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Research Article

Development of the Korean Paternal-Fetal Attachment Scale (K-PAFAS)

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SUMMARY

Purpose: This study is a methodological study aimed to develop the Korean Paternal-Fetal Attachment Scale (K-PAFAS) to measure the level of attachment between the father and the expected baby, and to examine its validity and reliability.

Methods: The K-PAFAS was developed in four steps. The first step involved derivation of the initial items through review of the literature and in-depth interviews with 10 expectant fathers. The second step was the process of expert panel review, examining content validity for the initial items. In the third step, items were examined for their usability through a preliminary survey with 30 expectant fathers. As the last step, the final K-PAFAS was applied to 200 participants and examined for its psychometric profile.

Results: K-PAFAS consisted of 20 items, and used a 5-point Likert scale with the total score ranging from 20 points to 100 points. A higher score indicated a higher level of attachment between the father and his unborn child. The K-PAFAS was composed of four factors. The K-PAFAS demonstrated satisfactory criterion validity, which was supported by its significant correlations with the Paternal Antenatal Attachment Scale, the Korean Dyadic Adjustment Scale, and the Center for Epidemiological Studies–Depression Scale. The Cronbach α of the K-PAFAS was .89. In test-retest reliability, the K-PAFAS showed a correlation coefficient of .91.

Conclusion: The K-PAFAS demonstrated initial validity and reliability. It was short, and relatively easy for use in evaluating the degree of paternal-fetal attachment in the antenatal management stage.

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Introduction

Due to the recent increase in the number of nuclear family and women's participation in economic activities, a father coparenting his child is becoming more common in Korean society. The use of parental work leave by men has gradually increased in Korea [1], showing that fathers are now actively involved in parenting. It has been reported that a father's coparenting positively influences the development of the child's social skills and is associated with positive behavioral outcomes in the child [2,3]. A father's attachment with the fetus is known to be correlated with his attachment with the child at infant phase [4]. Thus, an expectant father's antenatal attachment with the unborn baby is assumed to have beneficial effects on the child after birth.

According to the theory of attachment behavior, an individual should experience close and keen relationships with the primary caregiver in early childhood to make a successful adjustment to the environment [5]. Specifically, an attached relationship with parents in the infant phase is a significant psychological factor that has a critical influence on the child's cognitive and social development and on a healthy social life when the child becomes an adult [2,3,5]. The attachment between parents and their unborn baby is naturally developed during the pregnancy period [6]. Antenatal attachment reflects parents' emotion and ideation toward the fetus and is denoted through their psychological, cognitive, and behavioral approach to the fetus [7].

From the standpoint of traditional Korean culture, a human being is regarded as a spiritual being from the moment of conception [8], and the psychological communications of the parent with the fetus, called *Taegyo*, are emphasized as essential efforts by the parent that aim at helping the fetus maintain the best antenatal developmental status during pregnancy [9]. In the traditional Korean society, *Taegyo* has been characterized as a

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concept that influences parents to have appropriate attitudes and morality regarding parenting and engage in the actual implementation of antenatal support for the fetus [10]. This spirit of *Taegyo* is still embedded in Korean people's lifestyle or inner philosophy in modern times. The Korean philosophy of *Taegyo* that regards the fetus as a unique human being from the moment of conception is based on parental affection with the fetus [11] and thus is conceptually related to the phenomenon of parental-fetal attachment that emphasizes consistent bonding interactions between parents and the fetus [12,13]. Specifically, *Taegyo* has not been confined only to the mother but has also been applied to the father, implying that attention to and support for the fetus during the antenatal period should be instantiated by the entire family, including the expectant father [8,10]. Therefore, when evaluating the level of paternal-fetal attachment among Koreans, the cultural notion of *Taegyo* should be considered.

Whereas previous research on parental antenatal attachment has predominantly focused on the attachment between the mother and the fetus, emphasizing maternal-fetal affective bonding [6,14], there is limited evidence on the relationship between the father and his unborn child. Along with labor and postnatal periods, prenatal period is one of the major fatherhood stages, and a psychologically demanding period for expectant fathers who experience transition to fatherhood [15,16]. During the prenatal period, fathers often experience feelings of unreality and perceived disequilibrium in relating with their partner, and make an identity shift from spouse to parent by reorganizing self as an expectant father [15]. Therefore, assessing the father's antenatal experiences is important for researchers and clinicians, as this could be related to positive perinatal and postnatal outcomes from the standpoint of family health.

In measuring paternal-fetal attachment, the Paternal-Fetal Attachment Scale (PFAS) [17] and Paternal Antenatal Attachment Scale (PAAS) [18] are used in most studies. The PFAS is revised from the maternal-fetal attachment scale [17] and developed on the assumption that the fetal attachment process by an expectant father is similar to that by an expectant mother [17]. Therefore, it is insufficient to measure the essential attributes of paternal-fetal attachment. The PAAS [18] includes both qualitative aspects (e.g., affection toward the fetus) and quantitative aspects of attachment (e.g., frequency of thoughts about the fetus) but does not place a large focus on actual paternal attitudes towards and behaviors related to paternal roles during the pregnancy period. In addition, these scales were developed in the context of Western cultures, implying a potential gap in their ability to reflect the patterns of paternal-fetal attachment in Korean culture. Existing instruments developed to assess paternal-fetal attachment from the perspective of Western culture thus have limitations in reflecting the traditional Korean paternal prenatal care for an unborn child in the context of Korean culture. Therefore, this study aims to develop the Korean paternal-fetal attachment scale (K-PAFAS) and examine its validity and reliability.

