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Development and Psychometric Properties of the Arabic Parent Nutritional Assessment Scale (A-PNAS) for Children with Developmental Disabilities

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ABSTRACT

Aims: To describe the development of the Arabic-Parent Nutritional Assessment Scale (A-PNAS), and to examine construct and known-group discriminant validity, internal consistency, and test-retest reliability of the A-PNAS.

Methods: A cross-sectional design was used. Participants were 130-children with CP (mean age = 4.26 ± 3.29 years) who were registered in the national CP registry of Jordan with a matching group of 130-children with typical development (mean age = 4.65 ± 3.54 years). Parents completed the developed A-PNAS through a structured phone interview. Parents of children with CP confirmed their child's level of gross motor function classification system.

Results: Exploratory factor analysis identified three subscales in the A-PNAS: *Food Intake Problems*, *Health Problems*, and *Behavioral Problems* which explained 31.6% of the variance in nutritional problems of children with CP. Cronbach's alpha indicated acceptable internal consistency for *Food Intake* ($\alpha = 0.61$) and *Health Problems* ($\alpha = 0.67$)subscales. Parents of children with CP reported that their children had more food intake, health, and behavioral problems compared to children with typical development ($p < .001$). Test-retest reliability was excellent for the subscales of the A-PNAS (ICCs = 0.96, 0.98, 0.96).

Conclusions: The findings provide support for the face validity, construct validity, internal consistency, Known-Groups discriminant validity, and test-retest reliability of the A-PNAS.

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Cerebral palsy (CP) is the most common motor disability in childhood with prevalence estimates ranging from 1.5 to more than 4 per 1,000 live births (Stavsky et al., 2017). Nutritional problems are very common among children with CP (Fung et al., 2002; Speyer et al., 2019) which are associated with poor growth, low endurance, impaired immunity, and poor quality of life for both the children with CP and their caregivers (Sullivan, 2013). Therefore, regular assessment of nutritional problems is important for early detection and effective management of malnutrition in children with CP.

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Parent-report measures of nutritional problems are important, especially in follow-up registries of children with CP, that focus on early detection of health-related problems (Almasri et al., 2018). Parents are often the first to notice and report on nutritional problems and they are also the ones who seek nutritional consultation for their children (Verrall et al., 2000). In the CP registry in Jordan (called CPUP-Jordan) there was a need to include a parent-report nutritional assessment measure that allows for early identification of nutritional problems (Almasri et al., 2018). Yet, a recent evidence analysis from the Academy Of Nutrition And Dietetics reported a common lack of measures that assess malnutrition in the pediatric population (Becker et al., 2020). Furthermore, a systematic review highlighted the lack of evidence on the validity and reliability of most of the available measures (Speyer et al., 2019). The majority of studies in these reviews used clinical assessments such as anthropometric measures which should be performed by professionals (Benfer et al., 2016, 2013; Reid et al., 2012; Sedky, 2017), whereas few assessments' scales used parent or caregiver reports (Polack et al., 2018; Sullivan et al., 2000). Most of the available nutritional assessment measures were developed for use in hospital settings and very few for use in community settings (Becker et al., 2020). Furthermore, many assessments were developed to examine one aspect of nutritional problems such as dysphagia, swallowing, or self-feeding rather than examining different aspects of nutritional problems. Therefore, we recognized a need to develop a nutrition assessment scale to measure the nutritional problems of children with CP as reported by parents who speak Arabic that could help with guiding plans of services.

This paper includes a description of the development and validation of the Arabic Parent Nutritional Assessment Scale (A-PNAS) for children with developmental disabilities. Two parent-report measures were identified in a literature search and provided the items used to develop the A-PNAS. Both measures were developed for use in clinical and community settings to screen for the need for nutritional consultation, follow-up, and intervention for children with special health needs (Schlenker et al., 2003). One is the *Parent Eating and Nutrition Assessment for Children with Special Health Needs* (PEACH) (Campbell & Kelsey, 1994). The PEACH was found to have good sensitivity (88.6%), excellent specificity (90%), and a good positive predictive value (88.6%) (Campbell & Kelsey, 1994). The second measure was the *Parent Nutrition Screening Checklist* (PNSC) which was developed based on the PEACH to detect the level of parents' concern due to the nutritional problems for their children with special needs from age 1-18 years old (Schlenker et al., 2003). The PNSC was found to have good sensitivity (82.8%), moderate specificity (60%), and an excellent positive predictive value of (92.3%) to detect the need for nutritional consultation (Schlenker et al., 2003). Neither measure, however, has been subjected to generally accept psychometric reliability and validity examination.

