., 2023). Men also experience a range of other concerns, not currently addressed by maternal measures of pregnancy-related anxiety, such as worries about providing adequate practical and emotional support to their partner (Baldwin et al., 2018; Kao and Long, 2004), and concerns regarding the impact of parenthood on their sense of independence (Genesoni and Tallandini, 2009; Poh et al., 2014). Since maternal measures of anxiety are unlikely to encompass the full range of men's concerns, worries, and fears during the pregnancy period, a scale specifically designed for use with fathers is warranted.

Moreover, a further limitation of using adapted maternal scales for fathers is that the methods used to adapt these scales have been inconsistent or poorly reported across studies. For example, Skjothaug et al. (2015) adapted the PRAQ-R by removing three items related to childbirth pain, change in body perception, and fear of gaining weight, despite previous research identifying that fathers may worry about their partner's pain in childbirth (e.g., Forsyth et al., 2011) or changing body shape (Draper, 2003). In other research, Tolvanen et al. (2013) used all 10 items of the PRAQ-R, without describing how item wording was adapted for fathers. A further limitation is that psychometric evidence for the reliability and validity of using maternal scales in fathers is limited. To address this, Cameron et al. (2021) evaluated the psychometric properties of the PRAM, adapted for expectant fathers, finding good internal consistency ($\alpha = .87$) and evidence for predictive validity. However, the adapted PRAM had higher correlations with depression (EPDS; $r = .52$) than anxiety (STAI; $r = .45$), warranting further examination of construct validity.

3. Purpose of the study

The current absence of psychometrically sound measures assessing pregnancy-related anxiety in fathers means that screening continues to rely on the use of generic measures of anxiety, resulting in the risk that pregnancy-related anxiety in expectant fathers is not being adequately detected and addressed. Therefore, the primary goal of the present study was to develop a psychometrically sound measure of pregnancy-related anxiety, specifically developed for expectant fathers; and capturing men's relevant concerns during their partner's pregnancy. This is not to say that fathers may not also be affected by general anxiety, however, the rationale for developing a paternal pregnancy-related anxiety scale was on the basis of the previous research on maternal pregnancy-related anxiety, indicating that pregnancy-related anxiety is distinct from general anxiety, and is not reliably detected when using generic measures of anxiety (e.g., Brunton et al., 2019; Huizink et al., 2004).

An additional goal of the present study was to test the cross-country generalizability of the newly developed Paternal Pregnancy-related Anxiety Scale (PPrAS), taking into consideration that antenatal care systems vary between countries and have the potential to affect the wellbeing of parents (Bäckström et al., 2017). Therefore, expectant fathers were recruited from Australia and the USA, because these two countries have very different healthcare and maternity care systems, despite sharing similar socioeconomic standards. For example, Australia provides readily accessible obstetric care through the public health system, whereas in the USA, individuals receive different standards of care depending on their level of health insurance. This study compared

participant responses to items in the new scale, between expectant fathers residing in these two countries, to explore whether the new scale could be used regardless of the healthcare or maternity system in place within a country.

Finally, this study applied the Rasch measurement model (Rasch, 1960) as the primary framework for scale development, followed by additional evaluation of the scale using CTT approaches. The Rasch measurement model was selected for scale development to overcome known limitations with applying CTT approaches, which can result in parameters such as reliability, discrimination location, and factor loadings, being dependent on the sample being used (Balsamo et al., 2014; Linsner et al., 2020). Rasch analysis minimizes the risk of undue influence on scale development by individual respondents by calculating the person and item parameters separately, resulting in parameter estimates which are independent of each other (Bond et al., 2021; Townsend, 2017). Moreover, Rasch analysis was chosen for scale development because it facilitates the development of measurement instruments according to three essential principles of fundamental measurement (Medvedev and Krägeloh, 2022). First, measurement instruments should be unidimensional, so that the sum of all items is a valid measure of a single latent variable (Tennant and Conaghan, 2007). Second, measurement instruments should work equally well for all individuals, regardless of differences in their personal attributes (Medvedev and Krägeloh, 2022). And third, instruments should rely on units of measurement which remain consistent along a linear continuum (Thurstone, 1931). Development of the PPrAS was guided by these same principles of fundamental measurement by: (a) establishing the unidimensionality of the final scale, while including items drawn from a comprehensive range of men's pregnancy-related concerns, worries and fears; (b) ensuring no Differential Item Functioning (DIF), so that the final scale is applicable regardless of personal attributes, such as country of residence; and (c) transforming scale scores from ordinal-level to interval-level scores, allowing future users of the PPrAS to measure pregnancy-related anxiety in fathers, on a linear continuum. A unidimensional approach to the measurement of paternal pregnancy-related anxiety was adopted given that while previous reviews have identified different pregnancy-specific fears and worries in expectant fathers, we are not aware of any research that indicate that these fears and worries constitute different dimensions of paternal pregnancy-related anxiety.

Further psychometric evaluation of the PPrAS was conducted, using CTT approaches. Namely, internal consistency was evaluated using Cronbach's alpha; convergent validity was assessed through correlation with the adapted maternal measure of pregnancy-related anxiety (adapted PRAM); and divergent validity assessed through correlation with a generic measure of anxiety (GAD-7).

