The Factor Structure of Knowledge of Infant Development Inventory-Arabic Version

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Abstract

The Knowledge of Infant Development Inventory (KIDI) has been culturally adapted and translated for use with populations worldwide. This study aimed to (a) test the hypothesis of the unidimensionality of the Arabic KIDI, (b) report its internal consistency, and (c) compare the differences between participants' means and variances on the latent variable, parental knowledge of child development. Two groups of participants (n = 2,195) completed the KIDI: mothers of typically developing children ($Group_1$, n_1 = 1,369) and children with disabilities ($Group_2$, n_2 = 826). The results showed that the Arabic KIDI had a unidimensional factor structure (i.e., parental knowledge) in the two groups, with a higher single-factor model (i.e., governorates of residence). The results of the two-level factor model were associated with tenable goodness-of-fit indices. The Cronbach's alpha coefficient was adequate in each group: $Group_1$: α =.79, with a 95% confidence interval of [.77,.80], and $Group_2$: α = .85, with a 95% confidence interval of [.83,.87]. In addition, $Group_1$ had a higher mean than $Group_2$ on the studied underlying dimension, while $Group_1$ had a significantly lower variance than $Group_2$. The study findings implied that parental knowledge may differ due to children's disability status and place of residency. Additionally, the findings highlighted the possibility of assessing overall parental knowledge with the Arabic KIDI.

Keywords: parental knowledge, knowledge of infant development inventory (KIDI), factorial structure, two-group single-factor model, unidimensionality, Kuwait

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Parental Knowledge of Infant Development

Numerous literature associates parenting style and parental knowledge with positive early childhood developmental outcomes (September et al., 2016). Parenting styles consist of several components to create an emotional climate for sharing parents' child-rearing attitudes and practices with their children (Dalimonte-Merckling & Williams, 2020). Parental knowledge is a theoretical construct thought to influence parenting style and includes the following components: (a) parents' approaches to fulfilling the developmental needs of their children, (b) parents' understanding of normative child developmental milestones, and (c) parents' awareness of practices to maintain and promote children's health, safety, and effective coping with illness (e.g., Bornstein et al., 2020; MacPhee, 2002). As humans grow up in families and communities, several health and socio-economic issues may be traced back to early childhood development ([ECD], Cummins & McMaster, 2006; September et al., 2016). For instance, some studies have linked obesity, heart disease, diabetes, learning disabilities, and criminality with ECD (e.g., Irwin et al., 2007; Robinson et al., 2017). For these reasons, international organizations, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), have raised awareness of positive parenting styles and the importance of parental knowledge of ECD (September et al., 2016).

Several organizations, including the CDC, have established campaigns to raise parental knowledge of child developmental milestones. For instance, the CDC launched a campaign called "Learn the Sign. Act Early" (LTSAE) to improve developmental milestone understanding and raise awareness of early signs of developmental delays among parents of young children. Raspa et al. (2015) investigated parents' feelings about the LTSAE materials and healthcare providers. The parents of young children with developmental delays discussed two types of healthcare providers: (a) proactive and (b) wait-and-see healthcare providers. Proactive healthcare providers tended to ask about children's development, referring to screening and evaluation, while wait-and-see healthcare providers waited until clear signs of disability manifested themselves prior to acting. This wait-and-see approach may delay the provision of appropriate services to children. Therefore, parents should be aware of early signs of developmental delay or disability and proactively share any concerns with healthcare providers, rather than exclusively waiting for healthcare providers to initiate such discussions. In Raspa's study, parents reported uncertainty about how to act early and why to act if a child showed signs of delay. Thus, increasing awareness of ECD among parents may well contribute to positive outcomes in children's lives and early identification of developmental delays.

Prior research conducted across diverse countries and cultures has suggested that mothers and fathers tend to differ in parenting practices and knowledge of developmental milestones (e.g., Choi, Palmer, & Pyun, 2012; Padilla & Ryan, 2019). In the United States (McBride & Mills, 1993) and Australia (Craig, 2006), researchers found that mothers spent more time with children and were more engaged in parenting than fathers. Similar findings were also reported in studies conducted in predominantly Islamic countries such as Pakistan (O'Donnell et al., 2022) and Qatar (Al-Maadadi & Ikhlef, 2015). Taken collectively, these findings suggest that, on average, mothers and fathers contribute differently to child-rearing and therefore may have differing perspectives on ECD.

