

# Item Analysis of the Japanese Version of the Generic Health-related Quality of Life Questionnaire for Children and Adolescents : Kid-KINDL-R and Kiddo-KINDL-R

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## Abstract

We investigated psychometric properties of the Japanese versions of the Kid-KINDL-R and Kiddo-KINDL-R, questionnaires to measure generic health-related quality of life (QOL) of children and adolescents, based on single item scores. Results of item analysis and confirmatory factor analysis confirmed that these scales include some items that do not function in the same way in the Japanese version of these questionnaires as in the original versions. In particular, items 20 and 24 have especially low factor loadings, and hence appear unlikely to measure the dimensions of QOL that they are associated with in the original version of the questionnaires. We attempted to improve model fits using two different approaches. In the first approach, items 20 and 24 were deleted. In the second approach, another factor that represents the negative wording effect was introduced into the model. Both approaches improved model fits in the Kid-KINDL-R and Kiddo-KINDL-R. Moreover, introducing a negative wording factor improved model fits better than deleting items. In addition, the model fit of the Kiddo-KINDL-R was worse than that of the Kid-KINDL-R, and there was variation between the two questionnaires in terms of which subscale contributed more to general QOL measurement. This suggests that the Kid-KINDL-R and Kiddo-KINDL-R, which are basically identical in terms of item content and are intended to differ only in wording and phrasing, might differ in their structure. However, our results also verified that the basic structure of the Japanese versions of the Kid-KINDL-R and the Kiddo-KINDL-R, where general QOL is measured via six subscales, was relatively valid.

**Key words:** quality of life (QOL), QOL of adolescents and children, KINDL-R, item analysis, factor structure

## Introduction

The concept of quality of life (QOL) is increasingly being used as a theoretical framework for assessing outcomes in many fields. However, QOL is a broad and vague concept, and the specific content that defines QOL varies between domains (Fayers and Machin 2000). One of the general definitions of QOL is given by the WHOQOL Group (1993) as “an individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.” That is, the main concept of QOL should capture one’s subjective satisfaction with the situation or related issues.

In this study, we focused on QOL in everyday life. QOL in this sense is very useful because we can measure the impact of various real-life problems through one common scheme. One of the representative scales available for this purpose is the WHOQOL-100 (WHOQOL Group 1993) or the WHOQOL-BREF (WHOQOL Group 1998), which is an abbreviated version of the WHOQOL-100. These

questionnaires have the advantage of having been validated in many countries that differ in culture, custom, and economic level. Therefore, the WHOQOL is versatile, and results from different groups and countries can be compared.

However, there exists at least one situation where we cannot easily employ the WHOQOL when the respondent is a non-adult. The WHOQOL is intended for adults, and therefore it should not be administered to adolescents or children. Possible alternatives to the WHOQOL in such situations include the KINDL (Bullinger, Mackensen and Kirchberger 1993) and the KINDL-R (Ravens-Sieberer and Bullinger 1998a; Ravens-Sieberer and Bullinger 1998b), which are questionnaires designed to measure adolescents’ and children’s generic health-related QOL in everyday life. The KINDL-R is a revised version of the KINDL, and there are different versions based on the subject’s age and whether the rater is the subject themselves or a parent. The three self-report versions are the Kiddy-KINDL-R for children aged 4 to 7, Kid-KINDL-R for children aged 8 to 12, and Kiddo-KINDL-R for adolescents aged 13 to 16. The two proxy versions of

the questionnaires for parents are the Kiddy-KINDL-R for parents of children aged 4 to 7 and the KINDL-R for parents of children and adolescents aged 8 to 16 years. By employing the appropriate version of the KINDL-R, we can measure the general QOL of adolescents and children, which cannot be assessed using the WHOQOL.

