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Van den Bergh, B.R.H.; Simons, A.M.T.

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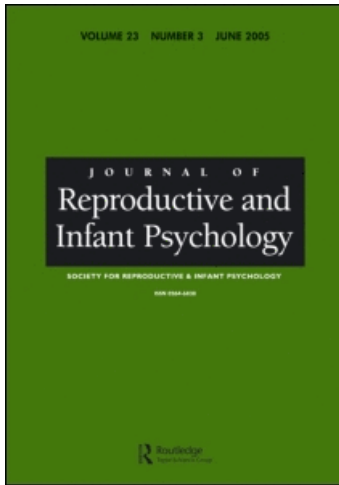
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Bea Van den Bergh^{abc}; Annelies Simons^{ab}

^a Pediatric Psychology Section, Tilburg University, the Netherlands ^b Department of Psychology, University of Leuven, Belgium ^c Department of Welfare, Public Health and Family, Flemish Government, Belgium

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A review of scales to measure the mother–foetus relationship

Bea Van den Bergh^{a,b,c*} and Annelies Simons^{a,b}

^a*Pediatric Psychology Section, Tilburg University, the Netherlands;* ^b*Department of Psychology, University of Leuven, Belgium;* ^c*Department of Welfare, Public Health and Family, Flemish Government, Belgium*

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Research focusing on the prenatal mother–child relationship has begun to create a body of scientific knowledge. The aim of our article is to bring a selective overview of research on scales to measure the mother–foetus relationship (MFR). First, we describe the construction and available information on psychometric properties of three frequently used scales – the Maternal Foetal Attachment Scale (MFAS), Maternal Antenatal Attachment Scale (MAAS), Prenatal Attachment Inventory (PAI), and some other scales. Second, we review empirical research using these scales (a) to study some of the supposed effects of the MFR on the health behaviour of the mother and the well-being of the child, and (b) to examine factors that influence the prenatal maternal–foetal relationship. We focus this review on a description of research with MFR scales that are relevant for clinical obstetrics, gynaecology and reproductive psychology. Some suggestions for further research are made.

Keywords: pregnancy; development; psychosocial factors; mother–foetus relationship

Introduction

The idea that building a relationship with the child does not start at birth but may begin during pregnancy was expressed in 1945 by Deutsch (cited by Condon, 1993). Twenty years ago, Mercer et al. (1988) noted that there was more to learn about the maternal–foetal relationship and that the concept was elusive at best. At that time the construction of scales to measure and quantify the mother–foetus relationship (MFR), for example, the Prenatal Tool (Rees, 1980) and the Maternal Foetal Attachment Scale (MFAS; Cranley, 1981) had given rise to empirical research testing seminal theories. These theories supposed that during pregnancy the development of a relationship with the unborn child is a key developmental task in the successful psychological adjustment for all pregnant women (Gloger-Tippelt, 1983; Raphael-Leff, 1991; Stern, 1995; Valentine, 1982). For primigravidas the formation of a maternal identity, based on representations of the self as mother, was thought to be another important developmental task (e.g. Bibring et al., 1961; Leifer, 1977; Rubin, 1975). Several authors concluded that research with these two scales revealed ‘counter-intuitive’ results. For instance, although the importance of self-esteem and the relationship (or past attachment experiences) with the own mother had been stressed, they were not associated with scores on the MFR scales. The question was raised whether these ‘counter-intuitive’ results had to do with the fact that

*Corresponding author. Email: Bea.vdnBergh@uvt.nl

(psychoanalytic) theories of the MFR were based too much on clinical impressions, or rather with the psychometric properties of the MFR scales (e.g. Koniak-Griffin, 1988; Mercer et al., 1988; Muller, 1993).

