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Cross-Cultural Adaptation and Psychometric Validation of the Alabama Parenting Questionnaire Among Rwandan Parents and Children: A cross-sectional study

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Cross-Cultural Adaptation and Psychometric Validation of the Alabama Parenting Questionnaire Among Rwandan Parents and Children: A cross-sectional study

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Abstract

Background

Reliable, culturally adapted instruments are essential for assessing parenting practices across diverse populations. Although the Alabama Parenting Questionnaire (APQ) is widely used internationally, its psychometric properties have not been evaluated in Rwanda. This study examined the reliability, validity, and factor structure of the APQ among Rwandan parents and children

Methods

A quantitative cross-sectional study was conducted among 402 parents and 385 children aged 9-18 years recruited from communities across Rwanda. The APQ was translated and culturally adapted into Kinyarwanda using standard cross-cultural adaptation procedures. Internal consistency was assessed using Cronbach's alpha, construct validity was examined through convergent and discriminant analyses, and confirmatory and exploratory factor analyses were conducted to evaluate the underlying factor structure and model fit.

Results

The adapted APQ demonstrated acceptable psychometric properties. Internal consistency was satisfactory for both the child-report (**α = .76**) and parent-report (**α = .81**) versions. Significant correlations between corresponding parent and child subscales (r = .369-.795, $p < .001$) and total scores (r = .662, $p < .001$) supported convergent validity, while weak correlations were observed between APQ scores and the Columbia-Suicide Severity Rating Scale (C-SSRS) for both parent- and child-report versions ($r = .037$, $p = .456$ and $r = .129$, $p = .010$, respectively), supporting discriminant validity. The fit of previously published APQ factor structures was first evaluated using confirmatory factor analysis (CFA), followed by exploratory factor analysis (EFA) to identify the underlying factor structure, which was subsequently confirmed using CFA. CFA confirmed the four-factor model with acceptable fit indices ($\chi^2/df = 1.36$, CFI = .903, TLI = .849, RMSEA = .030, SRMR = .039).

Conclusion

The adapted APQ demonstrated acceptable reliability, construct validity, and factorial validity for assessing parenting practices among Rwandan parents and children. The instrument provides a

culturally appropriate measure for research and clinical practice and supports future studies on parenting and child mental health in Rwanda.

Key words: Alabama Parenting Questionnaire; parenting practices; psychometric validation; reliability; validity; factor analysis; Rwanda.

Introduction

Parenting practices are among the most influential determinants of children's emotional, behavioral, and psychosocial development. Positive parenting behaviors, including parental involvement, effective monitoring, consistent discipline, and positive reinforcement, promote emotional competence, social adjustment, and adaptive behavior, whereas harsh, inconsistent, or coercive parenting practices are associated with increased risks of internalizing and externalizing problems, including anxiety, depression, aggression, and conduct difficulties [1,2]. Consequently, parenting practices have become an important focus of prevention and intervention strategies aimed at improving child and adolescent mental health worldwide.

Accurate assessment of parenting practices requires psychometrically sound and culturally appropriate instruments. The APQ is one of the most widely used measures of parenting practices associated with child behavioral outcomes [3]. The instrument assesses five theoretically derived parenting dimensions: parental involvement, positive parenting, poor monitoring and supervision, inconsistent discipline, and corporal punishment. Owing to its strong theoretical foundation and extensive international use, the APQ has been translated and evaluated in numerous cultural settings. However, previous studies show that the APQ factor structure varies across cultures. The original U.S. version had five factors: Parental Involvement, Positive Parenting, Poor Monitoring/Supervision, Inconsistent Discipline, and Corporal Punishment [3]. A five-factor

model was also found in Germany [4] and Poland [5], while three-factor models were reported in Spain [6,7] and a four-factor model in Uganda [8]. These findings indicate that parenting constructs may not operate identically across cultures and emphasize the importance of validating psychological instruments before their application in new populations.