Providing educational programs in developmental milestones for parents and healthcare providers may promote the early identification of children at risk of developmental delays (e.g., Alkherainej & Squires, 2016; Barbaro et al., 2011; Hix-Small & Alkherainej, 2017). For instance, a non-masked cluster randomized control trial of 18 communities and 995 children in China found that the provision of eight months of ECD training to parents was associated with a significant positive effect on parenting practices that supported the early identification of children at risk of developmental delay (Li et al., 2022). Additionally, in their study of healthcare providers in Kuwait (i.e., general practitioners, pediatricians, and family doctors), Hix-Small and Alkherainej (2017) found that less than one-third of the 398 healthcare providers surveyed used developmental screening instruments as part of their practice, with many prioritizing discussions with parents about topics such as childhood immunizations over child screening. The study also found that provider confidence and prior training in using developmental screening instruments predicted which healthcare providers used such instruments. Evaluating the efficacy of educational programs designed to improve parental or healthcare provider knowledge of childhood developmental milestones requires the use of valid and reliable measures. One such measure, the Knowledge of Infant Development Inventory ([KIDI], MacPhee, 2002), has been widely used across countries and cultures to assess parent and caregiver ECD knowledge (e.g., Bornstein et al., 2020; Nobre-Lima et al., 2014).

The Development of the KIDI

The KIDI is a criterion-referenced questionnaire comprising 58 items (MacPhee, 2002). The KIDI was developed to assess the evidence-based knowledge of parental practices that pediatricians believe parents should know (Bornstein et al., 2020). The items of this instrument target the following areas: (a) infant health and safety guidelines, (b) developmental processes, (c) child developmental milestones from 0 to 3½ years, and (d) parental practices. Of the 58 items, 1-39 ask respondents to indicate whether

they *agree*, *disagree*, or are *unsure* about a series of statements. The remaining 19 items (i.e., 40–58) consist of statements regarding the age at which a child should achieve a series of developmental milestones and ask respondents to choose from four responses; *agree*, *younger*, *older*, or *unsure*. According to MacPhee (2002), the scoring of the KIDI produces attempted, accurate, underestimated, and overestimated responses. The accuracy of responses results from selecting the correct answers to KIDI items, while the attempted responses result from selecting the not sure response to the KIDI items. Regarding the underestimated and over-estimated responses, these results relate to items 40-58, which reflect the wrong answers for age-appropriate demands for children. MacPhee (2002) reported an estimated Cronbach's Alpha of 0.88 for the internal consistency of the KIDI, 0.92 for the test-retest reliability, and 0.85 for the split-half reliability.

The KIDI has been used over the past four decades for three primary purposes. First, the questionnaire has been used to determine baseline parental knowledge to aid in the development of childcare-focused educational programs. Second, the KIDI has been used as a measure of parental knowledge of child development in studies of parental interactions with their children. Third, the questionnaire has been used to study influences on parental knowledge, such as individual characteristics (e.g., education level, number of children), culture, and group membership (Bornstein et al., 2020; MacPhee, 2002).

Cultural Adaptations and Psychometrics of KIDI

Cross-cultural research is essential to test the generalizability of constructs such as knowledge of ECD. To aid such research, measures with evidence of sufficient validity and reliability are often adapted and translated across cultures. Though originally developed for use with English-speaking populations in the U.S.A., the KIDI has subsequently been adapted for use with diverse populations in countries across the world. For example, Bornstein et al. (2020), in their cross-cultural study of mothers' parenting knowledge across five societies, culturally adapted and translated

the KIDI for use in Argentina, Belgium, Italy, and South Korea. Nobre-Lima et al. (2014) and Li et al. (2022) adapted and translated the KIDI for use in Portugal and China, respectively. Additionally, the KIDI has previously been translated to Arabic to assess parental knowledge of ECD in the Middle Eastern countries of Qatar, Jordan, and Saudi Arabia; however, to the best of our knowledge, the KIDI has never been culturally adapted for use in Kuwait (Al Maadadi et al., 2014; Habbash et al., 2022; Safadi et al., 2015). Although the KIDI has been widely translated and culturally adapted for use in a variety of populations, details regarding the changes to specific items of the questionnaire have typically been unreported. Researchers have recommended that any changes or adaptations made to items, including any problems in the adaptation process (e.g., pluralization, verb tense), should be reported in publications to allow journal readers and reviewers to better interpret cross-cultural findings (Hambleton, 2005; van Widenfelt et al., 2005).