Methods

Study design

This is methodological research study aimed at developing the K-PAFAS to assess the level of paternal-fetal attachment and examining the validity and reliability of the scale.

Setting and sample

Participants were a total of 230 men with pregnant spouse, including 30 participants for a pilot test and 200 participants for a large sample survey. The subjects were expectant fathers who were community-dwelling, aged 18 and above, and able to communicate

in Korean. The subjects were recruited from outpatient departments of maternity hospitals and midwifery clinics in Seoul, Korea.

Scale development process

The K-PAFAS was developed in four steps based on the instrument development guidelines by DeVellis [19]: (a) generation of an item pool; (b) estimation of content validity; (c) preliminary survey; (d) testing of validity and reliability in a large sample survey (Figure 1).

Step 1: generation of an item pool

Step 1 involved a process of generating initial scale items through a review of the relevant literature and in-depth interviews with expectant fathers in order to clarify the concept of paternal-fetal attachment. The literature was searched using search engines including Research Information Sharing Service (RISS), Korean studies Information Service System (KISS), DBpia, PubMed, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycInfo, ProQuest Nursing and Allied Health Source. Search of the literature was conducted using key words including attachment, paternal-fetal attachment, maternal-fetal attachment, antenatal attachment, expectant father, transition to parenthood, or parent-fetal relationship. As a result, a total of 70 studies on fetal attachment were searched and reviewed to generate the core attributes of paternal-fetal attachment.

In-depth interviews with expectant fathers were conducted to confirm the face validity of items proposed through the review of the literature and to explore the domain of paternal-fetal attachment. A convenience sample of 10 expectant fathers was recruited from outpatient departments at two maternity hospitals and two midwifery clinics in the metropolitan area of Seoul, Korea. The interviews were conducted from July to September 2015 in private

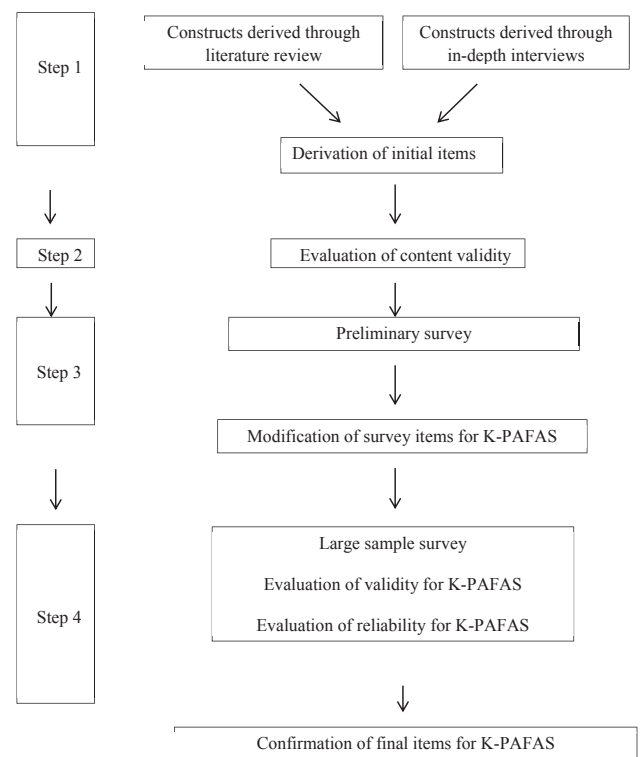


Figure 1. The K-PAFAS development process. Note. K-PAFAS = Korean Paternal-Fetal Attachment Scale.

indoor seminar rooms using a semi-structured questionnaire. Upon agreement by the participants, all interviews were tape-recorded and transcribed. During the interviews, an expectant father was asked to share his thoughts and feelings about the fetus, his expectations for the fetus, and any behavioral changes he exhibited as an expectant father. The collected data were analyzed using content analysis techniques that derived meaningful and specific statements from the data and convert those into general statements. All statements reported from the 10 expectant fathers were reviewed and compared to generate common statements and contents, which led to paternal-fetal attachment construct formation and the development of the preliminary items of the K-PAFAS.

Step 2: estimation of content validity

Step 2 was the process of expert panel review examining content validity for the initial items generated during step 1. Content validity was examined by content validity index (CVI) calculated based on item evaluations by a panel of 10 experts. The content validity of each item was evaluated by each expert using a 4-point Likert scale from 1 (*very invalid*) to 4 points (*very valid*). Item-level CVI was defined as the proportion of items that were rated as relevant or very relevant by the expert panel reviewers. A criterion of .80 was considered as the minimally acceptable standard for item-level CVI.

Step 3: pilot test

A pilot test of the preliminary scale was conducted on 30 partners of pregnant women who were recruited from outpatient departments at two maternity hospitals and two midwifery clinics in Seoul, Korea. This pilot sample was a separate group of participants not identical to those recruited at the large sample survey stage. The instrument pilot testing was performed to assess the clarity and understandability of the scale items. Each item was rated on a 5-point Likert scale, ranging from 1 (*very difficult to understand*) to 5 (*very easy to understand*). Comments on questions that were hard to understand were also solicited from participants. The wording of questions was modified based on participant responses to improve the understandability of the questions and confirm the final version of the K-PAFAS.