4. Method

Following institutional ethics approval, scale development was conducted in three stages. First, an initial item pool was generated. Second, the item pool was evaluated by an Expert Review Panel (ERP) and revised accordingly. Finally, expectant fathers completed online questionnaires with the item pool. Rasch analysis was used to identify items to be retained, and the psychometric properties of the new scale were subsequently evaluated using both Rasch analysis and CTT approaches to assess validity and reliability.

4.1. Generation of item pool

To comprehensively capture men's pregnancy-related concerns, a systematic review of qualitative and quantitative literature was previously conducted (Dabb et al., 2023). This review identified 75 distinct concerns relevant to expectant fathers, which were grouped into 10 categories of concern: childbirth concerns, attitudes towards childbirth, baby concerns, acceptance of pregnancy, partner concerns, relationship concerns, worry about self, transition to parenthood, attitudes towards

health care professionals, and practical and financial concerns. The systematic review findings informed the generation of 113 items for the initial item pool. Supplementary Table S1 shows the initial item pool, listed according to the pregnancy-related concerns of expectant fathers, as identified by the systematic review.

4.2. Evaluation of item pool by expert review panel (ERP)

Members of the expert panel were selected by identifying researchers with expertise in fathers' perinatal mental health or in scale development and psychometrics, either through the academic literature or through personal connections with the authors. In addition, experienced clinicians providing antenatal care, who were known to the authors; including obstetrician-gynaecologists, midwives, general practitioners, and allied health professionals; were also considered. A total of 37 researchers and/or clinicians were invited by email to participate in the ERP. Emails included a link to the participant information letter with an opportunity to provide consent to participate.

The ERP included nine female and three male members, living in Australia ($n = 7$), the United Kingdom ($n = 2$), Sweden ($n = 2$), and Germany ($n = 1$). ERP members included five professionals currently practising within clinical contexts, with an average of 24.4 years of experience providing medical care and/or mental health support to parents during the perinatal period. The other seven ERP members were researchers or academics affiliated with various universities, with an average of 15 years of experience.

The ERP members completed an online survey consisting of the 113 items, which were rated for relevance on a 4-point scale from 1 (*redundant/not important to include*) to 4 (*extremely relevant/extremely important to include*). Following this, items were rated from 1 (*poor*) to 4 (*excellent*) for wording, using the following characteristics: clarity (*Is the meaning of the item clear, with unambiguous wording?*), language (*Is the language simple, unbiased, and acultural - avoiding fashionable expressions or colloquialisms?*), and conciseness (*Does the item convey meaning without wordiness?*). ERP members could also provide additional written comments or feedback regarding the item pool.

Eight ERP members fully completed the questionnaire, two completed 33 %, and the remaining two members completed 26 % of the questionnaire. Partial responses were included in the analyses. After examining the ERP ratings and comments, items were removed due to low relevancy or poor wording, where alternative items addressing the same concerns were retained. In cases where removal of low-rated items would lead to specific concerns being omitted from the item pool, the wording of these items was amended to improve item clarity, language, and/or conciseness. The revised item pool included 95 items (refer to Supplementary Table S2 for the revised item pool, listed by item number).

4.3. Refinement of item pool using Rasch analysis and psychometric evaluation

4.3.1. Procedure

The study was promoted on Facebook/Meta and Instagram using paid advertising. Participation was anonymous. A modest incentive was offered in the form of a gift card draw. Participants accessed the survey through a hyperlink and first provided informed consent. Upon completion, (and for those not meeting the inclusion criteria for the study) participants were provided with debrief information which included telephone counselling numbers and support groups should they have experienced distress or discomfort.

4.3.2. Participants

The current study aimed to collect data from 250 participants, based on sample size guidelines for Rasch analysis (Linacre, 1994). Inclusion criteria required participants to be fluent English-speaking males, over the age of 18 years, living in Australia or the USA, with partners also

over 18 years and pregnant with singleton pregnancies. Since the study aimed to identify scale items appropriate for general community use, exclusion criteria were set to minimize potential influence from participants already predisposed to experiencing high levels of anxiety during pregnancy. Therefore, men who self-reported having partners who achieved pregnancy through assisted reproductive technology or partners experiencing medical complications in the current or a previous pregnancy were excluded. Additionally, men with a previous experience of miscarriage or stillbirth, or men currently receiving treatment for a mental health condition were excluded.

Beginning with 869 attempted survey responses, 195 participants who did not meet eligibility criteria were excluded. A further 198 participants who did not attempt questions in the item pool, and 18 participants who completed <50 % of the item pool were excluded, resulting in 458 responses. In accordance with guidelines for screening online survey data (Xu et al., 2022), 166 entries were deleted as potentially fraudulent. The final sample included 292 expectant fathers. Equal numbers ($n = 146$) were living in Australia and the USA. Table 1 provides the demographic data for both groups.

Participants were aged between 20 and 47 years ($M_{\text{age}} = 29.9$ years, $SD = 5.55$). Fathers living in Australia ($M_{\text{age}} = 28.94$ years, $SD = 4.47$) were significantly younger than those from the USA ($M_{\text{age}} = 30.88$ years, $SD = 6.33$), $t(290) = -3.02$, $p = .003$, two-tailed (using Welch's t -test

Table 1

Participant demographics for expectant fathers living in Australia and the USA.

