

Response Performance of Chinese General Children Aged 6-11 to EQ-5D-Y-3L: A Multicenter Study

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Introduction

- Patient self-reporting constitutes the gold standard for health assessment, giving rise to Patient-Reported Outcomes (PROs). Health-Related Quality of Life (HRQoL), as a pivotal domain of PROs, represents a critical outcome in healthcare, reflecting individuals' subjective evaluations of their health status. Measuring HRQoL is essential for understanding patient health and evaluating healthcare interventions.
- Pediatric populations require specialized HRQoL instruments. When children lack self-assessment capacity, guardians or designated proxies must complete proxy versions of HRQoL measures. However, unavoidable measurement bias persists between self-reported and proxy-reported data, despite the recognized superiority of self-reporting as the optimal health assessment modality.
- Children's self-reported HRQoL exhibits unique complexities compared to adults, posing significant challenges to the validity and reliability of pediatric health outcomes. These complexities stem from nonlinear developmental trajectories in cognitive capacities.
- The EQ-5D-Y-3L, among the most widely implemented and promising pediatric HRQoL instruments, has demonstrated robust reliability and validity across multiple Chinese populations. Nevertheless, significant discrepancies persist between self-reported and proxy-reported results, with no empirically validated minimum age threshold for independent administration.

Objectives

- This study aims to delineate age-dependent gradients in EQ-5D-Y-3L self-report validity and define its cognitive validity threshold for minimum age applicability, integrating Chinese evidence into global health measurement standardization to empirically inform international age-appropriateness criteria for pediatric health instruments.

Methods

Study design

✓ Convergent mixed methods design

–This study employed a convergent mixed methods design, leveraging the complementary strengths of qualitative and quantitative approaches to holistically examine age-specific response patterns to the EQ-5D-Y-3L among pediatric populations.

➢ Qualitative

–Semi-structured interviews were conducted to investigate children’s experiences in reading, completing, and responding to the EQ-5D-Y-3L.

➢ Quantitative

–Qualitative data were subsequently transformed into quantifiable metrics through a data transformation model to statistically examine age-related variations in response behaviors.

Participants

✓ Chinese General Children Aged 6-11

–Two primary schools and two kindergartens were randomly selected in Wuzhong City, Ningxia Province, China, with classrooms further randomly sampled across grade levels.

–Chinese children aged 6–11 years capable of understanding and communicating in Mandarin were included.

Data collection

✓ Trained investigators accompany

–All investigators received standardized training in qualitative interviewing techniques and completed at least two pilot interviews before formal data collection.

–A subset of participants underwent cognitive interviews based on the predefined guide, with all sessions audio-recorded and transcribed verbatim within 24 hours.

–Participants completed sociodemographic surveys (including age, grade, myopia status, and extracurricular outdoor activity duration), the PedsQL™ 4.0, and the EQ-5D-Y-3L self-report version, with randomized scale order to mitigate sequencing bias.

–Investigators assisted with reading tasks without explaining item meanings to preserve authentic response patterns.

✓ Investigators records and evaluations

–Nonverbal behaviors (e.g., hesitations, facial expressions) were documented to infer cognitive states.

–Post-interview, investigators independently completed evaluator assessment forms using Likert scales to rate children’s independent reading capacity and self-reported difficulty.

–Discrepancies between evaluators were resolved by the research team through triangulated discussion of audio recordings and observational notes, with final determinations made by the principal investigators.

Data analysis

✓ Descriptive statistics

–Continuous variables were summarized using means and standard deviations, while categorical variables were reported as frequencies and proportions.

–Response distributions across EQ-5D-Y-3L and PedsQL™4.0 dimensions were analyzed, with corresponding utility scores (EQ-5D-Y-3L) and total scores (PedsQL™4.0) calculated.

–Descriptive statistics (mean ± SD) were computed for EQ VAS scores.

✓ Children’s reading, completion and response performance of EQ-5D-Y-3L

➢ Children’s reading and completion performance

–primary metric: acceptability, evaluated by investigator-rated indicators: independent reading capacity and self-reported difficulty.

