Original Article

Psychometric Validation of a Nutrition Knowledge Questionnaire among Parents of 3–6-Year-Old Asian Indian Children in East Barddhaman District, West Bengal, India

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Abstract

Background: In India, virtually, no study was aimed to develop a psychometrically valid and reliable questionnaire to assess the nutrition knowledge and practice among parents of children aged between 3 and 6 years. **Objective:** The present study describes an evaluation of validity and reliability measures in a questionnaire designed for the assessment of nutrition knowledge among parents of children participating in a study finding relationship between physical growth and development and nonverbal intelligence quotient development being undertaken in a semi-urban area. **Design:** This was a cross-sectional school-based reliability and validity study. **Setting:** This study was conducted in seven primary schools within the limits of Purba (East) Barddhaman district legislation, West Bengal, India. **Participants:** One hundred and thirty-four parents of children aged 3–6 years were included in the study. **Results:** The final questionnaire consisted of 32 questions that were selected on the basis of content validity. Questions included closed-ended and multiple-choice items which could be answered correctly by 5%–95% of the target population with a difficulty index of 0.33–0.87, discrimination index of 0.12–0.44, and validity index of 0.10–0.86. Internal reliability of each item as measured by Cronbach's α of 0.87 was also significant. **Conclusions:** The test comprises basic psychometric criteria of a valid and reliable 32-item knowledge questionnaire which further forms an instrument for measuring current scenario and interpreting changes associated with intervention work aiming improvement of dietary and nutrition knowledge-practice in the middle-to-low socioeconomic community.

Keywords: Asia Indians, knowledge questionnaire, nutrition, parental knowledge, psychometric indices

Introduction

The *Dietary Guidelines for Americans* stated that "Healthful diets help children grow, develop, and do well in school" and recommends intake levels that are applicable to all age groups above 2 years old.[1]

Young children and their parents are important targets of lifestyle disease prevention because these early years are most important for growth and development in almost all domains in children, whereas they also gain knowledge about food, dietary preferences, and eating habits that may alter lifestyle goals.[2] Of the many factors that can influence developmental changes, a lack of nutrition knowledge is one of the most amenable to change. Children from socially deprived areas may find it harder to achieve a balanced diet when cultural, psychological, and social factors, advertising promotions, and nutrition knowledge interact with economic variables. Hence, promoting and maintaining good eating habits in childhood and changing existing eating patterns are major challenges for nutrition educators.

Over the years, questionnaires were developed to evaluate nutrition knowledge mostly for adult use.[3-8] Parmenter and Wardle established a questionnaire to comprehensively investigate nutrition knowledge in the United Kingdom and

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confirmed its reliability and validity.[3] Likewise, Wardle *et al*. showed that knowledge evaluated using this questionnaire was significantly associated with healthy eating, especially with more fruit and vegetable intake and less fat intake.[3] The need for valid and reliable tools in the area of nutrition education research for assessment of knowledge is now well established on basis of the realization that the poor association between nutrition knowledge and dietary intake may be due to the poor assessment of knowledge.[4,7,9-17] Furthermore, literature showed that the relationship between nutrition knowledge and nutritional status is often restricted to either intake data or body weight.[18-20]

There are virtually no validated tools in the literature to assess the knowledge on nutrient intake and food habit, resulting childhood obesity and other degenerative disorders which is an emerging area of concern in developing countries such as India. Since maximum developmental changes take place during childhood, the present study was aimed to develop a psychometrically valid and reliable questionnaire to assess the nutrition knowledge and practice among parents of children aged 3–6 years in a semi-urban setup participating in a study of finding the relationship and differentiation between physical growth and development and nonverbal intelligence quotient development.

Methods

Questionnaire development

The questionnaire was developed to assess practical knowledge toward a healthy balanced diet as suggested in the *Dietary Guidelines for Indians*.[21] The process of questionnaire construction consisted of forming an item pool, carrying out a content analysis, and analyzing the item difficulty, discriminative power, validity, and reliability.