Research Problem and Goals

Given the cultural adaptation and translations of the KIDI, there is a noticeable lack of studies investigating its psychometric properties. Our literature search across databases such as PsycINFO, Eric, and Academic Search Premier identified only a few studies focusing on the psychometric properties of the KIDI in the Western cultures. Moreover, information is scarce in the international literature concerning the nested nature of KIDI data, its unidimensionality, construct validity, the extent of missing data, and the cutoff scores for the KIDI. Additionally, it has been observed that international studies utilizing the KIDI often had small sample sizes (i.e., between 200 and 400 participants), potentially undermining the strength of these findings due to small statistical power (e.g., Finch, 2020; Lee, Cai, & MacCallum, 2012). Previous KIDI studies could have enhanced their findings by investigating the potential clustering effect variables; the units of analysis were clustered or aggregated in higher-level variables such as districts, treatment clinical centers, or companies(RayKov & Marcoulides, 2018).

Specifically, KIDI literature did not include analyses of a two-level model, which acknowledges the relations between higher-level variables (e.g., socio-economic status [SES], neighborhood) and parents' responses to the KIDI items. In other words, mothers' knowledge of child development assessed by the KIDI items might be influenced by several variables, such as their children's living districts, SES, nursery programs, or treatment clinic centers. Therefore, there is a need for investigating the differences between mothers of typically developing children and those with disabilities considering the governorate variable, which is associated with families' SES variable.

The main purpose of this study was to investigate the psychometric properties of the Arabic KIDI with the considerations of clustering effect variables such as governorates of residency. Although most of these studies on parental knowledge were conducted in Western societies using assessment instruments such as the Knowledge of Infant Development Inventory (KIDI), a paucity of studies and information about parental knowledge in Middle Eastern societies still exists. Thus, our study was a first-step project aiming to answer the following research questions: (a) Was the KIDI represented by a unidimensional domain? (b) Were there differences between the responses of mothers of typically developing children and those of disability on the KIDI items? And (c) What were the reliability coefficients of the KIDI for mothers of typically developing children and those with disability?

Methods

Participants

The participants were Kuwaiti mothers of typically developing children and of children with disabilities whose children were receiving special education services during the study. Participants were recruited from three locations across Kuwait: (a) well-baby clinics, (b) nurseries for typically developing children, and (c) nurseries for children with special needs. Well-baby clinics were available in primary healthcare centers, and they were run by board-certified family physicians who held their clinics once per week.

These clinics accept children aged zero to 5.5 years, and families were advised to bring their children to the clinic if they were not sick. Family medicine specialists usually evaluate growth charts and assess the overall health of children. Nursery programs are available in the private sector and are not under the supervision of the Ministry of Education. These nursery programs accept children aged from 6 months to 6 years. However, the nurseries for children with disabilities follow the rules and regulations of the Public Authority of People with Disabilities in the State of Kuwait. The staff of these nursery programs must receive special educational training. At the time of data collection, the children with disabilities, whose mothers participated in this study, had been formally diagnosed and had been receiving services for their disabilities form the Kuwaiti government. In this study, the disability categories were multiple health disabilities, hearing impairment, visual impairment, autism spectrum disorder, orthopedic impairment, intellectual disability, and developmental delay. Of 825 participating mothers, 170 (20.60%) had children with developmental delays, 64 (7.75%) with visual impairment, 76 (9.21%) with hearing impairment, 74 (8.96%) with multiple health disabilities, 122 (14.78%) with orthopedic impairment, 142 (17.21%) with autism spectrum disorder, and 177 (21.45%) with intellectual disability. Table 1 presents the demographic characteristics of the study participants.

Procedures

The research ethics committee of the Ministry of Health approved the study protocol for collecting data from well-baby clinics in primary healthcare centers. The owners of the nursery programs approved the study protocol. Nursery programs are not part of the government-run public education system in Kuwait; rather, they are individual owners' private businesses. Approval from the Ministry of Health helped expedite the review process of the nursery programs, which approved the implementation of the study in their settings.

