ORIGINAL ARTICLE

Psychometric properties of the ScreenQ for measuring digital media use in Portuguese young children

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Abstract

Aim: Digital media use is prevalent among children and linked to potential developmental and health risks, but validated measures of children's digital media use are lacking. The aim of this study was to validate the Portuguese version of the ScreenQ with three distinct children's age groups.

Methods: Parents of children living in Portugal completed an online survey including the 16-item version of the ScreenQ and items related to home activities and digital media use. A combination of classical and modern theory (Rasch) methods was used for analysis.

Results: A total of 549 mothers and 51 fathers of 325 girls and 322 boys from 6 months to 9 years and 11 months old responded to the survey. Point-measure correlations were all positive and endorsement of item values were within acceptable ranges. Cronbach's coefficient α was acceptable for a new measure, and test–retest reliability was high. Statistically significant correlations were found between ScreenQ total scores and relevant demographic, play-related, parenting and digital media use items.

Conclusion: The Portuguese version of the ScreenQ exhibited sound psychometric properties, including internal consistency and concurrent validity referenced to external items. Higher ScreenQ scores were correlated with higher digital media multitasking, lower parent–child interaction, and higher concerns regarding child's learning and behaviour.

KEYWORDS
digital media use, psychometrics, screenQ, screen time, validation

1 | INTRODUCTION

In the last few decades, there has been a massive global expansion in the use of digital technology by young children.[1] Studies carried out in the United States,[2] and in Portugal,[3,4] suggest that children begin using digital media before 2 years of age and, on average, children 0–8 years of age often spend more than 1 h and 30 min per day interacting with this media. This trend has raised concerns among scientists, advocates

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and policymakers, as increasing evidence has found detrimental effects of excessive digital media exposure during early childhood. Effects reported in the literature include cognitive and language delays,[5,6] difficulties with attention and self-regulation[7] and physical, nutritional and behavioural problems.[8,9] Thus, the American Academy of Paediatrics (AAP) and the World Health Organization (WHO) have released recommendations for limiting digital media use, including discouraging use altogether, for children younger than 18 months old.[10,11]

Although instruments have been developed to assess digital media use in children,[12–14] most often television, these instruments have rarely been rigorously validated. The ScreenQ is a novel parent-report measure of digital media use, recently validated in a sample of healthy, preschool-aged children in the United States of America (USA).[15,16] The 15-item scale reflects domains featured in AAP guidelines such as access, frequency, content and caregiver–child co-viewing. Scores range from 0 to 26 points, with higher scores reflecting lower adherence to AAP guidelines and a higher risk for adverse effects. In prior validation studies, the ScreenQ exhibited strong psychometric properties, including internal consistency, reliability and concurrent validity, suggesting that it is an efficient means of assessing digital media use in the context of known cognitive-behavioural risks.[15] A recent MRI-based study found associations between higher ScreenQ scores and reduced brain white matter microstructural integrity in tracts supporting language, executive function and early literacy skills in 3–5 years old children.[16]

Currently, in Portugal, there are no validated measures of digital media use among children, reflecting a major evidence gap given the growing concerns of parents, paediatricians and teachers in this field. The purpose of the current study was to describe the psychometric integrity of a Portuguese translation of the ScreenQ and determine whether it performs differently in three distinct age groups of children: under 36 months, 36–63 months (comparable with the American analysis) and over 63 months. A secondary aim was to explore associations between ScreenQ scores and selected demographic characteristics, home activities and media-use indicators, for the total sample as well as for each age group.

2 | METHODS

This study was approved by the Ethics Review Board of the School of Health of the Polytechnic Institute of Porto, Portugal. All participants consented to participate using an online informed consent form that was formulated according to the World Medical Association Helsinki Declaration.

2.1 | Sample

Two data sets served as the basis for this study. Data set 1 consisted of parents or legal caregivers of children from 3 to 6 years and 11 months of age and was obtained from June 2020 to April 2021. Participants in the first data set came from kindergarten schools in northern Portugal plus personal contacts of the research team, all

Key Notes

- Excessive digital media use by young children is a growing global concern and validated instruments for measuring digital media use by young children are needed in Portugal and Europe.
- A Portuguese translation of the ScreenQ measure was found to have sound psychometric properties.
- Higher ScreenQ scores were correlated with higher digital media multitasking, lower parent–child interaction, and higher concerns from parents regarding their child's learning and behaviour.

of whom speak Portuguese at home. Data set 2 consisted of parents of children 6 months–9 years and 11 months of age and was obtained from November 2020 to April 2021. These participants were recruited through multiple recruitment channels, including kindergarten and primary school mailing lists, social media and personal contacts of the research team.