However, the original versions of the KINDL and the KINDL-R were developed in Germany, and the validation studies were also carried out in Germany. Therefore, if we want to use these questionnaires in languages other than German, we first need to translate all the items into the new target language, and then verify whether the translated version measures QOL in the same way as the original version (see, e.g., Lee, Chang and Ravens-Sieberer 2008; Rajmil et al. 2004; Stevanovic, Lakic and Vilotic 2009; Wee et al. 2005). In the present study, we used the Japanese versions of the KINDL-R, specifically the Kid-KINDL-R for children aged 8 to 12 (Shibata et al. 2003) and the Kiddo-KINDL-R for adolescents aged 13 to 16 (Matsuzaki et al. 2007). The psychometric properties of these Japanese versions were previously verified and they showed good internal consistency, test-retest reliability, and criterion-related validity. However, those results were based on total scale scores. In the present study, we investigated statistical characteristics of the Japanese versions of the Kid-KINDL-R and the Kiddo-KINDL-R in detail, using responses to each of the items and with relatively large sample sizes.

## Methods

### Participants

We combined and analyzed data from surveys completed by two different samples. One sample consisted of 397 first-year junior high school students (45.9% male, 54.1% female) and 484 first-year high school students (45.9% male, 54.1% female). They were participants in the Global COE School Survey (Matsumoto et al. 2010), which was a 3-year longitudinal study investigating the relationship between home/family environment, school environment, and student outcomes.

This research was carried out in 2008, and three high schools and three junior high schools in Japan were involved.

The other sample consisted of 1875 second- to sixth-year elementary school students (48.1% male, 51.9% female), 878 first- to third-year junior high school students (50.3% male, 49.7% female), and 210 first-year high school students (49.3% male, 50.7% female). They were participants in a study about QOL and lifestyle, which was conducted with the help of the school board of a large urban city in the Kansai area of Japan. The research was conducted in 2009, and three elementary schools, two junior high schools, and one high school were involved.

### Measures

The Japanese versions of the self-report Kid-KINDL-R and Kiddo-KINDL-R (Matsuzaki et al. 2007; Shibata et al. 2003) were employed according to participant' age. The elementary school students completed the Kid-KINDL-R, and the junior high school and high school students completed the Kiddo-KINDL-R.

The Kid-KINDL-R and Kiddo-KINDL-R both consist of 24 items that are divided into six subscales. Each subscale corresponds to a different dimension of QOL: physical, emotional, self-esteem, family, friends, and school. Respondents are asked to recall their lives in the preceding week and rate how well each item applied to them using a Likert scale. Table 1 shows the Kiddo-KINDL-R items, but the structure of the questionnaire and the item content are basically the same for the Kid-KINDL-R. The main difference between the questionnaires is the use of age-appropriate wording and expressions. However, item 23 in the Kiddo-KINDL-R uses negative wording, whereas the same item in the Kid-KINDL-R uses positive wording ("I looked forward to the weeks ahead"). The Japanese versions used in this study were close translations of the German originals, and therefore the item content and structure described above holds for both the Japanese and original German versions.

**Table1:** Item content and structure of the Kiddo-KINDL-R

Dimension	Item	Content
Physical	1	I felt ill
	2	I was in pain
	3	I was tired and worn-out
	4	I felt strong and full of energy
Emotional	5	I had fun and laughed a lot
	6	I was bored
	7	I felt alone
	8	I felt scared or unsure of myself

Self-esteem	9	I was proud of myself
	10	I felt on top of the world
	11	I felt pleased with myself
	12	I had lots of good ideas
Family	13	I got on well with my parents
	14	I felt fine at home
	15	We quarreled at home
	16	I felt restricted by my parents
Friends	17	I did things together with my friends
	18	I was a "success" with my friends
	19	I got along well with my friends
	20	I felt different from other people
School	21	Doing the schoolwork was easy
	22	I found school interesting
	23	I worried about my future
	24	I worried about getting bad marks or grades

### Merged Dataset

By incorporating responses from two different surveys, the sample size of the merged dataset was  $N = 1875$  for the Kid-KINDL-R and  $N = 2009$  for the Kiddo-KINDL-R. The participants were asked to respond using a 5-point Likert scale (1 = never; 5 = always) in both surveys, and the corresponding number was recorded as their item response. Answers to the items using negative wording (items 1, 2, 3, 6, 7, 8, 15, 16, 20, 23 [only in the Kiddo-KINDL-R], and 24) were reverse-coded for analysis.

