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Research Article

Validity and Reliability of the Korean Version of the Paternal Postnatal Attachment Scale

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SUMMARY

Purpose: The study aimed to translate the Paternal Postnatal Attachment Scale (PPAS) into Korean and to evaluate the validity and reliability of the Korean version of the PPAS (K-PPAS).
Methods: The PPAS was translated, back-translated, and reviewed by 12 experts and 5 fathers following the World Health Organization's guideline. A convenience sample of 396 fathers with infants in their first 12 months participated in this study. For construct validity, an underlying factor structure and model fit was assessed with an exploratory and confirmatory factor analysis. Convergent and discriminant validity and reliability of the K-PPAS were evaluated.
Results: The construct validity of the K-PPAS with 11 items was identified by two-factor structures: healthy attachment relationship, and patience and tolerance. The final model fit was shown acceptable with the normed chi-square = 1.94, comparative fit index = .94, Tucker–Lewis index = .92, root mean square error of approximation = .07, and standardized root mean square residual = .06. This model had acceptable convergent and discriminant validity for each construct with the values of the composite reliability and heterotrait–monotrait ratio at a satisfactory level. Discriminant validity with known groups showed that fathers with no postnatal depression had significantly higher scores on the K-PPAS than those with postnatal depression. Cronbach's α and McDonald's omega coefficient of the K-PPAS was .84 and .83.
Conclusions: The K-PPAS would be beneficial to measure postnatal attachment among fathers with infants aged 12 months or younger in Korea. However, further studies are suggested to evaluate the applicability of the scale considering the various family structures, such as single or foster parents and multicultural families that exist within the Korean population.

Introduction

A father-infant attachment emerges as an important mechanism in raising a child and influences the biological, psychological, and social aspects of a child's development [1]. From biological aspects, a secure attachment in infants has been associated with stimulating an infant's brain growth and development and allowing strong emotional immunity to form, making them more tolerant to stress [1]. Also, a positive paternal attachment in the early infant phase of childrearing greatly influences the child's later cognitive development [2], and these children also grew up to exhibit fewer behavioral problems, including emotional symptoms, conduct problems, hyperactivity, peer relationship problems, and prosocial behavior [3]. In contrast, the children of fathers with disengaged interactions even at 3 months of age were to manifest early behavioral problems such as aggression, rebellion, and hyperactivity [4].

Many scholars in pediatric and child psychology suggest that maternal and paternal roles in caregiving are separate systems from the evolutionary perspective [5]. When comparing both parents, mothers as the primary caregiver spend more time with their children even in the case of both parents having to work full time [6]. Previous studies had mainly addressed maternal attachment to a child's developmental outcomes as mothers were considered to be a more influential figure to children. However, the growing interest in fathers' involvement in childrearing has become an increasing trend with nuclear families and dual-income households being more prevalent in Korea [7]. Women's participation in the

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workforce might have led to changes in the perceptions of fathers and mothers sharing parenting and housework [8]. With this transition, recent studies have explored the role of Korean fathers as caregivers and their impact on children's development [9,10].

Although recent studies have highlighted the importance of paternal involvement in early attachment with their infants [11,12], evidence concerning paternal attachment towards an infant was less examined in comparison to maternal attachment due to a limited number of valid assessment tools available in Korea [13]. Several maternal attachment measures varying from self-report questionnaires to observational approaches have been translated into Korean, such as the Maternal Postnatal Attachment Scale [14], Maternal Attachment Inventory [53], and Attachment Q-sort [15].

However, only one scale, the Paternal Attachment Scale (PAS) [16], has been available to assess paternal attachment in infancy in Korea. The PAS [16] is developed from the father's perspective to describe the involvement with his neonate, who refers to a child aged under 28 days [17]. It is a self-report measure of 35 items with seven subscales, which assess traits such as absorption, preoccupation, and interest exhibited in fathers who have formed bonds with their newborns. Often the term “infant” has been used interchangeably with the term “neonate” regarding paternal attachment in Korea. While the PAS measures paternal attachment in neonates, it has been referred to and used in previous studies to describe paternal attachment in infants [18,19], which is an unsuitable usage of the tool for fathers of infants as old as 24 months [17]. Moreover, the use of the PAS in cross-cultural studies may also be limited with its measuring concepts developed and addressed in Korean. Hence, to accurately assess the correct age group of the infants, tools that assess mother-infant attachment were used by modifying words such as “mother” to “father” [20]. Nonetheless, this is still inadequate because mothers and fathers develop attachments differently [21]. Therefore, a tool that specifically assesses father-infant attachment more accurately with infants correctly termed is in need.

