



Original Article

Structural validity of the mealtime behaviour questionnaire for children with autism spectrum disorder in Japan

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Abstract. [Purpose] Children with autism spectrum disorder (ASD) exhibit many problematic mealtime behaviours. Currently, there is no process for measuring the mealtime behaviours of children with ASD in Japan. Therefore, we developed the ASD-Mealtime Behaviour Questionnaire (ASD-MBQ) using the results of surveys measuring problematic mealtime behaviours in Japanese children with ASD aged 3–18 years. The objective of this study was to analyse the structural validity of the ASD-MBQ in Japan. [Participants and Methods] We recruited 378 children with ASD aged 3–18 years and performed a confirmatory factor analysis on the ASD-MBQ by using a five-factor structure. [Results] The confirmatory factor analysis demonstrated structural validity ($\chi^2=796.5$, degrees of freedom=265, comparative fit index=0.901, root mean square error of approximation [90% confidence interval]=0.073 [0.067–0.079]). [Conclusion] We have demonstrated the structural validity of the ASD-MBQ, which provided useful information for planning interventions and evaluations for children with ASD. Further studies need to consider cut-off score by age and inter-rater reliability.

Key words: Autism spectrum disorder, Mealtime behaviour, Structural validity

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INTRODUCTION

The worldwide prevalence of autism spectrum disorder (ASD) is 1–2%¹⁾. The characteristics and varying severity of ASD are now more widely recognized—thus significantly increasing the diagnosis rate²⁾. According to the Diagnostic and Statistical Manual of Mental Disorders-5th Edition (DSM-5)³⁾, the core dysfunctions of ASD occur in two behavioural domains: difficulties in social communication and social interaction, as well as restricted, repetitive behaviours and interests⁴⁾. In addition, motor impairments are also associated with ASD⁵⁾. A previous study has reported that between 10–79% of children with ASD had clear and borderline problems with coordinating movement⁶⁾.

Difficulties with eating have been reported in 46–89% of children with ASD⁷⁾. The association between food selectivity and sensory sensitivity in children with ASD has been reported previously; sensory sensitivity, such as that observed with

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eating, can negatively affect health and education in daily life⁸). In addition, difficulties with feeding are associated with parental stress and adversely impact family functioning^{9, 10}). In Japan, a survey of children with ASD showed that problematic behaviours at mealtimes included ‘walking away from the table’ and ‘making a clattering noise (hitting or kicking furniture)’ and many poor eating habits, including ‘eating just one food item’, ‘overfilling the mouth’, and ‘swallowing food whole’¹¹). An additional survey showed that the most common concern among parents was selective eating in children with ASD aged 3–5 years that worsened with age (to a maximum of 18 years), as well as ‘cannot use spoon or chopsticks well’, ‘poor eating manners’, and ‘poor posture’¹²). Problematic behaviours at mealtimes differ according to the developmental stage of children with ASD¹²). Kurasawa et al.¹³) have reported that problematic mealtime behaviours are the most common reason why teachers of children with ASD in special support schools consult physical therapists, occupational therapists, and psychologists. For these reasons, both parents and schoolteachers seek support from these types of experts.

A comprehensive and quantitative scale to evaluate problematic mealtime behaviours in children with ASD would enable further understanding of the condition, which, in turn, could provide useful information for planning interventions and evaluating the effects of these interventions. Furthermore, such a scale would improve our understanding of the behavioural problems and allow tailoring of interventions according to the developmental stage by continuously measuring problematic mealtime behaviours from infancy to adulthood.

In the USA, the Brief Autism Mealtime Behaviour Inventory (BAMBI)¹⁴) was developed to assess mealtime behaviours in children with ASD. Following its creation, the psychometric properties were studied and the 15-item BAMBI was published¹⁵). This inventory was designed for children aged 2–11 years and has a four-factor structure: (1) Food selectivity, (2) Disruptive mealtime behaviours, (3) Food refusal, and (4) Mealtime rigidity. A 20-items pool of the BAMBI was generated from literature describing and evaluating interventions for paediatric feeding complications in children with autism in 2002¹⁴). It is intended for autism based on the DSM-4 diagnostic criteria and does not cover ASD behaviour based on the DSM-5.