In addition, participants in the Global COE School Survey were required to answer items 13 and 16 separately for their father and mother. Therefore, the means of their responses for each parent were used as the answers for these items. If a response for one parent was missing, the response for the other parent was used as the answer to that question. If responses for both parents were missing, their response to the item was coded as missing. After data cleaning, the missing data rate per item ranged from 0.75 to 2.30% for the Kid-KINDL-R ( $M = 1.49\%$ ,  $SD = 0.39$ ) and from 0.20 to 1.94% for the Kiddo-KINDL-R ( $M = 0.48\%$ ,  $SD = 0.37$ ). The missing data rate per person ranged from 0.00 to 100.00% for the Kid-KINDL-R ( $M = 0.02\%$ ,  $SD = 0.08$ ) and from 0.00 to 87.50% ( $M = 0.01\%$ ,  $SD = 0.04$ ) for the Kiddo-KINDL-R.

As described above, the mean missing data rates were low. However, there were some respondents with extremely high missing data rates; in particular, respondents that were missing responses to more than 30% of the items (24 people in the Kid-KINDL-R group and five people in the Kiddo-KINDL-R group) were removed. The final dataset used in the analysis had 1851 respondents in the Kid-KINDL-R group (47.9% male, 52.1% female) and 2004 respondents in the Kiddo-KINDL-R group (50.7% male, 49.3% female).

### Results

Mean, SD, and item-total correlation for responses to each item in the Kid-KINDL-R and the Kiddo-KINDL-R are presented in Tables 2 and 3, respectively. In this analysis, when calculating results for each item, respondents with missing data for the item were omitted. Therefore, there may be different sample sizes for each item, and hence the sample size is also indicated. Mean item scores were generally high, and there was no item whose mean was less than 2.00. In particular, items 1, 7, and 19 of the Kid-KINDL-R and items 1 and 8 of the Kiddo-KINDL-R had relatively high mean scores. As a result, there is a possibility that those items do not discriminate between individuals. However, there were no items that had extremely large or small SDs. Most of the item-total correlations ranged from 0.3 to 0.5, but some items (1, 20, and 24 of the Kid-KINDL-R, and 15 and 24 of the Kiddo-KINDL-R) had relatively weak correlations, and thus may not necessarily be good measures of QOL.

Next, we verified whether the items had the same structure as the original questionnaires using structural equation modeling. The second-order factor analysis model with four items loading onto each of six factors that correspond to a dimension of QOL (represented in the structure in Table 1) was estimated for the Kid-KINDL-R and the Kiddo-KINDL-R (see Figure 1). The result of this analysis is presented in Table 4. Calculations were conducted using Mplus ver. 6.1 (Muthén and Muthén 1998-2010) and missing values were addressed by full information maximum likelihood (FIML) estimation.

The estimated model did not fit the data well for either the Kid-KINDL-R or the Kiddo-KINDL-R: CFI was less than 0.9 and RMSEA ranged from 0.05 to 0.10. In addition, the factor loadings of items 15, 16, 20, and 24 were

**Table2:** Item score analysis of the Kid-KINDL-R

Item <sup>a</sup>	Mean	<i>SD</i>	<i>N</i>	Item-total correlation
1 *	4.604	0.800	1835	0.186
2 *	4.013	1.035	1836	0.312
3 *	3.930	1.171	1832	0.372
4	4.206	1.076	1842	0.377
5	4.193	0.997	1844	0.510
6 *	4.124	1.025	1839	0.465
7 *	4.491	0.958	1837	0.407
8 *	4.207	1.199	1836	0.304
9	3.253	1.200	1845	0.511
10	3.193	1.217	1842	0.500
11	3.079	1.386	1837	0.505
12	3.078	1.220	1832	0.441
13	4.219	0.993	1842	0.443
14	4.037	1.129	1840	0.466
15 *	2.963	1.438	1822	0.218
16 *	3.628	1.247	1830	0.234
17	4.218	1.057	1844	0.324
18	3.379	1.310	1832	0.398
19	4.467	0.905	1840	0.405
20 *	3.592	1.353	1839	0.114
21	3.706	1.115	1843	0.397
22	3.544	1.291	1846	0.494
23	3.645	1.367	1842	0.446
24 *	2.819	1.548	1837	0.070

*Note.* <sup>a</sup> Asterisk indicates that the corresponding item was reverse-coded.