On the other hand, the Paternal Postnatal Attachment Scale (PPAS) [22] consists of 19 items with 3 subscales that measure the affective and cognitive part of paternal attachment by considering the subjective experience of a father in forming an attachment with his infant up to 12 months. The formation of a father's attachment with an infant up to 1-year-old has been considered a crucial developmental milestone for infants [11], as the growth and development of major functional networks occur within the first year of life [23]. Likewise, according to Bowlby [24], the sensitive period for the development of infant attachment is from 6 to 24 months. In contrast to the PAS, the PPAS properly captures the crucial period in which infants develop an attachment with their fathers, and a further assessment has proven it to be an acceptable measure for paternal attachment with infants that are 24 months old [25]. Thus, regardless of the terms of age used in the original study, the PPAS has been shown to assess the important developmental period of attachment across infancy. Moreover, because it has been used in many studies worldwide and was translated and adapted for use across diverse cultures with good validity and reliability to the original scale [26–28], it can also be used in cross-cultural studies. In light of the aforementioned gap in the postnatal field, a cross-culturally validated tool like the PPAS that evaluates attachment between fathers and infants of ages up to 12 months is required in Korea.

Hence, the aim of this study is to translate and adapt the PPAS into Korean and examine the validity and reliability of the Korean version of the PPAS (K-PPAS). The results of this study will provide a foundation for future research measuring and understanding Korean fathers' attachment to their infants.

Methods

Study design

In this validation study, a cross-sectional study was applied to evaluate the validity and reliability of the Korean version of the PPAS. The PPAS was translated into Korean following the four phases of the guideline of the World Health Organization: forward and back translation, cultural adaptation with an expert panel, content validity, and pretesting and cognitive interviewing [29]. The psychometric properties of the translated version of the PPAS were examined among Korean fathers. Permission to use and translate the PPAS was acquired by the copyright holder prior to this study.

Translation process

Forward and back translation

Firstly, two independent pediatric nurses, who are fluent in both Korean and English, translated the PPAS into two initial versions. These two initial versions were synthesized into one version by reviewing and resolving any inadequately translated expressions or concepts with an initial team of experts, comprising a professor, a researcher from the department of psychiatric mental health nursing, and three pediatric nurses with clinical experience of more than 6 years. The synthesized version was back translated into an English version by a bilingual professor in pediatric nursing, who has studied and worked in the United States.

Cultural adaptation with expert panel

A panel of 6 experts consisted of the initial team of 5 experts in the previous phase of forward and back translation and the bilingual professor in pediatric nursing. They ensured cultural and conceptual equivalence and reconcile any discrepancies between the back translated and the original. The panel agreed on maintaining item 1 (“When I take care of my child, I get bored or annoyed”) as the words “annoyance” and “irritation” used in the original tool were difficult to distinguish in general terms used in Korean. They also discussed to keep the change of item 13's response from “Neither” to “I don't care about the amount of time that I spend with my child” as the original option was unable to adequately convey the meaning needed for a person to answer a question. However, the panel suggested that consistency in response options for the scale should be needed for less confusion, and all back translated items were adapted into a 5-point Likert scale. After a consensus was reached within the panel of experts, the preliminary version of the tool was produced from this process.

Content validity

The final confirmation of the scale was assessed independently by a panel of 7 different experts with three professors and two researchers from the department of pediatric nursing and two senior pediatric nurses with more than 10 years of clinical experience. Experts were asked to evaluate each item on a 4-point Likert scale (1 = not relevant, 2 = item needs some revision, 3 = relevant but needs minor revision, and 4 = very relevant). The values of the item-level content validity index for each item and the scale-level content validity index based on the average method above .78 and .90, respectively, were considered adequate for content validity [30].

Pretesting and cognitive interviewing

The pretesting of the preliminary version of the K-PPAS was carried out using a purposive sampling method to recruit 5 fathers who have infants in their first 12 months. These participants were first-time fathers, with mean age of 34.60 (SD = 5.86) years. All of them were married with undergraduate degrees and worked full-

time earning middle-class income. Interviews were performed to probe about the clarity of words or expressions used in questions. No problems were raised regarding clarity and comprehension of all items, and hence, a final version of the K-PPAS was created.