Therefore, we aimed to develop an ASD-Mealtime Behaviour Questionnaire (ASD-MBQ)¹⁶) suitable for DSM-5 according to the standard scale development procedure^{17, 18}). The structural validity was assessed using exploratory factor analysis; content validity, by using expert panel review; and reliability, by Cronbach’s α . However, examination of structural validity using exploratory factor analysis is a method of hypothesis generation, and after hypothesis generation, confirmatory factor analysis, which is a method of hypothesis verification, is recommended¹⁹). Therefore, in this study, we investigated the factor structure of the ASD-MBQ using confirmatory factor analysis.

PARTICIPANTS AND METHODS

This multicentre study was conducted between August 2016 to October 2017. The participants of the present study were children and their caregivers. The inclusion criteria for the study were as follows: (1) children diagnosed with ASD by a doctor and (2) age between 3 and 18 years. The participants were recruited from 25 different facilities/hospitals with occupational therapists which specialize in developmental disorders and from 28 different self-help associations of parents of children with developmental disorders in Japan.

A total of 734 caregivers, including 450 from the aforementioned facilities/hospitals and 284 from the self-help associations, agreed to participate in this study and were sent the demographic information form, the Japanese version of the Social Communication Questionnaire, and the ASD-MBQ. We described the form and questionnaires in more detail below. We received responses from 454 individuals and excluded 76 individuals based on the inclusion criteria: 72 did not have a diagnosis of ASD, 2 were ≥ 19 years of age, and 2 did not respond to the ASD-MBQ. Informed consent was obtained from each caregivers. Figure 1 shows how the 378 respondents were recruited.

All procedures were approved by the Committee on Research Ethics of the Graduate School of Comprehensive Rehabilitation Osaka Prefecture University (approval number: 2016-207) and performed in accordance with their ethical standards and those of the 1964 Helsinki declaration and its later amendments.

Demographic Information Form: Caregivers were asked to provide their age, gender, and academic background as well as their child’s age, gender, coexisting disease diagnosis, ASD score, and the certification of intellectual disability level.

The Japanese version of the Social Communication Questionnaire: The Social Communication Questionnaire (SCQ)²⁰) was developed to assess communication and interpersonal skills. The Japanese version was created by Kuroda et al²¹). There is a current version that consists of 40 items. Caregivers responded to “Yes” or “No” questions. Higher scores indicated higher-level autism. Total scores were calculated; a higher score indicated strong ASD symptoms.

The ASD-MBQ: The procedure for developing the ASD-MBQ is as follows: Initially, the ASD-MBQ was designed with 66 items to evaluate the nature of mealtime behaviour problems in children with ASD according to 16 previously published studies. Then, we conducted a questionnaire survey and focus group interview for 11 caregivers, 16 teachers, 12 occupational therapists, and 1 speech therapist with experiences of working with children with ASD to confirm content validity. We also sought the advice of an expert panel consisting of two male and two female occupational therapists with 13 to 31 years of experiences in children with ASD. Using feedback from the focus group and the expert panel, the ASD-MBQ draft version was expanded to include 103 potential evaluation items. Items were phrased such that the caregiver was asked to indicate how often their child engages in a particular mealtime behaviour. Items were worded such that the caregiver was asked to indicate how often their child engages in a particular mealtime behaviour. Next, we conducted a further survey of 384