Step 4: estimation of validity and reliability

For examining the validity and reliability of the K-PAFAS, a large sample survey was conducted with 200 expectant fathers from January to March 2016. Recent evidence suggests that 10 participants per item may be an adequate ratio of item-to-respondents for factor analysis [20]. Thus, the sample size of the large scale survey was estimated based on the logic that 200 participants were recommended for the factor analysis of a scale with 20 preliminary items in this study. Participants were community-dwelling male spouses of pregnant women recruited from four maternity hospitals and two midwifery clinics in Seoul, Korea. Eligible partners of pregnant women were approached in the clinic waiting room and invited to participate in the study.

The validity of the K-PAFAS was examined using construct validity and criterion validity, including concurrent validity, convergent validity, and discriminant validity. The construct validity of the K-PAFAS was tested using exploratory factor analysis (EFA) to assess the factor structure of the scale. Principal component analysis was run using varimax rotation with eigenvalues set to be more than 1.0. Principal component analysis was conducted to reduce domains by grouping measured variables correlated with each other into independent components, which was a vital process for examining the construct validity of a scale. Varimax rotation was the most commonly recommended method of factor structure

rotation as it rotated factors by maximizing their independence in variance [21]. Once the domain was determined, confirmatory factor analysis (CFA) was conducted using maximum likelihood methods to confirm the dimensional structure of the K-PAFAS.

Concurrent validity, which reflected how well a scale correlated with a valid existing measure, was examined through K-PAFAS correlation with the PAAS [8] and *Taegyo* practice [12]. The PAAS measured the level of attachment between father and fetus, and consisted of 16 items. The PAAS was used for examining concurrent validity of the K-PAFAS, because it had been used as valid scale for measuring parents' attachment with the fetus among the Korean population [22]. For each PAAS item, responses ranged from 1 to 5, and the possible total score ranged from 16 to 80. A higher score indicated a higher level of paternal-fetal attachment. Cronbach α for the scale was .80 in this study. We hypothesized that a higher level of attachment between a father and his unborn baby would be correlated with a higher level of *Taegyo* practice by the father compared to fathers with a lower level of attachment [13]. Thus, the correlation between the K-PAFAS score and the degree of *Taegyo* practice was used to represent the concurrent validity of the K-PAFAS. A father's engagement in *Taegyo* practice was measured using the Practice of *Taegyo* scale, which was a 17-item scale [12,13]. All items were rated on a 5-point Likert scale with a total score ranging from 17 points to 85 points. A higher score indicated a higher level of *Taegyo* practice. Cronbach α of the scale was .91 in this study.

Several selected variables hypothesized to be related to K-PAFAS score were used for testing its convergent and discriminant validity. Marital satisfaction was used as one variable to examine the convergent validity of the K-PAFAS, as the concept was expected to be highly correlated with paternal-fetal attachment [15]. Marital satisfaction was measured using a short-form Korean Dyadic Adjustment Scale (K-DAS) [23,24]. The K-DAS has demonstrated its validity in the Korean population in a previous study [25]. The scale consisted of 10 items and the total score ranged from 0 to 50. Items containing negative meanings were reverse coded. A higher score indicated a higher level of marital satisfaction. Cronbach α of the scale was .79 in this study.

Paternal depression was used as a variable to support the discriminant validity of the K-PAFAS, as the concept was expected to be conceptually differentiated from paternal-fetal attachment [15]. Depression was measured using the Korean version of the Center for Epidemiological Studies–Depression Scale (CES-D) [26,27]. CES-D was used for examining discriminant validity of the K-PAFAS based on its conceptual distinction with antenatal attachment in a previous study [28]. The CES-D was composed of 20 items assessing depression levels experienced during the past week. Each item scored from 0 to 3 points, with the total score ranging from 0 to 60. A higher score indicated a higher level of depression. Cronbach α of the scale was .88 in this study.

Reliability of the K-PAFAS was tested using internal consistency and test-retest reliability coefficients. Internal consistency reliability was assessed using Cronbach α coefficients. Test-retest reliability was assessed using correlation coefficients between two data collection points with a 2-week interval; 30 of the 200 participants completed the repeat survey questionnaire 2 weeks after the initial survey.

Data analysis

The data were analyzed using SPSSWIN 19.0 and AMOS 23.0 programs. The data obtained from the preliminary survey were analyzed using descriptive statistics. For the large sample survey, general characteristics were described using descriptive statistics. Validity of the K-PAFAS was analyzed using EFA, CFA, and Pearson correlation coefficients. Internal consistency reliability was tested using Cronbach α . Test-retest reliability was examined using

correlation coefficients. The mean differences in major variables by general characteristic were analyzed using *t* test and analysis of variance.

Ethical consideration

Before collection of the data for the study, Institutional Review Board approval was obtained from The Catholic University of Korea (MC15OAS10075 & MC16QAS10006). Participants were informed about the purpose and procedures of the study and that their responses would be kept confidential. They were also informed that participation in the study was voluntary and that they had the right to withdraw from the study at any time.