➢ Children’s response patterns to EQ-5D-Y-3L

–Analyzed through cognitive interview data. a dual-dimensional analytical framework was constructed. (Table 1)

–Conceptual comprehension: Examined both the alignment between children’s cognitive representations and EQ-5D-Y-3L’s health constructs, and children’s cognitive recognition and attribution of associations between EQ-5D-Y-3L items and health perceptions.

–Item and task comprehension: Analyzed response issues across Tourangeau’s four-stage response model, including understanding, judgment, recall, and response mapping, while simultaneously examining children’s cognitive representations of EQ-5D-Y-3L response levels

Table 1 dual-dimensional analytical framework	
Dimensions	Description
Conceptual comprehension	Conceptual Discrepancies and Interdimensional Mapping of EQ-5D-Y-3L Health Constructs in Children's Cognitive Representations
	Cognitive Interpretation and Attributional Analysis of Item-Health Linkages in EQ-5D-Y-3L
	Semantic Comprehension and Processing Characteristics of EQ-5D-Y-3L Items
	Dynamic Cognitive Profiling During Children's Response Processes to EQ-5D-Y-3L
Item and task comprehension	Cognitive Representation of Response-Level Comprehension to EQ-5D-Y-3L Items

✓ Relationship between age and response performance

–Response issues identified via Tourangeau’s model were converted into categorical variables.

➢ Associations between age and overall/type-specific response issues

– Chi-square tests (or Fisher’s exact tests for small frequencies) assessed associations between age and overall/type-specific response issues.

➢ Age-related trends

– Cochran-Armitage trend tests and logistic regression analyzed age-related trends.