Where are we now? First, several MFR scales have been developed. Next to the MFAS (Cranley, 1981), the Maternal Antenatal Attachment Scale (MAAS; Condon, 1993) and the Prenatal Attachment Interview (PAI; Muller, 1993) are most often used in MFR research. Second, since their publication, the MFR scales have been used in various fields. For instance, in life span developmental psychology and developmental psychopathology it is assumed that the prenatal mother-child relationship has a potent influence on the postnatal mother-child relationship and in this way influences the subsequent behaviour as well as the well-being of the child (e.g. Huth-Bocks et al., 2004; Siddiqui & Hägglöf, 2000). From a health psychology perspective, the framework of the prenatal relationship may assist in understanding why some pregnant women act to improve their health practices while others are reluctant to do so, and in explaining the often puzzling behaviour and worries of drug-addicted (Shieh & Kravitz, 2002, 2006) or hospitalized pregnant women (Curry, 1987). The MFR scales are used in research that is useful for clinical obstetrics, gynaecology and reproductive psychology; for example, for understanding and managing reactions to loss via miscarriage or perinatal bereavement (O'Leary, 2004) and reactions to amniocentesis, maternal serum screening, ultrasound exposure (Boukydis et al., 2006; Heidrich & Cranley, 1989). Third, several reviews on MFR scales have been published. Reviews by Muller (1992), Erickson (1996) and Cannella (2005) were mainly focused on the MFAS, while the review by Beck (1999) included information on selected instruments available for measuring prenatal attachment and adaptation to pregnancy. Fourth, although the term 'maternal-foetal attachment' is often used to describe the MFR that is measured with the MFAS, MAAS and PAI, we suggest avoiding the use of the term 'attachment' in this context. It is obvious that due to the lack of reciprocity between mother and foetus, the meaning of the term 'attachment' as defined by Bowlby (1969) and Ainsworth (1972) cannot be transferred to the prenatal life period. Moreover, the way in which these scales are constructed (i.e. rating scales measuring overt behaviour) may not be suitable to tap the important concepts of these theories (e.g. covert mental representations, or working models; see also below).

The aim of our article is to provide a selective review of research with MFR scales. Firstly, we describe the construction and available information on psychometric properties of the MFAS, MAAS and PAI, and some other scales. Secondly, we review empirical research using these scales to study the MFR, that is, some of its reported associations with the health behaviour of the mother and the well-being of the child and factors that may influence its development. We focus this review on a description of research with MFR scales that is relevant for clinical obstetrics, gynaecology and reproductive psychology. In fact, some of these topics are studied from a life span developmental psychology, developmental psychopathology or health psychology perspective. Although the databases Medline, Web of Science and Science Direct were searched for the period 1980-2007, we especially focus on research conducted during the last decade. The keywords used were mother-foetus relationship, maternal-foetal attachment, MFAS, MAAS and PAI.

Scales to measure the maternal–foetal relationship: Construction and available information on psychometric properties

The underlying concept of MFR in the MFAS, MAAS and PAI

The construction of the MFR scales of the type we review in this article is based on the idea that the relationship with the foetus is manifested in behaviours, attitudes, thoughts and feelings that demonstrate care and commitment to the foetus, including: nurturance (eating well, abstaining from smoking and alcohol), comforting (stroking the belly), talking to the baby, physical preparation (buying baby clothes and furniture), talking to the partner about the baby and the future, choosing a name, getting information about the developing baby. Thoughts and feelings include: trying to picture what the developing baby looks like, having tender and loving thoughts versus feeling irritated; feeling emotionally close versus emotionally distant (Condon, 1993; Cranley, 1981, Hart & McMahon, 2006: 330; Salisbury, 2003). It is assumed that a woman is aware of these behaviours, attitudes, thoughts and feelings, admits them and is capable of rating them on a Likert-scale.

Maternal Foetal Attachment Scale (MFAS)

The Maternal Foetal Attachment Scale was developed by Cranley (1981) to measure ‘the extent to which pregnant women engage in *behaviours* that represent an affiliation and interaction with their unborn child’ (Cranley, 1981, p. 262). The scale originally consisted of 37 Likert-style items, organised into six subscales based on evaluation of their content validity by experts. Item analyses, performed on a sample of 71 pregnant women near the end of their pregnancy, resulted in the elimination of 13 items, including an entire subscale (i.e. nesting). The remaining 24 items measure 5 dimensions of MFR behaviours: (1) ‘differentiation of self from the foetus’ (4 items), (2) ‘interaction with the foetus’ (5 items), (3) ‘attributing characteristics and intentions to the foetus’ (6 items, e.g. ‘it seems the baby kicks and moves just to keep me from resting’), (4) ‘giving of self’ (5 items), (5) ‘role-taking’ (e.g. ‘I picture myself feeding the baby’, 4 items). The items are scored on a 5-point Likert-scale (0=definitely no to 5=definitely yes). One item, ‘I feel my body is ugly’, which has a reversed scoring, is sometimes deleted because it is not indicative of maternal feelings (Grace, 1989; Muller & Ferketich, 1993; Zachariah, 1994). Furthermore, since Sjögren et al. (2004) used the MFAS from early pregnancy onwards they removed seven items that can only be answered after quickening is felt; they also used a four-choice format instead of a five-choice format. However, if women are allowed to skip items that are not applicable and mean values are calculated for all answered items, the 24-item version can also be used in early pregnancy (e.g. Grace, 1989; Heidrich & Cranley, 1989).