Results

Item generation

The typology of initial items on paternal-fetal attachment was derived through a review of the relevant research and was grouped into three categories [7], the domains of emotion, cognition, and behavior. The domain of emotion included items related to subjective feelings of love, bonding, and connectedness for the fetus. The domain of cognition included concepts related to the value of the fetus, paternal responsibility and imagination, or curiosity for the unborn baby. Behavioral domain included efforts for interacting with the unborn child, expression of interests for the fetus, engagement in behaviors for protecting the unborn baby and in practicing *Taegyo*, and helping and supporting their pregnant spouse in daily lives.

In-depth interviews with the 10 expectant fathers resulted in several statements regarding a Korean father's paternal-fetal attachment. Attributes of the emotion domain included excitement, happiness, and cheerfulness from the pregnancy as a life event. Attributes of cognition domain involved appreciation for the pregnancy, awareness of paternal responsibility, future planning for the unborn child, and mental imaginations for the figure of the unborn child. The behavioral domain included attributes such as interaction with the fetus, attending antenatal education courses with spouse, practice of *Taegyo*, and caregiving behaviors for their pregnant partners such as helping out with household chores and accompanying spouse to maternity hospital for medical checkups and prenatal education classes. As a result, a total of 50 initial items were generated through a review of the literature and in-depth interviews with the expectant fathers.

Content validity of K-PAFAS

Content validity for the initial item pool was assessed through CVI analysis. Ten expert panel reviewers included six nursing professors, one midwife, one gynecologist, one psychiatrist, and one psychologist. They were asked to rank the 50 initial K-PAFAS items as *not relevant*, *somewhat relevant*, *relevant*, or *very relevant*. A total of 30 items were deleted from the 50-item scale as their CVI was below .80, leaving 20 items remaining in the item pool. The deleted items included items that were conceptually redundant with other items, related more to the relationship with the spouse than to the fetus, or overtly focused on general knowledge on pregnancy and perinatal process.

Pilot test

The pilot test of the preliminary K-PAFAS survey showed that the participants ($n = 30$) reported no difficulty in reading and understanding all items except for one question. Partial revisions were made on the syntax of this item to clarify its meaning. The item, "I

try to guess the character of the expected baby based on the patterns of quickening" was revised to, "I try to guess the character of the expected baby," because the former expression was not applicable to fathers who were unable to feel the quickening of the fetus directly. The mean age of the participants was 32.4 years, and most participants ($n = 27$) were college graduates. Twenty-four of the 30 participants reported that the fetus was the first child in their family and 6 participants reported that the fetus was the second or third child for them. About 10 minutes were spent on the completion of the pilot survey questionnaire.

Validity and reliability

To test the validity and reliability of the final version of the K-PAFAS, the sample survey was conducted with 200 expectant fathers. The results are as follows.

General characteristics of participants

The majority of participants were college graduates (94.0%) and in their 30s (79.0%). In terms of perinatal variables, 90.0% of the participants reported that the current pregnancy was the first parental experience for them. About 30.0% of the participants reported that their pregnant partners were in the second trimester of the pregnancy, and 64.5% reported that their spouse was in the third trimester of the pregnancy. Thirteen percent of the participants had previous experience using fertility treatments for pregnancy. The majority of participants had planned for the current pregnancy (75.5%) and received prenatal education (64.0%; Table 1).

Item analysis

The average K-PAFAS total score was 88.14 ($SD = 8.62$). Although normality of the items was not an essential assumption in factor analysis [21], skewness (-3.0 to -0.03), and kurtosis (-0.60 to 10.27) were examined, suggesting potential ceiling effects in the data. The item analysis for the K-PAFAS was examined by testing the item correlations with the total scale. All items had correlation

Table 1 General Characteristics of Participants ($N = 200$).

Variables	Categories	<i>n</i>	(%)
Age (yr)	≤ 29	26	(13.0)
	30–39	158	(79.0)
	≥ 40	16	(8.0)
Baby's birth order	1	180	(90.0)
	≥ 2	20	(10.0)
Gestational period	≤ 14th week & the 6th day	12	(6.0)
	15th–28th week & the 6th day	59	(29.5)
	≥ 29th week	129	(64.5)
Planned pregnancy	Yes	151	(75.5)
	No	49	(24.5)
Fertility treatment	Yes	26	(13.0)
	No	174	(87.0)
Religion	Have	118	(59.0)
	Did not have	82	(41.0)
Prenatal education	Yes	128	(64.0)
	No	72	(36.0)
Educational level	≤ High school	12	(6.0)
	≥ College	188	(94.0)
Job	Self-employed	21	(10.5)
	Company employee	110	(55.0)
	Technician	21	(10.5)
	Teaching profession	29	(14.5)
	Others	19	(9.5)
Family income (10,000 Won/per month)	≤ 300	29	(14.5)
	301–499	79	(39.5)
	500–699	58	(29.0)
	≥ 700	34	(17.0)

coefficients with the total scale from .41 to .70, showing that each item was neither overtly identical nor differentiated (Table 2).

Validity

EFA showed the value of Kaiser-Meyer-Olkin to be .89 and a χ^2 value of 1,786.48 ($p < .001$) from Barlett's test of sphericity, indicating sample adequacy for factor analysis. EFA with varimax rotation resulted in four factors which accounted for 58.95% of the items variance. Factor loadings for 20 items are shown in Table 2. Factor 1 included eight items and was labeled as "paternal bonding with the fetus". This factor focused on thoughts and feelings about the fetus as an expectant father and appreciation for the presence of the unborn child. Factor 2 included seven items and was labeled as "paternal behavioral change". This factor captured paternal interactions with the fetus, exploration of the presence of the unborn child, and engagement in a healthy lifestyle to be a healthy father in the future. Factor 3 included three items and was labeled as "recognition of paternal role". This factor expressed psychological preparedness for engaging in a paternal role after the birth of the child, and focused on feelings of responsibility as an expectant father, announcing the news of the pregnancy, talking about the fetus to others, and being cautious about talking and behaving for the sake of the unborn child. Factor 4 included two items and described imagining the physical outlook and characteristics of the unborn baby. This factor was named as "expectation for the unborn child".