A paper-and-pencil method was used to collect data from the participants in the study. The data were thereby collected from six

Kuwaiti governorates. A meeting was held with the heads of each primary healthcare center and nursery program. A file, including the study consent form and instruments, was handed to the heads of these settings, and explanations of the study purposes and data collection were provided. The heads of primary healthcare centers forwarded the files to professionals in well-baby clinics, whowere asked to return the collected data within two months. The owners of the nursery programs were provided with duplicate files and explanations, and they were asked to forward these files to the children's parents. The parents were asked to participate voluntarily in the study. Parents were requested to return the completed file to their children's nursery programs within two weeks. Data collection was completed within four months. No incentives were offered to the participants for completing the study instruments.

All data were manually entered into an Excel spreadsheet. The collected data files contained a sample size of n = 2,195 mothers. Using IBM SPSS version 29, descriptive statistics, including frequency tables,central tendency measures, and boxplots were used to screen the data for outliers. The dataset was also screened for missing data and to test whether data were missing at random. Results of the analyses identified no outlying data values, with a range of 0.4% to 2.3% missing values for the studied variables. Furthermore, a t-test of mean differences was not executed with the SPSS due to the low values of missing data in the dataset. Thus, we concluded that the missing data was missing completely at random because missing data in any variable was not explained by other variables (e.g., Allison, 2002; Enders, 2010). With the percentage of missing data being minimal, the missing data were coded using the flag "-999" in the resulting study data file. Note that throughout this study we used all 58 items of the KIDI instrument as part of our reported analyses.

Given that the data entry was manual, we randomly selected 30% of the whole dataset to check for data entry accuracy. With this recruited random sample of our dataset, The accuracy of data entry

was 100%. All Excel spreadsheet data were converted into IBM SPSS version 29 and Stata version 18.

Instruments

The Arabic version of the KIDI. The first author translated the KIDI into Arabic and adapted it to Kuwaiti culture. The Arabic version went through the following steps: (a) forward translations from English into Arabic by the first author, (b) back translation into English by two bilingual speakers, and (c) a review panel consisting of four bilingual speakers ensured the reading clarity and cultural appropriateness of Arabic items. For instance, some English KIDI items include vocabulary that is non-existent in Arabic, such as the plural form of foot (i.e., feet). To find the equivalence of these words, the first author sought common incorrect plural forms among children in Kuwait. For these items, the first author used the word "toy," which the Kuwaiti children often pluralize incorrectly. Specifically, Item 3 was adapted to include the incorrect plural form of toys commonly used by children in Kuwait. The second item adaptation included item 17; the English version of this item included the name of a pharmaceutical product called Ritalin. The Arabic form explains that Ritalin is a medicine used for patients, such as children with ADHD. This explanation was added to clarify this medicine's use and avoid the assumption that Ritalin is a known medication. The third cultural adaptation included Item 25, stating "If babies are fed cow's milk, they need extra vitamins and iron." As babies may be provided with other milk sources, such as goat's milk, the first author mentioned other milk sources (i.e., goat's milk). The fourth adaptation was carried out for Item 31. In it, the brand-named product *Pedialyte* was modified by finding a common concept familiar to Kuwaitis: baby pharmaceutical nourishing drinks, which are sold by pharmacies to treat dehydration. The fifth adaptation was in item 54; an explanation for the concept of babbling was added to clarify that babbling is a two-consonant sound such as "bub." This clarification was necessary because of the likelihood of mixing-up babbling with cooing. Finally, the English version of the KIDI response scale was retained.

Two bilingual translators participated in the translation process. One translated the Arabic KIDI form into English, and the second translated the first translator's work into Arabic. Both translators worked separately, without any connection. Additionally, the name KIDI was not provided to the translators to ensure the trustworthiness of the translations. A comparison was conducted between the two forms of the participating translators, and an agreement of 100% was reached between these forms in terms of general meaning. Slight differences in vocabulary that shared the same general meaning, such as use of the word defecating versus passing stool were ignored when calculating total agreement. The Arabic KIDI form was then sent to a panel of bilingual reviewers with MA and PhD degrees in education and psychology. They evaluated the Arabic form regarding language clarity and cultural appropriateness of the items. All 58 items were included, with none omitted. There was also 100% agreement among the reviewers regarding the cultural appropriateness of the items, and the reviewers suggested minor grammatical corrections for some items. The final Arabic version was created after implementing their comments. The review panel reported whether the Arabic version of the KIDI was appropriate for parents to understand. The review panel indicated in their answers that the KIDI was free of scientific terminology, except for item 17, and that this modification was appropriate for readers. Moreover, the review panel believed that parents might understand the items of the Arabic KIDI because they were written without scientific terminology and with formal Arabic words.