With respect to validity it is problematic that the construction of the subscales of the MFAS is not based on exploratory or confirmatory factor analyses; the five original dimensions (Cranley, 1981) were theoretically derived. However, the size of the sample of Cranley (1981) was not large enough to conduct factor analysis (Hatcher, 1994). The MFAS has now been factor analysed in samples of a large size by other authors. Muller and Ferketich (1993) have revealed two factors (in a sample of $N=371$) and three factors (in a sample of $N=310$), while four factors were identified by Van den Bergh (1989, $N=256$; only three factors were retained) and

Sjögren et al. (2004, $N=50$, 17-item version). Reliability data are widely available for the MFAS. They all concern internal consistency; over different studies, Cronbach alphas range between .76 and .92 for the total scale, and between .40 and .89 for the original subscales. The alphas for 'attributing' are between .63 and .84, the alphas for 'role-taking' are between .68 and .89, for all other subscales the alphas are below .69.

Maternal Antenatal Attachment Scale (MAAS)

According to Condon (1985), a number of items on the MFAS seem to have little to do with attachment to the foetus per se, but relate rather to the pregnancy state and the motherhood role. However, a woman may feel quite negative about being pregnant but yet be profoundly attached to the foetus. To avoid contamination of data, Condon (1993) constructed the MAAS, containing 19 items, all focusing upon feelings, behaviours and attitudes towards the foetus per se. The sample consisted of 112 multi- and primiparous (49%) women (all less than 38 weeks pregnant), a sample size that allows conducting a factor analysis for this instrument of 19 items (Hatcher, 1994). Items are scored on a 5-point Likert-scale (1=represents the absence of and 5=represents very strong feelings towards the foetus). Factor analysis revealed two factors, explaining 39% of the variance: (1) quality of the affective experiences or of attachment (11 items, e.g. 'Over the past two weeks I think of the developing baby mostly as ...' from 5='a real little person inside me with special characteristics' to 1='a thing not really alive') and (2) intensity of preoccupation with the foetus (8 items, that measure time spent in attachment mode, e.g. 'Over the past two weeks I have found myself talking to my baby').

Reliability was assessed by internal consistency: alphas of the total scale range between .69 (Schwerdtfeger & Goff, 2007) and .82 (Condon, 1993). Data on the internal consistency of the subscales and other psychometric data seem to be unavailable.

Prenatal Attachment Inventory (PAI)

Muller (1993) developed the PAI on a sample of 336 low-risk pregnant women, all beyond the 20th week of gestation. Prenatal attachment was defined as 'the unique, affectionate relationship that develops between a woman and her foetus'. The original PAI consisted of 48 items which were based on pregnancy adaptation and attachment literature and describe the 'affiliation' (thoughts, feelings) with the foetus; they were reviewed by an expert panel to establish their content validity. The final PAI consists of 21 Likert-type items, scored on a four-point scale, ranging from 'almost always' to 'almost never' (e.g. 'I get very excited when I think about the baby', 'I feel love for the baby'). Support was found for construct validity. Exploratory factor analysis revealed one factor and higher scores on the PAI are correlated with a positive adjustment to pregnancy as measured with the Maternal Adjustment and Maternal Attitude Scale ($r=-.25$, $p<.01$) (Muller, 1993). Concurrent validity was also established in other studies (with the MFAS: $r=.72$, $p<.01$, Muller, 1993 and $r=.72-.74$, $p<.001$, Damato, 2004b; with the Pregnancy Involvement List: $r=.62$, $p<.001$, Kleinveld et al., 2007; see below). The reliability was assessed by internal consistency; alphas range between .81 and .93. The unidimensionality was confirmed in a confirmatory factor analysis and it was shown that the 21 items explained 79% of the variance (Gau & Lee, 2003). However, an

earlier, explorative factor analysis (Siddiqui & Hägglöf, 1999) revealed a five-factor solution ('fantasy', 'interaction', 'affection', 'differentiation of self from foetus', 'sharing pleasure'; alphas between .57 and .76).

