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Is the Pediatric Quality of Life Inventory Valid for Use in Preschool Children with Refractive Errors?

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Abstract

Purpose—To determine the psychometric validity of the pediatric quality of life inventory (PedsQL 4.0) in assessing the impact of refractive errors on health-related quality of life (HRQoL) in preschool children in Singapore.

Methods—Parents of toddlers (aged 25 to 48 months) and young children (49 to 72 months) completed the PedsQL 4.0, an HRQoL scale as part of population-based trial in Singapore. The outcome measures were the overall score, and the “physical”; “emotional”; “social”; and “school” functioning subscales. Rasch analysis was used to validate the PedsQL 4.0.

Results—Parents of 939 (48.9%) toddlers and 982 (51.1%) young children completed the PedsQL 4.0 survey. The overall mean ($\pm$ standard deviation) spherical equivalence for the right eye was 0.47 ± 1.13 diopter (D) for toddlers and 0.74 ± 1.22 D for young children. One hundred forty-nine (15.9%) toddlers and 90 (9.2%) young children were considered myopic (-0.50 D). Most participants ($n = 1286$, 89.6%) had presenting visual acuity 6/9 or better. Rasch analysis showed evidence of disordered category thresholds and poor person-item targeting for both groups. The separation reliability was 0.00 for toddlers and 0.03 for young children, indicating there was no variance in both samples. The PedsQL 4.0 overall and subscale scores displayed substantial multidimensionality as the variance values explained by the measures was $<25\%$ in both groups. A minimum value of 60% is usually considering acceptable.

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Conclusions—The PedsQL 4.0 in its current state is not a valid psychometric scale to effectively evaluate the impact of refractive errors on HRQoL in preschool children in Singapore.

Keywords

refractive errors; preschool children; Rasch analysis; health-related quality of life

Refractive errors (myopia, hyperopia, and astigmatism) are common ocular disorders in the world and a significant public health concern. In Singapore, the prevalence of myopia is among the highest in the world and ranges from 60 to 80% in young adults compared with 20 to 50% in older adults in the United States and Europe.^{1–3} People with high myopia [> -6.0 diopters (D)] have an increased risk of ocular complications including retinal tear, retinal detachment, central vision loss from subfoveal choroidal neovascularization, and glaucoma.⁴ In young children, there is a critical period of visual development and any disruption of vision during this period can result in permanent loss of visual acuity (VA).⁵

Although there have been several reports describing the impact of refractive errors, strabismus and amblyopia on psychosocial measures, and quality of life (QoL) in adults,^{6–11} little is currently known about their impact in children. In 98 participants (mean age, 4.5 years) who have undergone strabismus surgery, Archer et al.¹² found improvement in functional limitations, anxiety/depression, social relations, eye alignment concerns, and clumsiness using instruments completed by parental proxies. By using the Children's Visual Function Questionnaire with 773 pediatric patients (age 7 years) with a wide range of ophthalmological diagnoses, Feliuss et al.¹³ found the scale to have valid internal consistency reliability indices using parents as proxies. The questionnaire is however still in development.

There are very little published population-based data on Asian children with vision impairment¹⁴ and given that visual conditions such as refractive errors are common in Singapore, this is an important area that deserves attention. Although there is no widely used vision-specific instrument to measure the functional impact of vision disorders in children, generic health-related QoL (HRQoL) scales are alternative options. In adults, scales such as the Short Form-12 (SF-12) and Short Form-36 (SF-36) have been used to demonstrate a significant relationship between vision loss¹⁵; ocular conditions (refractive error,¹⁶ glaucoma,¹⁷ diabetic retinopathy,¹⁸ age-related macular degeneration,¹⁹ and retinal diseases²⁰); and core generic dimensions such as social functioning, physical, and emotional well-being. In the absence of a vision-related scale, it can be hypothesized that the impact of refractive errors could be assessed by a generic pediatric HRQoL scale.