	Australia ($n = 146$)	USA ($n = 146$)
Relationship status		
Married/Defacto	146 (100 %)	143 (97.9 %)
Single	0 (0 %)	3 (2.1 %)
	$M = 18.01$, $SD = 8.65$	$M = 26.13$, $SD = 8.89$
Gestation of partner (weeks)		
Trimester 1 (0–13 weeks)	52 (35.6 %)	15 (10.3 %)
Trimester 2 (14–26 weeks)	68 (46.6 %)	50 (34.2 %)
Trimester 3 (27+ weeks)	26 (17.8 %)	81 (55.5 %)
Parity		
First-time father	119 (81.5 %)	73 (50 %)
Second or subsequent pregnancy	27 (18.5 %)	73 (50 %)
Country of birth		
Australia	133 (91.1 %)	13 (8.9 %)
USA	4 (2.7 %)	130 (89.0 %)
New Zealand	2 (1.4 %)	0 (0 %)
Canada	2 (1.4 %)	3 (2.1 %)
UK	2 (1.4 %)	0 (0 %)
Germany or Netherlands	2 (1.4 %)	0 (0 %)
Philippines	1 (0.7 %)	0 (0 %)
Cultural background		
Caucasian	110 (75.3 %)	133 (91.1 %)
Aboriginal/Torres Strait Islander	14 (9.6 %)	0 (0 %)
European	5 (3.4 %)	2 (1.4 %)
Hispanic	3 (2.1 %)	10 (6.8 %)
African	2 (1.4 %)	1 (0.7 %)
Asian	6 (4.1 %)	0 (0 %)
Caucasian & Aboriginal/Torres Strait Islander	1 (0.7 %)	0 (0 %)
European & Caucasian	3 (2.1 %)	0 (0 %)
European & Middle Eastern	1 (0.7 %)	0 (0 %)
Not specified	1 (0.7 %)	0 (0 %)
Education		
High School	12 (8.2 %)	2 (1.4 %)
Trade certificate or diploma	13 (8.9 %)	6 (4.1 %)
University (undergraduate, i.e., Bachelor)	99 (67.8 %)	110 (75.3 %)
University (postgraduate, i.e., Masters, PhD)	22 (15.1 %)	28 (19.2 %)
Employment status		
Full-time employment	123 (84.2 %)	120 (82.2 %)
Part-time, >20 h per week	5 (3.4 %)	6 (4.1 %)
Casual/Part-time, <20 h per week	1 (0.7 %)	1 (0.7 %)
Self-employed	14 (9.6 %)	19 (13.0 %)
Unemployed	3 (2.1 %)	0 (0 %)

due to greater variance in USA sample), $d = -0.354$, 95 % CI of the mean difference $[-3.20, -0.68]$. Moreover, gestation for the Australian sample ($M_{\text{gestation}} = 18.01$ weeks, $SD = 8.65$) was significantly lower than the USA sample ($M_{\text{gestation}} = 26.13$ weeks, $SD = 8.89$), $t(290) = -7.91$, $p < .001$, two-tailed, $d = -0.926$, 95 % CI of the mean difference $[10.14, 6.10]$. A greater proportion of fathers from the USA were expecting a second or subsequent baby, $\chi^2(1) = 32.18$, $p < .001$. Fathers from the USA were more likely to have a higher level of education than fathers from Australia, $\chi^2(3) = 11.02$, $p = .012$. No significant differences in employment were found between the two groups.

Supplementary Table S3 shows the participant medical and mental health information. No fathers reported currently receiving treatment for a mental health condition. Six fathers from Australia reported a history of a mental health condition, compared with none from the USA. Given that the medical and mental health information was based solely on participant self-report, with no independent verification, the decision was made to retain the participants reporting a history of a mental health condition in the data analyses.

4.3.3. Measures

Participants completed the study via an online survey platform (Qualtrics.com). Following screening for eligibility criteria, demographic questions were completed by participants (e.g., age, marital status, education, employment, cultural background, gestation of partner, parity, and medical history for themselves and their partners).

Participants then completed the 7-item GAD-7 (Spitzer et al., 2006). Participants rated how often they had experienced anxiety symptoms during the previous two weeks, from 0 (*Not at all*) to 3 (*Nearly every day*). An example item is, "Worrying too much about different things." Higher scores indicated greater levels of anxiety. The scale has moderately high internal consistency ($\alpha = .82$) for expectant fathers (Göbel et al., 2019). Cronbach's alpha in the present sample was .87.

Additionally, the 10-item PRAM (Rini et al., 1999), as adapted for fathers by Cameron et al. (2021) was completed. Participants rated the extent of their agreement from 1 (*Not at all or Never*) to 4 (*Very much or Almost all of the time*) for items, such as, "I am concerned or worried about losing the baby." After summing scores, the mean provided an overall measure of pregnancy-related anxiety, with higher mean scores indicating higher levels of paternal pregnancy-related anxiety. The scale has previously demonstrated moderately high internal consistency ($\alpha = .87$) for expectant fathers (Cameron et al., 2021). Cronbach's alpha in the present sample was .77.

