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Re-Evaluation of the Psychometric Properties of the Maternal–Fetal Attachment Scale in a Hungarian Sample

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Re-evaluation of the Psychometric Properties of the Maternal-Fetal Attachment Scale in a Hungarian Sample

Abstract

Objective: To explore the factor structure of the Maternal-Fetal Attachment Scale MFAS and to investigate its psychosocial and demographic correlates in a Hungarian sample.

Design: Cross-sectional survey.

Setting: A sonography clinic in a metropolitan area.

Participants: One hundred and fourteen (114) primiparous and multiparous women over the age of 18 years in the second or third trimester of pregnancy.

Methods: Participants completed the Hungarian version of the MFAS and provided information on demographic, socio-economic, and pregnancy-related factors.

Results: The internal consistency of the MFAS total scale was acceptable (Cronbach's alpha coefficient = 0.87). However, the reliability of the five subscales was low (alpha coefficients between 0.57 and 0.74), and the original 5-factor model was not supported by the factor analyses. Married mothers had higher scores on MFAS compared to participants who were unmarried, and uncertainty about the sex of the fetus was associated with lower attachment scores. Further, gestational age showed a positive correlation with MFAS scores. No

27 significant association was found between the total score of MFAS and such factors as age,
28 income, or education of the parents, whether the pregnancy was planned, method of
29 conception, number of children born previously, prior perinatal losses, and circumstances of
30 the mother's own birth.

31 Conclusion: Our study showed that marital status, uncertainty about the sex of the fetus, and
32 gestational age was associated with maternal-fetal attachment however, more detailed analysis
33 was not possible because of the instability of the subscales of the instrument. Further research
34 is warranted on the underlying factors related to maternal-fetal attachment.

35 *Precise:*

36 The internal consistency of the Maternal Fetal Attachment Scale was found to be acceptable
37 when measuring overall maternal-fetal attachment in a Hungarian-speaking sample.

38

39 *Callouts:*

40 1. The predictors and underlying structure of maternal-fetal attachment need further
41 assessment, and studies to be extended to different cultural areas, such as Central Europe.
42 2. The Maternal Fetal Attachment Scale was reliable when measuring overall maternal-fetal
43 attachment, but internal consistency reliability estimated for Differentiation, Interaction, and
44 Giving of Self subscales were low.
45 3. Living in a marriage, feeling the movement of the fetus, and knowing the sex of the fetus
46 were associated with higher attachment scores.

47 *Keywords:* maternal-fetal attachment; measurement of prenatal attachment; Maternal-Fetal
48 Attachment Scale (MFAS); motherhood

49

Re-evaluation of the Psychometric Properties of the Maternal-Fetal Attachment Scale in a Hungarian Sample

Ever since John Bowlby's pioneering work, human attachment in different key stages of life has been the focus of attention from the perspective of both research and clinical practice (Bowlby, 1969). Research results accumulating over the past four decades indicated that the attachment of mother and child begins as early as pregnancy due to the dynamics of interaction between the mother and her unborn child (Erikson, 1996; Canella, 2005; Alhusan, 2008; Brandon, Pitts, Denton, Stringer, & Evans, 2009). Earlier studies showed a correlation between prenatal and postnatal attachment and demonstrated that mothers with more intense prenatal attachment provided more proximal nurturing stimuli to their children following delivery (Müller, 1996; Siddiqui & Haegglöf, 2000). Women reporting higher MFA during pregnancy had more secure attachment styles and their children had more optimal early childhood development (Alhusen, Hayat & Gross, 2013). These results indicated continuity between prenatal and postnatal attachment and confirmed the importance of studying mother-fetal attachment.

A frequently used measure of prenatal attachment is the Maternal-Fetal Attachment Scale (MFAS, Cranley, 1981). The 24-item questionnaire measures the behaviors and attitudes of pregnant women towards their pregnancy and their developing fetus. Although the MFAS has five subscales: Role Taking, Differentiation, Interaction, Attribution, and Giving of Self, the psychometric properties of the subscales were shown to be poor in previous studies (Doan et al., 2003). The MFAS inspired many studies in the field of mother-fetal attachment, and led to the development of new instruments assessing different aspects of prenatal bonding such as the Prenatal Attachment Inventory (Müller, 1993), and the Antenatal Attachment Scale (Condon, 1993). In spite of the critiques and the spread of new measures developed to address the limitations of Cranley's measure, the MFAS remains the most

75 commonly used scale to measure maternal-fetal attachment and has been translated into
76 several languages (Beck, 1999; Alhusen, 2008). Furthermore, despite construct concerns, a
77 recent comparative study listed the MFAS among the three most useful measures of maternal-
78 fetal attachment because of its good reliability.