The Pediatric Quality of Life Inventory (PedsQL 4.0) has been used to assess general health-related QoL in children as young as 2 years old.^{21,22} The PedsQL 4.0 is the product of a programmatic instrument development research since 1987.^{23,24} From versions 1.0, 2.0, and 3.0, PedsQL 4.0 represents the outcome of an iterative process with previous versions and is designed to measure the core health dimensions delineated by World Health Organization (WHO) in 1948. Initially developed in the United States, the scale has been translated in several languages other than English and has been internationally used (including Singapore²⁵) and in multiple conditions.^{26–31} The aim of this article was therefore to

determine if the PedsQL 4.0 is a valid instrument to assess the impact of refractive errors on general and specific domains of HRQoL in Singapore Chinese children.

METHODS

Study Population

The STRabismus, Amblyopia and Refractive error in Singapore preschoolers study (STARS) is a population-based study examining the prevalence of ocular disorders principally refractive error, amblyopia, and strabismus in Singaporean Chinese children. A representative sample of 3000 Chinese children aged 6 to 72 months living in Housing Development Board (HDB) apartments in the south western part of metropolitan Singapore were recruited for the study. Our study used a subsample of the STARS group, which included children aged 25 to 72 months. Enumerated households were contacted and residents with eligible children were recruited. A total of 3009 children were examined in the STARS study, with a participation rate of 72.3%. All clinical examinations were conducted by trained eye care professionals. At the clinic visit, parents of children aged 25 to 72 months were invited to complete the PedsQL 4.0 survey. Research staff administered each questionnaire to the parents by an interview process. The study obtained ethics approval from Institutional Review Boards of the Singapore Eye Research Institute and the National Healthcare Group and was conducted according to the tenets of the Declaration of Helsinki.

Measures

The PedsQL 4.0 Generic Core Scale—The PedsQL 4.0 Generic Core Scale includes the following subscales: physical functioning (8 items); emotional functioning (5 items); social functioning (5 items); and school functioning (3 items for ages 25 to 48 months and 5 items for those aged 49 to 72 months). It was developed through focus groups, cognitive interviews, pretesting, and field-testing measurement development protocols.^{22,32} A 21-item PedsQL 4.0 is available for children aged 25 to 48 months, and a 23-item version is used for those aged 49 to 72 months. Two items from the “school functioning” subscale of the 23-item version are not included in the 21-item format, namely “Forgetting things” and “Paying attention in class.”

The PedsQL 4.0 comprises parallel child self-report and parent proxy-report formats. The parent proxy-report forms are designed to assess the parent’s perceptions of their child’s HRQoL although it is acknowledged that proxy-report’s estimate may be insufficiently accurate.²² However, parents’ perceptions of their child’s life quality tend to influence health care utilization³³ and can be useful when the child is either unable or unwilling to complete the scale.²² Child self-report forms are available for age 60 months onwards, whereas parent proxy-report forms includes ages 25 to 48 months (toddler) and 49 to 72 months (young child) onwards. As our study population ranged from ages 25 to 72 months, we used the parent proxy-report forms. The questionnaires were translated into Chinese by two different translators. Both translated versions were compared and back-translated into English and administered in the parent’s preferred language.

The survey asks how much of a problem each item has been during the past month. A 5-point response scale is used (1 = never a problem; 2 = almost never a problem; 3 = sometimes a problem; 4 = often a problem; and 5 = almost always a problem). The physical health summary score (8 items) is the same as the physical functioning scale. The psychosocial health summary score (13 items for ages 25 to 48 months or 15 items for ages 49 to 72 months) is calculated by summing the item scores divided by the number of items answered in the emotional, social, and school functioning scales. The total score is the sum of all the item scores across all scales divided by the number of answered items. The study testing protocol ranged from 45 to 90 min and questionnaires, including the PedsQL 4.0, were administered in the first 15 to 30 min of the testing protocol. Three trained interviewers administered the questionnaires between May 2006 and November 2008.

Clinical Examination—The following eye and physical tests have been described extensively in a previous publication.³⁴ They include (a) height/recumbent length, weight, and automated blood pressure; (b) distance VA, stereoacuity, and color vision; (c) axial length and anterior chamber depth; (d) pupil response testing, slit-lamp anterior segment examination, and cover testing; (e) cycloplegic autorefraction and keratometry; (f) cycloplegic retinoscopy, if unable for or unreliable autorefraction; and (g) fundus examination, using direct or indirect ophthalmoscopy.