Results

✓ Descriptive statistic

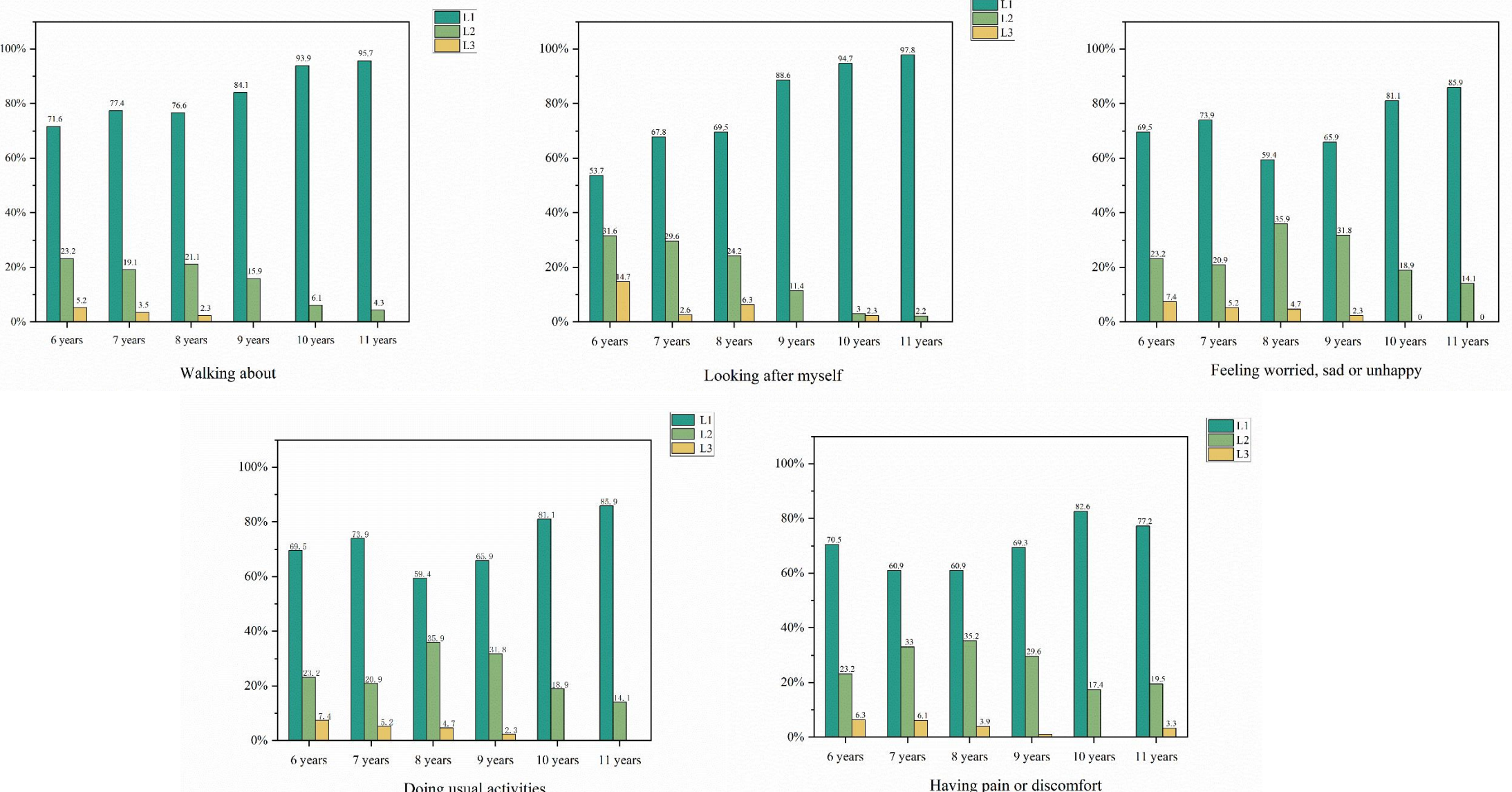
➢ Sociodemographic information

- A total of 650 children completed both the scale and cognitive interviews.
- Mean age (SD) of participants was 8.50 (1.66) years, 53.7% (n=349) were male, and grades spanned from kindergarten to sixth grade.

➢ Response

- The mean completion time (SD) was 18.31 (16.03) minutes.
- All children completed the EQ-5D-Y-3L descriptive system, while 11 missing/erroneous EQ VAS responses were identified (5 in 6-year-olds, 2 in 7-year-olds, 4 in 8-year-olds).
- The distribution of the responses to the EQ-5D-Y-3L are presented in Fig.1.

Figure 1. Distribution of responses to the EQ-5D-Y-3L



✓ Children’s reading, completion and response performance of EQ-5D-Y-3L

➢ Acceptability

- Post-interview evaluations by investigators revealed marked age-dependent declines in reading assistance needs (Fig 2).
- Self-reported difficulty assessments further corroborated developmental gradients (Fig 3).