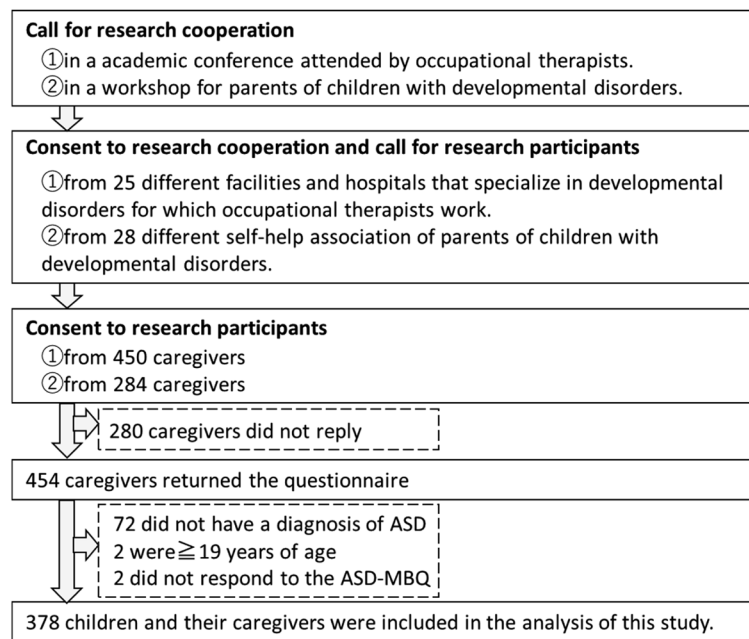


Fig. 1. Participant recruitment process.

children with ASD aged 3–18 years using the 103-item trial version ASD-MBQ; on the basis of the results of this survey, 42 items that showed floor effects were excluded from the analysis. An exploratory factor analysis was performed on the remaining 61 items, and 19 items with a factor loading of less than 0.4 were excluded and the subsequent remaining 42 items were grouped into a five-factor structure: (1) selective eating, (2) clumsiness/manners, (3) interest in/concentration on eating, (4) oral-motor function, and (5) overeating. Retention and elimination of items was based on item statistics. The Cronbach's α coefficient was 0.930 overall and 0.781 to 0.923 among the five-factors¹⁶.

The ASD-MBQ, a 42-item caregiver-report questionnaire, was developed to capture problematic mealtime behaviours specific to children with ASD aged 3–18 years¹⁶. The caregiver responds on a five-point Likert scale where 1 indicates that a certain behaviour was never observed for recent a week and 5 indicates that the behaviour is always observed for recent a week. The mean total score is calculated based on 11 criteria (items 1–11) which assess selective eating, 12 criteria (items 12–23) for clumsiness/manners, 9 criteria (items 24–32) for interest in/concentration on eating, 5 criteria (items 33–37) for oral-motor function, and 5 criteria (items 38–42) for overeating. The scores for each factor and the overall score ranged between 1 to 5 points. Higher scores indicated the presence of more problematic behaviours.

We analysed the structural validity. Due to the large number of items in the data analysis, we used an item parcelling approach. We performed confirmatory factor analysis with a five-factor structure (Table 2). To evaluate the fit of each model, we used two criteria: the comparative fit index (CFI) should be >0.90 and the root mean square error of approximation (RMSEA) should be <0.10²².

RESULTS

The mean age of the caregivers was 43.1 ± 5.6 years (range: 27–60 years) and included 368 females, 9 males, and 1 participant who did not answer the question regarding gender. Of these, 5 are junior high school graduates, 77 high school graduates, 157 junior college graduates, 137 university/graduate school graduates, and 2 did not answer the question regarding academic background.