After initial allocation of the items into the four factors based on the factor analysis, two items were relocated based on a conceptual reasoning process. This relocation was performed based on the assumption that conceptual logic was as important as technical aspects in developing a scale [19]. Factor analysis initially categorized the item, "I believe that the fetus recognizes my voice," into factor 2, but this item was relocated into factor 1 as it could relate more to paternal bonding with the fetus based on a trusting relationship and had a factor loading (.40) onto factor 1 similar to its loading onto factor 2 (.49). Factor analysis classified another item, "I feel an increased sense of responsibility

when I think of the expected baby," onto factor 1 but was relocated into factor 3, as it reflected the perception of the paternal role more than emotional bonding and its factor loading was also higher onto factor 3 (.50; Table 2). Intercorrelations among the four factors were examined to confirm if the factors derived through factor rerotation reflected mutually exclusive concepts well. Correlations between the factors ranged from .41 to .58, suggesting that each factor was neither overtly identical nor differentiated.

After this relocation, CFA was conducted to confirm the final factor structure of the K-PAFAS. Results from the CFA yielded a χ^2 value of 383.807 ($df = 164, p < .001$), goodness of fit index of .836, adjusted goodness of fit index of .790, normed fit index of .793, comparative fit index of .868, and root mean square error of approximation of .082, showing an acceptable, rather than a good fit of the model to the sample data [29]. Factor loadings of each item and error ratios are presented in Figure 2.

From the standpoint of criterion validity, the K-PAFAS highly correlated with the PAAS ($r = .84, p < .001$) and Practice of Taegyoo Scale ($r = .62, p < .001$), supporting the concurrent validity of the K-PAFAS. The concurrent validity of the K-PAFAS was confirmed based on the general rule that concurrent validity was supported when two variables had a correlation coefficient of over .45 [30]. The K-PAFAS was positively correlated with the K-DAS ($r = .31, p < .001$), showing the convergent validity of the K-PAFAS. As expected, the K-PAFAS was negatively correlated with CES-D ($r = -.18, p = .011$), demonstrating the discriminant validity of the K-PAFAS (Table 3).

Reliability

Cronbach α of the K-PAFAS was .89 with 95% confidence interval (CI), ranging from 0.87 as lower bound and 0.91 as upper bound. Cronbach α of the K-PAFAS by subdomains were .86 for paternal bonding with the fetus [$p < .001, 95\% \text{ CI} (0.83, 0.89)$], .81 for paternal behavioral change [$p < .001, 95\% \text{ CI} (0.76, 0.84)$], .61 for recognition of paternal role [$p < .001, 95\% \text{ CI} (0.51, 0.69)$], and .56 for expectation for the fetus [$p < .001, 95\% \text{ CI} (0.41, 0.66)$]. The test-retest correlation

Table 2 Item Analysis for K-PAFAS (N = 200).

Factor	Items	M ± SD	CL	Factor loading			
				F1	F2	F3	F4
Paternal bonding with the fetus	7 I picture myself having happy moments with the expected baby after his or her birth.	4.71 ± 0.63	.58	.80	.21	-.04	.21
	3 I look forward to meeting my expected baby for the first time.	4.83 ± 0.46	.60	.79	.21	.01	.17
	1 I feel happy when I think of the expected baby.	4.73 ± 0.56	.65	.78	.31	-.07	.25
	4 I feel thankful and appreciative when I think of the expected baby.	4.79 ± 0.54	.65	.75	.24	.21	.09
	6 The expected baby reminds me of the significance of family.	4.78 ± 0.51	.54	.70	.08	.35	.01
	5 The expected baby is precious to me.	4.90 ± 0.33	.50	.68	.12	.30	-.12
	2 I get excited when I feel the movements of the expected baby.	4.76 ± 0.51	.59	.62	.28	-.05	.39
	8 I believe that the expected baby recognizes my voice.	4.98 ± 1.06	.62	.40	.49	.21	.17
Paternal behavioral change	19 I try to sense the expected baby in many ways.	4.34 ± 0.79	.63	.22	.78	.05	.17
	20 I try to spare my time to interact with the expected baby.	3.97 ± 1.00	.64	.28	.77	.15	.01
	17 I talk to my wife about the expected baby.	4.67 ± 0.56	.50	.18	.66	-.10	.21
	18 I actively search for information concerning pregnancy, childbirth and parenting.	3.54 ± 0.98	.46	-.05	.62	.40	.02
	15 When I have the chance, I view ultrasonic photographs or videos of my unborn baby.	3.56 ± 1.06	.62	.28	.59	.31	.07
	14 I try to live a healthier lifestyle when I think of the expected baby.	3.60 ± 1.07	.51	.10	.51	.33	.20
	16 I have told those around me about the expected baby.	4.42 ± 0.79	.33	.10	.16	.62	-.03
Recognition of paternal role	13 I believe that my role as a father requires preparation.	4.48 ± 0.78	.46	.12	.18	.57	.36
	12 I am always cautious in the way I speak and behave when I think of the expected baby.	4.13 ± 0.88	.50	.08	.31	.53	.35
	11 I feel an increased sense of responsibility when I think of the expected baby.	4.81 ± 0.51	.44	.54	-.11	.50	.17
Expectation for the unborn child	10 I try to guess the character of the expected baby.	4.61 ± 0.66	.39	.09	.13	.18	.73
	9 I think about whom the expected baby will resemble.	4.56 ± 0.75	.49	.28	.17	.10	.72
Total score		88.14 ± 8.62					
Explained variance				4.58	3.42	2.00	1.79
Explained (%)				22.91	17.08	10.00	8.96
Cumulative (%)				22.91	39.99	49.99	58.95
Kaiser-Meyer-Olkin		.89					
Bartlett's test of sphericity, χ^2		1,786.48 ($p < .001$)					