Cross-cultural adaptation extends beyond linguistic translation and aims to achieve semantic, conceptual, and cultural equivalence between the original and translated versions of an instrument [8,9]. International methodological standards, including the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN), recommend rigorous evaluation of reliability, validity, and structural validity to ensure that adapted instruments accurately measure the intended constructs within the target population [10]. Without such evaluation, measurement error and cultural bias may compromise the interpretation of research findings and the effectiveness of clinical and public health interventions.

In Rwanda, parenting has received increasing attention within child development and mental health initiatives, particularly through national efforts to strengthen responsive caregiving and positive parenting. However, research evaluating parenting practices has been constrained by the absence of culturally validated assessment instruments. Although parenting interventions have demonstrated positive effects on child development [11-13], no published study has comprehensively evaluated the psychometric properties of the APQ among Rwandan. Consequently, researchers and clinicians lack a validated instrument for assessing parenting practices and evaluating parenting interventions within the Rwandan context.

To our knowledge, this is the first study to examine the psychometric properties of the APQ among Rwandan parents and children. The aim of this study was to evaluate the reliability, construct

validity, and factorial validity of the instrument following cultural adaptation in order to determine its suitability for assessing parenting practices in the Rwandan context.

Methods

Participants and procedure

A quantitative cross-sectional design was employed. Participants were recruited from communities across Rwanda using convenience sampling to ensure broad sociodemographic representation. Two independent groups were included: parents or primary caregivers and children aged 9-18 years. Eligible participants could communicate in Kinyarwanda or English, provided written informed consent or assent (with parental consent for children), and agreed to participate. Individuals with cognitive impairment or medical conditions that prevented questionnaire completion, as well as those who declined consent or assent, were excluded.

Data were collected through face-to-face interviews using Kobo Toolbox by trained research assistants. Written informed consent was obtained from parents or primary caregivers, and children provided written assent alongside parental consent. Parent- and child-report questionnaires were administered separately to ensure independent responses.

A total of 410 parents and 398 children were initially enrolled. After data cleaning and removal of incomplete responses, the final analytical sample included 402 parents and 385 children. These sample sizes were adequate for psychometric validation, including exploratory factor analysis (EFA) and confirmatory factor analysis (CFA [14], and exceeded the recommended minimum subject-to-item ratio of 10:1 [15]. Larger samples also improve the stability and replicability of factor structures [14].

Cultural adaptation of instruments

APQ, and C-SSRS were translated and culturally adapted into Kinyarwanda following internationally recommended guidelines [9,10] including forward translation, synthesis, back translation, expert review, pilot testing, and final revision. Content validity of the translated versions was evaluated by six experts using the Item Content Validity Index (I-CVI) and the Scale Content Validity Index (S-CVI), while face validity was assessed through pilot testing with 10 parents and 10 children. This sample size is consistent with recommendations for cognitive pretesting, which suggest that 5-10 participants per target group are sufficient to identify issues related to wording, comprehension, and cultural relevance before large-scale data collection [16].

Measures

Sociodemographic Characteristics

A structured sociodemographic questionnaire was developed by the research team to collect background information on participants [Supplementary file 1]. For parents, information included age, sex, marital status, educational level, employment status, and place of residence. For children, data included age, sex, school level, living arrangement, and place of residence. These variables were used to describe the study sample.

Parenting Practices

Parenting practices were assessed using the APQ, a widely used measure of parenting associated with child and adolescent behavioural outcomes [17,18]. No formal permission is required for its use; however, authors are encouraged to notify the original developer (Frick) of its use and any resulting publications. The APQ includes separate parent and child-report versions. The instrument has 42 items across four dimensions: Parental Involvement (10 items), Positive Parenting (6 items),

Corporal Punishment (3 items), Poor Monitoring and Supervision (10 items), and Inconsistent Discipline (6 items) and 7 items of other discipline practices which is not a scale, but provides information on an item-by-item basis. Items are rated on a 5-point Likert scale from 1 (Never) to 5 (Always), with higher scores indicating greater endorsement of each parenting practice. In this study, the adapted APQ showed acceptable internal consistency, with **α = .81** for the parent-report and **α = .76** for the child-report version.