Adapted versions of MFAS, MAAS and PAI and less frequently used scales

Rees (1980) developed the Prenatal Tool, consisting of 39 items, scored on a 6-point Likert-type scale (1=strongly agree to 6=strongly disagree). One scale (20 items, $\alpha=.91$) measures a woman's perception of the baby; the other measures feelings of motherliness. Hsu and Chen (2001, quoted in Hang et al, 2004) merged the items of the MFAS with those of the PAI and developed the Modified Maternal Foetal Attachment Scale; 41 items scored on a 5-point Likert-type scale (1=never to 5=always). Factor analysis revealed 4 factors; with alphas between .84 and .87 (Hang et al, 2004). Honjo et al. (2003) developed the Antenatal Maternal Attachment Scale (AMAS), which consists of 13 items, scored on a 4-point scale (1=yes to 4=no). Factor analysis revealed two factors but only the first was retained ($\alpha=.79$; 8 items). Test-retest reliability at an interval of 4 weeks was .75. Kleinveld et al. (2007) developed the Pregnancy Involvement List (PIL): 10 items of the sort that were used in existing questionnaires scored on a 5-point Likert-type scale (1=absolutely not applicable to 5=very applicable). This scale can be used very early in pregnancy, before quickening is felt. Factor analysis revealed one factor; alphas range between .79 and .81 at various points in time. The PIL correlated .62 with the PAI (see above). These scales are not frequently used in research and are therefore not reviewed in this article.

Critical evaluation of the psychometric qualities of MFAS, MAAS and PAI

The total scale of the MFAS has shown to be reliable in several samples of pregnant women; however of the original MFAS subscales only two show high internal consistency scores. Too few psychometric data are available to judge the psychometric properties of the MAAS. The PAI is a promising, psychometrically sound instrument; however, further research is needed to examine its dimensions. As the psychometric qualities of these MFR scales were mainly tested in samples of Caucasian, well-educated, middle-class women, their reliability and validity still needs to be studied in varied and larger samples. Although the use of combined or adapted scales may hamper the progress in constructing sound MFR instruments, adaptations are sometimes necessary to improve the construct validity.

Overview of research with MFR scales that is useful for clinical obstetrics, gynaecology and reproductive psychology

Does parental viewing of the early foetus (before 'quickening') by means of ultrasound imaging accelerate bonding with the foetus? If so what are the medical, emotional, and ethical implications of this phenomenon? (Fletcher & Evans, 1983, p. 392)

These questions were asked 25 years ago by Fletcher and Evans in *The New England Journal of Medicine* and other journals (e.g. Campbell et al., 1982). The title of a recent publication '4D and prenatal bonding: still more questions than answers', by Campbell (2006) indicates that these questions are still worth asking. We focus our

overview on results of research with MFR scales that try to answer these and other questions relevant to the fields of clinical obstetrics, gynaecology and reproductive psychology. The answers to many of these questions are very complex; results of studies set up from a life span developmental psychology, developmental psychopathology or health psychology perspective may be useful in answering them. Specific topics of the latter disciplines that were reviewed in recent articles are only briefly summarized in what follows (e.g. demographic variables; Cannella, 2005; Erickson, 1996).

Notice that for many topics or factors conflicting results are revealed, with some studies showing positive relationships, some negative relationships and others no relationship. Although the reasons for these inconsistent results are not always clear, the following factors seem to play a role: (1) the use of different instruments each stressing other aspects of the MFR and with differing psychometric qualities, (2) different conceptual definitions for other key variables (e.g. social support), (3) the use of small samples and the lack of external validity (many studies are conducted in Caucasian, well-educated and middle-class samples), (4) univariate versus multivariate method of analysis, that is, the number of the confounding variables controlled for varied across the various studies, (5) the fact that the MFR in all the studies was measured during a different time period of pregnancy, either cross-sectional or longitudinal, (6) range of age of pregnant women varied across the samples, with some studies especially focusing on adolescents. Therefore, it is clear that the research results should be interpreted with caution.