Finally, the 95-item revised item pool was presented in randomized order to prevent response-order effects. Items were rated from 1 (*not at all*) to 4 (*very often*).

4.3.4. Data analyses

Descriptive statistics and correlation analyses were calculated using IBM SPSS v29. Rasch analysis was conducted using RUMM2030 software (Andrich et al., 2009). A likelihood ratio test determined which Rasch model to adopt (Leung et al., 2014). Where significant differences between response option thresholds existed across individual items, the unrestricted partial-credit model (Masters, 1982) was selected rather than the rating scale model (Andrich, 1978).

Rasch analysis guided the reduction of the item pool, using an iterative approach. The overall model fit for the entire item pool was evaluated by examining the item-trait interaction chi-square statistic. A nonsignificant chi-square probability ($p > .05$) indicated good fit (Balsamo et al., 2014). Misfitting items with standardized residuals outside the range of -2.50 to $+2.50$ were deleted (Medvedev and Krägeloh, 2022; Pallant and Tennant, 2007). DIF was examined in relation to the following person factors: country of residence (Australia vs. USA), parity (first baby vs. second/subsequent baby), partner's pregnancy trimester (first, second or third), and fathers' age (within ranges: 20–26 years, 27–29 years, or 30–47 years). Items displaying DIF were removed to ensure that the new scale would function equally well

for all individuals, regardless of personal factors. Item category probability curves and the item threshold map were examined to identify items with disordered thresholds.

Once the item pool was reduced, additional psychometric evaluation was conducted within the Rasch measurement framework. Local dependency between items was assessed by examining the residual correlation matrix as a means to identify sources of misfit. Unidimensionality was tested by conducting a Principal Components Analysis (PCA) of the standardized residuals. Following the procedure of Smith (2002), items with the highest positive or negative factor loadings on the first component of the PCA of residuals were grouped into two subsets and the person estimates for each subset were compared using paired-samples t -tests. When the percentage of significant t -tests was below 5 % (or the lower bound binomial proportions Confidence Interval [CI] value for the percentage was below 5 %), unidimensionality was inferred (Tennant and Pallant, 2006). The Person Separation Index (PSI) was examined as an estimate of internal consistency reliability (Tennant and Conaghan, 2007). Models with a high PSI allow for a greater number of class intervals, enabling more accurate differentiation of individuals based on their level of latent variable. A minimum value of .70 indicates suitability of the scale for reliable group comparisons, and a minimum value of .85 indicates suitability for within-participant comparisons (Tennant and Conaghan, 2007). Finally, sample targeting was examined before creating ordinal-to-interval transformation tables.

Further evaluation of the newly developed PPrAS was conducted using CTT approaches with the same sample. Before calculating scale total scores and correlations, a missing-values analysis was conducted with the Little's Missing Completely at Random (MCAR) test. Missing values for any items were imputed using Expectation Maximization (EM), considered a superior approach to the regression method, which may artificially inflate correlations (Schafer and Olsen, 1998). Internal consistency was examined using Cronbach's alpha. Convergent and divergent validity of the new PPrAS was evaluated by calculating the Pearson's r correlation coefficients of the new scale with the adapted PRAM and GAD-7, respectively.

5. Results

The likelihood-ratio test confirmed the selection of the unrestricted partial-credit model for Rasch analysis. Initial analysis of the complete item pool of 95 items indicated a considerable degree of misfit between the data and the overall model, with a significant item-trait interaction, $\chi^2(855) = 1139.32$, $p < .0001$. Table 2 provides the overall Rasch model statistics for the initial and subsequent analyses.

Individual item fit statistics were examined, and eight items with standardized fit residuals outside the range of -2.50 to $+2.50$ were removed from the item pool (items 2, 27, 29, 41, 42, 46, 69, and 66; shown in Supplementary Table S2). The overall model statistics were recalculated on the remaining 87 items. One additional misfitting item (i.e., item 14) was identified and removed. The remaining 86 items still showed a significant item-trait interaction, $\chi^2(774) = 911.47$, $p < .0001$.

Once there were no remaining misfitting items, examination of DIF was conducted. No evidence of DIF was found for any items, across the following person factors: country of residence, parity, partner's pregnancy trimester, and fathers' age. This indicated that all items were measuring pregnancy-related anxiety in an equivalent way, for all expectant fathers, across the examined demographic groups.

No items with disordered thresholds were found when examining the item category probability curves and item threshold map. Groups of psychometrically redundant items were identified, which included two or more items with similar difficulty values and similar threshold patterns. Items from each group were selected for the final scale, maintaining the full range of item difficulties found in the item pool, and ensuring that items retained reflected the breadth of expectant fathers' concerns previously identified (Dabb et al., 2023). Items were selected

Table 2
Summary of Rasch model fit statistics for the paternal pregnancy-related anxiety scale.