79 Given the importance of prenatal attachment in connection with postnatal maternal
80 behavior, there has been high interest in understanding the predictors and potential
81 moderating factors related to maternal-fetal attachment. In their 2009 meta-analysis,
82 Yarcheski, Mahon, Yarcheski, Hanks, and Cannella identified 183 studies exploring the
83 predictors of maternal-fetal attachment. Their findings indicated that gestational age, social
84 support, and prenatal testing had the most substantial effect on prenatal attachment but
85 anxiety, self-esteem, depression, planned pregnancy, age, parity, ethnicity, marital status,
86 income, and education were also predictors to a lesser degree. The authors of this systematic
87 review concluded that more studies were needed to explore potential cultural differences in
88 maternal-fetal attachment. Previous reports also showed marital status as a significant
89 predictor for maternal-fetal attachment, but age and socio-economic status did not influence
90 attachment to the fetus (Cranley, 1981; Grace, 1989; Lindgren, 2001, Doan, Cox, &
91 Zimmerman, 2003; Canella, 2005). The mode of conception, that is, conception through
92 natural or assisted reproduction, and history of miscarriage were also found to be unrelated to
93 maternal-fetal attachment (Hjelmstedt, Wildström, & Collins, 2006, Armstrong, 2002), while
94 some reports indicated that initially feeling fetal movement helped significantly deepen
95 maternal attachment (Heidrich & Cranley, 1989; Doan et al., 2003).

96 There are cultural differences in the time of acknowledgement of the fetus as a
97 separate person, which might drive cultural dissimilarities in maternal-fetal attachment as
98 well. The knowledge that the fetus is a separate person is deeply rooted in the Hungarian
99 culture. This is well reflected by the folk superstition that if the mother is frightened by

100 something, she has to say “we saw this together” to protect the child from harm. Today, the
101 attitude toward the fetus as a separate entity is ambivalent: the misconception that the
102 expectant mother has to “eat for two” is very popular, on the other hand, artificial abortion
103 can be conducted until the 24th week of gestation. The fetus’ right for life only starts with the
104 25th week.

105 Furthermore, medical guidelines and laws are different from country to county, which
106 might indirectly influence attachment by enabling or restricting certain behaviors, such as
107 seeking information or medical care. In Hungary, pregnancy care is free for every expectant
108 mother with health insurance. Following the medical confirmation of the pregnancy, the
109 expectant mother is taken into the care of the regional health visitor. The national health
110 visitor system has been in place in Hungary since 1915. The duty of the health visitor is to
111 protect the health of, to prevent harm to, and to provide care for the childbearing mother and
112 the child. According to Hungarian medical guidelines, every expectant women is entitled to a
113 free medical visit at least one time with the general practitioner, at least one time per trimester
114 with the health visitor, and at least one time per trimester with the gynecologist/obstetrician
115 (this visit may include lab work, ultrasound examination, cardiotocography (CTG),
116 gestational diabetes testing, etc.).This system is notably different from that found in the USA
117 for example, where the majority of studies of MFAS originate from.

118 The purpose of our study was to explore the internal consistency and the factor
119 structure of the questionnaire on a Hungarian sample. Additionally, we also aimed to
120 investigate the demographic and psychosocial factors that are associated with maternal-fetal
121 attachment in this population. The examination of the factor structure was important because
122 there has not been consensus among researchers on the essential components of maternal-fetal
123 attachment as a construct: Different measures highlight different components of overall

124 attachment (Brandon et. al, 2009). While the information on the correlates of maternal-fetal
125 attachment will contribute to the cultural diversity of the data accumulated to date and will
126 allow future meta-analyses to further assess cultural differences.

127 **Method**

128 **Research Design**

129 Data for this cross sectional study were collected through the health visitor network
130 nurses and healthcare assistants in a sonography clinic. The study was approved by the Ethics
131 Committee of the Károli Gáspár University in Hungary (approval number 389/2012/1).