The aims of this study were to (1) describe the development of the A-PNAS, (2) examine the construct and known-groups discriminant validity of the A-PNAS, and (3) examine the internal consistency and test-retest reliability of the A-PNAS. The results were expected to inform further development of an Arabic nutritional assessment scale.

Methods

Study Design and Ethical Consideration

A cross-sectional design study was conducted with a cohort of families who are included in the CPUP-Jordan registry during the period 2014–2018. The registry was approved by the Institutional Review Board of the University of Jordan. The parents or other primary caregivers of children with CP or children with typical development provided informed written consent before participating in the study.

Development of the A-PNAS

Phase I: Selecting and Revising Items/Questions from the PEACH and the PNSC

The PEACH and PNSC items were reviewed to identify the initial items for the A-PNAS. Eighteen items were selected and reworded to improve readability. For example, five items on these two scales measured more than one problem: (1) "*Compared to other children the same age, my child is thin (underweight) or heavy (overweight)*", (2) "*While eating, my child usually has difficulty with: sucking or chewing or swallowing or choking or gagging or coughing or very sensitive around the mouth*", (3)"*My child usually: refuses to eat or eats too much*", (4)"*At mealtime, my child has difficulty letting me know: when he/she is hungry or what foods he/she likes to eat or when he/she is full*", and (5)"*My child drinks too much or too little liquid every day*" and were reworded since they were found difficult for parents to read and understand. Therefore, they were modified to measure one construct per item. For example, the item "*Compared to other children the same age, my child is thin (underweight) or heavy (overweight)*" was divided into two items: "*Compared to other children the same age, my child is thin (underweight)*" and "*Compared to other children the same age, my child is heavy (overweight)*". As a result, the total number of items that formed the A-PNAS was 28.

The scoring method was also modified from yes/no format to rating the level of a parent's concern related to each problem on a 4-point Likert scale: 0= problem does not exist, 1= problem exists but the parent is not concerned, 2= problem exists and parent is moderately concerned and might seek medical consultation, and 3= problem exists and parents are very concerned and will seek medical consultation. This scoring method provided a clear perspective on the nutritional problems that need to be further examined and treated by nutritionists.

Phase II: Translation of the Modified Items to Arabic

The WHO guidelines for the translation of scales like the A-PNAS were applied (WHO., 2017). First, the 28 items were translated from English to Arabic producing the forward translated version of the scale by a health professional whose native language is Arabic and who is fluent in English but who was not involved in the study. Second, the forward translated version was sent to a professional translator whose native language is English and who is fluent in Arabic for back-translation to English. Third, upon receiving the backward translated version, the authors compared and discussed the two English versions of the PNAS for accuracy, and consistency, and the intended meaning of the items. Five parents, two dietitians, and two other health professionals familiar

with the nutritional needs of children with CP reviewed the translated version of the A-PNAS. Questions were revised based on their recommendations and a few other changes were made to enhance the clarity of the items.

Phase III: Face Validity

The A-PNAS was sent to five collaborators who have professional experience working with children with CP and their families (dietitian, special educator, occupational therapist, physical therapist, and a parent of a child with CP) to provide feedback on the (1) clarity of the items, (2) clarity of the scale, (3) and readability of items. For each item, the collaborators independently answered the following questions: "Is the item stated clearly?" "Do you understand the meaning of the question?" "Do you suggest changes in the wording?" and "Do you understand the scoring scale of the answers?". Most of the changes included simplifying the items and culturally adapting the items such as removing examples on food intake questions like tofu and peanut butter which are not common types of food in the Arabic culture and adding examples to clarify the meaning of food allergies as a milk allergy.

Participants

The convenience sample was obtained from parents of children with CP who were registered in the CPUP-Jordan between the years 2014-2018. Table 1 shows the

Table 1. Characteristics of study participants.