The mean age of children with ASD was 9.8 ± 4.2 years (range: 3–18 years). Of the 378 children, 296 were male, 81 were female, and 1 participant did not answer the question pertaining to gender. The SCQ score was used as the ASD score, and the mean score was 12.4 ± 7.4 (range: 0–33). The age, gender, and intellectual disability level of children with ASD are shown in Table 1. In assessments for coexisting diseases, 25 children with ASD had learning disorder, 62 had attention deficit hyperactivity disorder, and 192 had intellectual disability. The sample size we analysed was excellent, based on the COSMIN checklist [number of samples is $\geq[(\text{the number of items}) \times 7]$ and ≥ 100]. The number of items in the ASD-MBQ and samples in which factor analyses were performed were 42 and 378, respectively, meeting the criterion for excellence. We successfully obtained responses from the full range of ages of children with ASD (3–18 years). ASD-scores ranged from low to high, and intellectual disability level ranged from severe to normal. The boy:girl ratio was 3–4:1, which is similar to that reported in

Table 1. The age, gender, and intellectual disability level of children with ASD (n=378)

Age	Gender			Intellectual disability level			Total
	Male	Female	Not answered	Severe	Medium to mild	Normal	
3 years	6	4	0	0	4	6	10
4 years	17	5	0	3	12	7	22
5 years	20	6	0	3	13	10	26
6 years	38	9	0	10	22	15	47
7 years	29	8	0	9	14	14	37
8 years	23	12	0	5	7	23	35
9 years	19	1	0	2	9	9	20
10 years	24	6	0	6	10	14	30
11 years	16	2	0	3	3	12	18
12 years	18	5	0	5	9	9	23
13 years	14	3	0	4	3	10	17
14 years	16	5	0	1	8	12	21
15 years	15	3	1	2	5	12	19
16 years	15	5	0	2	4	14	20
17 years	15	4	0	2	7	10	19
18 years	11	3	0	1	4	9	14
Total	296	81	1	58	134	186	378

epidemiological studies¹⁾.

The ASD-MBQ question items, parcels, and mean scores is shown in Table 2. We performed a confirmatory factor analysis on the ASD-MBQ with a five-factor structure ($\chi^2=796.5$; d.f.=265, CFI=0.901, RMSEA [90% CI]=0.073 [0.067–0.079]). A path diagram of the confirmatory factor analysis is shown in Fig. 2. According to the criteria, a value greater than 0.9 for the CFI would indicate a ‘traditional fit’. An RMSEA value of about 0.05 or less would indicate ‘close fit’ of the model, an RMSEA value of about 0.08 or less would indicate ‘reasonable fit’, and an RMSEA value of greater than 0.1 would indicate ‘unacceptable fit’²³⁾; according to these criteria, our data indicated a reasonable fit. There was a strong correlation between ‘oral-motor-function’ and ‘overeating’ ($r=0.703$, $p<0.001$); moderate correlation between ‘selective eating’ and ‘clumsiness/manners’ ($r=0.572$, $p<0.001$) and ‘interest in/concentration on eating’ ($r=0.479$, $p<0.001$); and a moderate correlation between ‘clumsiness/manners’ and ‘interest in/concentration on eating’ ($r=0.632$, $p<0.001$), ‘oral-motor-function’ ($r=0.429$, $p<0.001$), and ‘overeating’ ($r=0.512$, $p<0.001$).

DISCUSSION

The purpose of this study was to confirm the structural validity of the ASD-MBQ. The sample size we analysed was excellent, and a confirmatory factor analysis with a five-factor structure indicated a model fit.

The ASD-MBQ includes 42 items with a five-factor structure: (1) Selective eating, (2) Clumsiness/manners, (3) Interest in/concentration on eating, (4) Oral-motor function, and (5) Overeating; the 15-item BAMBI¹⁵⁾ has a four-factor structure: (1) Food selectivity, (2) Disruptive mealtime behaviours, (3) Food refusal, and (4) Mealtime rigidity. Both questionnaires include common questions. The BAMBI items may be capturing the consequences of sensory sensitivities by way of food selectivity, disruptive mealtime behaviours and food refusal¹⁵⁾. The ASD-MBQ has more items than BAMBI, and includes items related to clumsiness, oral function, and overeating. The participants in BAMBI development were 40 children with typical development and 68 children with ASD aged 3–11 years. The small sample size was reported as a study limitation¹⁴⁾. The participants in the development of the 15-item BAMBI were 273 children with ASD aged 2–11 years. The young age of the participants was reported as a study limitation¹⁵⁾. In this study, the analyses included 378 children with ASD between the ages of 3 to 18 years, so the ASD-MBQ included problematic mealtime behaviours of a wide range of ages. Additionally, ASD scores ranged from low to high, and intellectual disability level ranged from severe to normal, thus participants based on the diagnostic criteria of DSM-5 were covered. A previous study has reported that between 10–79% of children with ASD had clear and borderline problems with coordinating movement⁶⁾. In addition, immature oral-motor function and overeating have also been reported^{11, 24)}. This matches the results of our study, which indicated that these factors are important in our study population.