132 **Sample and Procedure**

133 Expectant women were asked to participate in the study personally in the waiting
134 area for the sonography clinic by their health visitor or medical assistant who followed
135 instructions from the study authors. Informed consent was obtained. Individuals entering the
136 study were assured that participation was voluntary, the data they provided would be kept
137 confidential, and neither their participation nor the data they provided would affect their
138 medical care in any way. A convenience sample was used. Inclusion criteria were 18 years of
139 age and pregnancy previously confirmed by a physician. Inability to read or write was an
140 exclusion criteria. Those who were willing to participate and were eligible, received the study
141 materials in an envelope, and completed the questionnaires during the waiting time for their
142 visit or examination. Confidentiality was emphasized by the fact, that participants deposited
143 their completed questionnaires into a collection box in an unmarked sealed envelope instead
144 of handing the completed questionnaire to the health practitioner.

145 The data collection period lasted from November 2012 to September 2013. One
146 hundred and fourteen expectant women were recruited for participation during this time

147 period, mainly in the second or third trimester of pregnancy. None of the individuals
148 approached refused to fill out the questionnaire; however, some of them were called in to the
149 examination room before completing the questionnaire, and did not have time after the
150 examination to finish the task. As a result, four questionnaires were excluded from the study
151 because of incomplete responses.

152 **Instruments**

153 **Demographic Data Sheet.** Participants were surveyed to collect demographic data
154 and information on socio-economic status. Data were collected on the following items:
155 mother's age, gestational age, education, employment status, income, share of income in
156 family household, parity. Additional information was also collected on whether the current
157 pregnancy was planned, mode of conception, previous loss of pregnancy, physical or
158 psychological problems with regard to the pregnancy, information about the marital status of
159 the mother's parents, whether the sex of the fetus was known or not, and whether the mother
160 felt the movement of the fetus. Participants were also asked if they had been born at expected
161 due date or pre-term, whether there had been any medical interventions such as caesarean
162 section, medicinal or caudal analgesia, assisted birth (vacuum, forceps) that they knew about
163 related to their own birth history.

164 **Maternal-Fetal Attachment Scale (MFAS).** Maternal-fetal attachment was measured
165 using the Hungarian translation of the Maternal Fetal Attachment Scale (MFAS). The
166 linguistic adaptation of the questionnaire was performed by our study team as part of this
167 project. During the adaptation we applied the standard translation-retranslation approach. As a
168 first step, two individuals, a professional translator and an English teacher, translated the
169 questionnaire to Hungarian independently. In the next step, inconsistencies were resolved by
170 consensus, and the final Hungarian translation was created. The Hungarian translation was

171 retranslated independently to English by two other translators independently. The final
172 Hungarian version was prepared after further discussions between these two translators,
173 taking into account the comments of the authors of this study. The participants answered the
174 24 questions of the questionnaire on a 5-level Likert-type scale: ‘I think/do the following:
175 definitely yes (5), yes (4), uncertain (3), no (2), definitely no (1)’. The choices for each of the
176 24 items, scored between 5 (highest) and 1 (lowest), giving a total attainable score between 24
177 and 120. Items were grouped into 5 subscales: Role Taking (4 items, e.g. I picture myself
178 feeding the baby.), Differentiation (4 items, e.g. I enjoy watching my tummy jiggle as the
179 baby kicks inside.), Interaction (5 items, e.g. I poke the baby to get him/her to poke back.),
180 Attribution (6 items, e.g. I can almost guess what my baby’s personality will be like from the
181 way she/he moves around.), and Giving of Self (5 items, e.g. I feel all the trouble of being
182 pregnant is worth it.). Findings from earlier studies indicated that the MFAS total score had
183 good internal consistency with Cronbach's alpha coefficients ranging from .71 and .91 (see
184 the following reviews: Beck, 1999; Alhusen, 2008; Perrelli, Zambaldi, Cantilino & Sougey,
185 2014). In the literature, the reliability of the subscales was less consistent with Cronbach
186 alpha coefficients ranging from .36 to .89 (see the following reviews: Beck, 1999; Alhusen,
187 2008; Perrelli, Zambaldi, Cantilino & Sougey, 2014).

188 **Statistical Analysis**

189 Neither the MFAS total scores, nor the MFAS subscale scores were normally
190 distributed according to the Kolmagorov-Smirnov test ($ps < .05$). Although kurtosis was
191 generally in the normal range, total score and subscale scores were negatively skewed, except
192 for the Interaction subscale. Thus, nonparametric statistical tests were used for hypothesis
193 testing.