Item pool

Items were designed to assess the relative nutrition content (healthy option) of familiar foods in everyday meal. The item pool addressed within the three major domains: (1) general food habit of familiar foods from everyday meal of the population; (2) source and functions of nutrients that were known to be deficient among the population; and (3) awareness about the child nutrition practice among the parents, especially mothers. Other than the above some questions on general health, nutrition was also included [Table 1]. Among the fat-soluble vitamins, Vitamin A and folic acid were selected among the water-soluble. Iron[22] and calcium are the minerals considered for its low intake and widespread deficiency. Iodine was considered for its relation to reasoning abilities and cognitive functions in early childhood. An item pool of 53 questions was included from available literature, validated questionnaire, and by consulting experts in concerned field and subjected to content analysis.

Content analysis

Content analysis was done using judgment method. All questions were direct, so no negative phrasing was used.

Table 1: Knowledge segments included under the domain of function, deficiency, and practice in the item pool

Segment	Number of items
General awareness on health and lifestyle	11
Balanced diet, physical activity, handwashing, breastfeeding	
Dietary habit	8
Regular meal of the day, frequency of intake of green vegetables, fruits, outside foods, nonvegetarian items in the diet	
Awareness on nutrients and eating habit	20
Ability to identify food sources of protein, vitamins, and minerals	
Cooking method, use of oils	
Child nutrition practice	14
Eating habit, food preferences, choice of food, frequency of eating outside foods, activity level	
Total number of items	53

A panel of five experts reviewed the questionnaire from the field of nutrition, psychology, medicine, basic science, and health communication. Acceptance, rejection, and modifications of the items were done based on majority. The questionnaire was translated into regional language, Bengali.

Scoring

The 32-item questionnaire consisted of all closed-end questions containing 15 "yes/no" questions and 17 multiple-choice questions. There was only one correct answer to each question, and option "not sure" was included to reduce bias in individual responses. For each question, subjects were asked to identify the healthier choice from a list of options according to their opinion. The responses were scored with 1 to each correct response and 0 to each incorrect or blank response.

Item difficulty index

The item difficulty index (*P*), with a value below 0.20 indicating difficult as well as a value above 0.80 indicating an easy item, was obtained by the number of participants in the group performed correctly on an item and expressed as a ratio of correct responses to the total number of questions. This particular test assesses the items neither too easy nor too difficult for the selected population.

Item discrimination index

Reliability-robustness tests that can differentiate according to a range of ability include item discrimination index (*D*), which measures the ability of the item to discriminate between the subjects who do well (27%) on the test and those who do not (27%). The *P* of the higher group was subtracted from the *P* of the lower group, resulting *D*. The higher the *D*, the more discriminating was the item. A value of 0.20–0.29 was considered "acceptable," 0.30–0.39 as "good," and > 0.40 was considered "excellent" as per available literature.[23]

Internal consistency

Reliability testing was undertaken to ensure that components of the cognitive domains related to the total assessment

(Cronbach's alpha).[24] Cronbach's alpha estimates the reliability of test scores with respect to (i) how well the individual items of the scores fit together and (ii) whether there is the same construct or not. It assesses the intercorrelations of the items in the test and the correlations of the items with the test as a whole. A value of an above 0.70 was considered acceptable on the internal consistency as per literature available.[9,25]

Pilot studies

Two pilot studies were undertaken for reliability and validity testing of the 32 item questionnaire with a total of 134 parents of children aged 3–6 years from both genders (62 girls and 72 boys) in seven primary schools in Purba (East) Barddhaman district, after a gap of 7 days.[14] Children were purposely selected from this age group cohort ($M_{age} = 4.8 \pm 1.1$) because of the mentioned age group purposely significant for examining the process of transgenerational transmission of health-related practices, recruited during September 2018 to November 2019 by one of us (ND). The questionnaire was self-administered. Oral instructions were given to the parents of each child and also informed that the questionnaire is not the part of their school work but was important that they did not confer with each other. All data were collected by the researcher herself.

An interclass correlation coefficient (ICC) was calculated considering acceptable value above 0.71. All data were analyzed using SPSS statistics, (version 21.0 for Windows version 10, Armonk, NY). $P < 0.05$ (two-tailed) was considered as significant.

The study was approved by the University Research Board. Permission was obtained from the school inspectors and principals of the participating schools and the local bodies authorized for legislative work of the Government of West Bengal, India. Written informed consent from participating parents and assent from students were obtained. This assessment comprised only one part of the overall evaluation of the intervention.