This study has several limitations. First, study participation is voluntary. Hence, our study population may not have been representative of individuals with all types of conditions. Second, we should have considered the criteria-related validity of the ASD-MBQ and BAMBI. However, there is no Japanese version of BAMBI. Mealtime behaviours and intellectual

Table 2. The ASD-MBQ question items, parcels, and mean scores (n=378)

No	Question items	Parcel	Mean \pm SD
	[Selective eating]		
1	The child only eats a few types of foods.	1	1.96 \pm 1.1
2	The child only eats certain foods/ingredients or products of certain manufacturers.	1	
3	The child does not eat food with a strong smell.	1	
4	The child does not eat some foods due to their appearance.	2	2.64 \pm 1.2
5	The child does not want tastes to be blended.	2	
6	The child does not eat some foods due to the colour.	3	2.27 \pm 1.3
7	Places to eat out are limited/restricted.	3	
8	The child does not eat food that he/she has never eaten.	4	2.33 \pm 1.2
9	The child does not eat school meals.	4	
10	The child eats a narrow variety of foods.	5	2.31 \pm 1.2
11	The child does not eat food when the shape is changed.	5	
	[Clumsiness/manners]		
12	The child eats with his/her hands, not with utensils.	6	2.10 \pm 1.0
13	The child walks away from the table during mealtime.	6	
14	The child cannot wait and eats soon after served.	6	
15	The child has difficulty handling chopsticks.	7	2.65 \pm 1.2
16	The child has difficulty with certain actions (opening the package or wrapping paper of food, opening the cap of a plastic bottle, etc.).	7	
17	The child does not hold a bowl while eating.	7	
18	The child is unable to set a meal.	8	2.00 \pm 1.1
19	The child has difficulty handling a spoon/fork.	8	
20	The child plays with food or utensils.	9	1.79 \pm 1.0
21	The child is unable to wait until mealtime.	9	
22	The child spills lots of food.	10	2.40 \pm 1.1
23	The child is unable to clear up dishes after a meal.	10	
	[Interest in/concentration on eating].		
24	The child seems to have no appetite.	11	1.69 \pm 0.8
25	The child rattles a chair or table during mealtime.	11	
26	The child is unable to concentrate on eating.	12	2.86 \pm 1.3
27	The child is unable to maintain a good posture during mealtime.	12	
28	The child continues to talk using one side during mealtime.	13	1.62 \pm 0.8
29	The child does not seem to feel hungry.	13	
30	The child is unable to eat while talking and listening to music.	14	1.92 \pm 1.1
31	The child takes a lot of time to finish a meal.	14	
32	The child is unable to switch from a previous activity to start a meal.	15	1.89 \pm 1.2
	[Oral-motor function]		
33	The child swallows food too quickly.	16	2.00 \pm 1.3
34	The child does not chew the food enough.	17	2.52 \pm 1.4
35	The child eats too quickly.	18	2.26 \pm 1.4
36	The child stuffs the mouth with food.	19	2.32 \pm 1.4
37	The child swallows food without chewing.	20	1.64 \pm 1.0
	[Overeating]		
38	The child is unable to control the amount of food he/she eats.	21	2.04 \pm 1.3
39	The child seems to not feel full.	22	1.64 \pm 1.1
40	The child eats all the food in front of him/her.	23	1.81 \pm 1.2
41	The child eats more food than other children of the same age.	24	2.01 \pm 1.3
42	The child eats a lot of food in addition to three meals.	25	2.11 \pm 1.2