Suicidal Ideation and Suicidal Behavior

Suicidal ideation and behaviour were assessed using the Columbia-Suicide Severity Rating Scale (C-SSRS), a standardized measure of 6 items that assess suicidal thoughts and behaviours [19]. The screening version assesses the presence and severity of suicidal ideation, suicidal behaviour, and recent suicide attempts. Higher scores indicate greater suicide risk. In the present study, internal reliability was acceptable, with **α = .84** for the child sample and **α = .89** for the parent sample. It was used to examine the discriminant validity of the adapted APQ.

Statistical analysis

Statistical analyses were conducted in JASP (Jeffrey's Amazing Statistics Program) version 0.96.0. Data were screened for completeness, missing values, and outliers. Participant characteristics were summarized using frequencies, percentages, means, and standard deviations. Content validity was assessed using the Item Content Validity Index (I-CVI) and Scale Content Validity Index (S-CVI). Internal consistency was evaluated using Cronbach's alpha.

Construct validity was assessed using Pearson's correlation, with convergent validity evaluated through correlations between corresponding parent- and child-report APQ scores and discriminant validity examined using correlations between APQ scores and C-SSRS. Factor structure was

evaluated using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Statistical significance was set at $p < .05$.

Results

Participants Characteristics

The final analytical sample comprised 402 parents or primary caregivers and 385 children aged 9-18 years. The mean age of parents was 44.17 years (SD = 15.57), while the mean age of children was 13.55 years (SD = 2.96). (Table 1).

Table 1. Socio-demographic characteristics of study participants

This table presents the socio-demographic characteristics of the parent and child participants included in the study.

Characteristic	Parents (402), n (%)	Children (N = 385), n (%)
Sex		
Male	227 (56.5)	192 (49.9)
Female	154 (38.3)	163 (42.3)
Prefer not to say	21 (5.2)	30 (7.8)
Age group (children)		
9-12 years	-	157 (40.8)
13-15 years	-	51 (13.2)
16-18 years	-	177 (46.0)

Marital status (parents)		-
Married	345 (85.8)	-
Divorced	32 (8.0)	-
Widowed	24 (6.0)	-
Educational level (parents)		-
No formal education	72 (17.9)	-
Primary	130 (32.3)	-
Secondary	120 (29.9)	-
University	82 (20.4)	-
Employment status (parents)		-
Employed	153 (38.1)	-
Unemployed	249 (61.9)	-
School level (children)		
Not in school	-	16 (4.2)
Primary	-	113 (29.4)
Ordinary level	-	164 (42.6)
Upper secondary	-	92 (23.9)
Living arrangement (children)	-	

Both parents	-	340 (88.3)
Mother only	-	27 (7.0)
Father only	-	14 (3.6)
Other family member	-	4 (1.0)
Residence		
Rural	232 (57.7)	171 (44.4)
Urban	170 (42.3)	214 (55.6)

Source: Field data, 2026

Reliability and Construct Validity

Internal consistency reliability

The child-report version of the APQ demonstrated acceptable internal consistency (α = .76), whereas the parent-report version demonstrated good internal consistency (α = .81), indicating satisfactory reliability of both versions of the instrument.

Convergent validity

Convergent validity was supported by significant positive correlations between corresponding parent-report and child-report APQ subscales, with correlation coefficients ranging from r = .369 to .795 ($p < .001$). The total APQ scores were also strongly correlated (r = .662, $p < .001$), indicating good agreement between parent and child reports of parenting practices.

Discriminant validity

Discriminant validity was examined by correlating APQ parent- and child-report scores with the C-SSRS. Weak correlations were observed between the APQ and theoretically distinct construct, supporting the discriminant validity of the adapted APQ (r = .037-.129) respectively.

Factorial Validity

Confirmatory Factor Analysis of Existing APQ Models

Confirmatory factor analyses were conducted to test whether previously established APQ structures (United States five-factor, Spanish three-factor, and Ugandan four-factor models) fit the Rwandan sample (Table 2).