Setting and Samples

The survey for this study was conducted through online child-rearing communities in Korea. Convenience sampling was adopted to recruit fathers. The inclusion criteria were as follows: fathers aged 18 to 65 with infants in their first 12 months and have no problem communicating and answering questionnaires written in Korean, and have given a statement of consent prior to the study. A total of 396 fathers participated in this study, excluding four fathers who provided incomplete and inconsistent responses to survey questionnaires. To assess the construct validity of the scale, the necessary sample size for factor analysis was suggested as a minimum of 10 participants per item for exploratory factor analysis (EFA) and 200~300 participants for confirmatory factor analysis (CFA) [31]. Based on this, the data sample size was appropriate to conduct the factor analysis.

Ethical Considerations

The current study was conducted after receiving ethical approval from the Institutional Review Board at Ewha Womans University (Approval no. ewha-202203-0045-01). Participants were all informed about this study, and consent was gathered before commencing data collection.

Instruments

The PPAS [28] is a self-report measure that assesses the emotional responses of fathers to their infants during the first year of life in relation to the father-to-infant attachment. It comprises 19 items grouped in three subscales: patience and tolerance (PT) (8 items), pleasure in interaction (7 items), and affection and pride (4 items). Each item is scored with two to five response options. The score in the questionnaire ranges from 19 to 95, with a higher score indicating greater father-infant attachment. The PPAS has demonstrated adequate construct validity and reliability, and Cronbach's α coefficient ranged from .78 to 81 in the original study.

The K-Edinburgh Postnatal Depression Scale (EPDS) [32] translated from the original EPDS [33] is administered to assess postnatal depression. This 10-item scale is scored on a 4-point rating with a higher score indicating a greater level of postnatal depression. Cronbach's α coefficient of the K-EPDS and the EPDS was .84 and .87, respectively. As paternal depression is conceptually differentiated from father-infant attachment [34], the K-EPDS was used to examine discriminant validity.

Data Collection

This study recruited participants from online childrearing communities throughout April 2022. Prior to conducting data collection, consent from the administrators of online childrearing communities was obtained with a clear explanation regarding the study's purpose. The details of this study and a URL to the online survey were posted on each permitted online community. Participants were informed that their responses would remain anonymous and confidential, and assured of their right to refuse or withdraw their consent at any stage of this study without any consequences. A statement of consent was obtained from all participants before the survey began by allowing only those who have pressed “I consent” to continue onto the questionnaires. A gift voucher was given upon the completion of the questionnaires.

Data Analysis

The data were analyzed using IBM SPSS 28.0 and SPSS AMOS 28.0 programs (IBM Corp., Armonk, NY, USA). For the item analysis, means, standard deviations, skewness (<3), and kurtosis (<10) of an item's normal distribution [35] and item-total correlations ($\geq$.30) were assessed [36].

Construct validity was evaluated with EFA and CFA. The data collected were divided randomly to perform the EFA (n = 190) and CFA (n = 206). To determine the underlying factor structure, principal axis factoring with varimax rotation was used in the EFA [37]. The Kaiser–Meyer–Olkin (KMO >.60) and Bartlett's test of sphericity ($p < .05$) were used to confirm data suitability [38]. The optimum number of factors was extracted in accordance with an eigenvalue of 1 or above the elbow represented in a scree plot [37]. Items with loading onto their primary factors of .40 or above, alternative factors of .30 or below, and having a loading difference of .20 between their primary and alternative factors were considered acceptable [38]. For model fit verification, the CFA was performed with normed chi-square ($\chi 2/df$), comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). The model fit was evaluated using the following criteria: $\chi 2/df \leq 3$, CFI and TLI $\geq$.90, RMSEA $\leq$.08, and SRMR $\leq$.06 [39,40].

Convergent validity and discriminant validity for each construct in the model were evaluated using the values of the composite reliability (CR) and heterotrait–monotrait ratio with the CFA data set [41,42]. Discriminant validity with known groups was assessed with the scores determined from the K-EPDS [32], comparing the scores of the postnatal depressed (K-EPDS $\geq$10) and the normal (K-EPDS <10) group. Cronbach's α and McDonald's omega coefficients ($\geq$.70) were assessed to determine acceptable internal consistency [41].

Results

Sample Characteristics

The sample consisted of 396 fathers with data distributed randomly to have necessary sample sizes for both the EFA and CFA. The mean age of the total sample was 34.07 (SD = 3.86). The majority of fathers were married (98.7%) and living together with someone (97.7%). Most were first-time fathers (83.3%), and slightly more than half of the children were male (50.5%). Other characteristics of the fathers and their children are shown in Table 1.