194 The structure of MFAS was analyzed using exploratory factor analysis following

195 recommendations by Field (2013) and Costello & Osborne (2005). Principal Axis Factor
196 extraction method was used for the exploratory factor analysis due to the inadequacy of
197 normality, and a direct oblimin rotation (Delta=0) was applied.

198 The violation of the assumption of normality of residuals prevented the use of
199 multivariate regression. Thus, the strength of association of MFAS and the proposed
200 predictors was assessed using Mann-Whitney U test (categorical independent variable, 2
201 groups), Kruskal-Wallis test (categorical independent variable, several groups), or Spearman
202 correlation (continuous independent variable) variable-by-variable. Groups that included less
203 than 10 individuals were not entered into the analyses.

204 Results

205 Characteristics of the Study Population

206 In our study, 114 expectant women participated with an average age of 31.8 (ranging
207 23-44, SD = 4.27), which was comparable to the average age for Hungarian women in their
208 first or second pregnancy (30-34). Most of the participants (64%) had graduated from college
209 or university. High education in the sample might have been due to the fact that sonography
210 examinations are not mandatory, they are only recommended, and these examinations are
211 more frequently obtained by individuals with higher education. Most participants rated their
212 socio-economic status as average (49.1%) or slightly above average (30.7%), and most of the
213 time the mothers' relative contribution to standard of living equal to that of their partner's for
214 (55.3%). Almost all participants (96.5%) lived with the father of the fetus. The majority of the
215 participants were in either the second trimester 55 (48%) or the third trimester 56 (49%).
216 Details of the demographic characteristics of the sample can be found in Table 1.

217 *[Insert Table 1]*

218 **Internal consistency reliability**

219 The results of the internal consistency analysis are displayed in Table 2. The
220 Cronbach's alpha coefficient was 0.87 for the total scale, indicating an excellent internal
221 consistency, and each subscale score showed positive correlation with the total scale score
222 (r=0.63 – 0.85). However, the subscales were found to be less reliable with coefficient alphas
223 ranging from .57 to .74. The only exception was the Role Taking subscale, which was above
224 the .70 limit of acceptable reliability (Szokolszky, 2004). Item-rest and item-drop statistics
225 were computed to discover the source of inconsistency in the subscales (see Table 3). We
226 found that dropping item 5 (I am looking forward to seeing what the baby looks like.) from
227 Differentiation, item 7 (I refer to my baby by nickname.) from Interaction, item 21 (I can tell
228 that the baby has hiccups.) from Attributing, and item 22 (I feel my body is ugly.) from
229 Giving of Self increased alphas slightly, but not substantially. The low internal consistency of
230 the subscales was explained mostly by the low intra-subscale correlation of the items.

231 *[Insert Table 2*]

232 *[Insert Table 3*]

233 **Factor Analyses**

234 Exploratory factor analysis was used to determine the number of latent factors
235 described by the MFAS. Communality of the items was poor overall. Mean communality was
236 .45, and ten items showed communality lower than .40 (items 4, 9, 21, 11, 10, 23, 15, 24, 7,
237 22).

238 The ideal number of factors was explored with several model fit indices. Very Simple
239 Structure (VSS) complexity 2, Velicer Minimum Average Partial (MAP), and Empirical
240 Bayesian Information Criterion (BIC) indicated a 2 factor solution to be ideal, Sample Size

241 adjusted BIC and the Eigenvalue suggested a 6 factor solution, while visual inspection of the
242 inflection point on the scree plot indicated a 4 factor model to be ideal. None of these
243 solutions equated to the originally proposed 5-factor model. When testing the 5-factor model,
244 several items showed low factor loadings (< .40 on all factors). For these items (items 24, 19,
245 14, 15, 22, 8), loadings were distributed amongst several factors.

246 Considering that no previous studies could verify the 5-factor solution, and that our
247 analysis could only support the reliability of the single-factor solution, we focused on the total
248 score of MFAS in further analyses, as recommended by several authors (Cranley, 1992;
249 Müller & Ferketich, 1993).

250 **Determinants of maternal –fetal attachment**

251 Table 4 provides a summary of the results on the determinants of maternal–fetal
252 attachment.

253 *[Insert Table 4]*

254 **Demographic Factors.** Those who were married had higher scores on the MFAS than
255 those who lived together with the father but were unmarried (U = 1022.00, W = 1883.00, Z =
256 2.43, p = 0.015). The MFAS scores did not show substantial linear correlation with mothers'
257 age (r = -.07, all p = .460).