Table 2. Previously Published APQ Models Tested in the Rwandan Sample

This table presents the fit indices of previously established APQ factor structures tested in the Rwandan sample.

Model	X^2/df	CFI	TLI	RMSEA	SRMR
Original United States 5-factor	1.72	.856	.831	.091	.087
Spain 3-factor	2.372	.549	.702	.083	.071
Uganda 4-factor	1.383	.856	.831	.071	.067

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual. Recommended thresholds: $\chi^2/df < 3.00$, CFI/TLI ≥ .90, RMSEA < .08, SRMR < .08

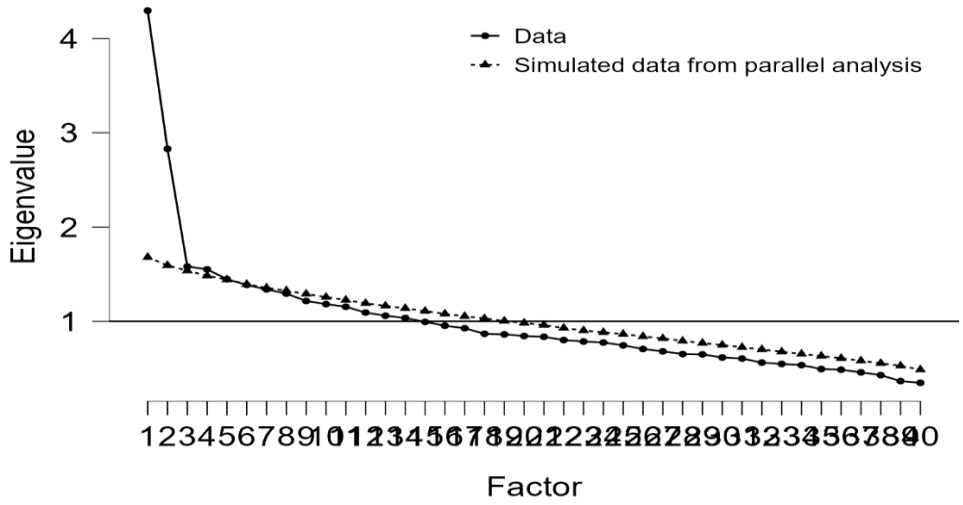
Exploratory factor analysis

Given the inadequate fit of previously published APQ models in Rwandan sample, exploratory factor analysis was conducted on the child-report APQ (n = 385) to identify the underlying factor structure of the APQ among Rwandan. The data were suitable for EFA, as shown by acceptable KMO values for both the parent-report dataset (**.71**) and the child-report dataset (.**73**), along with

significant Bartlett's tests of sphericity, χ^2 (861) = 2272.57, $p < .001$, and χ^2 (1275) = 3623.99, $p <$ .001, respectively

EFA was performed using Principal Axis Factoring (PAF) with Promax rotation. Based on the Kaiser criterion (eigenvalues > 1), four factors were retained, explaining **42.6%** of the total variance. Inspection of the scree plot also supported the retention of four factors (Figure 1).

Figure 1. Scree plot of the exploratory factor analysis of the child-report APQ.



The retained factors were Parental Involvement/Positive Parenting, Corporal Punishment, Poor Monitoring and Supervision, and Inconsistent Discipline. Standardized factor loadings ranged from .61 to .71, .66 to .72, .64 to .73, and .68 to .72, respectively (Table 3), and all retained items loaded saliently (≥ .40), supporting the four-factor solution.

Table 3. Extracted and Factor loadings of the adapted-APQ following exploratory factor analysis

This table presents the extracted factor structure of the adapted APQ, including retained items and their corresponding factor loadings from exploratory factor analysis.