Children's characteristics			
		Children with Cerebral Palsy (N = 130)	Children with Typical Development (N = 130)
Age (years)	Mean ± SD	4.26 ± 3.29	4.65 ± 3.54
		N (%)	**N** (%)
Gender	Female	57 (43.8%)	52 (40%)
	Male	73 (56.2%)	78 (60%)
GMFCS-E&R	Level I	36 (27.7%)	
	Level II	23 (17.7%)	
	Level III	31 (23.8%)	
	Level IV	24 (18.5%)	
	Level V	16 (12.3%)	
Parents' characteristics			
Age (years)	Mean ± SD	32.17 ± 7.77	
		N (%)	
Relationship to child	Mother	100%	
Educational level	Less than high school	65 (50%)	
	High school	24 (18.5%)	
	College degree	13 (10%)	
	Graduate degree	11 (8.5%)	
	Postgraduate degree	1 (0.8%)	
	Unreported	16 (12.3%)	
Employment	Unemployed	102 (78.5%)	
	Employed	12 (9.2%)	
	Unreported	16 (12.3%)	

*GMFCS-E&R: Gross Motor Function Classification System Expanded & Revised.

characteristics of the study participants both parents and children. One hundred and thirty parents of children with CP were included in the study with their children. The children's ages ranged between 1 month and 16 years (Mean = 4.26 years, SD = 3.29, 56.2% males). Around 30% of the participants' children had spastic diplegia, 21% had spastic quadriplegia, and 28% had hypotonia. All of the participant parents were the mothers of the children mainly because they were the main caregivers for their children and most of them were unemployed and available for the interview. Table 1 shows the distribution of the children according to their Gross Motor Function Classification System levels (GMFCS-E&R)(Palisano et al., 2008). The GMFCS-E&R is a 5-level classification system for children with CP, with Level I including children who can walk and Level V including children who are dependent on others for mobility.

A matching group of 130 children with typical development was also recruited for the study. The children with typical development were either siblings (70%) or relatives (30%) of the children with CP and within 1-4 years of an age difference. The reason was to decrease the variability due to differences in family resources and routines which might influence the nutritional choices and habits of children. The mean age of the children with typical development was 4.65 years (SD = 3.54), and 60% were males.

Procedure

A research assistant, who is a physiotherapist with five years' experience both working with children with disabilities and conducting interviews with families of these children, was trained on conducting the interviews via phone. The research assistant explained the aim of the study, obtained family consent for participation in the study, and scheduled a time for the phone interview. Parents were sent a copy of the A-PNAS before the phone call to facilitate the interview. The same research assistant conducted phone interviews with the participants. Each phone interview took approximately 20 minutes. The GMFCS-E&R (Palisano et al., 2008) scores for the children with CP were obtained from the registry records and were confirmed based on parent reports during the phone interview.

To examine the known-groups discriminant validity of the A-PNAS, 130 parents of a matching group of children with typical development were interviewed using the same protocol that is used for children with CP. For the test-retest reliability of the A-PNAS, a random subsample of 30 participant parents of children with CP was interviewed again after two weeks of conducting the first interview to report on their same child with CP.

Data Analysis

All analyses were conducted with SPSS 24.0 (IBM, 2016). The construct validity of the A-PNAS was examined by conducting an exploratory principal component factor analysis with varimax rotation. The number of factors was selected based on (1) its theoretical support; (2) the 'leveling off' of eigenvalues on the scree plot after three factors; (3) the insufficient number of items with significant loadings of 0.30 as a cutoff value; and (4) the interpretability of the factors' solutions. The factor structure of the items of the A-PNAS was examined using the following generally recognized criteria: (1) the number of items correlated 0.30 with at least one other item, suggesting reasonable factor

structure, (2) the Kaiser-Meyer-Olkin measure of sampling adequacy recommended value of 0.60, (3) the significance of Bartlett's test of sphericity, indicating that the scale items are correlated and can be summed to measure subscale scores, (4) the diagonals of the anti-image correlation matrix should be 0.40 or greater for all selected items, and (5) the commonalities should be above 0.20 for items confirming that each item shared some common variance with other items (Tabachnick et al., 2007).