Statistical Analysis

Rasch Analysis—We initially used Rasch analysis to determine the validity, reliability, and measurement characteristics of the PedsQL 4.0 separately for the groups 25 to 48 months and 49 to 72 months.^{35–38} We used Winsteps (version 3.67)³⁹ and the Andrich rating scale to determine whether the PedsQL 4.0 data fitted the Rasch model.⁴⁰ We first examined the pattern of category thresholds. Disordered thresholds indicate that the participants could not reliably discriminate between the response categories and is usually addressed by category collapsing. Estimates of person and item measures were then examined and their validity and reliability were evaluated. Rasch analysis locates item difficulty and person ability on a Logit scale. A Logit (log-odds unit) is the log odds ratio of the probability of a person endorsing a particular rating scale step in an item over 1- the same probability. Therefore, persons of higher ability and items of greater difficulty are located on the positive side of the Logit scale, whereas persons of lower ability and items of less difficulty are located on the negative side. For the Rasch analysis, the rating scale was reversed (1 as 5, 2 as 4, 4 as 2, 5 as 1, and there was no change for 3) for ease of interpretation of the scores indicating participants with higher ability were given higher scores.

Targeting is a method of assessing how well the items in the scale target the sample population and is assessed by inspecting the person-item maps. The means of the person and item measures are expected to be close to each other to be considered as a good targeting. If the mean person measure is significantly lower or higher than the mean item measure, the scale is too easy or too hard for the sample. Targeting can also be measured by the difference between person and item mean values, which in a perfectly targeted instrument would be 0. A difference between means of more than one Logit indicates notable

suboptimal targeting. Content validity is also tested using the person separation value as a measure of precision and can be used to calculate how many groups or strata of person ability the instrument can discriminate.^{41–44} The higher the person separation reliability (PSR), the more groups the instrument is able to define. A PSR value of 0.80 indicates that three strata can be discriminated and 0.90 four strata.⁴³ A PSR of 0.80 is the minimum level of discrimination for an instrument to be considered satisfactory.⁴⁵

To test the hypothesis that the PedsQL 4.0 measures a single underlying construct (child's health related QoL), we examined the fit statistics and principal component analysis (PCA) of the residuals. The fit statistics are indices that indicate how well the data fit the model and are mostly examined by "Infit" statistics. The information-weighted (Infit) statistic is based on the chi-square statistic with each observation weighted by its model variance. Infit is more sensitive to the pattern of responses to items targeted on the person. Mean square (MNSQ) fit statistics show variance in the data and the value is expected to be 1.0. The MNSQ values <1.0 indicate the items are too predictable which could be due to redundancy. High Infit MNSQ values suggest unpredictability because of noise in the data and are considered misfitting for the people the items are targeted. The values between 0.7 and 1.3 are considered acceptable.

The PCA of Rasch residuals (difference between the observed and expected responses) is used to investigate secondary dimensions in the data.^{46–48} The data are considered unidimensional if the variance explained by the measures is more than the residual variance, and there is no common factor explained by the first contrast in the residuals. The variance explained by the measures for the empirical calculation should be comparable with that of the model and should be more than 60% for an acceptable model.³⁹ Furthermore, the unexplained variance by the first contrast should be <3.0 Eigenvalue units (<5%), which approximates that seen in random data.

RESULTS

Participants' Demographics

Of the total 3009 children examined in the STARS, parent-administered "quality of life" questionnaires were completed for 1921 children, 965 (50.2%) boys and 956 (49.8%) girls aged between 25 to 72 months (mean age = 49.32 months). The toddler and young child groups included 939 (48.9%) and the 982 (51.1%) participants, respectively. The characteristics of these two groups are shown in Table 1. The overall mean spherical equivalence for the right eye was +0.16 D (range = +5.80 D to -16.40 D). Most children's VA measurements were better than 6/9 ($n = 1286$, 89.6%), with 86 children (6.0%) having VA measurements within 6/9 to 6/12. With both groups combined, only 63 children (4.4%) were considered to have visual impairment (VA <6/12; Table 1).