Item Analysis

The results of the item analysis are shown in Table 2. The skewness and kurtosis of each item of the initial 19-item K-PPAS ranged from −.87 to .30 and −.49 to 1.83, respectively, meeting the criteria for normality. No items were additionally deleted with the initial item-total correlation coefficients ranging from .30 to .71.

Content Validity

The item-level content validity index value for each item was above .78, with all items scoring 1.00 except .85 for item 8; however, still demonstrated excellent content validity for 11 items [30]. The scale-level content validity index based on the average method value scored .99, with the above recommended value of .90 [30], also satisfying the criterion for good content validity, and thus all items were retained.

Construct Validity

Both EFA and CFA were performed to determine underlying factor structures that might exist as cultural adaptation and confirm any possibilities for reclassifying the items from the

Table 1 *General Characteristics of the Participants (N = 396).*

	Characteristics	Categories	Total (n = 396)	EFA (n = 190)	CFA (n = 206)
			Mean ± SD or n (%)	Mean ± SD or n (%)	Mean ± SD or n (%)
Father	Age (years)		34.07 ± 3.86	34.44 ± 3.98	33.72 ± 3.71
	Marital status	Unmarried	5 (1.3)	2 (1.1)	3 (1.5)
		Married	391 (98.7)	188 (98.9)	203 (98.5)
	Educational level	High school or less	24 (6.0)	11 (5.8)	13 (6.3)
		College/university	325 (82.1)	173 (91.0)	152 (73.8)
		Graduate or above	47 (11.9)	6 (3.2)	41 (19.9)
	Job status	Yes	382 (96.5)	181 (95.3)	201 (97.6)
		No	14 (3.5)	9 (4.7)	5 (2.4)
	Family structure	Alone	9 (2.3)	3 (1.6)	6 (2.9)
		Nuclear family	353 (89.1)	181 (95.3)	172 (83.5)
		Parents/parents-in-law	33 (8.3)	6 (3.1)	27 (13.1)
		Others	1 (0.3)		1 (0.5)
	Planned pregnancy	Yes	319 (80.6)	148 (77.9)	171 (83.0)
		No	77 (19.4)	42 (22.1)	35 (17.0)
	Number of children	First	330 (83.3)	160 (84.2)	170 (82.5)
		Second	60 (15.2)	28 (14.7)	32 (15.5)
		Third or more	6 (1.5)	2 (1.1)	4 (2.0)
	Childrearing (hours)	Weekdays	3.65 ± 2.36	3.67 ± 2.65	3.63 ± 2.06
	Childrearing (hours)	Weekends	8.68 ± 4.30	7.99 ± 4.08	9.32 ± 4.42
	Childrearing support	None	125 (31.6)	74 (38.9)	51 (24.8)
		Parents/parents-in-law	243 (61.4)	99 (52.7)	144 (69.8)
		Others	28 (7.0)	17 (8.4)	11 (5.4)
Child	Age (months)		8.47 ± 2.77	8.61 ± 2.51	8.33 ± 2.99
	Gender	Men	200 (50.5)	95 (50.0)	105 (51.0)
		Women	192 (48.5)	93 (48.9)	99 (48.0)
		Twins or more	4 (1.0)	2 (1.1)	2 (1.0)
	Gestational age (weeks)		37.19 ± 3.55	37.08 ± 3.53	37.29 ± 3.58
	Birth weight (grams)		3069.35 ± 368.09	3127.32 ± 396.74	3146.47 ± 375.41

Note. CFA = confirmatory factor analysis; EFA = explanatory factor analysis; SD = standard deviation.

original PPAS. The KMO was .89, and Bartlett's test of sphericity was $\chi 2 = 1559.02$ ($p < .001$), indicating adequate sampling and suitability for factor analysis. The principal axis factoring and varimax rotation revealed two factors with eigenvalues above 1 and consistent with the scree plot. The criteria for primary and alternative factor loadings and their differences [38] were considered in addition to content coherence with the original scale [22]. As a result, items 10, 12, 13, 14, 15, 16, 18, and 19 were deleted.