Note. CL = corrected item-total correlation; K-PAFAS = Korean Paternal-Fetal Attachment Scale.

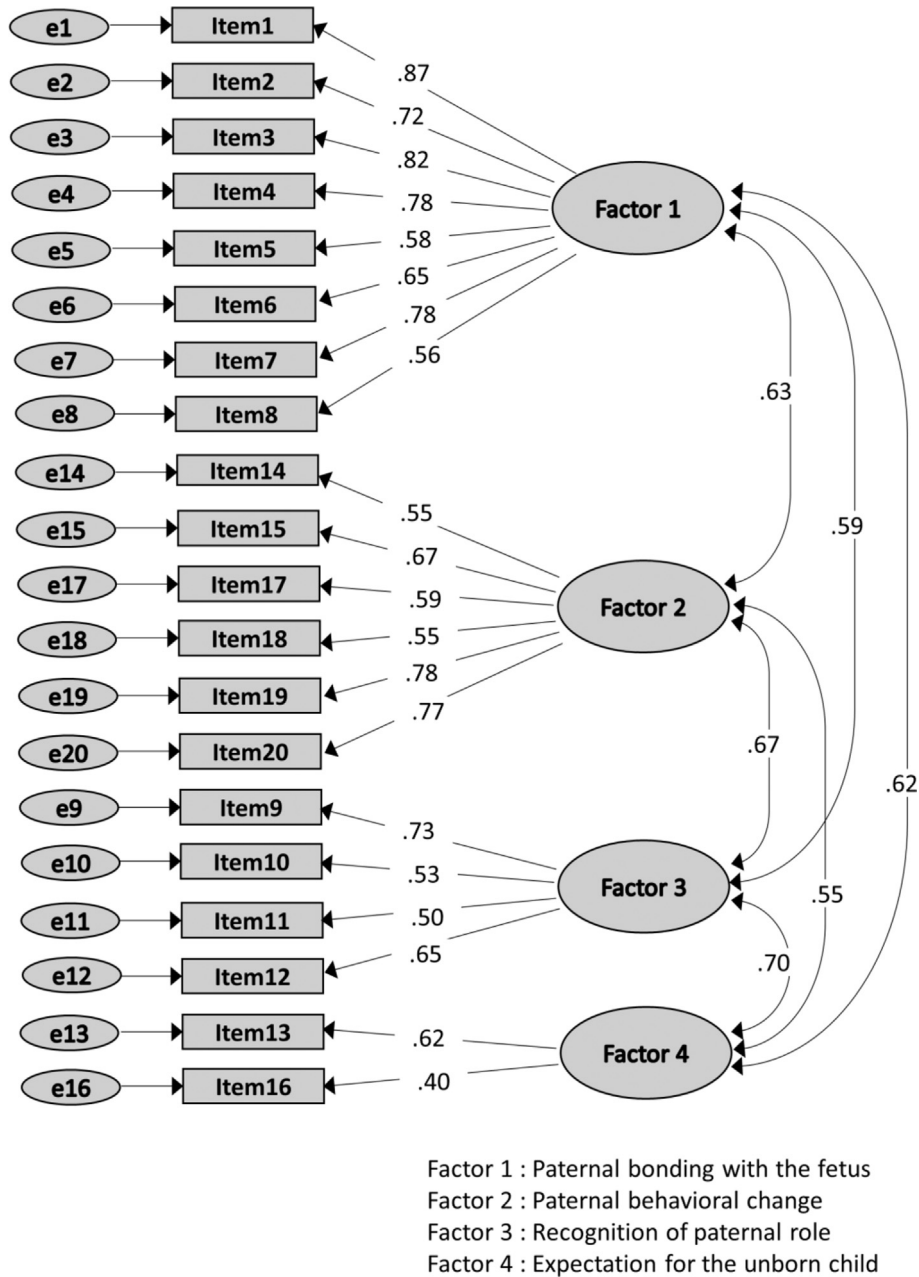


Figure 2. Confirmatory factor analysis for Korean Paternal-Fetal Attachment Scale.

coefficient of .91 ($p < .001$) showed that the K-PAFAS had robust psychometric stability in terms of test-retest reliability [31]. Test-retest reliabilities of the K-PAFAS by subdomains were .94 for paternal bonding with the fetus ($p < .001$), .67 for paternal behavioral change ($p < .001$), .87 for recognition of paternal role ($p < .001$), and .69 for expectation for the fetus ($p < .001$). The final version of the 20-item K-PAFAS is presented in Appendix I.