Item N0	Item	Pare/Pos	Corp	Poor & Sup	MInc. Dis	Uniqueness
APQ 11	Your mom helps you with your school homework. *Kiny: Mama wawe agufasha mu mikoro yo ku ishuri ikorerwa mu rugo*.	.70	-	-	-	.51
APQ 14	Your mom asks you what your plans are for the coming day. *Kiny: Mama wawe akubaza gahunda zawe z'umunsi ukurikiraho.*	.71	-	-	-	.49
APQ 15	Your mom go with you to your special activity like school party or other parties *Kiny: Mama wawe aguherekeza mu bikorwa byawe byihariye nk'iminsi mikuru yo ku ishuri cg indi?*	.61	-	-	-	.62
APQ 16	Your parents praise you for behaving well. *Kiny: Ababyeyi bawe bagushimira imyitwarire myiza.*	.67	-	-	-	.55
APQ 1	You have a friendly talk with your mom. *Kiny: Ugirana ikiganiro cya gishuti na Mama*	.69	-	-	-	.52

APQ 33	Your parents slap you with their hand when you have done something wrong. *Kiny: Ababyeyi bawe bagukubita urushyi iyo wakoze amakosa*	-	.66	-	-	.56
APQ 39	Your parents yell or scream at you when you have done something wrong. *Kiny: Ababyeyi bawe baragutonganya cg bakagutuka cyana iyo wakoze ikosa.*	-	.72	-	-	.48
APQ 35	Your parents scold at you verbally when misbehaving or when you have done something wrong. *Kiny: Ababyeyi bawe baragutonganya iyo witwaye nabi cg wakoze ikintu kibi.*	-	.66	-	-	.52
APQ 19	You go out of home without a set time to be back. *Kiny: Uva murugo cg ujya gutembera ntagihe ntarengwa wahawe cyo kuba wagarutse mu rugo*	-	-	.71	-	.49
APQ 29	Your parents leave home without telling you where they are going.	-	-	.69	-	.52

	Kiny: Ababyeyi bawe bava mu rugo bakagenda batakubwiye aho bagiye. You go out during night without an adult to accompany you.					
APQ 21	*Kiny: Ujya hanze mu ijoro nta muntu mukuru uguherekeje.* Your parents do not know the friends you are with.	-	-	.64	-	.59
APQ 17	*Kiny: Ababyeyi bawe ntibajya bamenya inshuti mu gendana* You leave home without telling your parents where you are going.	-	-	.67	-	.55
APQ 6	Kiny: Uva murugo utabwiye ababyeyi aho ugiye Your parents stop a punishment early before it is finished, such as doing household chores or	-	-	.73	-	.46
APQ 22	standing in the corner for a given time. *Kiny: Ababyeyi bawe bahagarika igihano baguye mbere y'uko kirangira. Nko gukora*	-	-	-	.72	.48

	imirimo yo murugo cg guhagarara mu nguni igihe runaka.				
APQ 25	Your parents do not punish you when you have done something wrong. *Kiny: Ababyeyi bawe ntibaguhana iyo wakoze amakosa.*	-	-	-.68	.53
APQ 3	Your parents threaten to punish you and then do not do it. *Kiny: Ababyeyi bawe bagutera ubwoba bwo kuguhana ariko ntibabikore.*	-	-	-.70	.51
APQ 31	The punishment your parents give depend on their mood. *Kiny: Igihano ababyeyi bawe baguha gishingira ku byiyumvo byabo.*	-	-	.69	.52

Note. Pare & Pos: parental involvement/positive parenting, Corp: Corporal punishment, Poor M & Sup: Poor monitoring and supervision, Inc. Dis: Inconsistency Discipline, Kiny: Kinyarwanda. Only factor loadings ≥ .40 are presented. Factors were extracted using PAF with Promax rotation. Factors were retained according to the Kaiser criterion (eigenvalues > 1.00). Uniqueness values represent the proportion of item variance not explained by the retained factor

Confirmatory Factor Analysis of the Rwanda-Derived Model

CFA was performed on the parent-report APQ (n = 402) using maximum likelihood estimation to evaluate the four-factor model identified through EFA. The four-factor Rwanda-derived APQ model demonstrated good overall fit (Table 4 and Figure 2).