EFA was performed again with a final 11 items, resulting in a KMO of .84 and Bartlett's test of sphericity of $\chi 2 = 790.95$ ($p < .001$), demonstrating suitability for factor analysis. With eigenvalues above 1 and based on the elbow in the scree plot, the final factor structure consisted of two factors. The two-factor structure accounted for

Table 2 *Item Analysis and Factor Analysis of the K-PPAS (N = 396).*

Factors	Item no.	Mean ± SD	ITC	EFA (n = 190)				CFA (n = 206)		CR
				Initial factor structure		Final factor structure		FL	*p*	
				1	2	1	2			
Healthy attachment relationship	Item 3	3.98 ± 0.75	.59	.50	.31	.49	.28	.64	<.001	.81
	Item 4	3.53 ± 0.83	.39	.58	.00	.65	−.03	.48	<.001	
	Item 5	3.68 ± 0.72	.48	.62	.08	.72	.06	.61	<.001	
	Item 7	3.87 ± 0.85	.59	.60	.28	.59	.28	.64	<.001	
	Item 8	3.96 ± 0.71	.55	.61	.20	.69	.18	.58	<.001	
	Item 9	3.56 ± 0.89	.46	.49	.15	.49	.17	.67	<.001	
	Item 10	3.45 ± 0.87	.30	.31	−.07					
	Item 11	3.99 ± 0.64	.65	.65	.34	.54	.29	.66	<.001	
	Item 12	3.96 ± 0.76	.57	.49	.37					
	Item 13	3.96 ± 0.74	.65	.59	.37					
	Item 14	4.07 ± 0.71	.71	.55	.50					
	Item 15	4.13 ± 0.73	.69	.55	.48					
	Item 16	3.95 ± 0.80	.65	.55	.45					
	Item 19	3.58 ± 0.76	.39	.36	.22					
Patience and tolerance	Item 1	3.68 ± 0.87	.58	.10	.81	.11	.84	.80	<.001	.65
	Item 2	3.85 ± 0.9	.60	.13	.81	.18	.79	.68	<.001	
	Item 6	3.70 ± 0.98	.56	.18	.70	.19	.72	.43	<.001	
	Item 17	3.65 ± 1.00	.50	.11	.68	.16	.64	.30	<.001	
	Item 18	3.05 ± 0.97	.31	.12	.35					
	Eigenvalue (%)			34.09	7.78	35.40	12.84			
	Cumulative (%)			34.09	41.88	35.40	48.24			

Note. CFA = confirmatory factor analysis; CR = composite reliability; EFA = explanatory factor analysis; FL = standardized factor loading; ITC = item-total correlation; K-PPAS = Korean version of Paternal Postnatal Attachment Scale; SD = standard deviation.

48.2% of the total variance, having a similar result to the PPAS [22] that accounted for 45% of the total variance, and meeting the total variance criteria of 40-60% [39,43]. The percentages of the variance explained by each factor are presented in Table 2. Factor 1 was labeled "healthy attachment relationship (HAR)" (items 3, 4, 5, 7, 8, 9, and 11) and factor 2 was labeled "PT"' (item 1, 2, 6, and 17). Factor loadings of all the 11 items ranged from .49 to .84, with each factor consisting of more than three items (Table 2).

Based on the result of the EFA, the assumption of multivariate normality was tested by calculating Mardia's coefficient of multivariate kurtosis before conducting maximum likelihood estimation for CFA. The value of Mardia's coefficient multivariate kurtosis and the critical ratio was 110.91 and 47.07, which was greater than the threshold criteria of the multivariate kurtosis <5 and critical ratio <1.96 [44]. Thus, multivariate normality was not met, and the Bollen-Stine bootstrap [45] method using recommended 250 bootstrap samples was applied [46]. The initial fit indices of the two-factor structure were Bollen-Stine bootstrap $p = .056$, $\chi 2/df = 2.85$, CFI = .87, TLI = .83, RMSEA = .10, and SRMR = .07. The initial model showed a poor fit to the data with CFI, TLI, RMSEA, and SRMR not meeting the criteria for good fit indices [39,40]. The modification index (MI) values were inspected, and the covariance modification between error terms could significantly improve the initial model fit. The MI values of 3.84 or above suggested a need for model improvement [39]; however, a threshold of 10 was used for greater efficiency [44]. After considering the items' content and MI values, the initial model was revised by setting the covariance of the error term to item 6 and 17 (MI = 30.41), and the fit indices of the new model were Bollen-Stine bootstrap $p = .291$, $\chi 2/df = 2.12$, CFI = .92, TLI = .89, RMSEA = .07, and SRMR = .06. This model fit was improved than the initial model, but TLI of .89 still suggested a poor fit. The covariance of the error term was additionally set to items 4 and 5 (MI = 10.20), and the fit indices of the revised model were Bollen-Stine bootstrap $p = .422$, $\chi 2/df = 1.94$, CFI = .94, TLI = .92, RMSEA = .07, and SRMR = .06 (Table 3). The difference in the CFI value between model 1 and model 2 indicates a substantial improvement in the model fit. Additionally, the final model showed a better model fit than model 2 [35]. The fit indices of this revised model were improved substantially compared with the initial model by having all the criteria met for fit indices: $\chi 2/df \leq 3$; CFI and TLI ≥.90, RMSEA ≤.08, and SRMR ≤.06 [39,40]. The final model was confirmed (Figure 1). As shown in Table 2, the standardized factor loadings of all the 11 items in the final model ranged from .30 to .80, with all factor loading coefficients reaching significance ($p < .001$). In terms of the rule of thumb, a standardized factor loading >.50 is ideal in CFA. However, the results were considered acceptable and in agreement given that each loading coefficient was statistically significant ($p < .001$) and had a minimum value of .30 [39]. In addition, the revised model revealed to have adequate convergent validity for each construct in the model with the CR values of the two factors as .81 and .65 (Table 2), meeting the criterion of CR > .60 [41]. Discriminant validity was also supported by the heterotrait–monotrait ratio of .66, meeting the criterion of < .85 [42].