Supposed associations between MFR and (health) behaviour of the mother and well-being of the child, before and after birth

The development of a relationship with the unborn child is a key developmental task in the successful psychological adjustment to pregnancy. Importantly, it is supposed that the MFR may be associated with the (health) behaviour of the mother and the well-being of the child, before as well as after birth. Research with MFR scales enabled testing these potential effects. First, with regard to associations between MFR and health behaviour of the mother before birth, the study of Lindgren (2001, MFAS) has shown that MFR increases participation in good health practices (e.g. those involving diet, exercise, sleep, drug and alcohol use, prenatal appointments) in low-risk, middle-aged, pregnant women. Sedgmen et al. (2006, MAAS) observed that the more alcohol women reported drinking, the lower MFR score they had and, interestingly, a significant reduction in the reported average number of drinks following ultrasound exposure was observed. However, Sedgmen et al. (2006) also found a positive association between smoking and MFR. Shieh and Kravitz (2006) have shown that pregnant adolescent illicit drug (cocaine/heroin) users are as capable as marijuana users of developing an MFR. However, they concluded that it remains a major challenge to use the MFR to impact on concrete behaviours, such as decreasing drug use, to maintain a healthy pregnancy. Second, with regard to associations between MFR and behaviour of the mother and well-being of the child after birth, two studies show associations between third trimesters MFR scores and observer scores of maternal behaviour, namely (1) affectionate and caretaking maternal behaviours at feeding in the first week (Bloom, 1995, MFAS) and (2) sensitivity and involvement during *en face* play interactions at 3-months (Siddiqui &

Hägglöf, 2000, PAI). MFR was also associated with scores on a self report measure of mother–infant attachment 1–2 months after birth (Muller, 1996, PAI; Damato, 2004a, PAI), at 1 week and 8 months in high-risk pregnancies (Mercer & Ferketich, 1990) and of maternal sensitivity, self-identity and identification with the baby 1–6 weeks after birth (Shin et al., 2006, MFAS) and with infant's temperament at 8 months (White et al., 1999). Wilson et al. (2000) did not replicate the latter finding. Cranley (1981) found no association between the MFAS and the Neonatal Perception Inventory.

Ultrasound exposure and prenatal diagnostic tests

Heidrich and Cranley (1989, MFAS) concluded that feeling foetal movements at 16 weeks had a positive effect on MFR at 16 weeks and 20 weeks, while ultrasound exposure at 16 weeks had no effect on MFR at 20 weeks. It has been proposed, however, that the presentation of foetal images via ultrasound early in pregnancy and before any bodily cues are experienced has superseded the earlier importance of quickening for the mother's realisation of actual life inside the womb (Sedgmen et al., 2006). Furthermore, the question was recently raised whether effects depend on: (1) the timing of exposure, (2) whether 2-dimensional (2D), 3-dimensional (3D), or moving 3D (i.e. 4D) imaging is used, and (3) whether ultrasound consultation or standard care is provided. Results are as follows: in the study of Sedgmen et al. (2006, MAAS), women who had their first exposure to ultrasound at 12 weeks showed the greatest change in MFR and had a MFR level that was similar to that of women who had (repeated) exposure at 18 weeks. These results suggest that ultrasound in early pregnancy may indeed facilitate an increase in attachment without the necessary gestational experiences of foetal movement. Concerning the effect of 2D, 3D or 4D imaging, the study of Sedgmen et al. (2006, 3D) confirmed the 2D vs. 4D findings of Righetti et al. (2005, MAAS) in women 19–23 weeks pregnant; between 12 and 23 weeks, that ultrasound has a positive impact on MFR and that 3D or 4D exposure does not offer enhanced benefits. These results reveal that the quality and clarity of the image may not be critical for a maternal–foetal relationship. However, Boukydis et al. (2006) observed that compared to a group that receives routine ultrasound examination, the ultrasound consultation group (i.e. receiving extended consultation on foetal development between 16 and 26 weeks) had a significant positive change in MFAS scores and lower state anxiety.