Results

The original test questionnaire was repeated with the same cohort of parents of 3–6 years of children. In total, 134 parents of children (62 girls and 72 boys) completed the revised version of the questionnaire. The main aim of the second test was for repeat reliability analysis. There was no significant gender difference in the scores of respondents during the pretest. All results were significant, indicating good correlation of individual items with the total score for the component.

The final questionnaire consisted of 6 questions on general health awareness, 6 questions on dietary habit, 7 questions on nutrition knowledge, and 13 questions on child nutrition practice and eating habit after an initial construction of 53 questions [Table 1]. The questionnaire took about 15 min to complete.

Psychometric indices

In the final questionnaire, the item difficulty index P ranged from 0.33 to 0.87. There were 11 relatively easy questions (P = 0.80–0.87) and 2 difficult questions (P = 0.33–0.40), and all the rest were in the ideal range [Table 2].

The item discriminative index D ranged from 0.12–0.44. A total of 21 questions with a discriminative index below 0.12 were discarded as poorly discriminating questions. Twelve questions with acceptable range (D = 0.12–0.22), 10 questions with good discriminative range (D = 0.23–0.33), and 4 questions with excellent range ($D \geq 0.34$) were retained, resulting in 18-item questionnaire [Table 3].

A Cronbach's α value of 0.87 was obtained for this 32-item questionnaire. No changes were carried out on the questionnaire after the local and final pilot study, as it was felt that the majority of problem issues had been addressed and it was uneconomic to undertake further pilot study for small refinements. Thus, the final questionnaire comprised a suitable range of questions for discriminating between high- and low-scoring subjects and a few questions with a suitable difficulty level but also some relatively easy and some relatively difficult questions. The ICC of 0.77 was significant at $P < 0.01$.

Discussion

In the present study, special attention was given to designing a questionnaire that could be completed by parents from low-to-medium education level and socially deprived inner-city areas and could be important to measure all the factors which have been assessed psychometrically. Several studies have been found to report knowledge questionnaire being "pretested" without providing the statistical attributes to establish its reliability and validity.[26-29] Measuring a multifaceted concept like nutrition knowledge may become difficult for subjects from economically deprived backgrounds, where not only food choices differ, but experiences with written text; linguistic code; levels of writing, reading, cognitive and conceptual skills also considerably vary.

The items queried were based on currently available data and the food items selected are widely consumed by local people. Topics used in this test focused on foods familiar to the subjects in the particular area where the studies were planned. Micronutrients selected in the questionnaire have established evidence of deficiency and also available national database for intake and/or deficiency[30], though Zn and Vitamin D deficiencies are concurrent problems worldwide; there was no national database on intake or deficiency for these nutrients in India at the time of designing the study. Accordingly, a number of questions on dietary sources that were judged inappropriate were deleted from the questionnaire. The spread of data, difficulty level, and discriminative power of this 32-item questionnaire were within acceptable ranges. Thirteen items from the domain of dietary sources of nutrients did not show a significant item to total correlation thus discarded in the final questionnaire. Some of the items were poorly intercorrelated but were retained due to content validity. The reliability of the

Table 2: Difficulty index and discrimination index values of questions included in knowledge questionnaire