Figure 2. Independent Reading Capacity

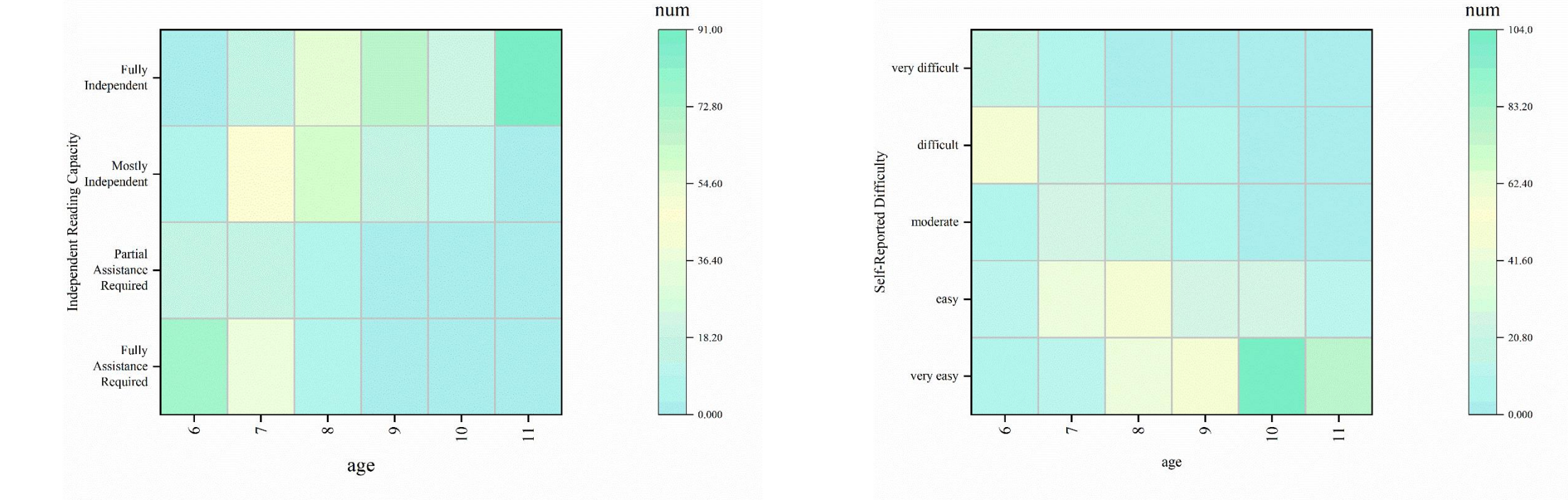
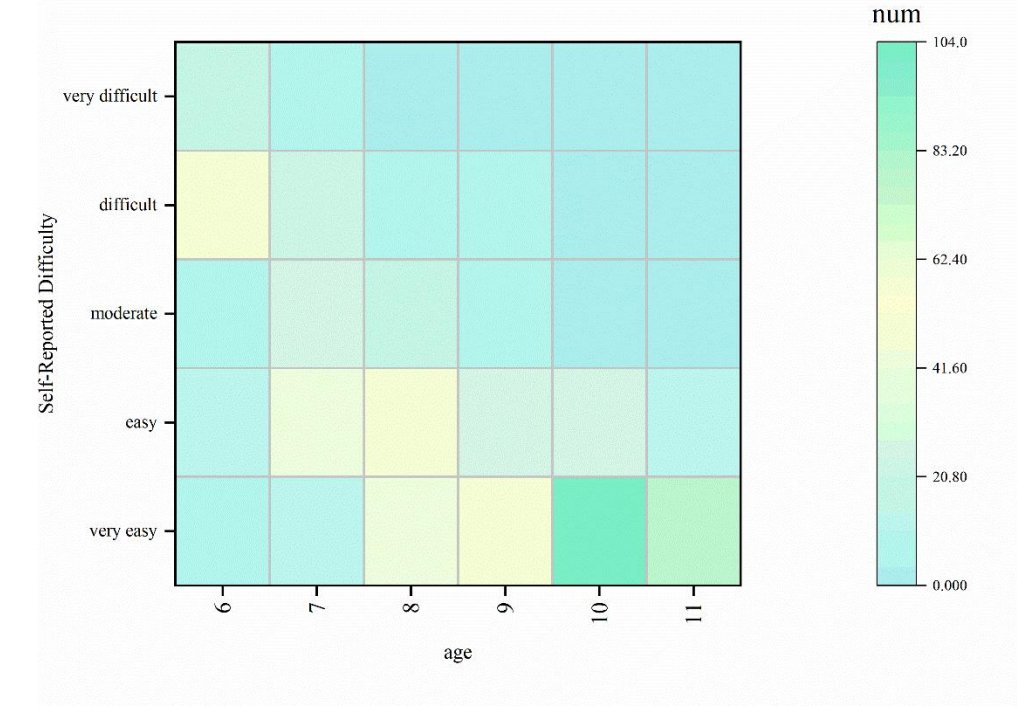