Validation of the PedsQL 4.0

Rasch analysis for the 21-item and 23-item PedsQL 4.0 questionnaires showed similar results. The category thresholds were disordered for both scales suggesting our participants could not reliably discriminate between the response categories (Fig. 1A). The response

category 2 “often a problem” was less frequently used. To resolve this, adjacent categories 2 and 3 and 4 and 5 were collapsed and recoded as 1 “almost always a problem”; 2 “often or sometimes a problem”; and 3 “almost never or never a problem.” These produced ordered thresholds (Fig. 1B).

Table 2 shows the item measures estimated for the toddler and young child groups, respectively, in Logits and Infit MNSQ values. The item “bathing” showed misfit for both groups (Infit MNSQ = 1.68 and 1.54, for toddlers and young children, respectively). Its removal however did not influence the fit statistics in both the scales and it was therefore kept.

Fig. 2 displays the person-item maps determined by the Rasch analysis for the 21- and 23-item of the PedsQL 4.0, respectively. Rasch-calibrated person measures (#) are on the left hand side and relative item locations are on the right hand side. Floor and ceiling effects (items and participants, respectively) were evident for both scales, which indicate poor targeting of the items to the sample. If the items were well targeted to the sample, the means of the two distributions, denoted by M in the Fig. 2, would be close to each other. The mean person measures were 5.55 (SD, 1.13) Logits for the toddlers and 5.22 (SD, 1.22) Logits for young children indicating the perceived ability of our sample is more than the required ability of the items. Ideally mean values should approximate 0.

Examination of the person fit statistics showed poor fit to the Rasch model for both scales. One-half the participants in toddler (n = 465, 49.5%) and young child (n = 490, 49.8%) groups were considered to have a pattern of extreme responses. All these participants reported that they did not have a problem with the items in the scales. However, removal of these participants did not improve the fit statistics.

The separation reliability was 0.00 for toddlers and 0.03 for young children, indicating there was no variance in each sample. The PCA of the items residuals revealed substantial multidimensionality as the variance explained by measures was only 22.8% (31.1% by Rasch model) in the toddler group and 20.2% (28.8% by Rasch model) in the young children group. A minimum value of 60% is usually considering acceptable.³⁹ The unexplained variance by the first contrast accounted for 1.9 Eigenvalue units in both groups, suggesting there are no clear factors determining the second dimension.

As the PedsQL 4.0 displayed poor psychometric properties as an overall scale, we further assessed the psychometric validity of its four subscales separately using Rasch analysis. However, all sub-scales equally showed poor fit characteristics (Table 3). The main reason for the poor validity of the scale is due to lack of variance in the sample. This was mostly because of 89.6% of the participants in this study had VA better than 6/9. In other words, they did not have any visual disability of significance. Consequently, to determine if the scale was valid for those with vision loss, we assessed the PedsQL 4.0 using participants with vision impairment (VA <6/12) for both age groups. Again, both versions showed poor psychometric properties even with sample with vision impairment and deletion of the misfitting items did not improve the fit statistics (Table 4).

Finally, we assessed the PedsQL 4.0 conformity to the Guttman Scale,^{49,50} which is a matrix of items (in columns) ordered by average rank scores across all persons and the persons (in rows) ordered by average rank scores across all items. Establishing a hierarchy with a Guttman scale helps to legitimize the use of a summed score because the rank ordering of scale items is confirmed. Fig. 3A illustrates an ideal scalogram that fits the Guttman scale, which is color-coded with red representing the hardest items and most able persons and blue representing easiest items and least able persons. When the items and persons are rank-ordered, a diagonal pattern is seen. Fig. 3B, C illustrate scalograms of the PedsQL4.0 data for the toddler and young children groups, respectively. The lack of diagonal patterns in both figures indicates that the data do not conform to the Guttman scale and should therefore not be used in its raw form.

DISCUSSION

In this article, we investigated if PedsQL 4.0 was a valid HRQoL scale to assess the impact of ocular conditions on overall health and specific domains such as physical, emotional, social, and school functioning in toddlers (25 to 48 months) and young children (49 to 72 months). We were, however, unable to generate valid scores for any of the latent traits assessed in this study. Most of the responses were considered “extremes” indicating that respondents repeatedly answered that they had “no problem” with the items on the questionnaire. There was almost no variance recorded in this sample. With person separation values approximating 0, the scale demonstrates that it could not discriminate between groups with different levels of the trait being measured. The findings of poor person separation reliabilities were consistent for both aged groups and also those with vision impairment alone (VA <6/12). Combined with poor targeting, disordered thresholds, and evidence of multidimensionality, our findings indicate that the PedsQL 4.0 is not suitable to assess generic overall and associated health domains in this population. Considering the PedsQL 4.0 has never been validated using Rasch analysis, future studies would need to determine if it is psychometrically a suboptimal instrument across all conditions or unsuitable for use in young children with refractive errors.