Serial number	Item	*P*	*D*	Serial number	Item	*P*	*D*
1	Importance of nutrition	0.79	0.18	17	Relation of Vitamin A and eyesight	0.75	0.22
2	Responsible for daily cooking	0.86	0.15	18	Low intake of iron as a reason for anemia	0.74	0.28
3	Consumption of iron-folic acid capsule during pregnancy	0.76	0.23	19	Cooking losses of Vitamins and minerals	0.57	0.33
4	Immunization of child	0.76	0.13	20	Good eating habit	0.55	0.29
5	Breastfeeding	0.87	0.13	21	Child's eating pattern (fussy eater)	0.82	0.19
6	Importance of physical activity	0.80	0.22	22	Time taken by the child to finish meals	0.84	0.19
7	Regular meal of the day	0.81	0.17	23	Decision of choice of foods	0.82	0.19
8	Use of iodized salt	0.72	0.23	24	Choice of different types of foods	0.78	0.22
9	Frequency of fruit intake	0.79	0.18	25	Mode of eating/drinking	0.66	0.34
10	Frequency of outside food intake	0.66	0.18	26	Types of milk/milk substitutes	0.72	0.11
11	Frequency of green leafy vegetable eating	0.80	0.19	27	Frequency of outside food intake of the child	0.69	0.23
12	Types of cooking oil used	0.83	0.13	28	Daily activity level of the child	0.80	0.23
13	Example of a protein source	0.58	0.32	29	Watches TV while eating	0.81	0.19
14	Example of a Vitamin a source	0.34	0.44	30	Relation of good nutrition practice v overall school performance	0.76	0.26
15	Example of an energy source	0.33	0.40	31	Example of a good nutrition practice	0.58	0.36
16	Fruits and vegetables as a source of Vitamins and minerals	0.77	0.23	32	Example of an essential for child's growth	0.68	0.19

The item difficulty index *P* is the ratio of the number of correct responses to the total number of responses (*n*=134). The higher the index value, lower the difficulty. *D*: Discrimination index

Table 3: Summery of psychometric of the 32-item questionnaire

Index	Category	Range	*n*
Item difficulty index (*P*)	Difficult	<0.40	2
	Ideal	0.40-0.79	19
	Easy	>0.80	11
Item discrimination index (*D*)	Acceptable	0.12-0.22	18
	Good	0.23-0.33	10
	Excellent	>0.34	4
Item validity index (*r*)	Low	0.1-0.2	14
	Good	0.2-0.9	18

n: Number of items

questionnaire of α =0.87 was also within the acceptable range which is widely accepted in general nutrition knowledge test.[4]

Qualitative analysis helped to refine the questionnaire over and above an assessment of its psychometric properties alone and resulted in alteration of length, question format, nutritional criterion, and ease of reading. After modification, all scores statistically analyzed were found to have reasonable to good internal consistency. Test–retest reliability was good for all scores except the source of nutrient knowledge. As parental factors have a robust influence on food choices of their children before their adolescence, the participants of the present study were proposed to parents of 3–6-year-old children.

In addition, the recruitment method used in the study may have yielded biases inherent to chain-sampling such that the final sample is likely to resemble the initial sample. Steps were involved to minimize the bias,[31] i.e., clearly defining the population in question and initiating chains appropriately. Nonetheless, the samples included in these studies should not be taken as representative of all parents. Despite rigorous quantitative and qualitative assessment and reconstruction of questionnaire, issues may still remain over the use of questionnaires as instruments for reliably assessing nutrition knowledge over a period of time. Questioning in itself may alter postintervention effects by making respondents more aware of nutritional information and their knowledge practice. The inclusion of a corresponding sample of control subjects in designing the questionnaire, however, should help to alleviate this problem.

The development of a valid and reliable tool to measure parental nutrition knowledge practices may relate to many possible research directions. Research priorities in this area include a better understanding of the impact that good nutrition practices have on child health, eating habits, and health outcomes in both the short and long term, as well as an observation of both parent and child characteristics that are related to the use of these practices.

There are limitations that need to be considered when interpreting the study results. Research tools such as this nutrition knowledge questionnaire that can be used to assess the feeding practices of parents with children of a wide range of ages are especially useful. It is equally important to consider that further detailed work needs to be done to assure the psychometric properties of this measure are appropriate working in more diverse samples. Finally, although this scale was primarily developed for use as a research tool, additional uses are possible. This scale has potential as a clinical instrument; it is possible that researchers working with degenerative/lifestyle

disorders among children or children with eating problems could use this questionnaire to assess dietary habits, family food choices, parental knowledge, etc.

Conclusions

The questionnaire was designed to assess practical knowledge as one of several tools used to evaluate nutrition intervention aimed at improving knowledge about food, nutrient intake, and dietary record in children from a socially deprived background also can be used as an effective tool in future studies to look at the relationships between nutrition knowledge, demographic characteristics, and dietary behavior. We believe this tool could also be used without an intervention setting and may be useful in national nutrition education programs and policies and evaluating their efficacy.

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Conflicts of interest

There are no conflicts of interest.

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