Heidrich and Cranley (1989, MFAS) had found no effect of ultrasound or amniocentesis at 16 weeks on MFR at 20 weeks. Compared to the ultrasound and the control group the amniocentesis group had lower MFR baseline scores at 16 weeks. In contrast, Lawson and Turriff-Jonasson (2006, PAI) observed that throughout their pregnancy women who underwent maternal serum screening (and had favourable results) reported lower MFR levels as compared to the amniocentesis and control group without prenatal testing. They assumed that this may be related to the fact that the probabilistic nature of maternal serum screening contributes to feelings of ambiguity and may not be sufficiently reassuring to overcome a 'tentative' pregnancy phase. Kleinveld et al. (2007, PIL, PAI) observed that the mere offering of prenatal screening seems to temporarily increase attachment, but the increase is small. In contrast to Lawson and Turriff-Jonasson (2006, PAI), no difference in MFR was observed between women who received a

negative result of ultrasound screening as compared to blood screening (Kleinveld et al., 2007).

Method of conception, previous miscarriage or loss of a baby, hospitalisation, high-risk pregnancy

It is shown that conception by in vitro fertilisation (IVF) or the number of IVF treatment cycles has no effect on the MFR (Hjelmstedt et al., 2006, PAI; McMahon et al., 1997, MAAS). Previous miscarriage(s) or loss of a baby does not lead to a lower score on MFR (Armstrong, 2004, PAI; Lawson & Turriff-Jonasson, 2006, PAI; Sedgmen et al., 2006, MAAS; Tsartsara & Johnson, 2006, MAAS) in the first or third trimester of pregnancy or to a delay in the development of a MFR in the subsequent pregnancy. However, previous research demonstrated a negative association (see Armstrong, 2002, PAI; Armstrong & Hutti, 1998, PAI). Women with low- and high-risk pregnancies do not differ in MFR (Curry, 1987, MFAS; Kemp & Page, 1987, MFAS; Lindgren, 2001, MFAS); hospitalisation for a high-risk condition has no impact on MFR (Mercer et al., 1988, MFAS).

Depressive symptoms, anxiety and (perceived) stress during pregnancy

Some authors found no association between MFR and mood state (Condon & Esuvaranathan, 1990, MAAS), depression (Hjelmstedt et al., 2006, PAI), general anxiety (Mercer et al., 1988, MFAS) or pregnancy-related anxiety (Armstrong & Hutti, 1998, PAI) while other authors observed that MFR was negatively influenced by depressive symptoms (Condon & Corkindale, 1997, MAAS; Hart & McMahon, 2006, MAAS; Lindgren, 2006, MFAS; Mercer et al., 1988, MFAS), general anxiety (Condon & Corkindale, 1997, MAAS; Hart & McMahon, 2006, MAAS; Lindgren, 2006, MFAS) and (perceived) stress (Cranley, 1981, MFAS; Feldman, 2007, PAI). Van den Bergh (1989, MFAS) observed a positive relation between MFR and specific pregnancy-related anxieties.

Self-esteem, body image, social support and relationship with significant others

All these factors have been put forward as predictors of the MFR (e.g. Leifer, 1977; Rubin, 1975). However self-esteem was significantly associated with MFR in only some studies (Curry, 1987, MFAS; Feldman, 2007, PAI) but not in other studies (Cranley, 1981, MFAS; Damato, 2004b, PAI; Koniak-Griffin, 1988, MFAS; Mercer et al., 1988, MFAS). Huang et al. (2004, Modified MFAS) observed a positive correlation between MFR and body image before pregnancy and body image in the third trimester. Social support (Condon & Corkindale, 1997, MAAS; Cranley, 1981, MFAS), a particular aspect of social support (e.g. the extent of the social network and received support, Mercer et al., 1988, MFAS), support expectations and lack of social isolation (Feldman, 2007, PAI) are positively associated with the MFR or at least with some MFR-subscales (Koniak-Griffin, 1988, MFAS). However, Damato (2004b, PAI), Van den Bergh (1989, MFAS) and Wilson et al. (2000, MFAS) observed no significant association between social support measures and MFR. Concerning the relationships with significant others, the quality of the relationship with either the own partner (Hjelmstedt et al., 2006, PAI), the father (Mercer et al., 1988, MFAS; Schwerdtfeger & Nelson, 2007, MAAS) or the mother (Curry, 1987,