Our findings contrast with those which have investigated the impact of vision impairment and/or visual field loss in adults using HRQoL scales such as the SF-12,¹⁸ SF-36,^{15,51,52} The WHOQOL,⁵³ EuroQoL (EQ 5D),^{54,55} and Health Utilities Index Mark 3.^{56,57} Although disease-specific instruments have shown to be more sensitive to assess the impact of vision loss, several studies have shown a significant relationship between the severity (and/or ocular conditions) and general health status in community living, clinical, or residential care samples. All these investigations, however, have used a classical test theory (CTT) approach to analyze their data. Underpinning CTT is simple scoring of responses to questionnaires; for multi-category response scales, this is usually summary scoring where response categories are assigned ordinal numbers that are summed across questions to arrive at a total score. Whether the findings of these studies would persist using an Item Response Theory method as used in this current investigation would need to be ascertained.

Other factors may also have contributed to the main finding of this study. The initial PedsQL 1.0³² was derived from a cancer database and designed as a generic instrument to

be used non-categorically across pediatric populations. The validity of the core items was established from healthy children and those with acute or chronic health conditions. Although the authors endeavored to maximize the heterogeneity of the sample during the validation phase, children were recruited from only four hospital speciality clinics namely orthopaedics, cardiology, rheumatology, and diabetes. As such, the non-inclusion of children with sensory impairment in the developmental phases of the PedsQL, may partly explain its unsuitability for use in this population. Another potential contributing factor to the inappropriateness of the PedsQL 4.0 to our sample is the absence of a “Not applicable” response option, which “compelled” the majority of our respondents to choose the option “Not a problem.” This, in turn, contributed to the substantial invariance shown in our data. Contrary to traditional methods of analyzing psychometric data, Rasch analysis is suited to handle missing data because the estimation of a person’s latent trait is based on the person’s observed item responses. The inclusion of a “Not applicable” option will have informed about items relevant to this population and perhaps generate valid overall and subscales scores for those who have answered relevant items.

The PedsQL 4.0 has been used in previous trials in vision research. Chak and Rahi⁵⁸ implemented it in children with congenital cataract. The authors concluded that the PedsQL 4.0 was an acceptable instrument for assessing generic HRQoL for children and their parents. Considering that the authors used a CTT approach to analyze their data, caution is warranted about the validity of the authors’ concluding statement. A recent study evaluated the impact of presenting visual impairment and refractive errors in an Asian population of adolescent school pupils using the PedsQL 4.0.¹⁴ Although the authors used summary scores, they concluded that healthy adolescents with visual impairment experienced statistically although not clinically impaired HRQoL, and refractive errors did not appear to have an impact on QoL. Summary analyses of our data (not shown in our results) would also have indicated that there were no significant associations between those with and without vision loss or ocular conditions on the overall and sub-scales of the PedsQL 4.0. This finding indicates that the PedsQL 4.0 in its current state is unsuitable for use in toddlers and younger children with vision impairment or refractive errors in an Asian population. It is possible that the questionnaire is not specific or suitable for mild eye disorders such as refractive error. Alternatively it is possible that moderate levels of visual impairment may not significantly impair functional quality of life (or at least the parental perception of it) in children of this age. Further studies are, however, needed to substantiate these hypotheses.