Sociodemographic factors and supports checklists. A 24-item checklist was sorted and adapted from several sociodemographic checklists (e.g., Bornstein et al., 2020). Of the 24 items, 13 had a closed-ended format, which assessed participants' educational level, childbirth conditions (premature or mature), types of mothers' delivery (cesarean section or normal), number of visits to well-baby clinics, child health conditions, and lists of people who provided support to their children. The open-ended items required parents to

provide written information regarding their ages, children's weights, categories of children's disabilities, mothers' occupations, names of training parenting courses, sources of information for rearing their children, number of children in the family, number of hours children spend with nannies, and the educational level of nannies.

Data Analysis

Frequency counts for each item were conducted to indicate the percentage of missing data. The missing data on the 58 items were less than 5%, and the mothers with missing values were excluded from these univariate analyses because they did not provide relevant information for these single-item-based analyses (Dong & Peng, 2013). Therefore, as recommended in the literature, no further missing data procedures (e.g., multiple imputations or full maximum likelihood) were applied to estimate these missing values (Dong & Peng, 2013).

To test the homogeneity of our sample and determine if all participants belonged to the same population, we used the Benjamin-Hochberg multiple testing procedures to evaluate multiple null hypotheses simultaneously. We tested for differences between mothers of typically developing children and mothers of children with disabilities on each item of the KIDI. This approach allowed for the determination of whether each group belonged to the same population. The Benjamin-Hochberg procedure was chosen over other multiple testing methods like Bonferroni because it is based on the false discovery rate (FDR), which controls the familywise error rate and has more statistical power (RayKov & Marcoulides, 2018).

To test the factor structure of the KIDI, a two-level confirmatory factor analysis was used to test the hypothesis of unidimensionality. The variable governorates of residence was used as a clustering effect variable and was modeled as a level-1 factor. The level-2 latent variable was parental knowledge of child development, which was modeled using all 58 items of the KIDI. Owing to the categorical nature of the data, the weighted least square mean and variance adjusted (WLSMV) estimator was used (Muthén &

Muthén, 2023). The means and variances of the two groups on the latent variable (i.e., parental knowledge of infant development) were also compared.

Finally, as recommended by the American Psychological Association (Bonnet & Wright, 2015), we calculated the internal consistency of the KIDI and reported its confidence interval. To accomplish our analytic and modeling aims, four software programs were used: (a) SPSS, (b) R-Studio, (c) Mplus, and (d) Stata.

Results

As previously noted, the present study included a total of 2,195 participants. Using the IBM SPSS version 29, the participant sample was composed of mothers of typically developing children (n = 1,369) and children with disabilities (n = 826). Data were collected from several location sources using the paper-and-pencil method. These were nurseries and preschool programs for children with disabilities and for typically developing children in the six governorates in Kuwait. The study participants were mothers only. Table 1 shows their demographic characteristics. As seen from Table 1, statistically significant differences were observed between mothers of typically developing children and those of children with disabilities in variables such as age, education, children born prematurely, and the number of children in the family. Specifically, mothers of typically developing children, on average, were younger, had more formal education (i.e., higher degree attainment), were less likely to have reported having a child born prematurely, and had fewer children than mothers of children with disabilities.

As a next step, we used the Benjamini-Hochberg multiple testing procedure to examine any possible differences between the groups of mothers of typically developing children and mothers of children with disabilities, on each of the KIDI items. The rationale for these analyses was to test whether the two samples came from the same overall population of Kuwaiti mothers or from different subpopulations, while accounting for clustering effects due to where the mothers lived (i.e., governorates). The results showed that the groups were statistically different on 8 out of 58 items (with

pertinent *p*-values, <.001). These results imply that the two groups of mother participants differed significantly on these items.

Unidimensionality of the KIDI

To determine whether the KIDI-Arabic version had only one underlying dimension, i.e., a single common factor, a categorical confirmatory factor analysis (CFA) was performed with Mplus. This CFA was carried out separately on the group of mothers of children with disabilities, and on the group of mothers of typically developing children, using version 8.4 of the Mplus software. For mothers of children with disabilities, the goodness of fit indices of this one-factor CFA model indicated a tenable model and were as follows: χ^2 (1595, n = 826) = 1714.055, p <.05, RMSEA = 0.01, CFI = 0.90, TLI = 0.90, and SRMR = 0.06. All 58 items significantly loaded on this factor (p <.05). The loadings ranged from 1.00 to 3.15. The R^2 values ranged from 0.02 to 0.28. The factor variance was 0.028, with pertinent $p < 0.05$, indicating significant individual differences among the mothers of children with disabilities with respect to their level of parental knowledge.