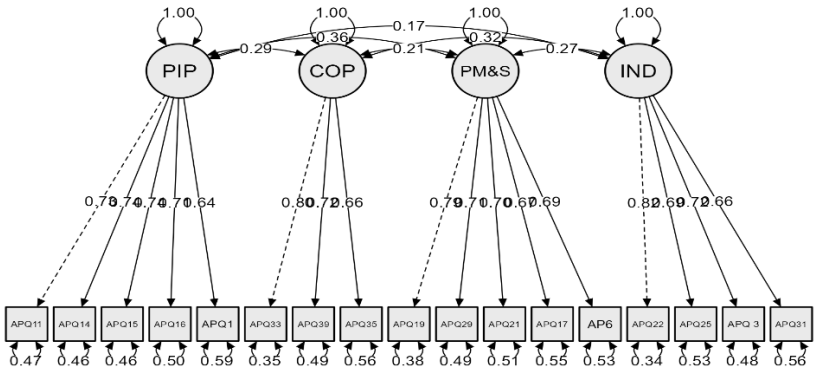
Table 4. Goodness-of-fit indices for the CFA of the Rwanda-derived four-factor of APQ

This table presents the model fit indices used to evaluate the adequacy of the proposed factor structure

Fit Index	Value	Recommended Criterion
χ^2 (df)	266.00 (196)	-
χ^2/df	1.36	< 3.00
CFI	.903	> .90
TLI	.849	≥ .90
RMSEA (90% CI)	.030 (.000-.051)	≤ .06
SRMR	.039	≤ .08

Note. χ^2 = Chi-square statistic; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Figure 2. Standardized CFA of the four-factor Rwanda adapted APQ model



Note. PIP = Parental Involvement/Positive Parenting; COP = Corporal Punishment; PM&S = Poor Monitoring and Supervision; IND = Inconsistent Discipline. Values on single-headed arrows represent standardized factor loadings. Curved double-headed arrows represent correlations among latent factors. Values beneath observed variables represent standardized residual variances.

Discussion

This study aimed to evaluate the psychometric properties of the APQ among Rwandan parents and children to assess its suitability for measuring parenting practices in Rwandan context. Overall, the adapted instrument demonstrated acceptable reliability, construct validity, and factorial validity. Both parent- and child-report versions showed satisfactory internal consistency, evidence of convergent and discriminant validity, and a culturally appropriate four-factor structure supported by exploratory and confirmatory factor analyses. These findings indicate that the adapted APQ is a sound tool for assessing parenting practices in Rwanda and provided a valuable tool for research, clinical assessment, and parenting interventions.

The present study showed satisfactory internal consistency for both the parent- and child-report versions of the adapted APQ. After factor refinement, Cronbach's alpha values were .81 and .76,

for parent- and child-report respectively, indicating acceptable reliability for assessing parenting practices in the Rwandan context. These results are consistent with previous APQ validation studies across cultural settings, which have generally reported acceptable internal consistency despite some variation across subscales [3,4,8]. As in prior cross-cultural research, refining the factor structure improved the coherence of retained subscales, suggesting that removing culturally less relevant or conceptually inconsistent items enhances psychometric performance [20]. Overall, the findings support the adapted APQ as a reliable measure of parenting practices among Rwandan parents and children.

Evidence for construct validity was also supported in the present study. The significant correlations observed between corresponding parent- and child-report APQ dimensions and between the total scores provide evidence of convergent validity, indicating that both versions of the instrument assess comparable parenting constructs despite reflecting different informants' perspectives. At the same time, the weak associations between APQ scores and measure of suicide risk (C-SSRS) support discriminant validity by demonstrating that the APQ measures parenting practices rather than conceptually distinct psychological constructs. These findings are consistent with previous APQ validation studies conducted in the United States, Germany, and other cultural settings, which have similarly reported satisfactory evidence of construct validity [3,4,21]. These findings further suggest that the translation and cultural adaptation process maintained the intended parenting constructs while ensuring their cultural relevance within the Rwandan context.