258 The family's income did not correlate with the level of maternal-fetal attachment (r = -
259 .01 p = .899). In addition to a general assessment of the family's financial situation, we also
260 examined the contribution of the mother's earnings to the family's household. Furthermore,

261 the proportion of financial contribution to family income by the mother did not influence the
262 MFAS total score ($\chi 2$ = 2.88, df = 2, N = 108, p = .236).

263 Because of the small number of women with a low level of education, we examined
264 three groups with regard to education: those with secondary education (technical
265 school/secondary grammar school), college or university students, and those who graduated
266 from college or university. According to the results of the Kruskal-Wallis test, educational
267 level was not associated with MFAS total score ($\chi 2$= 4.10, df = 2, N = 107, p = .130).

268 **Pregnancy-related factors.** The MFAS total score moderately correlated with
269 gestational age ($r = .36$, $p < .001$). Those with a more advanced pregnancy had a higher score
270 on the attachment scale. Those who were uncertain about the sex of the fetus displayed lower
271 attachment compared to those who knew and those who were certain that they did not want to
272 know the sex ($\chi 2$ = 13.62, df = 2, p < .001). Participants who noted that they certainly felt the
273 movement of their fetus (N = 99, 88%) were compared to those who reported that they did not
274 feel, or that they were not certain that they felt fetal movement (N = 14, 12%). No effect of
275 fetal movement was found on the MFAS total score (U = 542.50, W = 647.50, Z = 1.31, p =
276 .189).

277 Only seven (6.1%) participants had no information about the circumstances of their
278 own birth. As the number of mothers born prematurely was low, only those born at the
279 expected due date were involved in the analyses exploring the effects of the circumstances of
280 the mother's birth on MFAS. MFAS score of mothers born at expected due date with vaginal
281 delivery was compared to the scores of mothers born at expected due date but with assistance,
282 such as caesarean section, medical or caudal analgesia, or otherwise assisted birth. MFAS

283 scores were higher for those who were born naturally, although this relationship did not reach
284 statistical significance (U = 490.50, W = 661.50, Z = -1.80, p = .073).

285 The following factors were also unrelated to maternal-fetal attachment: planned vs.
286 unplanned pregnancy ($\chi 2$ = 1.05, df = 2, N = 114, p = .593), mode of conception ($\chi 2$ = 0.20,
287 df = 2, N = 114, p = .904), number of previously born children (r = .04, p = .704), previous
288 perinatal loss(es) (U = 1392.50, W = 2022.50, Z = 0.06, p = .951), and information about the
289 parents of the expectant mother i.e. whether the parents of the participant were currently
290 living together, were divorced, or had passed away ($\chi 2$ = 2.95, df = 2, N = 110, p = .229).

291 **Discussion**

292 Since the early 1980's, the Maternal-Fetal Attachment Scale, developed by Mecca
293 Cranley (1981), has been one of the most widely used measures of prenatal attachment. Ours
294 was the first study to examine the reliability and factor structure of the MFAS in an Eastern
295 European context. During the adaptation of the MFAS in Hungary, we tested the reliability,
296 factor structure, and correlates of MFAS. Our results indicated that a single-factor model
297 should be used instead of the originally proposed 5-factor model. This single-factor model
298 proved to be reliable and to have reasonable fit with the data. Marital status, uncertainty about
299 fetal sex, and gestational age were significantly associated with maternal-fetal attachment in
300 the Hungarian sample.

301 Our findings regarding the poor reliability of the 5-factor model of MFAS are not
302 unique. The Cronbach's alpha coefficients of the subscales in Cranley and colleagues were
303 generally poor with alphas ranging from 0.52 to 0.73. Similar results were found in a later
304 review of psychometric properties (Beck, 1999), and in our own study. The low internal
305 consistency of the subscales in our study was generally the result of mediocre item-rest
306 correlations within the subscales. Item-drop tests also revealed that the dropping of some

307 items would somewhat increase reliability of the subscale. However, the scope of our current
308 study did not extend to revising item-composition. Conversely, the Cronbach's alpha
309 coefficients for MFAS total scores were generally good in previous studies. For example,
310 Beck's summarizing paper published in 1999 described 12 studies on the reliability of the
311 MFAS. These studies all concluded that total score had good reliability, however the
312 subscales were not adequately reliable (Beck, 1999), and Cranley and others (Cranley, 1992;
313 Müller & Ferketich, 1993) also recommended the use of a single-factor model. Following
314 these previous findings, we explored the psychometric properties of the single-factor solution.
315 The internal consistency of the MFAS total scale using a single-factor model was excellent
316 with acceptable item-drop statistics and item-rest correlations. Thus, we retained the total-
317 score model and dropped the 5-factor model in subsequent analyses, and recommend that this
318 strategy be used in future studies.