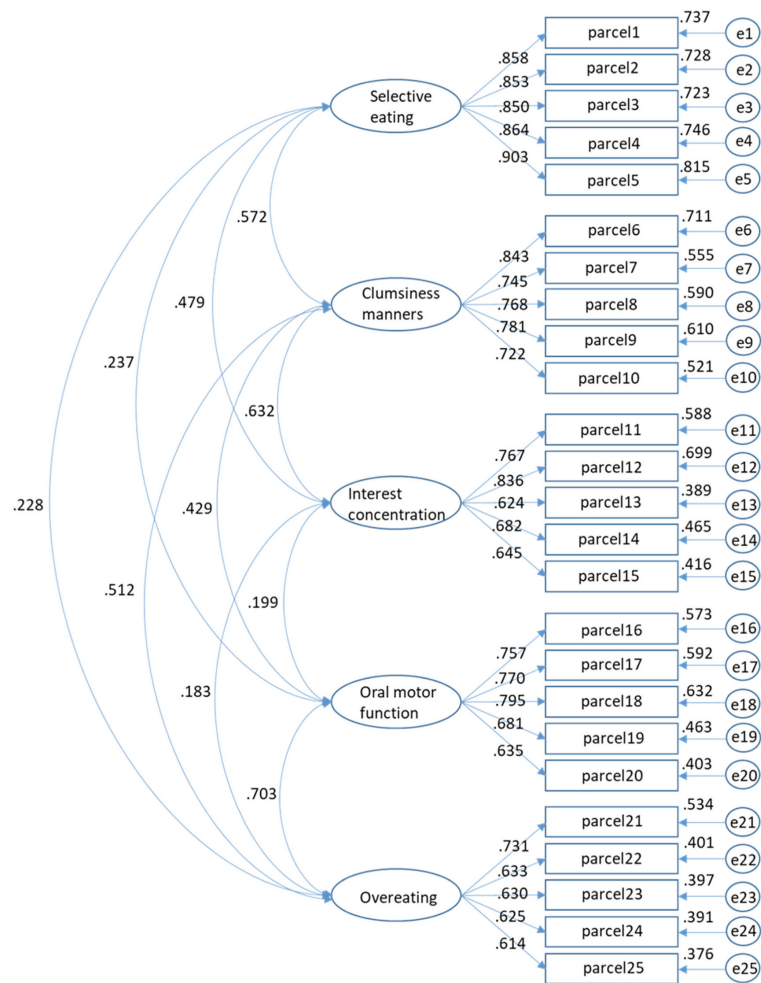


Fig. 2. Path diagram of the confirmatory factor analysis. Rectangle: observed variables; ellipse: latent variables; circle: error variables. The numerical values listed on the upper right of each variable represent the square of the multiple correlation coefficient. The closer the value is to 1, the higher the explanatory power. One-way arrow: causal relationship; two-way arrow: correlation.

development are closely related to each other in all children regardless of with or without ASD. So, future studies need to consider cut-off score by age, and to clarify whether autism itself or intellectual development affect mealtime behaviours. Finally, based on the COSMIN checklist, we should examine the inter-rater reliability.

In this study, we developed the ASD-MBQ, used it to survey ASD caregivers, and analysed the questionnaire's structural validity. A confirmatory factor analysis with a five-factor structure indicated a model fit. Based on these results, we believe the ASD-MBQ could be an effective tool to evaluate problematic mealtime behaviour in children with ASD aged 3 to 18 by helping to determine if these behaviours are related to 'selective eating', 'clumsiness/manners', 'interest in/concentration on eating', 'oral-motor function', and 'overeating'.

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Conflict of interest

The authors have no potential conflicts of interest to declare with respect to the research, authorship, and/or publication of this article.

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