The categorical CFA for the KIDI items of mothers of typically developing children also showed a plausible fit of the single-factor model, and the latter was associated with the following tenable model goodness of fit indices: χ^2 (1595, n = 1364) = 1875.096, $p <$ 0.05, RMSEA = 0.01, CFI =.90, TLI =.90, and SRMR = 0.06. Each of the 58 items had positive, statistically significant loadings on the underlying factor ($p < 0.05$). Factor loadings ranged from 0.99 to 1.82, with R^2 values ranging from 0.04 to 0.22. The factor variance was 0.057, with pertinent $p < 0.05$, thus also indicating significant individual differences between the mothers of typically developing children with respect to their level of parental knowledge. In either group, the modification indices did not indicate a possible further improvement in model fit.

The Internal Consistency of the KIDI

We evaluated the internal consistency of the KIDI instrument in each of the two groups using Cronbach's alpha (α). The Stata software version 18 was used to estimate α, while accounting for

clustering effects due to governorate, and to obtain a bootstrap confidence interval for coefficient alpha using 5,000 bootstrap resamples with replacement, within each group. The results showed that the internal consistency values for mothers of typically developing children, and for mothers of children with disabilities, were at an adequate level in each group (e.g., Nunnally & Bernstein, 1994; Taber, 2017). Specifically, for the mothers of children with disabilities, the following point and interval estimates were obtained: α =0.85, with 95%-CI of [0.83, 0.87]. For the mothers of typically developing children, the following estimates were obtained: α = 0.79, with 95%-CI [0.77, 0.80].

Group performance on the KIDI

Next, we compared the parental knowledge trait means and variances of mothers of children with disabilities with those of mothers of typically developing children. This two-group single-factor model was based on our above findings of a tenable one-factor model within each of the two groups for the KIDI instrument. To enable latent group comparisons, we used a two-group model with all factor loadings and item thresholds set equal across groups (e.g., Millsap, 2011; Raykov, 2012). The results of goodness of fit indices associated with plausiblefit : χ^2 (3323, n = 2188) = 3917.81, $p < 0.05$, RMSEA = 0.01, CFI =0.90, TLI =0.90, and SRMR = 0.06. To identify the model, we constrained the mean of the mothers of children with disabilities to zero and their variance to 1.00 (Millsap, 2011; Muthén & Muthén, 2023). The results showed that mothers of typically developing children had a significantly higher mean (estimated group mean = 0.042, 95%-CI [0.286, 0.339]) than that of mothers of children with disabilities for the KIDI latent variable, which as mentioned was fixed to 0. However, the variance in parental knowledge in the group of mothers of typically developing children was significantly lower (estimated variance = 0.518, 95%-CI [0.684, 0.720]) than the variance in the group of mothers of children with disabilities, which was fixed at 1. The results revealed that mothers of typically developing children were, on average, higher on the underlying latent variable. This suggests that mothers

of typically developing children have, on average, a higher level of parental knowledge on child development than mothers of children with disabilities. Additionally, the findings demonstrate that mothers of children with disabilities have higher group variance than mothers of typically developing children. This result implies that there is less individual difference and variability on the parental knowledge on child development trait among mothers of typically developing children, than there are individual differences among mothers of children with disabilities. We would like to stress that the last parental knowledge related conclusions were possible due to the above-mentioned plausibility of the fitted two-group single-factor model for the entire KIDI instrument in both groups of the present study.

Discussion

The KIDI was developed as a criterion-referenced instrument to measure parental ECD knowledge. The KIDI serves several objectives, including designing educational programs to increase parents' knowledge of ECD. Although the KIDI has been used worldwide and adapted to several cultures, the interpretation of the findings of cross-cultural studies would be strengthened by reporting specific details of item adaptation and testing for clustering effects within study samples. In this study, we addressed these issues with the aim to enhance the utility of the Arabic KIDI.

We tested the unidimensionality of the Arabic KIDI following MacPhee's (2002) recommendations (i.e., to use the total score of the instrument rather than domain scores). In the present study, the hypothesis of unidimensionality was found to be tenable, and single-factor model goodness-of-fit indices supported the unidimensionality of the KIDI instrument in each of the two groups of participants (i.e., mothers of children with disabilities and mothers of typically developing children). Furthermore, the item loadings were positive and significant, ranging from 1.00 to 3.15. In this study we used all 58 items of the KIDI.