319 In concert with previous findings, we found that the expectant mother's marital status
320 was connected to maternal-fetal attachment. Married women had higher scores than women
321 living together with their partner. This finding is important because the statistical data
322 published by the Hungarian Central Statistical Office (KSH) indicate that currently 40% of
323 children in Hungary are born to parents who are not married (KSH, 2012). While many might
324 think that formal commitment has little importance, our results indicated just the opposite:
325 women living in marriage reported stronger attachment to their fetus than do those unmarried
326 women living together with their partners. One important influence might be that expectant
327 women living in marriage consider their relationship more stable, invest less energy in
328 maintaining or strengthening it, and can focus more on their fetus. It is assumed that
329 pregnancy is a turning point in the circumstances of living together, and therefore it may
330 require more attention and energy to stabilize the partner relationship, and attempt to establish
331 a sense of security. Other investigators have predominantly reported positive association

332 between marital status and maternal-fetal attachment as well (Lindgren, 2001; Doan et al.,
333 2003; Yarcheski et al., 2009).

334 Our results indicated that uncertainty about the sex of the fetus was associated with
335 lower attachment. It is interesting to note that individuals who reported that they certainly
336 knew or that they certainly did not know the sex of the fetus were characterized by similar
337 MFAS scores. Only those who indicated uncertainty had lower attachment scores. Certainly
338 not knowing the sex of the fetus might mean that the mothers/families did not ask for any
339 information in the course of the ultrasound examination intentionally, because they would
340 rather not know the sex of the child. This result draws attention to a common professional
341 misconception that certain knowledge of the fetus' sex can help parents attach to their fetus.
342 Based on this finding and our clinical experience with expectant couples, we speculated that
343 when knowing the sex of the child was not important to the parents, the expectation and the
344 inner visualization of the parent about the fetus might have been as valuable as the supporting
345 effect of the factual information related to whether the fetus was a boy or a girl. Future studies
346 could test this hypothesis by directly collecting information on the parents' attitude toward
347 knowing the sex of the fetus. If the hypothesis is supported, it would invite professionals to
348 respect the wish of parents/mothers who only want to know their child's sex at the moment of
349 birth. We have to note though, that it is sometimes not possible to determine the sex of the
350 fetus, especially early in pregnancy. Therefore, not knowing might result from several
351 influences, not just the fact that this information may not have been requested. More studies
352 are warranted in this area.

353 The results of our study confirmed data in numerous scientific papers that the age and
354 socio-economic status of the mother did not influence attachment to the fetus (Cranley, 1981;
355 Grace, 1989; Doan et al., 2003; Canella, 2005). Although a previous meta-analysis identified
356 age, income, and education as significant predictors, these predictors actually had a small

357 effect size with negligible influence on attachment scores (Yarcheski et al., 2009). Contrary to
358 our results, Müller (1993) found a significant negative correlation between educational level
359 and MFAS. However, the majority of women included in Müller's study were expectant
360 women of higher age and educational level working in high status jobs, thus their active
361 employment status may have influenced their attachment to their fetus. We did not collect
362 information on whether the mothers were currently actively employed or had suspended
363 employment during pregnancy, so we could not study this relationship.

364 It is theorized that as the pregnancy progresses and fetal movements become more
365 frequently discernible, the intensity of maternal-fetal attachment increases. We did not find
366 supporting evidence for this hypothesis. However, most women included in the present study
367 were more advanced in pregnancy and only 14 participants had not felt, or were uncertain if
368 they had felt fetal movement. As Yarcheski and colleagues stated, the influence of fetal
369 movement is understudied and needs more targeted research (Yarcheski et al., 2009).
370 Furthermore, in line with previous evidence (Yarcheski et al., 2009), we found that maternal-
371 fetal attachment increased with the progression of pregnancy.