	Person location		Person fit residual		Item fit residual		Overall model fit: Item-trait interaction		PSI
	Mean	SD	Mean	SD	Mean	SD	χ^2 (df)	p	
Initial analysis 95 items	−0.85	1.37	−0.16	1.87	0.06	1.53	1139.32 (855)	<.0001	.98
87 items	−0.89	1.41	−0.17	1.80	0.05	1.14	925.89 (783)	<.0001	.98
86 items	−0.89	1.42	−0.17	1.81	0.04	1.10	911.47 (774)	<.0001	.98
Final analysis 33 items	−0.92	1.44	−0.18	1.25	0.01	1.08	332.75 (297)	.075	.96

Note. $N = 292$. $SD =$ Standard Deviation. $\chi^2 =$ chi-square statistic. $df =$ degrees of freedom. PSI = Person Separation Index.

for retention during collaboration between research team members and guided by theoretical considerations. For example, item 62 (*I worry about experiencing a loss of independence*) was retained in preference to item 60 (*I am concerned about how I will manage with less sleep once the baby is born*) for the following considerations. Independence had previously been more frequently identified as a relevant concern for expectant fathers than loss of sleep (15 % vs. 5 % of qualitative studies included in systematic review) and represents a more enduring aspect of the transition to parenthood. Another example is the removal of item 80 (*I worry about caring for the baby*), in favor of two retained items which addressed the practical (item 76; *I'm afraid I don't have the ability to be a good parent*) and emotional (item 83; *I am afraid that I will find it hard to love the baby*) aspects of caring for the baby.

The resultant scale included 33 items (see Table 3). Refer to Supplementary Figure S1 for the threshold map, ordered by item location. The overall model for the 33 items indicated good fit, with a non-significant item-trait interaction, $\chi^2(198) = 226.86$, $p = .078$. A repeated analysis of the 33 items confirmed no DIF. Inspection of the residual correlation matrix confirmed no local dependency. The PCA of

Table 3
33-items retained in final scale.

33-Item Partner's Pregnancy-related Anxiety Scale (PPrAS)	
1	I'm afraid of complications happening during childbirth
2	I am concerned about my partner requiring an emergency caesarean
3	I worry about my baby being harmed during childbirth
4	I fear that my partner may die in childbirth
5	I am concerned about not being able to help my partner in childbirth
6	I am afraid because I cannot control what will happen in childbirth
7	I do not feel prepared for childbirth
8	I am afraid that my baby will not be healthy
9	I am afraid that my child will have a genetic problem
10	I'm afraid of having a baby with a disability
11	I constantly worry about my partner having a miscarriage
12	I am not looking forward to this baby
13	I felt unprepared for this pregnancy
14	I worry that my partner might experience pregnancy complications
15	I worry about my partner having postnatal depression after the birth
16	I worry about my ability to emotionally support my partner
17	I am concerned about whether I am doing enough to support my partner
18	I'm afraid that our relationship will never go back to the way it was
19	I am concerned that my partner and I won't have time for each other once the baby is born
20	I worry about changes to our sexual relationship during pregnancy
21	I am worried that I will no longer feel attracted to my partner because of changes to their body
22	My worries sometimes overwhelm me
23	My fears and concerns interfere with my daily activities
24	My concerns are keeping me awake at night
25	I worry about experiencing a loss of independence
26	I feel unprepared for parenthood
27	I'm afraid I don't have the ability to be a good parent
28	I am afraid that I will find it hard to love the baby
29	I do not feel supported by the health care professionals
30	I'm afraid that my partner will not receive good care from the health care professionals
31	I worry about the loss of my partner's income
32	I worry about being responsible to financially support the family
33	I am worried about balancing my work responsibilities with family commitments

standardized residuals was conducted to assess unidimensionality, followed by paired samples t -tests (items 3, 5, 6, and 14, vs. items 12, 13, 28, and 31; refer to Supplementary Table S2 to identify relevant items by item number). The number of significant t -tests was 21 out of 292 participants (7.19 %). The lower bound of the 95 % binomial CI for the percentage was 4.69 %, which provided acceptable evidence for unidimensionality. The PSI for the 33-item scale was .96, indicating excellent internal consistency reliability. Table 2 shows the overall model statistics for the final scale and Supplementary Table S4 shows the individual item statistics.

The mean person location for the final scale was -0.92 logits, falling outside the recommended range for a well targeted scale (-0.50 to $+0.50$), and indicating that fathers in this sample generally had low levels of pregnancy-related anxiety. To further evaluate sample targeting, the person-item threshold distribution plot was generated (see Supplementary Figure S2). As shown, more than 90 % of the sample had pregnancy-related anxiety levels (top panel) which were well covered by the item thresholds (bottom panel) of the scale. The sample was better covered by item thresholds at higher levels of pregnancy-related anxiety (see right side of plot). At the lower end, 29 participants (9.93 %) were outside the item threshold coverage, indicating that the scale was unable to differentiate between individuals with low levels of pregnancy-related anxiety. However, there was no evidence of a floor effect, since the percentage of participants not covered at the lower end was below 15 % (McHorney and Tarlov, 1995). Therefore, the scale demonstrated acceptable targeting of the sample by item thresholds, and ordinal-to-interval transformation of scores was computed.