Our analyses showed statistically significant differences between the two groups on 8 out of the 58 KIDI items, while accounting for

clustering effects of governorates. Based on these findings, we tested each group's unidimensionality separately and found that the KIDI unidimensionality hypothesis was plausible in either group, whereby these eight items were not omitted from our analysis but instead kept intact and modeled along with the remaining 50 KIDI items.

Accounting for clustering effects, as in this study, has been generally recommended, especially in nationally representative studies that are likely to produce data with a nested structure (Raykov, 2023). Therefore, the present paper adds to the literature on examining the KIDI instrument by drawing attention to the fact that KIDI data may be affected by clustering effects because of demographic characteristics such as place of residence (i.e., governorate).

We named the factor underlying the KIDI instrument parental knowledge of ECD, as it may encompass several factual knowledge aspects and skills relevant for the process of raising children. The goodness of fit indices for the single-factor model when fit to our data indicated a tenable model, according to the RMSEA threshold value of 0.06 recommended by Hu and Bentler (1999). Specifically, the single-factor model was associated in our data with an RMSEA < 0.05 and SRMR < 0.07, which are values aligned with the recommendations for model plausibility (e.g., Hu & Bentler, 1999; Xia & Yang, 2019). Additionally, all item loadings were statistically significant, and the modification indices did not suggest any recommendations to improve model fit in either of the two groups. Overall, our results reveal that the interrelationships underlying all 58 KIDI items are consistent with a single underlying factor. Therefore, this finding provides empirical support for the KIDI original authors' recommendation to use the total score of the items in subsequent instrument applications and result interpretations.

Furthermore, we have found that the internal consistency of the 58 KIDI items was adequate in each group. The current study's results overlap therefore with those of studies in the U.S. and other international alpha studies. In the U.S., the KIDI's Cronbach's

alphas ranged from .61 to .89 (MacPhee, 2002). The unidimensionality of the KIDI items as evinced by our study is consistent also with the relatively high value of Cronbach's for a unidimensional scale (Hays & Coutts, 2020).

Regarding the above findings with the two-group single-factor model reported in this article, our results showed that the two groups differed in the mean level of parental knowledge of ECD. Mothers of typically developing children had a higher mean level of parental knowledge of ECD than mothers of children with disabilities. Additionally, the individual mothers' knowledge of ECD for typically developing children varied less than that knowledge level in mothers of disabled children. These results suggest that these two subpopulations of Kuwaiti mothers of young children have different mean levels of parental knowledge of ECD as well as different degrees of mothers' individual differences in this knowledge. This finding should be accounted for by KIDI users when they interpret the KIDI score in their empirical work. Finally, with respect to Cronbach's alpha, our findings showed that the KIDI items had adequate internal consistency. Cronbach's alpha was computed and reported in adherence to the guidelines of the American Psychological Association, which emphasize the importance of reporting the 95% CI and considering the nature of the data (e.g., categorical data) when reporting Cronbach's alpha (Bonnet & Wright, 2015).

Implications of the study

The KIDI is used for several purposes, including the development of educational programs for parents (MacPhee, 2002). Therefore, this instrument has been adapted to several cultures and languages; however, various details pertaining to this adaptation process of the KIDI instrument remain unclear. In particular, the assumption of universal parental knowledge for raising children may not be tenable, because the KIDI instrument addresses concepts that do not exist in other cultures, such as in the Middle East. Thus, this study adhered to the adaptation standards recommended by several organizations (Hambleton, 2005). In other words, we tried to find

cultural concepts that were appropriate to those in the original instrument, such as Pedialyte and *footses*. This adaptation might have eased some concepts presented in the Arabic KIDI and saved the main concept targeted by the original English instrument.

Parental knowledge may be taught and enhanced (e.g., Bornstein, 2020; MacPhee, 2002), but the increase in this knowledge must be measured. The unidimensionality finding for the KIDI instrument may imply some ease of comparison of parental knowledge using its total score. For instance, educational program providers may use the Arabic KIDI to measure knowledge improvement before and after a particular training program is administered. In other words, the Arabic KIDI may help evaluate the potential increase in knowledge of parents before and after the training. A universal training program may rely on several educational resources on child rearing published in English by well-known authorities such as the CDC, Mayo Clinic, and Harvard University. These resources could contribute to the enhancement of parental knowledge in the Middle East if they were translated and provided to parents.