**Table3:** Item score analysis of the Kiddo-KINDL-R

Item <sup>a</sup>	Mean	<i>SD</i>	<i>N</i>	Item-total correlation
1 *	4.454	0.916	2000	0.294
2 *	3.670	1.226	2000	0.244
3 *	3.188	1.210	1998	0.362
4	3.307	1.153	1999	0.409
5	3.896	1.043	2001	0.507
6 *	3.605	1.108	2002	0.502
7 *	4.203	0.992	2001	0.475
8 *	4.383	0.962	1999	0.391
9	2.369	1.094	2002	0.455
10	2.383	1.071	2001	0.427
11	2.322	1.133	2002	0.476
12	2.435	1.106	2001	0.361
13	3.762	1.075	2002	0.436
14	3.735	1.119	1999	0.474
15 *	3.686	1.221	1999	0.151
16 *	3.890	1.125	1995	0.290
17	3.837	1.177	2000	0.373
18	3.816	1.071	1970	0.416

19	4.029	1.003	1994	0.463
20 *	3.370	1.226	1987	0.236
21	2.816	1.174	1999	0.330
22	3.531	1.257	2000	0.502
23 *	3.249	1.294	2000	0.219
24 *	2.509	1.292	2001	0.112

Note. <sup>a</sup> Asterisk indicates that the corresponding item was reverse-coded.

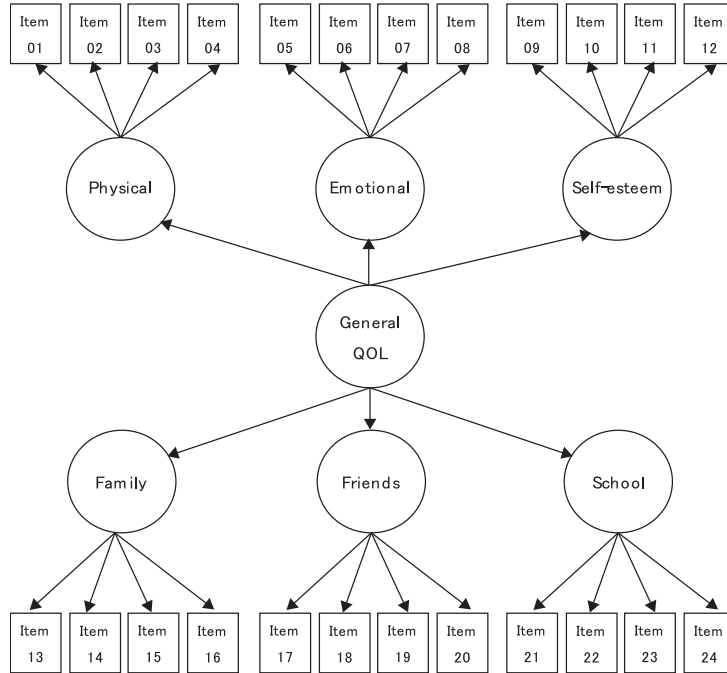


Figure 1: Path diagram of the estimated second-order factor analysis model. Note that the error terms of the 24 items and six factors corresponding to the subscales are omitted.

Table 4: Results of structural equation modeling assuming the factor analysis model corresponding to the original KINDL structure

	Kid-KINDL-R	Kiddo-KINDL-R
df	246	246
Chi-square	1708.148	3637.746
CFI	0.840	0.778
RMSEA	0.057	0.083
90% C.I.	(0.054, 0.059)	(0.081, 0.085)
Item factor loadings <sup>a</sup>		
1	0.369 ***	0.536 ***
2	0.499 ***	0.587 ***
3	0.580 ***	0.695 ***
4	0.495 ***	0.420 ***
5	0.613 ***	0.644 ***
6	0.575 ***	0.691 ***
7	0.501 ***	0.611 ***
8	0.359 ***	0.455 ***
9	0.765 ***	0.835 ***
10	0.746 ***	0.842 ***

11	0.679 ***	0.764 ***
12	0.646 ***	0.673 ***
13	0.686 ***	0.799 ***
14	0.728 ***	0.837 ***
15	0.247 ***	0.231 ***
16	0.295 ***	0.377 ***
17	0.499 ***	0.652 ***
18	0.527 ***	0.797 ***
19	0.641 ***	0.895 ***
20	0.077 **	0.063 **
21	0.507 ***	0.388 ***
22	0.765 ***	0.708 ***
23	0.661 ***	0.119 ***
24	-0.033	0.012