372 As demonstrated in our study, whether the pregnancy was planned or not loses its
373 significance in most of the cases during the prenatal period, and did not determine attachment
374 to the fetus. The high rate of unplanned pregnancies in our sample was surprising, taking into
375 consideration that the majority of the sample were highly educated women with good socio-
376 economic status. It is possible, that during the early course of pregnancy, the reality was
377 accepted and there was an incidence of high maternal-fetal attachment. Similar to other
378 studies, we found no difference in maternal attachment in the second trimester between
379 women who had conceived by assisted reproductive technology and women who had
380 conceived spontaneously (Hjelmstedt, Wildström, & Collins, 2006).

381 In terms of previous perinatal loss, Armstrong found, similarly to our results, that
382 previous perinatal loss did not influence the levels of attachment that are measured by MFAS
383 in the subsequent pregnancy (Armstrong, 2002). It has been emphasized that MFAS focuses
384 primarily on attachment components manifested in self-reported maternal behavior rather than
385 emotions, or fantasies experienced by the mother. It is possible that a maternal-fetal
386 attachment measure which focuses primarily on the role of maternal emotions might reveal
387 more information about the emotional effects of prior pregnancy loss.

388 **Limitation and future perspectives**

389 The construct of maternal-fetal attachment has yet to be adequately defined,
390 operationalized, or clearly mapped out. Our study not only confirmed the inadequacy of the 5-
391 factor model using the current MFAS items, but also indicated low communality of the items,
392 which affects the single-factor solution as well. Modification of the MFAS by changing items
393 and testing their contribution to the overall scale and possible sub-scales was beyond the
394 scope of our study.

395 The study used a cross-sectional design, which is unsuitable for determining the
396 direction of relationships and effects over time. There is an increasing need for longitudinal
397 scientific studies aimed at phenomena which contribute to the development of attachment.
398 Other ongoing important influences such as the quality of mother and new-born experience in
399 connection with delivery and birth, the importance of skin-to-skin contact in the first few
400 hours after delivery/birth, the role of breastfeeding, and other significant events during the
401 first year of life influence the quality and developing pattern of attachment over time. An
402 increasing number of studies also emphasize the importance of the father's role from the
403 beginning of their child's life (Finnbogadóttir, Svalenius, & Persson, 2003; Lamb, 2010;
404 Zanoni, Warburton, Bussey, & McMaugh, 2013). Significant relationships between these

405 phenomena can only be discovered in well-planned collaborative research between
406 professionals from different disciplines.

407 The lack of information on the employment status of the participants was a limitation
408 of the study; future studies should take this variable into consideration. The relative
409 abundance of low education individuals in sample was also a limitation.

410 The studies performed on the predictors of maternal-fetal attachment so far have found
411 several important relationships, yet, the measures need to be revised and updated, taking into
412 consideration the important features that change during the 40 weeks of pregnancy, as well as
413 cultural differences and other important influencing factors.

414 **Conclusion**

415 The practical importance of the issue of the quality of maternal-fetal attachment is
416 enormous. Establishing secure attachment is an invaluable preventive benefit during the
417 prenatal period. Some studies suggest that attachment to the fetus has a positive effect on the
418 mental and physical health of both parents and their health-conscious behavior during
419 pregnancy. This also confirms the preventive aspects of the phenomenon of secure maternal-
420 fetal attachment (Boukydis, 2006). The study of the predictors and influencing factors related
421 to prenatal attachment is crucial. As maternal-fetal attachment is influenced by cultural
422 factors, it needs to be studied in the environment in which it is embedded. This highlights the
423 importance of the adaptation of valid and reliable measures of the construct to different
424 languages enabling the study of different contributing factors in different cultural settings.

425 Our results indicated a successful adaptation of the MFAS to Hungarian language with
426 findings on reliability, factor structure, and predictors matching previous scientific evidence.
427 Successful adaptation of the MFAS to Hungarian language enables further, culturally
428 sensitive, studies on the factors that positively or negatively influence maternal-fetal

429 attachment. These studies will facilitate development of an individualized prenatal care
430 program. Although the psychometric properties of the single-factor solution were reasonably
431 good and can be applied in future Hungarian studies, future research needs to explore the
432 possibility of improving reliability and model fit. Future studies should also seek to employ
433 longitudinal designs to identify the factors that most effectively influence early attachment
434 between parents and child, facilitating the development of effective interventions and
435 prevention strategies.

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