The use of Rasch analysis or other forms of Item Response Theory to analyze patient-centered outcome data has been critically highlighted in this trial. As mentioned earlier, the use of a CTT approach by the study investigators would have concluded that refractive errors have no impact on generic health-related QoL. This would have been an erroneous conclusion as refractive errors may potentially have an impact on QoL but our scale of choice is unsuitable to assess this relationship. In addition to a lack of variance found in the data, the PedsQL 4.0 was also found to display (a) poor targeting, (b) disordered thresholds, and (c) multidimensionality. Therefore, compared with CTT, Rasch analysis provides unparalleled insight into the psychometric properties of questionnaires, including appropriateness of the response categories, measurement precision, unidimensionality, and

item fit to the construct. It remains the indispensable statistical technique to analyze questionnaire data.^{46,59–63}

The strengths of this study are its population-based nature and the relatively large sample size. The STARS study was undertaken on a large representative sample of young Singaporean Chinese children who resided in the south western regions of Singapore. The participation rate was 72.3%. The use of Rasch analysis to validate a PedsQL 4.0 scale available in English and Chinese is another strong point of this study. To our knowledge, this is the first time this technique has been used in a population-based survey of eye diseases in toddlers and young children. Conversely, the cross-sectional design is a limitation of this study. Another potential shortcoming is the lack of a prestudy validation phase to test the PedsQL 4.0 using a small sample. However, considering the low prevalence rates of visual impairment or myopia in each age group, it would have taken a similar period of time to collect the data for the prestudy phase as for the main study. In addition, we would have lost the benefits associated with population-based designs. Nonetheless, our study findings are useful in providing directions for future population-based pediatric investigations including our STARS follow-up study.

In conclusion, this study was unable to effectively evaluate the impact of refractive errors on HRQoL in toddlers and young school children in Singapore using the PedsQL 4.0. The scale failed several key psychometric properties of questionnaire validation. Considering that only 3.7 and 2.7% of the toddlers and school children, respectively, had vision impairment, it is possible that their resulting visual disability was of too little magnitude to impact on the current items of the PedsQL 4.0. Future studies could consider if the PedsQL 4.0 can be psychometrically reengineered for use in this population by including additional items. Alternatively, future studies should investigate the development and validation of a disease-specific QoL instrument in very young children with ocular conditions.

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FIGURE 1.

Category probability curves showing disordered thresholds using five response categories of PedsQL 4.0 (Panel A) and ordered thresholds after having collapsed categories 1, 2, and 3 of the PedsQL 4.0 (Panel B).

FIGURE 2.

Person-item map of the 21- and 23-item PedsQL 4.0 questionnaires for the (A) toddler and (B) young children, respectively, showing the distribution of the person (left) and item measures (right). More able participants and items with high problem are near top of the diagram with less able participants and items with fewer problems near the bottom. M, mean; S, 1 SD from the mean; and T, 2 SD from the mean.

FIGURE 3.

Left-most panel (A) represents an ideal scalogram that fits Guttman scale. Middle (B) and right-most (C) panels are scalograms for PedsQL4.0 data for the toddler and young children groups. The white cells represent missing data. The lack of diagonal patterns in (B) and (C) indicates that the data do not conform to the Guttman scale and should therefore not be used in its raw form.

TABLE 1

Characteristics of the study participants

	Toddler (25–48 months)	Young child (49–72 months)
Number of participants	939	982
Age (months)		
Mean $\pm$ SD	37.13 $\pm$ 6.82	60.5 $\pm$ 6.82
Range	25–48.95	49.02–72
Gender		
Male (N, %)	463 (49.3%)	502 (51.1%)
Female (N, %)	476 (50.7%)	480 (48.9%)
Presenting VA		
6/6–6/9 (N, %)	399 (42.5%) ^a	887 (92.4%)
<6/9–6/12 (N, %)	54 (5.7%)	32 (3.3%)
<6/12–6/18 (N, %)	32 (3.4%)	22 (2.2%)
<6/18–6/60 (N, %)	4 (0.4%)	5 (0.5%)
Refractive error (spherical equivalent)		
Mean (D) $\pm$ SD	0.47 $\pm$ 1.13	0.74 $\pm$ 1.22
Range (D)	–9.38 to 4.15	–16.40 to 5.80
Myopia (–0.50 D) (N, %)	149 (15.9%)	90 (9.2%)
Hyperopia (+2.00 D) (N, %)	54 (5.7%)	69 (7.0%)
Amblyopia (N, %)	22 (2.3%)	15 (1.5%)
Strabismus (N, %)	11 (1.2%)	10 (1.0%)
Parent education level (N, %)		
No education	1 (0.1%)	1 (0.1%)
Primary school	87 (9.3%)	105 (10.7%)
Secondary school	105 (11.2%)	142 (14.5%)
Pre-university level	161 (17.1%)	183 (18.6%)
Polytechnic/Diploma/ Certificate	270 (28.8%)	264 (26.9%)
University	299 (31.8%)	271 (27.6%)
Others	4 (0.4%)	6 (0.6%)
Parental myopia status (N, %)		
Neither father nor mother	261 (27.8%)	307 (31.3%)
Either father or mother	372 (39.6%)	375 (38.2%)
Both father and mother	305 (32.5%)	298 (30.3%)