A total of 695 participants completed the survey; however, 48 did not meet the eligibility criteria, which was due to not having children in the specified age groups, informed consent was not provided or parents younger than 18 years of age. As such, 647 records were used for analysis with 252 from the first data set. For the analysis, the sample was divided into three age groups: the youngest age, with children under 36 months; middle age, with children from 36 to 63 months; and oldest age, with children over 63 months. The total sample, including all ages groups, constituted its own group and was also analysed.

2.2 | Instrument

The ScreenQ used in this study (Appendix S1) consisted of 16 items; the same 15 items featured in the tested American version,[15] plus an additional item regarding educational content. This item had been removed from the American version due to poor performance attributed to item wording but was revised and reinserted for this study. A 'not applicable' option was included for items 6, 7, 8, 9, 10 and 11 for children who may never have been exposed to digital media. This option was assigned a score of 0. Detailed description of ScreenQ items and scoring can be found elsewhere.[15]

Demographic information collected included parental sex, age, education level, employment status and household income and child age and sex. The survey also collected information about relevant home activities, namely, how much time children spend on free play, outdoor play and school activities and homework, and the approximate time spent interacting with parents during weekdays or weekends. Additional items involved parents' concerns about the child's learning and behaviour and how often they use more than one electronic device at the same time, referred to as digital media multiuse.

2.3 | Questionnaire translation and cross-cultural adaptation

Translation and adaption of the ScreenQ was conducted in the following sequence: first, all items on the English version were translated into Portuguese; second, these items were evaluated using a think aloud strategy to assure appropriate and meaningful interpretation for revisions; third, the Portuguese version was then back-translated to English by a native speaker of both languages with no previous contact with the questionnaire; and fourth, the back-translated version of the Portuguese version was sent to the principal investigator of the measure (JH) for comparison and discrepancies resolved by email. A final version of the ScreenQ was then approved by the American authors and the Portuguese research team.

2.4 | Data analysis

Parametric and nonparametric measures of central tendency, variability and association were computed to fully characterise each sample. Modern theory Rasch methods were used to estimate item performance for the total sample and as well as for each age group, to estimate the likelihood of endorsement for each item. Response frequencies, item difficulty and point-measure correlations were then computed and evaluated for each item as indicators of item and scale integrity. Two measures of reliability were computed: internal consistency using Cronbach's coefficient α_{Coef}, and temporal stability using the Pearson correlation coefficients. Finally, to assess validity, we computed the relationship between ScreenQ total score and relevant demographic variables including sex, household income, parental education, household size, screen use patterns, home activities and parental concerns about use using the Spearman-rho (r_p) correlation coefficients, for the total sample as well as for each of the three age groups. All analyses were evaluated at an unadjusted $\alpha = 0.05$ level. All data were analysed using SAS v9.4 (SAS Corporation) and Winsteps© v5.2.3.

3 | RESULTS

3.1 | Demographic characteristics

The survey was completed by 549 (92.1%) mothers and 51 (7.9%) fathers on a total of 647 parents of 325 (50.2%) girls and 322 (49.7%) boys. Children ranged in age from 6 months to 9 years and 11 months (mean 55.8 ± 25.6), distributed into three age groups: <36 months (20.2%), 36–63 months (41.2%) and >63 months (38.4%). Descriptive statistics of participants are summarised in Table S1.

3.2 | Descriptive statistics for ScreenQ and additional items

ScreenQ Total Score was 8.2 ± 3.9 for the combined sample, and 5.5 ± 3.3, 8.3 ± 3.6 and 9.6 ± 3.8 for the three age groups, respectively.

Scores were normally distributed for the whole sample and for the three age groups using Shapiro–Wilk W test. Histograms of ScreenQ score distributions are shown in Figure S1.

Mean hours per day on weekdays and weekends, respectively, were reported for the following activities: free play (2.3 ± 1.8; 3.9 ± 2.2), outdoor play (1.1 ± 1.0; 2.0 ± 1.3) and school activities (2.7 ± 3.1; 0.5 ± 0.8). Mean hours per day of parent–child interaction were 4.6 ± 2.6 on weekdays and 8.8 ± 3.2 on weekends. (Table S1).