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

*Note.* <sup>a</sup> These are the values of standardized solutions for path coefficients from six factors corresponding to the subscales of KINDL-R to the 24 items.

relatively low. In particular, items 20 and 24 barely contributed to measurement of the corresponding factors. These results suggest that the Japanese versions of the Kid-KINDL-R and the Kiddo-KINDL-R do not function in exactly the same way as the original versions.

Next, we investigated two approaches for improving model fit. In the first approach, items 20 and 24, which had extremely low factor loadings, were deleted. In the second approach, a new factor that represents the negative wording effect was introduced into the model. Typically, in psychological measurements, both positively and negatively worded items are employed, and then one of their values is inverted during scoring to make every item score proportional to the magnitude of the psychological trait being measured. However, it has been suggested that simply inverting scores is not enough to equate negatively and positively worded items, especially in questionnaires that have relatively few items. Instead, the use of factors that represent the difference in wording are recommended to describe the structure of the scale more precisely (see for example Horan, DiStefano and Motl 2003). Therefore, we revised the model by adding one factor that represents the negative

wording effect. This new factor affected items 1, 2, 3, 6, 7, 8, 15, 16, 20, 23 (only in the Kiddo-KINDL-R), and 24, and was not correlated with other existing factors. The changes in model fit when items were deleted, when a negative wording factor was added, or when both approaches were used together, are presented in Tables 5 and 6.

Both approaches improved model fit in the Kid-KINDL-R and Kiddo-KINDL-R. Moreover, introducing a negative wording factor improved model fits better than deleting items. For the Kid-KINDL-R, adding a negative wording factor was enough to achieve an acceptable model fit, where the CFI was greater than 0.9 and the RMSEA was less than 0.05. However, the model fit in the Kiddo-KINDL-R was still poor even after applying both approaches separately and together, with RMSEA values remaining greater than 0.05. The difference between the item structure assumed in the original version of the questionnaires and the structure obtained in the Japanese versions was larger for the Kiddo-KINDL-R than the Kid-KINDL-R.

Finally, the standardized estimates of the path coefficients from the second-order factor (“General QOL”

**Table 5:** Comparison of goodness of fit indices for the Kid-KINDL-R

	Baseline	Deleted items 20 and 24	Added negative wording factor	Deleted items and added wording factor
df	246	203	236	195
Chi-square	1708.148	1361.476	917.653	762.690
CFI	0.840	0.868	0.925	0.936
RMSEA	0.057	0.056	0.040	0.040
AIC	130291.800	117140.270	129521.337	116557.481
BIC	130722.700	117309.220	130007.404	116999.360

**Table 6:** Comparison of goodness of fit indices for the Kiddo-KINDL-R

	Baseline	Deleted items 20 and 24	Added negative wording factor	Deleted items and added wording factor
df	246	203	235	194
Chi-square	3637.746	2701.809	2032.54	1522.296
CFI	0.778	0.826	0.882	0.908
RMSEA	0.083	0.078	0.062	0.058
AIC	135389.400	122233.830	133806.148	121072.316
BIC	135578.600	122637.240	134304.806	121526.151

in Figure 1) to the first-order factors (from “Physical” to “School” in Figure 1) derived from each model are presented in Tables 7 and 8. For both the Kid-KINDL-R and Kiddo-KINDL-R, the different models only showed minor changes from baseline. Therefore, the finding that all six subscales measure one common latent trait seems robust. However, which first-order factor is more strongly

affected by the second-order factor varies between questionnaires: in the Kid-KINDL-R, the path coefficient to the Emotional factor was relatively large; whereas in the Kiddo-KINDL-R, the path coefficient to the School factor was relatively large, and those to the Emotional and Self-esteem factors were relatively small.