The present study also provides evidence supporting the factorial validity of the adapted APQ. Confirmatory analyses demonstrated that previously published APQ factor structures, including the original United States five-factor model and the Spanish and Ugandan models, did not provide the best representation of the underlying factor structure in the Rwandan sample. These findings

justified further exploration of the instrument's latent structure through exploratory factor analysis. The EFA identified a culturally meaningful four-factor solution comprising Parental Involvement/Positive Parenting, Corporal Punishment, Poor Monitoring and Supervision, and Inconsistent Discipline, which was subsequently supported by confirmatory factor analysis. Notably, parental involvement and positive parenting merged into a single factor, suggesting that these dimensions represent closely related aspects of positive parenting behavior within the Rwandan cultural context. Similar modifications to the original APQ structure have been reported in several cross-cultural validation studies, including those conducted in Spain, Chile, Uganda, and other non-Western settings, where fewer than five factors were identified or conceptually related dimensions were combined [8,21,22]. Collectively, these findings highlight the influence of cultural context on the expression and measurement of parenting practices and underscore the importance of culturally adapting and psychometrically validating parenting instruments before their application in new cultural settings.

The findings of this study have important implications for research, clinical practice, and parenting interventions in Rwanda. The availability of a culturally adapted and psychometrically validated APQ provides a reliable and valid instrument for assessing parenting practices within the local context. It will facilitate research on the relationship between parenting practices and child mental health, support the evaluation of parenting interventions, and inform the development of evidence-based family support programs. Furthermore, the validated APQ enables meaningful cross-cultural comparisons while ensuring culturally appropriate and psychometrically sound assessment of parenting practices.

Strengths and limitations

The present study has several strengths. To our knowledge, it is among the first to culturally adapt and psychometrically validate the APQ for use in Rwanda using internationally recommended procedures. The inclusion of both parent- and child-report versions, relatively large and socio-demographically diverse samples, and a comprehensive psychometric evaluation (including content and construct validity, reliability, and both exploratory and confirmatory factor analyses) strengthen the robustness of the findings. Consequently, the validated APQ provides a reliable and culturally appropriate tool for research, clinical assessment, and the development and evaluation of parenting and child mental health interventions in Rwanda.

This study has several limitations. First, the cross-sectional design did not permit assessment of test-retest reliability. Second, the use of convenience sampling may limit the generalizability of the findings to the broader Rwandan population. Finally, reliance on self-report measures may have introduced recall and social desirability bias. Future studies should examine the temporal stability, predictive validity, and measurement invariance of the adapted APQ in more diverse and representative populations.

Conclusion

The present study demonstrated that the adapted APQ is a reliable, valid, and culturally appropriate instrument for assessing parenting practices among Rwandan parents and children. The findings provide evidence of satisfactory internal consistency, construct validity, and factorial validity, supporting the use of the instrument in the Rwandan context. The validated APQ provides a valuable tool for research, clinical assessment, and the evaluation of parenting and child mental

health interventions. More broadly, the study highlights the importance of culturally adapting and psychometrically validating parenting measures before their application in new cultural settings.

List of Abbreviations

APQ: Alabama Parenting questionnaire

CFA: Confirmatory factor analysis

CFI: Comparative Fit Index

C-SSRS: Columbia-Suicide Severity Rating Scale

EFA: Exploratory Factor Analysis

RMSEA: Root Mean Square Error of Approximation

SRMR: Standardized Root Mean Square Residual

TLI: Tucker-Lewis Index

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of the University of Rwanda, College of Medicine and Health Sciences with approval reference number CMHS/IRB/895/2025, issued on 22/12/2025. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its later amendments version adopted in October 2024 with respect of key principles including primacy of participant rights, physician responsibility, informed consent, scientific validity and social value, risk-benefit assessment,

community engagement, transparency and oversight, environmental considerations, global and local compliance.

Consent for publication

Not applicable. This manuscript does not contain any individual personal data or identifiable information.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interests.

Finding

This research received no specific funding.

Authors' contributions

JNC: Conceptualization, Methodology, Formal analysis, Validation, Investigation, Data curation, Writing of original draft, Visualization. JMN, JN, CK: Supervision, Methodology, Writing review & editing, PM, PU: Review and Editing.

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