Supplementary Table S5 presents the ordinal-to-interval conversion table. The SPSS syntax to convert the total PPrAS scores to the corresponding Rasch interval scores, is provided in Supplementary Table S6. Transformation of the PPrAS scores from ordinal to interval resulted in a significant difference between the mean PPrAS ordinal score ($M = 68.67$, $SD = 20.16$) and the mean Rasch interval score ($M = 75.37$, $SD = 12.68$), compared using a paired samples t -test, $t(291) = -13.85$, $p < .001$, two-tailed, $d = -0.810$, 95 % CI of the mean difference [-7.65 , -5.74]. Moreover, the Standard Error (SE) of the mean Rasch interval score ($SE = 0.74$) was lower than for the ordinal scores ($SE = 1.18$), indicating that transformation of the ordinal scores to interval scores resulted in reduced measurement error. In other words, transformation of ordinal scores into interval level data enhances the accuracy of the assessment and encourages usage of interval scores.

5.1. Further psychometric evaluation

Missing values analysis was conducted on the 33-item PPrAS, GAD-7, and adapted PRAM items along with participant ages and the number of weeks gestation of pregnant partners. No item was missing > 2 % of values. Little's MCAR test was not significant, $\chi^2(2310) = 2401.99$, $p = .089$, indicating that the data was missing completely at random. EM was used to impute missing values.

Internal consistency reliability of the PPrAS was excellent ($\alpha = .96$). Correlations were calculated between the PPrAS and adapted PRAM, $r(290) = .74$, $p < .001$, to assess convergent validity; and the PPrAS and GAD-7, $r(290) = .85$, $p < .001$, to assess divergent validity. Contrary to

expectations, the PPrAS was more highly correlated with the GAD-7 than the adapted PRAM.

6. Discussion

The purpose of the present study was to develop the PPrAS as a new measure of pregnancy-related anxiety for expectant fathers, using the Rasch measurement model as the framework for scale development. Key aims were to include a comprehensive range of fathers' pregnancy-related concerns in the final scale, and to ensure cross-country generalizability of the PPrAS when comparing item functioning for fathers from Australia with fathers from the USA. An additional goal was that the PPrAS would be characterized by three essential elements of measurement instruments, by demonstrating unidimensionality, showing no evidence of DIF, and allowing measurement of pregnancy-related anxiety in fathers on a linear continuum. Following development and psychometric evaluation using Rasch analysis, the present study also sought to evaluate internal consistency reliability and convergent and divergent validity, within the CTT framework.

To the best of our knowledge, the PPrAS is the first measure of pregnancy-related anxiety, designed specifically for use with expectant fathers. The 33 items included in the PPrAS were selected from a large item pool, which was generated after a comprehensive literature review and input from an ERP. Moreover, item selection for the final scale ensured that a minimum of two pregnancy-related concerns were included from each of the 10 categories of concern identified by the systematic review (Dabb et al., 2023), including: childbirth concerns, attitudes towards childbirth, baby concerns, acceptance of pregnancy, partner concerns, relationship concerns, worry about self, transition to parenthood, attitudes towards health care professionals, and practical and financial concerns. This study addressed one of the limitations of adapting maternal measures of pregnancy-related anxiety for use in fathers, by avoiding assumptions about which items originally designed for women would be relevant for men. For example, consistent with previous qualitative research which identified that fathers may worry about their partner's changing body shape (Draper, 2003), the PPrAS includes the item, "I am worried that I will no longer feel attracted to my partner because of changes to their body." This is in contrast to approaches that have adapted maternal measures of pregnancy-related anxiety (e.g., Skjothaug et al., 2015) where items related to change in body perception, and fear of gaining weight are simply deleted.

Items included in the PPrAS address specific pregnancy concerns of fathers, which are not evaluated by generic anxiety measures or adapted maternal measures of pregnancy-related anxiety. For example, the PPrAS includes items related to worries about the financial responsibility of parenthood, and having no control over the events of childbirth (Baldwin et al., 2018). Additionally, the PPrAS addresses men's common concerns that they will not be able to help their partner during childbirth and they often feel unprepared for pregnancy and parenthood (Kowlessar et al., 2015; Shorey and Chan, 2020). Moreover, since the PPrAS was designed specifically for fathers, items address men's commonly reported partner/relationship concerns, which are not included in maternal scales, such as worrying about whether they are doing enough to provide emotional (Kao and Long, 2004) and practical (Baldwin et al., 2018) support to their partner, worry about the impact of pregnancy and parenthood on the couple relationship (Poh et al., 2014), and worry about losing their sense of independence in the transition to parenthood (Genesoni and Tallandini, 2009; Poh et al., 2014). By drawing upon the 10 categories of men's concerns, worries, and fears, identified by systematic review (Dabb et al., 2023), the 33 items included in the PPrAS represent the core concerns of expectant fathers described in the literature.