MFAS) were positively associated with MFR in some studies but not in the study of Zachariah (1994, MFAS). Schwerdtfeger and Nelson (2007, MAAS) found that having an interpersonal trauma history (e.g. childhood sexual or physical abuse, adult domestic violence) was related to lower scores on MFR than non-interpersonal trauma history (e.g. being in of witnessing a serious accident or a natural disaster). Positive family dynamics, characterised by consensus, reciprocity, care and cohesion, seem to play a positive role in the prenatal relationship (Wilson et al., 2000, MFAS). With functioning of the family in general no relationship was found by Mercer et al. (1988, MFAS).

Specific pregnancy-related factors and demographic factors

For all MFR scales reviewed, significant relationships were not always found for many specific pregnancy-related factors (such as gestational age, parity, gravidity, planning of the pregnancy, infertility history, knowing the gender of the baby, medical intervention during pregnancy, having twins) as well as for most of the demographic variables (such as age of the mother, educational level, socio-economic status, ethnicity, marital status, duration of the partner relationship and marital satisfaction) (MFAS: Ahern & Ruland, 2003; Bloom, 1995; Cranley, 1981; Curry, 1987; Grace, 1989; Heidrich & Cranley, 1989; Hjelmstedt et al., 2006; Huang et al., 2004 [Modified]; Kemp et al., 1990; Koniak-Griffin, 1988; Lindgren, 2001; Mercer et al., 1988; Muller, 1993, 1996; Shieh & Kravitz, 2006; Sjögren et al., 2004; Van den Bergh, 1989; Wilson et al., 2000; Zachariah 1994; MAAS: Condon, 1985; Condon & Corkindale, 1997; Condon & Esuvaranathan, 1999; Feldman, 2007; Hart & McMahan, 2006; Tsartsara & Johnson, 2006; PAI: Armstrong, 2002; Damato, 2000; Hjelmstedt et al., 2006; Lawson & Turriff-Jonasson, 2006; Muller, 1993; Prenatal Tool: Kemp & Page, 1987).

Conclusion

During the last 25 years, research with MFR scales has steadily gained importance in several disciplines. To strengthen the quality of this research and its clinical applications the following considerations and recommendations can be taken into account. The reliability and validity of MFR scales needs to be studied in large and varied samples. More attention should be paid to women who, due to a combination of risk factors such as unplanned pregnancy, illicit drug use, adolescence, advanced maternal age, maternal depression or attachment problems in the family of origin have a sub-optimal MFR. Intervention studies should be set up to examine the enduring impact of ultrasound consultations (Boukydis et al., 2006) or prenatal classes (Bellieni et al., 2007), for example, on MFR throughout pregnancy. Testing the impact of interventions on tangible health-behaviour benefit seems to be an even more important goal. Health practices in pregnancy are important for maternal and infant outcome; however, it is not yet clear how they interact with MFR exactly (Campbell, 2006; Lindgren, 2001; Shieh & Kravitz, 2006). The MFAS, MAAS and PAI tap overt (conscious) behaviours, attitudes, thoughts and feelings. Other instruments, such as the Semantic Differential Method (Pajulo et al., 2006), the Adult Attachment Interview (Huth-Bocks, 2004), and the Relationship Questionnaire-Clinical Version (Holmes & Lyons-Ruth, 2006) have been used to examine empirically more covert aspects of the MFR relationship – for example, the

mother's own attachment experiences in building a relationship with her unborn child. Methods such as cluster analysis may be useful in identifying subgroups of women sharing similar patterns of MFR at one point in time or over the course of pregnancy. In addition to psychological variables, biological variables or biomarkers (e.g. oxytocin: Levine et al., 2007) and neurobiological variables (Leckman et al., 2004; Mayes et al., 2005) should be studied.

Although the mother–foetus relationship is not well understood (Mercer et al., 1988) following these guidelines in future research may help in unraveling its nature and the underlying mechanisms a bit more.

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