Table 3 *Goodness of Model Fit Indices of the K-PPAS (N = 206).*

Modified model	Bollen-Stine bootstrap (p)	Absolute fit index			Incremental fit index		
		$\chi 2/df$	RMSEA	SRMR	CFI	Difference value of CFI	TLI
1	.056	2.85	.10	.07	.87		.83
2	.291	2.12	.07	.06	.92	.05	.89
Final	.422	1.94	.07	.06	.94	.02	.92

Note. $\chi 2/df$ = chi-square minimum/degree of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standard root mean residual; TLI = Tucker-Lewis index.

Discriminant Validity (known groups)

The results of the discriminant validity using known groups are shown in Table 4. The group of fathers with no postnatal depression (K-EPDS <10) scored significantly higher on the K-PPAS ($t = -9.97$, $p < .001$) than those who did (K-EPDS ≥10). Similar significances were found in the subscales of the K-PPAS, with HAR ($t = -12.01$, $p < .001$) and PT ($t = -5.77$, $p < .001$) scoring higher in a group with the absence of postnatal depression.

Reliability

Cronbach's α coefficient for 11 items of the K-PPAS was .84, with .81 and .85 for the subscales of HAR and PT, respectively. The McDonald's omega coefficient for the scale was .83 and for the subscales of HAR and PT was .81 and .85. An acceptable internal consistency of the K-PPAS was demonstrated with the result of all coefficient values above .70.

Discussion

In this study, the PPAS was culturally adapted into Korean and had its psychometric properties evaluated among 396 Korean fathers with infants up to 12 months old. The results revealed that the 11-item K-PPAS had acceptable validity and reliability to assess the construct of father-infant attachment in Korea. The use of this tool may contribute to gaining knowledge and supporting further studies on father-infant attachment to bring about positive outcomes in an infant's later development.

The two-factor structure of 11-item K-PPAS was identified by conducting factor analysis: healthy attachment relationship, and patience and tolerance. This result was not consistent with the three-factor structure of the original PPAS ("patience and tolerance", "pleasure in interaction", and "affection and pride") [22], as well as the 15-item Spanish [26] and 18-item Turkish [28]. On the other hand, compared to the three-factor, the findings in this study were similar to the two-factor structure in the 16-item Portuguese version ("quality of attachment" and "patience and tolerance") [27]. One of the reasons for these differences in the factor structure may be due to not performing CFA in the original study to support its structure and items [26]. The absence of CFA may leave how well the proposed factor structure fits with observed data unexplored [32]. However, cultural differences may have also influenced the inequivalent number of factors and item placements. Therefore, it is advised to use the K-PPAS after careful consideration.

One strength of this study is that both EFA and CFA were performed to validate the factor structure among 396 fathers with infants, who were randomly divided into two data, one for EFA and the other for CFA. The results showed a total of 11 items after removing 8 items (10, 12, 13, 14, 15, 16, 18, and 19) from the original 19-item PPAS. Consistent with this study by conducting both factor analyses, the Spanish version had 4 items (6, 8, 9, and 15) and the Turkish version had 1 item (16) omitted. Although item deletion happened in all studies above, it was incomparable with the findings of this study as the cultural context was not dealt with as one of its reasons. In contrast, the cultural context was dealt with as having contributed to all 8 item deletions in this study as low parental responsibilities were observed in Korean fathers, who believe that being involved in childrearing is important but still perceive themselves to be in assisting roles in childrearing [47]. The Confucian culture, which has deeply rooted in the Korean society, influenced a physical and psychological gap to form between the Korean