^aMissing data for 450 toddlers (48%).

TABLE 2

The item Infit statistics and Logit scores of PedsQL 4.0 for the toddler (25–48 months) and young child (49–72 months) group

Item No.	Items	25–48 Months		49–72 Months	
		Item Logit	Infit MNSQ	Item Logit	Infit MNSQ
1	Walking	-1.56	1.29	-2.10	1.02
2	Running	-1.40	0.98	-2.62	0.97
3	Participating in active play or exercise	-1.26	0.93	-2.62	0.96
4	Lifting something heavy	-0.40	0.97	-0.70	0.93
5	Bathing	1.80	1.68	1.57	1.54
6	Helping to pick up his or her toys	0.17	0.98	0.03	0.99
7	Having hurts or aches	0.17	0.93	0.34	1.03
8	Low energy level	-1.14	1.02	-1.38	0.90
9	Feeling afraid or scared	2.12	0.83	1.67	0.87
10	Feeling sad or blue	0.57	0.86	0.90	0.90
11	Feeling angry	2.55	0.88	2.21	0.94
12	Trouble sleeping	1.00	1.11	0.50	1.17
13	Worrying	-1.55	0.96	-0.09	0.89
14	Playing with other children	0.57	0.98	-0.17	0.99
15	Other kids not wanting to play with him or her	-0.73	0.90	-0.24	0.87
16	Getting teased by other children	-0.43	1.03	-0.13	0.93
17	Not able to do things those other children his or her age can do	-0.84	0.94	-0.70	1.03
18	Keeping up when playing with other children	-1.95	0.98	-1.19	1.32

Item No.	Items	25–48 Months		49–72 Months	
		Item Logit	Infit MNSQ	Item Logit	Infit MNSQ
19	Keeping up with school activities	−0.47	0.85	−0.35	1.16
20	Missing school/day care because of not feeling well	1.61	0.98	1.15	0.89
21	Missing school/day care to go to the doctor or hospital	1.17	1.00	0.72	0.94
22	Paying attention in class	N/A	N/A	1.91	1.14
23	Forgetting things	N/A	N/A	1.28	1.11

TABLE 3

Rasch analysis fit statistics of the subscales of the PedsQL 4.0

Subscales	No. of items in subscale	No. of misfitting items	Person separation reliability	Mean person location (Logits)	Principal component analysis			Variance explained by Rasch model (%)
					Eigenvalue for first contrast	Variance explained by measures (%)		
21-item PedsQL 4.0								
Physical function	8	0	0.00	4.54	1.7	33.0		37.0
Emotional function	5	1	0.00	6.31	1.5	39.7		39.8
Social function	5	0	0.00	5.87	1.6	29.8		28.3
School function	3	1	0.00	3.14	1.7	64.1		46.8
23-item PedsQL 4.0								
Physical function	8	0	0.00	5.07	1.6	38.4		46.2
Emotional function	5	1	0.00	5.13	1.5	36.8		35.0
Social function	5	0	0.06	4.63	1.7	20.4		21.9
School function	5	0	0.00	4.55	2.0	23.7		24.9

TABLE 4

Rasch analysis of the PedsQL 4.0 for sample with vision impairment (VA <6/12)

Questionnaire	No. of misfitting items	Person separation reliability	Mean person location (Logits)	Principal component analysis		
				Eigenvalue for first contrast	Variance explained by measures (%)	Variance explained by Rasch model (%)
21-item version	2	0.00	4.20	2.4	34.0	40.9
23-item version	3	0.00	4.02	3.2	13.7	14.1