**Table 7:** Standardized estimates of the path coefficients from the “General QOL” factor to the other factors in the Kid-KINDL-R

Factor	Baseline	Deleted items 20 and 24	Added negative wording factor	Deleted items and added wording factor
Physical	0.650	0.648	0.689	0.688
Emotional	0.861	0.858	0.920	0.917
Self-esteem	0.711	0.714	0.761	0.760
Family	0.699	0.699	0.678	0.678
Friends	0.754	0.750	0.754	0.757
School	0.742	0.746	0.764	0.766

*Note.* All of the estimates were statistically significant at  $p < .001$ .

**Table 8:** Standardized estimates of the path coefficients from the “General QOL” factor to the other factors in the Kiddo-KINDL-R

Factor	Baseline	Deleted items 20 and 24	Added negative wording factor	Deleted items and added wording factor
Physical	0.478	0.477	0.654	0.653
Emotional	0.828	0.828	0.879	0.874
Self-esteem	0.481	0.481	0.497	0.507
Family	0.567	0.567	0.547	0.549
Friends	0.630	0.628	0.678	0.672
School	0.931	0.926	0.839	0.863

*Note.* All of the estimates were statistically significant at  $p < .001$ .

## Discussion

The item score analysis shown in Tables 2 and 3 and the confirmatory factor analysis shown in Table 4 suggest that the Japanese versions of the Kid-KINDL-R and Kiddo-KINDL-R include some items that do not behave in the same way as in the original questionnaires. In particular, items 20 and 24 had especially low factor loadings, and hence appear unlikely to measure the corresponding dimensions of QOL specified in the original

structure. As shown in Tables 5 and 6, if those items are removed from the questionnaire, model fits can be improved. However, it is also possible that those items reflect different dimensions of QOL than the ones specified in the original structure. For example, it may be that item 20 is related to the Emotional dimension rather than the Friedens dimension, and that item 24 is related to the Self-esteem dimension rather than the School dimension. Therefore, further studies that explore other item/dimension structures for the Japanese versions of

KINDL-R are required.

Tables 5 and 6 indicate that adding a negative wording factor can also improve model fit. This suggests that simply inverting (or reverse-coding) item scores for negatively worded items, as prescribed in the KINDL-R manual, is insufficient to make the resulting total scale score accurately reflect respondent's QOL, at least in the Japanese versions. Instead, we can obtain a more precise measure of overall QOL by using the second-order factor analysis model with a negative wording factor and estimating individual factor scores.

With the exception of the issues described above, the Japanese versions of the Kid-KINDL-R and Kiddo-KINDL-R have acceptable psychometric structure and performance characteristics, indicating that these questionnaires can be used to estimate QOL in practical situations. As discussed in the Introduction, previous studies using scale scores of these scales reported levels of internal consistency and criterion-related validity that were similar to the original versions (Matsuzaki et al. 2007; Shibata et al. 2003). In addition, this study confirmed the validity of the basic structure of the questionnaires, in which six subscales are purported to measure one common latent trait (see Tables 7 and 8). Of course, the existence of a few items that have low factor loadings is problematic. However, because of the low value of these factor loadings, such items are expected to have less impact on the scale scores at the level of group means.

Because there already exist a lot of studies in various languages employing the KINDL-R that has the same item structure as the original version, it may not be realistic to recommend modifying the item content or structure in Japanese versions only. However, if the results of item analysis are compared between different countries, knowledge about intercultural structural differences in QOL might be profitably explored. If the measurement accuracy of certain items varies consistently between language groups, such items could be candidates for removal from all versions of the questionnaire. It is therefore highly desirable to accumulate additional data about the item structure of the KINDL-R in various languages, and to work toward greater measurement agreement or, at the least, greater transparency about cross-cultural measurement differences.

The present study also suggests that the Kid-KINDL-R and the Kiddo-KINDL-R, which are nearly identical in terms of item content and are intended to differ only in wording and expressions, might differ in their structure. As is obvious from Tables 5 and 6, the model fit of the Kiddo-KINDL-R is worse than that of the Kid-KINDL-R. This implies that some items that function well in the Kid-KINDL-R might not adequately reflect QOL in the Kiddo-KINDL-R. The results presented in Tables 7 and 8 also suggest that there is disparity between the Kid-

KINDL-R and the Kiddo-KINDL-R, such that different dimensions make different contributions to general QOL. This variation will be another important focus of future research on the KINDL-R.

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