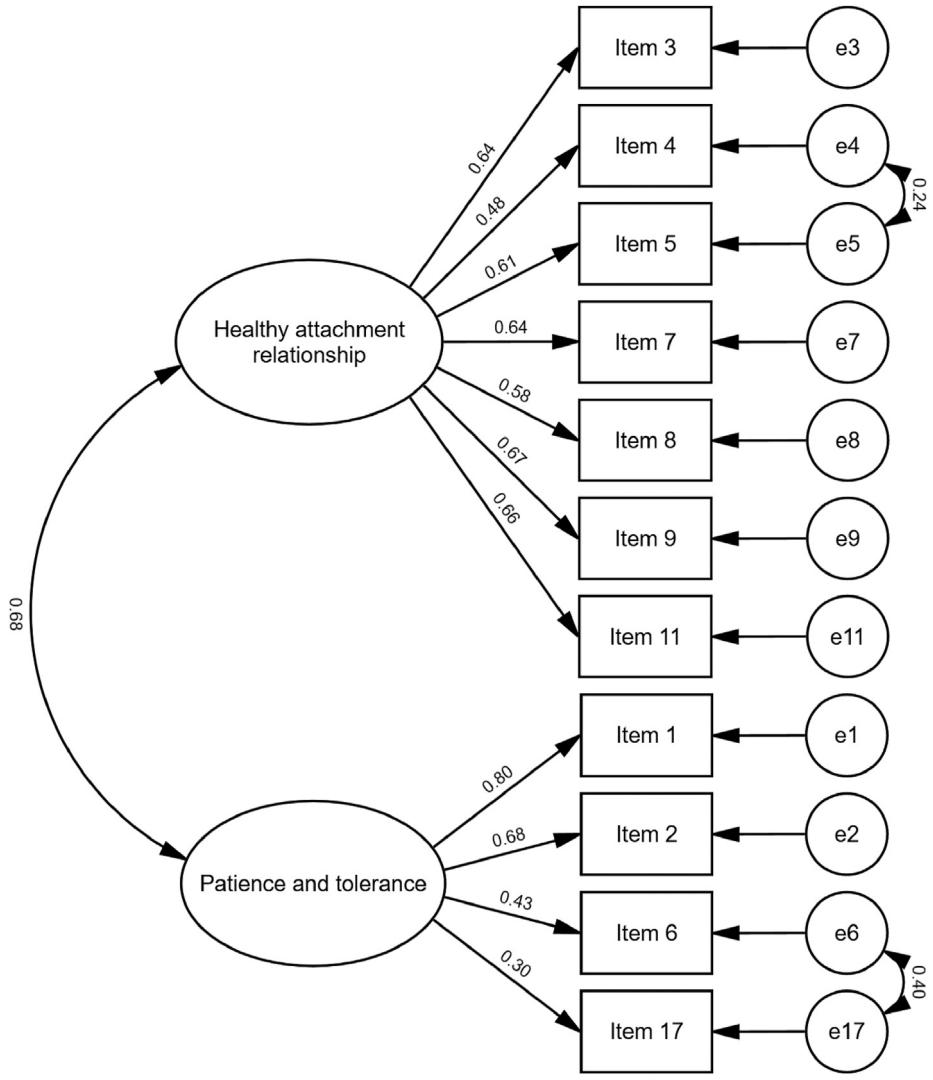

Figure 1. Confirmatory Factor Analysis of the Korean Version of the Paternal Postnatal Attachment Scale.

men and women [48]. This has typically made Korean fathers to be the financial providers of their families and lacked opportunities to be involved with their children [49]. Likewise, with a majority of Korean fathers in this study holding a job, conflict in the work-life balance may have also influenced responses to be inconsistent with these items. Therefore, characteristics such as being apart from one's infant (item 10, 12, and 14), balancing time spent on one's infant and for oneself (item 13 and 18), feeling affectionate (item 15), accepting the infant as one's own (item 16), and being patient (item 19) may have differed from the study's participants.