Figure 3. Self-Reported Difficulty



➢ Children’s response patterns to EQ-5D-Y-3L

• Conceptual comprehension

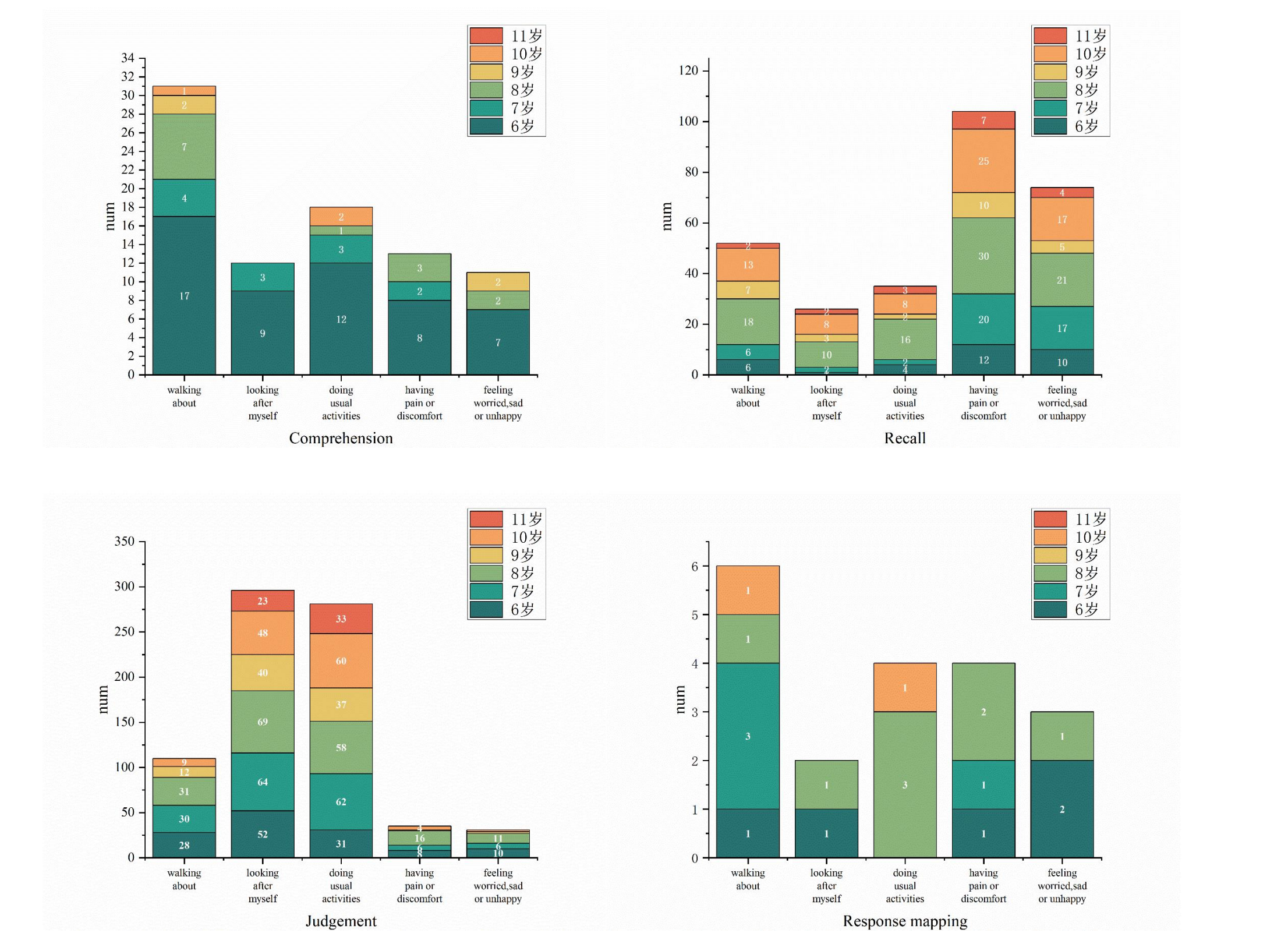
- Older children (9–11 years) demonstrated a multidimensional integrated health cognitive framework, with conceptual representations effectively mapped onto EQ-5D-Y-3L’s core constructs, indicating age-appropriate conceptualization capacity for scale response.
- Narrowed conceptualization of health, health-ability cognitive decoupling, and concretization limitations in risk perception were prevalent contributors to irrelevant judgments across age groups. Compared to 6–8-year-olds, 9–11-year-olds showed significantly consolidated attributional patterns, reflecting superior intra-group consistency.