3.3 | ScreenQ item analysis

For the combined sample ($n = 647$), the ScreenQ item most likely to be endorsed overall involved entertainment/educational content (−1.67) while the item least likely to be endorsed involved violent content (1.79). Point-measure correlations reflecting the relationship between a specific item and the rest of the scale were all positive and acceptably low to moderate in magnitude from 0.24 to 0.54. All items reflected good fit with the Rasch model except for one item reflecting the age at which a child began using digital media. (Table S2) Inter-item correlations were acceptably low to moderate, ranging from $r_p = 0.08$ to 0.45. (Table S3).

For the youngest group (<36 months, $n = 131$), the item most likely to be endorsed by parents involved the age at which the child begins using digital media (−3.56) while the item least likely to be endorsed by parents involved violent content (3.31). Point-measure correlations ranged from 0.07 to 0.64. Item fit was strong except for the item regarding age at which the child began using digital media. (Table S2) Significant inter-item correlations were again low to moderate, ranging from $r_p = 0.19$ to 0.60. (Table S3).

For the middle age group (36–63 months, $n = 267$), the item most likely to be endorsed by parents involved entertainment/educational content (−1.73) and least likely to be endorsed involved violent content (2.19). Point-measure correlations were low to moderate, from 0.26 to 0.47. (Table S2) Significant inter-item correlations were also low to moderate, ranging from $r_p = 0.10$ to 0.42. (Table S3).

For the oldest age group (63<months, $n = 249$) the item most likely to be endorsed by parents involved entertainment/educational content (−2.13) while that least likely to be endorsed involved using digital media to help the child to calm down (1.64). Point-measure correlations were all positive, between 0.26 and 0.51. Significant inter-item correlations were low to moderate, ranging from $r_p = 0.12$ to 0.48. (Table S3).

3.4 | Reliability

Internal consistency was strong for the combined sample ($r_{Co-\alpha} = 0.69$), and comparable across the three age groups: $r_{Co-\alpha} = 0.66$ for the youngest, $r_{Co-\alpha} = 0.63$ for the middle and $r_{Co-\alpha} = 0.64$ for the oldest. The measure of temporal stability (test–retest reliability) for the combined sample was high and statistically significant ($r_p = 0.85$; $p < 0.001$).

3.5 | Validity

3.5.1 | ScreenQ total score and demographic variables

Validity of the ScreenQ was evaluated by computing Pearson correlations between ScreenQ total score and demographic variables known to be associated with child use. For the combined sample, there were low but negative, statistically significant correlations between the ScreenQ total score and household income ($r_p = -0.14$, $p = 0.0005$) and parental education ($r_p = -0.25$, $p < 0.0001$), and positive correlation between total score and household size ($r_p = 0.13$, $p = 0.0010$).

For the youngest and middle age groups, there were similar, negative, statistically significant correlations between the ScreenQ total score and household income, for the youngest $r_p = -0.28$, $p = 0.0012$; for the middle $r_p = -0.17$, $p = 0.0061$). ScreenQ total score was negatively correlated with parental education for the middle age group only ($r_p = -0.31$, $p < 0.0001$). There was a positive, statistically significant correlation between ScreenQ total score and concerns about the child's health for the oldest age group ($r_p = 0.13$, $p = 0.0424$).

3.5.2 | ScreenQ total score and screen use patterns

Relationships between the ScreenQ total score and reported media use patterns, home activities and parental concerns are summarised in Table S4. Significant, positive correlations were found between the ScreenQ score and child multiuse ($r_p = 0.48$, $p < 0.0001$) and parents' concerns about the child's learning ($r_p = 0.15$, $p < 0.0006$) and behaviour ($r_p = 0.15$, $p < 0.0004$). ScreenQ score was significantly, negatively correlated with parent–child interaction on weekdays ($r_p = -0.22$, $p < 0.0001$) and weekends ($r_p = -0.13$, $p < 0.0001$), and also with free play activities on weekdays ($r_p = -0.20$, $p < 0.0001$) and weekends ($r_p = -0.15$, $p < 0.0001$).