The K-PPAS has two subscales of "HAR (7 items)" and "PT (4 items)", which differed from the original PPAS consisting of three subscales: "PT (8 items)", "pleasure in interaction (7 items)", and "affection and pride (4 items)". The "HAR" subscale is a combination of items from the "pleasure in interaction" and "affection and pride" subscales of the original PPAS and contains similar items of the "quality of attachment" and "quality of bonding" from the Portuguese and Spanish versions, respectively. While these translated versions focus on the aspect of "quality", the K-PPAS emphasizes the "healthy" part of attachment, the quality, and nature of

Table 4 *Known Group Validity of the K-PPAS with K-EPDS (N = 396).*

Factors	Known group Validity Mean (SD)		t(*p*)	Cohen's *d*
	Normal group (K-EPDS <10)	Depressed group (K-EPDS ≥10)		
Healthy attachment relationship	16.57 (2.09)	13.00 (3.18)	−12.01 (<.001)	1.40
Patience and tolerance	28.13 (3.88)	25.65 (4.50)	−5.77 (<.001)	0.60
K-PPAS	76.64 (8.46)	67.3 (9.69)	−9.97 (<.001)	1.04

Note. K-EPDS = Korean version of Edinburgh Postnatal Depression Scale; K-PPAS = Korean version of Paternal Postnatal Attachment Scale; SD = standard deviation.

the actual relationship between the parent and infant that is formed from repetitive nurturing behaviors involving interaction and affectionate touches [50]. These characteristics of a healthy attachment relationship between the father and infant include being attentive to the infant's needs with warmth and care and having conversational interactions and positive attitudes [51]. Likewise, item 8 ("I try to involve myself as much as possible in childrearing"), included only in the K-PPAS, captures the aspect of a healthy attachment relationship representing a father's active involvement with his infant. This demonstrated the difference between the two translated versions' subscales and the "HAR" of the K-PPAS, as not only this subscale assesses the father's capability of childrearing but also their will to maintain healthier attachment relationships with their infants.

The second subscale of the K-PPAS represents the degree of PT that fathers have when interacting with their infants [22]. The 4 items (1, 2, 6, and 17) of this subscale were in correspondence to the "patience and tolerance" subscale of the original PPAS, the Turkish, and Portuguese versions. This may suggest that "PT" represents a common quality among fathers despite cultural differences. Fathers' high level of PT to infants help them become more engaged as a father and cope with difficult situations in parenting [52], which in turn may promote father-infant attachment. The cultural context of low parental responsibilities in Korean fathers [47] and having low paid paternity leave [53] may have contributed to low factor loading on item 17, as some fathers may not be involved enough with their children to feel like they have given up on things. However, item 17 was retained for the importance it would have in the near future as the current trend of Korean fathers' involvement in childrearing [7] and more paid leave entitlements being available for fathers [53] may affect perceptions and parenting practices among Korean fathers.

Moreover, the discriminant validity using known groups demonstrated that discrimination existed between nondepressed and postnatal depressed fathers in relation to attachment formed with their infants. The finding was similar to the systematic review examining the use and performance of father-child relationship tools [34], in which nondepressed fathers formed a higher level of attachment with their infants than depressed fathers. Fathers with postnatal depression are shown to have more withdrawn parental behaviors and are less involved in interacting with their infants [54]. Hence, this may suggest that further studies are in need to interpret this occurrence of depressed fathers during the postnatal period in association with the attachment towards their infants.

The present study had some limitations. First, the K-PPAS was culturally adapted by applying a 5-point Likert scale to all items of the original PPAS, which is from a 2- to 5-point Likert scale. This resulted in difficulty in comparing this study's findings with other studies due to items' response options all being modified. Second, test-retest reliability to investigate the internal consistency of the K-PPAS was unable to be performed because online surveys have difficulty in gathering the same participants. Thirdly, an online survey has made it difficult to examine any physical, psychological, and social problems in fathers and infants that could interrupt the formation of father-infant attachment prior to the study. Future research should consider this in the exclusion criteria. Lastly, other influences including cultural differences may be suggested as the reason behind the inconsistency of the number of factors between the K-PPAS, the original, and the other translated versions. Hence, future studies should be performed to further examine the psychometric properties and application of the K-PPAS in a broader Korean population considering the various family structures and cultural diversity that exist within the Korean population.

Conclusion

The 11-item K-PPAS adapted from the original PPAS for the assessment of the father-infant attachment in the postnatal period consists of two aspects: "healthy attachment relationship" and "patience and tolerance". However, inconsistencies in the structure compared to the original scale could have occurred with cultural differences, and thus, it is recommended to carefully consider all the necessary aspects when using the K-PPAS in the Korean population.

Conflicts of interest

There are no conflicts of interest and ethical adherence of this manuscript, and the authorship belongs to Yookyung CHOI and Suk-Sun KIM.

Ethical approval

The study was approved by the Institutional Review Board of Ewha Womans University (ewha-202203-0045-01). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

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