Discussion

This was a methodological research study aimed at developing the K-PAFAS to assess the level of paternal-fetal attachment and examining its validity and reliability. The K-PAFAS consisted of 20 items, and used a 5-point Likert scale with the total score ranging from 20 to 100 points. A higher score indicated a higher level of

Table 3 Correlations among K-PAFAS, PAAS, K-DAS, CES-D and Practice of Taegyo Scale (N = 200).

Measurement	M ± SD	K-PAFAS	PAAS	r (p)		
				K-DAS	CES-D	Practice of Taegyo scale
PAAS	68.61 ± 7.87	.84 (< .001)				
K-DAS	44.01 ± 4.23	.31 (< .001)	.27 (< .001)			
CES-D	3.74 ± 5.52	-.18 (.011)	-.21 (.003)	-.25 (< .001)		
Practice of Taegyo scale	66.90 ± 10.32	.62 (< .001)	.64 (< .001)	.31 (< .001)		-.25 (< .001)

Note. CES-D = Center for Epidemiological Studies-Depression Scale; K-DAS = Korean Dyadic Adjustment Scale; K-PAFAS = Korean Paternal-Fetal Attachment Scale; PAAS = Paternal Antenatal Attachment Scale.

paternal-fetal attachment (Appendix 1). The results of the study supported the validity and reliability of the K-PAFAS for measuring paternal-fetal attachment level. Factor analysis showed that the K-PAFAS was composed of four factors, including paternal bonding with the fetus (factor 1), paternal behavioral change (factor 2), recognition of paternal role (factor 3), and expectation for the unborn child (factor 4).

Factor 1, “paternal bonding with the fetus” involved the father’s subjective feelings of love and emotional bonding with the fetus. This factor showed that the father, like the mother, experienced psychological attachment to the fetus [5–7,14,17,18]. Specifically, the item, “The expected baby reminds me of the significance of family” reflected Korean familism that regarded the fetus as an individual human being and respected the unborn baby as a member of the family [8–13]. This item was not included in existing instruments on parental attachment and implied the unique aspect of the K-PAFAS as compared to other scales. Factor 2, “paternal behavioral change” addressed the demonstration of paternal attachment in terms of observed behavior, such as searching for the information on antenatal care, viewing ultrasound photos of the fetus, and trying to feel the quickening of the fetus. The item, “I try to live a healthier lifestyle when I think of the expected baby” reflected the tradition of paternal *Taegyo*, which assumed that the physical and psychological wellness of the father was important for the development of the fetus [8–13]. Factor 3, “recognition of paternal role” addressed conscious recognition of the fetus’ existence, which was expressed as feeling responsible as a father and thinking about the role of the father in parenting the unborn baby. The item, “I feel an increased sense of responsibility when I think of the expected baby” reflected the formation of paternal identity as an expectant father and supported the idea that psychological preparation for being a father occurred before a child was born [8–13]. Factor 4, “expectation for the fetus” addressed the father’s imagining the characteristics of the unborn baby after birth and suggested that expectant fathers imagined their baby’s physical figures based on their affiliation with the fetus.

In this study, the K-PAFAS demonstrated satisfactory criterion validity and psychometric properties. The concurrent validity of the K-PAFAS was supported by its high correlation with PAAS [18] ($r = .84$), which was assessed at the same point in time as the K-PAFAS as a related valid measure of paternal-fetal attachment. In this study, paternal-fetal attachment was associated with the father’s performance in *Taegyo* practice. As expected, higher levels of paternal-fetal attachment correlated with higher levels of *Taegyo* practice (.62), in accord with the findings of previous research [31] and supported the concurrent validity of the K-PAFAS. Paternal-fetal attachment was proposed to be correlated with the practice of *Taegyo* based on the theoretical assumption that an expectant father with a high level of attachment to the unborn child was likely to engage in *Taegyo* practice during the prenatal period, which would then result in the father’s positive adaptation to the role of fatherhood during their child’s early infancy phase. In fact, maternal-fetal attachment was known to strengthen maternal affiliations and interactions with the child after birth [32], and paternal-fetal attachment had a strong prognostic significance for father-infant relationships [4]. Examination of the K-PAFAS scores as an empirical predictor of positive father-to-child relationships in the early parenting phase should be done in further longitudinal research. Due to the lack of a gold standard to measure paternal-fetal attachment, the K-PAFAS was examined of its correlations with PAAS and *Taegyo* practice as proxy criterion measures in the current study. Therefore, use of alternative methods to assess paternal fetal attachment, such as observational method or concurrent reports from the mother,

should be considered in testing the criterion validity of the K-PAFAS in future studies.

As expected, the K-PAFAS scores correlated with the K-DAS scores, in accord with the findings of previous research on the positive relationship between parental attachment with the child and the marital satisfaction of the couple [25,28]. This represented a high convergence between paternal-fetal attachment and marital satisfaction constructs, supporting convergent validity of the K-PAFAS. Increased K-PAFAS scores were inversely correlated with CES-D scores ($r = -.18$), showing that higher levels of paternal-fetal attachment were associated with lower levels of depression in the expectant fathers. This finding confirmed the findings of previous studies [28,33] and demonstrated that the K-PAFAS differentiated paternal-fetal attachment from paternal depression, supporting the discriminant validity of the K-PAFAS.