Concurrently, our findings imply there were group differences in the Arabic KIDI items. These differences were also associated with a clustering effect variable, governorates of residence. This finding may let us think of other variables influencing parental knowledge, such as socio-economic status, educational attainment, and the number of children in a household. Furthermore, the finding may imply the need to increase the parental knowledge of mothers of disabled children. Hix-Small and Alkherainej (2017) reported that healthcare providers in Kuwait had less knowledge of child development than American healthcare providers. Hence, owing to healthcare providers' limited knowledge and use of developmental screening in Kuwait, and mothers' low parental knowledge of children with disabilities, there may be an increased likelihood of late identification of children with disabilities in Kuwait. Thus, training programs and workshops aiming to raise parental knowledge of child development may help healthcare providers identify children at risk for disability. These programs may use the

Arabic KIDI to assess the increase in parental knowledge, as this tool was developed as a criterion-norm-referenced instrument.

Study Limitations

This study had some limitations. First, the data were collected from three distinct settings: well-baby clinics, nursery programs for typically developing children, and nursery programs for disabled children. This variable was not coded, however, in the datasheet during data entry, and thus we were unable to account for these settings differences in our analyses. Second, our data might not represent other mothers' subpopulations in Kuwait. Specifically, enrolling children in nursery programs and visiting well-baby clinics are not mandatory in Kuwait. The findings of our study may have had broader generalizability if other data settings, such as maternity hospitals or online data, were included. Third, the study would have been further extended if data on fathers' ratings on the KIDI had been included as well. Finally, the use of convenience samples rather than randomly selected participants may limit the generalizability of the present study's findings to the broader population of Kuwaiti mothers.

Future studies

Further investigation of the psychometric properties of the KIDI instrument is recommended. For instance, future studies and ensuing data analyses may include the application of item response theory and modeling to identify item difficulty, and a graded response model may be used to evaluate the response scale of the Arabic version of the KIDI (e.g., Raykov & Marcoulides, 2018). Furthermore, such studies may request additional evaluation of the Arabic KIDI items by asking parents to identify potentially unclear items.

The validity of the Arabic KIDI may be examined using a matching sample from the U.S. Thus, future investigations should compare the findings of the Arabic KIDI with those of the U.S. Moreover, such studies should aim at considerably larger sample sizes in order to facilitate conducting additional exploratory factor analyses and testing of generated hypotheses using CFA (e.g., Raykov, 2023).

Finally, future studies should include cross-cultural comparisons of parental knowledge using samples of mothers and fathers from both Middle Eastern and Western cultures. Future studies may also establish a cutoff score of the Arabic KIDI to classify the level of parental knowledge and to identify the necessary educational programs to enhance this knowledge.

Conclusion

This study contributes to the process of evaluation of the psychometric properties of the KIDI instrument by considering the complexity of the ordered categorical data resulting from its items. The study revealed evidence in favor of a single-factor structure of the instrument, which is associated with adequate internal consistency. Further evaluation of the KIDI instrument in Kuwait can be recommended, consistent with the discussions in this paper and the preceding sections, to optimize its local use.

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Table 1

Demographic characteristics of mothers of typically developing children and mothers of children with disabilities.

Variables	Mothers of typically developing children		Mothers of children with disabilities			
	M	*SD*	*M*	*SD*	Group difference	Cohen's d
Mothers' ages	30.14	6.09	33.76	7.05	*t* (1533.15) = 12.12*	0.56
Mothers' education[a]	4.53	0.85	4.37	1.00	*t* (1528.87) = -3.80*	-0.18
Children's birth weight (kg)	2.73	0.75	2.77	1.95	NS	
Number of children	2.80	1.67	3.32	1.71	*t* (2183) = 7.00*	0.31
Variables	***N***		***N***		**Group difference**	**Φ**
Children's sex					NS	
Male	714		424			
Female	651		401			
Premature children					*χ2* (1, 2187) = 65.79*	0.17
Yes	169		215			
No	1192		611			

***Note*. NS means no statistically significant differences.**

[a] Mother's education = (1) elementary, (2) middle school, (3) high school, (4) associate's degree, (5) bachelor's degree, (6) Master's degree, and (7) doctoral degree.

*** = $p < .05$.**