• Item and task comprehension

– The response issues of children in each age group in the four stages are shown in Table 2, and the response problems of each type are shown in Figure 4.

Table 2. Frequency of children’s response issues					
Demographic characteristic	Comprehension n (%)	Recall n (%)	Judgement n (%)	Response mapping n(%)	Total (unique) n (%)
Age					
6 years (N=95)	21 (22.1)	30 (31.6)	61 (64.2)	5 (5.3)	80 (84.2)
7 years (N=115)	11 (9.6)	36 (31.3)	81 (70.4)	4 (3.5)	94 (81.7)
8 years (N=128)	11 (8.6)	53 (41.4)	91 (71.1)	7 (5.5)	104 (81.3)
9 years (N=88)	3 (3.4)	16 (18.2)	57 (64.8)	0 (0.0)	61 (69.3)
10 years (N=132)	3 (2.3)	48 (36.4)	78 (59.1)	2 (1.5)	91 (68.9)
11 years (N=92)	0 (0.0)	14 (15.2)	44 (47.8)	0 (0.0)	50 (54.3)
Gender					
Male	29 (8.3)	118 (33.8)	231 (66.2)	12 (3.4)	265 (75.9)
Female	21 (7.0)	79 (26.2)	180 (59.8)	6 (2.0)	215 (71.4)

Figure 4. Frequency graph of response issues of types in different dimensions



✓ Relationship between age and response performance

➢ Overall Response Issues

- A significant age-response issue association was observed ( $\chi^2$  test,  $P<0.001$ ).
- Cochran-Armitage trend tests revealed a pronounced age-dependent decline in response issue prevalence ( $Z=-5.37$ ,  $P<0.001$ ).
- Logistic regression confirmed this trend, with a 26% reduction in risk per additional year of age (OR=0.740, 95% CI [0.662, 0.828],  $P<0.001$ ).

➢ Issue-Type-Specific Patterns

- Age exhibited significant associations with all four response issue types ( $P<0.001$ ,  $<0.001$ ,  $0.002$ ,  $0.009$ ).
- Cochran-Armitage tests demonstrated declining trends across issue types: comprehension ( $Z=-5.95$ ,  $P<0.001$ ), retrieval ( $Z=-2.06$ ,  $P=0.040$ ), judgment ( $Z=-3.16$ ,  $P=0.002$ ), and response mapping ( $Z=-2.74$ ,  $P=0.006$ ).
- Logistic models quantified annual risk reductions: comprehension (OR=0.531, 95% CI [0.423, 0.667],  $P<0.001$ ; 46.9% reduction), retrieval (OR=0.899, 95% CI [0.812, 0.995],  $P=0.040$ ; 10.1% reduction), judgment (OR=0.855, 95% CI [0.775, 0.943],  $P=0.002$ ; 14.5% reduction), and response mapping (OR=0.647, 95% CI [0.466, 0.897],  $P=0.009$ ; 35.3% reduction).

Conclusions

- To our knowledge, this study constitutes the first international effort to delineate age-dependent gradients in self-report validity and empirically determine the cognitive validity threshold for EQ-5D-Y-3L.
- Compared to older children, those under 9 years exhibited systematic interpretive biases toward EQ-5D-Y-3L dimensions, characterized by larger cognitive deviations in item-health relevance recognition and complex attribution mechanisms, resulting in higher rates of response issues.
- While children aged  $\geq 9$  demonstrated acceptable overall self-report validity, age-specific response anomalies and intra-group variability persisted, requiring case-by-case evaluation of age appropriateness based on contextual factors.

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