In the present study, Cronbach α for the K-PAFAS was .89, showing sound internal consistency reliability of the scale. The estimated test-retest correlation coefficient for the K-PAFAS was .91, supporting stability reliability of the instrument. The 20 item K-PAFAS consists of short sentences that are easy to understand and can be used for an adult male with a pregnant partner. Prenatal nurses and midwives can use the K-PAFAS as a simple tool to assess father-to-fetus attachment during the prenatal period, and to examine if the paternal fetal attachment needs further exploration. Although we suggest that the K-PAFAS be used during the second or third trimester of pregnancy due to its inclusion of items on fetal movement, it can also be used in early pregnancy phase because the concept of attachment in an expectant father is dominantly related to emotional and cognitive domains and is different from a pregnant woman who experiences the phenomenon of quickening directly. Furthermore, the K-PAFAS can also be used as a research tool to measure levels of paternal-fetal attachment at pretest and post-test time points for nursing intervention research in the area of prenatal care.

This study has several limitations. First, the model fit of the CFA results to the sample data was acceptable but still was relatively poor. Further replication research is needed to examine whether this poor fit is due to the matter of item validity of the scale or the sample bias of the current study. Second, the two items in factor 4 showed low internal consistency reliability (.56). Although these items remained in the scale because the domain, “expectation for the fetus”, was an essential attribute of paternal-fetal attachment from the theoretical perspective [16], the Cronbach α of the factor needs to be further tested in future studies to justify its exclusion from the total item pool. Lastly, because participants of this study were a convenience sample recruited from maternity hospitals holding prenatal education courses, they were likely to have a normal, functioning family and their responses may have been biased. In the current study, potential ceiling effects were identified in the normality test of the scale items, indicating that skewness and kurtosis values should be standardized in future psychometric testing of the K-PAFAS in different groups of subjects to minimize threats to normal distribution of the data. It should be noted that the overall education level of the study participants was relatively high; thus, further studies should address the applicability of the K-PAFAS to fathers from low-income households who may have relatively low levels of paternal-fetal attachment.

Nevertheless, the K-PAFAS provides a baseline measure of paternal-fetal attachment in the context of Korean culture by incorporating the traditional notion of *Taegyo* into the scale and adds to the literature as it may promote research in the area of prenatal care by providing a valid scale to measure a father’s level of attachment with his unborn child during the pregnancy period.

Conclusion

On the basis of the results above, the K-PAFAS, developed through this study, showed validity and reliability. The scale was short, and relatively easy to use in evaluating the degree of paternal-fetal attachment. The K-PAFAS could be used as a simple tool to examine the level of paternal-fetal attachment in the antenatal management stage and to provide preliminary suggestions if further investigation on paternal fetal attachment was needed. It can also be used as a research instrument to evaluate the effects of nursing intervention programs concerning paternal-fetal attachment. The factor structure of the K-PAFAS should be further explored through CFA in future replication studies in order to support the construct validity of the scale.

Conflict of interest

The authors declared no potential conflicts of interest.

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Appendix I. The Korean Paternal-Fetal Attachment Scale (K-PAFAS)

This questionnaire is a self-report instrument in order to assess your attitude, feelings, thoughts, expectations, and behaviors towards your unborn baby. Please circle the number that best describes your answer for each item.

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		How much do you agree with				
		Strongly disagree	Disagree	Moderate	Agree	Strongly agree
1	I picture myself having happy moments with the expected baby after his or her birth	1	2	3	4	5
2	I look forward to meeting my expected baby for the first time.	1	2	3	4	5
3	I feel happy when I think of the expected baby.	1	2	3	4	5
4	I feel thankful and appreciative when I think of the expected baby	1	2	3	4	5
5	The expected baby reminds me of the significance of family.	1	2	3	4	5
6	The expected baby is precious to me.	1	2	3	4	5
7	I get excited when I feel the movements of the expected baby.	1	2	3	4	5
8	I believe that the expected baby recognizes my voice.	1	2	3	4	5
9	I try to sense the expected baby in many ways (e.g., caressing my wife's belly, putting my ear against wife's belly).	1	2	3	4	5
10	I try to spare my time to interact with the expected baby (e.g., calling the expected baby by his or her nickname, talking to the expected baby, reading and singing to the expected baby, inducing fetal movements).	1	2	3	4	5
11	I talk to my wife about the expected baby.	1	2	3	4	5
12	I actively search for information concerning pregnancy, childbirth and parenting (e.g., searching the internet, watching documentaries or video clips, looking for related publications).	1	2	3	4	5
13	When I have the chance, I view ultrasonic photographs or videos of my unborn baby.	1	2	3	4	5
14	I try to live a healthier lifestyle when I think of the expected baby (e.g. exercising, stop drinking and/or smoking).	1	2	3	4	5
15	I have told those around me about the expected baby (e.g., parents, friends, and colleagues etc).	1	2	3	4	5
16	I believe that my role as a father requires preparation (i.e., in life's philosophies, parenting philosophies).	1	2	3	4	5
17	I am always cautious in the way I speak and behave when I think of the expected baby.	1	2	3	4	5
18	I feel an increased sense of responsibility when I think of the expected baby.	1	2	3	4	5
19	I try to guess the character of the expected baby.	1	2	3	4	5
20	I think about whom the expected baby will resemble.	1	2	3	4	5

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