4 | DISCUSSION

The rapid increase of digital media use, often referred to as screen time, by children beginning in infancy, which had been found to exceed both AAP and WHO guidelines,[2] is a major concern for caregivers, paediatricians and developmental professionals. Thus, it is critical to have efficient, reliable instruments to measure digital media use to help understand developmental and other health risks. The primary aim of the current study was to psychometrically test a Portuguese translation of the ScreenQ measure that was recently validated in the USA and to determine whether it performs differently in three age groups: under 36 months, 36–63 months (same as the American analysis) and over 63 months. This reflected an extension of current evidence to both a distinct cultural and geographic context and wider age range. The approach mirrored the one in the

American-based validation study, combining classical and modern theory Rasch methods.[15]

The Portuguese version of ScreenQ performed well in terms of internal consistency (Crohnbach's alpha) for the combined sample and each age group, exceeding the acceptable level for new measures ($\alpha_{Coeff} > 0.6$). This performance was similar to the American-English version ($\alpha_{Coeff} = 0.74$).[15] This suggests coherence as a composite instrument, where individual items worked together while also contributing unique information. Temporal stability was also good, as revealed by test–retest reliability.

By far, the easiest item for parents to endorse for all age groups involved entertainment vs. educational content, consistent with known parental preferences for this purpose,[17] such as learning videos and mobile apps.[2,3] This item was initially removed from the American version due to poor wording but has been added back, including in the Portuguese version, due to the importance of this aspect of use cited in AAP guidelines.[18] Somewhat surprisingly, reported media use for calming was not highly endorsed for the whole sample, possibly as this may be a stigmatised behaviour subject to desirability bias. By contrast, the age of initial use item was exceedingly endorsed, particularly for the youngest group, and did not perform well compared to the American version, perhaps reflecting high prevalence of digital media use at young ages in Portugal.[3,19]

Analyses of concurrent validity involved associations between ScreenQ total scores and demographic, play-related, parenting and other screen time items known to be related to digital media use. Higher ScreenQ scores were significantly correlated with both lower household income and parental education in most age groups, consistent with current usage statistics in both the USA[2,20] and Portugal,[19] where digital media exposure tends to be highest in socioeconomically disadvantaged families. Higher ScreenQ scores were also associated with significantly higher levels of child media multiuse, less free play and lower parent–child interaction on weekdays and weekends. These findings are consistent with prior studies reporting higher digital media use linked to decreased physical activity, participation, duration and frequency of outdoor play activities[21] and less parent–child interaction.[22] Higher levels of media multiuse or multitasking had also been linked to more reported emotional, behavioural and developmental problems during preschool and school ages.[16,23–25] And while not ranking as high as basic needs such as general health and education, parental concerns regarding the impact of digital media use on the child's social skills, physical activity level and potential for mental health concerns such as addiction are well documented.[20] Altogether, associations between ScreenQ scores and these external items suggested that it is capturing information that accurately reflects both known usage trends and relationships with child health, behaviours and family dynamics, which are important validation criteria.

This study had limitations that should be noted. Sample recruitment was non-probabilistic nor calculated to be representative of the Portuguese population and may not be fully generalisable. While large, the sample size was not equally distributed across age groups,

nor determined in the context of formal power analysis. Finally, these data were collected during the COVID-19 pandemic, which involved periods of confinement at home and this has been associated with higher than typical digital media use, which may have influenced survey responses; namely, frequency and other activities at home.[26]

This study had also important strengths. The sample was large and involved a broader age range than in the American-English study, from 6 months to 9.9 years old, almost fully covering that addressed in AAP guidelines.[11] This allowed analyses of the overall sample and for distinct age ranges, where performance was consistently strong. Analyses involved rigorous psychometric techniques, providing insights into both ScreenQ individual items and the composite measure, while establishing acceptable internal consistency, reliability, test–retest reliability and concurrent validity. While sub-optimal to establish validity compared to a gold standard of media use such as objective recording, correlations with numerous external items known to be linked to media use and consequent health and behavioural risks provide reasonable evidence at this stage.[7,16,23] Altogether, this study represented an important step towards introducing an efficient, reliable tool to measure child digital media use in Portugal and Europe, where one is needed.

5 | CONCLUSION

In this study involving 647 parents of children ages 6–119 months, the Portuguese version of the 16-item ScreenQ composite measure of digital media use exhibited strong psychometric properties, including internal consistency and concurrent validity referenced to items reflecting known usage trends and risks of excessive use. Although there were small differences in performance between older and younger age groups, these results were similar to the prior, American-based validation study. Higher ScreenQ scores were correlated with socioeconomic disadvantage, higher screen media multitasking, lower parent–child interaction and higher parental concerns about their child's learning and behaviour. Altogether, these findings suggested that this Portuguese version of the ScreenQ has potential to fill a major gap and opportunity to efficiently assess screen use in Portugal and in other Portuguese-speaking populations, and current findings highlight potential areas for further study and intervention.

CONFLICT OF INTEREST
The authors have no conflicts of interest to declare.

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SUPPORTING INFORMATION

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