6.1. Psychometric evaluation of the PPrAS using the Rasch measurement model

The PPrAS was developed as a unidimensional scale so that the total score can be considered a valid measure of pregnancy-related anxiety in expectant fathers, as a single latent variable. Considering that the final scale included items drawn from 10 categories of pregnancy-related concerns identified by the systematic review (Dabb et al., 2023), this could have resulted in item response data that is multidimensional. However, research has found that multidimensionality in the item response data does not necessarily require a multidimensional statistical approach (Ip, 2010). The present research took the approach of Reise et al. (2015) and treated the construct of pregnancy-related anxiety as a target latent variable which is in common among all the items. Using this approach, the aim was to create a scale which was sufficiently unidimensional to fit the Rasch measurement model (Reise et al., 2015). Moreover, since the length of the new scale includes more than 20 items, this would minimize the impact of possible multidimensionality (Kirisci et al., 2001). Given that the PPrAS displayed a high internal consistency ($\alpha = .96$), the magnitude of the correlation among any possible underlying dimensions would be high, and therefore, the application of a unidimensional Rasch model is reasonable (Kirisci et al., 2001).

Cross-country generalizability of the 33-item PPrAS was demonstrated for fathers from Australia and the USA, by confirming that all items included in the final scale displayed no evidence of DIF. This means that all items measure pregnancy-related anxiety in an equivalent way for expectant fathers, regardless of country of residence. Examination of DIF also indicated that all items functioned equally well for fathers, regardless of their age, the pregnancy trimester of their partner, and whether or not they were first-time fathers. The creation of the ordinal-to-interval level conversion table for PPrAS scores allows future users of the PPrAS to transform scores based on ordinal responses into interval-level scoring, resulting in greater measurement precision.

Psychometric evaluation of the PPrAS using Rasch analysis indicated that the final model achieved good fit. No evidence for local dependency or disordered thresholds were found. Moreover, the high PSI provided strong evidence for excellent internal consistency and indicated that the PPrAS differentiates well between individuals, particularly at higher levels of pregnancy-related anxiety, making it useful for identifying fathers who may need additional support and/or intervention. Additionally, the PPrAS demonstrated acceptable sample targeting, with no evidence of floor or ceiling effects.

6.2. Psychometric evaluation of the PPrAS using Classical Test Theory (CTT)

Further psychometric evaluation of the PPrAS within the CTT framework confirmed excellent internal consistency. However, evaluation of convergent and divergent validity produced unexpected results. Contrary to expectations, the PPrAS was found to be more highly correlated with the GAD-7 (a measure of generalized anxiety) than with the PRAM (an adapted maternal measure of pregnancy-related anxiety). A possible explanation for this finding is that the 10-item PRAM contains two positively-worded items, whereas both the PPrAS and GAD-7 only contain negatively worded items. Additionally, when comparing the 33 items included in the PPrAS with the adapted PRAM items, the majority of PRAM items addressed childbirth concerns (4 items) and baby concerns (4 items), with two additional items addressing partner concerns and concerns relating to the transition to parenthood. Unlike the PPrAS, the adapted PRAM did not include items addressing acceptance of pregnancy, relationship concerns, attitudes towards health care professionals, and practical and financial concerns. Moreover, no PRAM items addressed anxiety-related symptoms. Contrastingly, the PPrAS includes three items which describe anxiety symptoms previously reported by expectant fathers (*my worries sometimes overwhelm me*, *my fears and concerns interfere with my daily activities*, and *my concerns are keeping*

me awake at night). These anxiety-related symptoms are likely to be highly correlated with symptoms of generalized anxiety disorder, measured by the GAD-7. Taken together, the overlap of anxiety symptoms measured by the GAD-7 and PPrAS, along with the differences in content between the PPrAS and adapted PRAM may account for the current findings.

An additional consideration is that despite the approach used in the present study, of treating paternal pregnancy-related anxiety as distinct from general anxiety, the results of the classical test theory evaluation suggest that this may not be the case. That is, these findings suggest that pregnancy-related anxiety in expectant fathers may not be as distinct from non-specific or general anxiety as has been demonstrated in research with expectant mothers (e.g., Anderson et al., 2018; Huizink et al., 2004). However, the availability of a paternal measure of pregnancy-related anxiety, such as the PPrAS, will still be beneficial for expectant fathers given its focus on pregnancy-specific concerns. Fathers have been reported to be reluctant to seek help for their emotional needs during pregnancy and are more likely to engage with services for practical skills building or for assistance with parenting challenges (Matthey et al., 2009; Rominov et al., 2018). Moreover, while expectant fathers may be aware of their increasing levels of anxiety and/or depression during their partner's pregnancy, they may not seek help due to fears of the stigma associated with mental health conditions (Letourneau et al., 2011). Accordingly, fathers may be more willing to engage with clinicians if asked to complete a measure that explores their pregnancy-related concerns (e.g., PPrAS), rather than a generic measure of anxiety and/or depression (e.g., HADS-A, GAD-7).

6.3. Limitations and future directions

Several limitations of the present study need to be noted. Despite the perinatal mental health expertise of the members of the ERP, this group included more female ($n = 9$) than male ($n = 3$) members, which may have introduced bias in the evaluation of the initial item pool due to a lack of male perspective, particularly in rating the relevance of potential items for use with men. This limitation is important to note, considering the objective of the research, which was to ensure that the scale reflects a comprehensive understanding of the concerns, worries, and fears unique to expectant fathers. Future research should aim to further evaluate the validity of the scale with expectant fathers. For example, a mixed-methods research approach, incorporating qualitative feedback from male participants could offer additional insights and confirm whether the scale accurately reflects men's experiences of pregnancy-related anxiety.

Due to the length of the online questionnaire (including the item pool of 95 items), the present study was limited to including the GAD-7 and adapted PRAM as the only additional measures for assessing construct validity. The unexpected correlational findings relating to convergent and divergent validity warrant further psychometric evaluation of the 33-item PPrAS to establish convergent and divergent validity. For example, examining the correlation between the PPrAS and other adapted maternal measures of pregnancy-related anxiety, such as the adapted PRAQ-R (Skjothaug et al., 2015) may shed light on the findings of the present study. Moreover, examining correlations between the PPrAS and different constructs (e.g., depression or neuroticism), may help to establish divergent validity.

Given the present study was a cross-sectional research design, further psychometric evaluation of the 33-item scale should also include longitudinal research evaluating criterion-related and predictive validity. It is also recommended that future research examines the clinical utility of the PPrAS by assessing sensitivity and specificity, using Receiver Operating Characteristic (ROC) curve analysis.

Since this study was conducted with fathers from Australia and the USA, there may be limits on generality for fathers from different cultures or less economically developed countries. Moreover, the fathers included in this research were predominantly Caucasian, with university

education, and did not adequately represent the cultural and economic diversity found within the general population of Australia or the USA. Therefore, future research examining the psychometric properties of the PPrAS should endeavor to include a more diverse cross-section of fathers. Future research should also further examine the cross-cultural validity of the PPrAS, extending the present findings to other countries.

Generalizability was also limited by the present study's focus on cisgender men in heterosexual relationships. The validity of the PPrAS for gender diverse or non-heterosexual co-parents cannot be assumed. Further examination of DIF on the basis of personal factors pertaining to gender or sexual identity would help to establish the utility of the PPrAS for all co-parents. Improving support provided to gender diverse and non-heterosexual co-parents is especially important, given that they face distinct challenges interacting with heteronormative systems and they often experience a lack of social recognition for their role during the antenatal period (Wojnar and Katzenmeyer, 2014).

Likewise, generalizability was limited by the present study's strict inclusion criteria. Consequently, there is a need for future research to examine pregnancy-related anxiety and the psychometric properties of the PPrAS with partners who may already be predisposed to experiencing high levels of anxiety during pregnancy (e.g., partners who are currently experiencing a mental health condition, or expecting a baby after assisted reproduction technology, or have a history of perinatal loss).

Finally, the availability of a new measure of pregnancy-related anxiety for expectant fathers is only helpful to the extent that it is utilized within clinical settings. It is recognized that there is still much work remaining to improve perinatal mental health services provided to partners (Fletcher et al., 2015). Evaluation needs to be undertaken, regarding routine assessment of partners in the context of antenatal care, and how to ensure uptake by partners. Given the limited time available for clinical consultations, one factor which may limit application of the current 33-item scale, is its length. Future research aimed at further refinement and reduction of the scale to develop a screener would address this limitation.

6.4. Implications for clinical practice and research

The PPrAS is the first measure of pregnancy-related anxiety, designed specifically for use with expectant fathers, that has been evaluated using both Rasch and CTT methodologies. The items included in the PPrAS address a comprehensive range of men's pregnancy-related concerns, worries, and fears, not addressed by generic measures of anxiety, nor by existing maternal scales adapted for fathers. Therefore, the PPrAS is a promising new measure for pregnancy-related anxiety in expectant fathers. The PPrAS item thresholds provided excellent coverage of the sample at the high end of the scale. This makes the PPrAS useful in clinical contexts, since it differentiates well between fathers with high levels of pregnancy-related anxiety. Additionally, the high PSI met clinical criteria for the PPrAS as a suitable measure for group ($PSI > .70$) or individual ($PSI > .85$) assessment (Tennant and Conaghan, 2007). With the availability of the ordinal-to-interval conversion table, analysis of PPrAS scores is made more precise. Provided that the transformed interval-level data is normally distributed, researchers may confidently use parametric statistics, knowing that fundamental test assumptions are not being violated by using ordinal data in arithmetic operations.

6.5. Conclusion

The PPrAS outlined in the present study addresses a current need in clinical practice and research. The PPrAS provides clinicians with a comprehensive measure of pregnancy-related anxiety in expectant fathers, developed using the robust psychometric approach of Rasch analysis. With a high PSI, the PPrAS is suitable for group or individual assessment. Moreover, with item thresholds displaying excellent

coverage at the high end of the scale, the PPRAS differentiates well between fathers with high levels of pregnancy-related anxiety. In research settings, the PPRAS offers researchers an opportunity to extend on the current understanding of pregnancy-related anxiety in partners.

CRedit authorship contribution statement

Carol Dabb: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rachel Dryer:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Robyn J. Brunton:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Chris Krägeloh:** Writing – review & editing, Methodology, Formal analysis. **Michele Moussa:** Investigation, Conceptualization. **Keong Yap:** Writing – review & editing, Supervision. **Vijay J. Roach:** Writing – review & editing, Supervision, Conceptualization. **Oleg Medvedev:** Writing – review & editing, Methodology, Formal analysis.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2025.03.184>.

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