The discriminant validity was tested by a known-groups method of comparison using paired *t*-tests. The effect size of differences between the means of the two groups (children with CP and children with typical development) were estimated using Cohen's *d* where values between 0.20 and 0.49 are considered a small effect size, values between 0.50 and 0.79 are considered a medium effect size, and values equal to or greater than 0.80 are considered a large effect size. The reliability of the A-PNAS was examined by calculating the internal consistency estimates (Cronbach's alpha) for each identified factor. Internal consistency is considered excellent ($\alpha \geq 0.90$), good ($0.7 \leq \alpha < 0.9$), acceptable ($0.6 \leq \alpha < 0.7$), poor ($0.5 \leq \alpha < 0.6$), or unacceptable ($\alpha < 0.5$) (Kline, 1999). The test-retest reliability was examined using the interclass correlation coefficient ICC (Two-way random, single measure). ICC values less than 0.50, between 0.50 and 0.75, between 0.75 and 0.90, and greater than 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively (Koo & Li, 2016). The variability of the scores from measurement to measurement was analyzed using the standard error of measurement (SEM = SD $\sqrt{1}$- ICC) (De Vet et al., 2006), and the minimal detectable change (MDC), indicating the smallest difference between repeated assessments that cannot be attributed to a measurement error. This was determined by the formula: MDC = $1.96 \times \sqrt{2} \times SEM$(De Vet et al., 2006).

Results

No missing data or univariate outliers were found based on data screening. Table 2 shows the frequencies of responses to each item of the A-PNAS. At least 25% of the mothers reported that their child had a problem with 5 items. Forty-one percent of the mothers reported that "*compared to other children the same age, my child is thin (underweight)*", 39% of the mothers reported that "*over one week: my child likes to eat a lot of unhealthy snack foods*", 29% reported that "*my child has a problem with bowel movement*", 28% of the mothers reported that "*my child takes supplements*", and 26% reported that "*my child takes medication to treat his/her health problems*". Less than 5% of the mothers reported the following problems with their children: "*my child usually eats too much*" was reported by 3.8%, "*my child refuses to drink liquid every day*" was reported by 2.3%, "*over one week: my child does not eat enough bread, cereal, etc.*" was reported by 2.3%, "*my child is on tube feeding*" was reported by 0.8%, and "*at mealtime, my child has difficulty letting me know when he/she is full*" was reported by 0.8%.

Construct Validity

Factor Analysis

An exploratory principal component factor analysis with varimax rotation was conducted to examine the construct validity of the A-PNAS. The eigenvalues for the first

Table 2. The number and percentages of responses to each of the *Arabic-Parent Nutrition Assessment Scale* items.

Scale Items	No problem N (%)		No concern N (%)		Moderate concern N (%)		Extreme concern N (%)	
1. Compared to other children the same age, my child is thin (underweight).	77	(59.2)	9	(6.9)	29	(22.3)	15	(11.5)
2. Compared to other children the same age, my child is heavy (overweight).	124	(95.4)	2	(1.5)	1	(0.8)	3	(2.3)
3. My child takes medications to treat his health problems.	96	(73.8)	17	(13.1)	12	(9.2)	5	(3.8)
4. My child vomits or throws up a lot.	119	(91.5)	2	(1.5)	4	(3.1)	5	(3.8)
5. My child has problems with bowel movements (e.g. constipated or too watery).	92	(70.8)	3	(2.3)	12	(9.2)	23	(17.7)
6. My child has problems with his/her teeth which makes it hard to eat.	111	(85.4)	0	(0.0)	11	(8.5)	8	(6.2)
7. While eating, my child usually has difficulty sucking or chewing.	112	(86.2)	3	(2.3)	3	(2.3)	12	(9.2)
8. While eating, my child usually has difficulty swallowing or choking.	102	(78.5)	2	(1.5)	14	(10.8)	12	(9.2)
9. My child is on a special diet (e.g. food allergies, diabetes, etc ...).	124	(95.4)	4	(3.1)	2	(1.5)	0	(0.0)
10. My child is on tube feeding.	129	(99.2)	0	(0.0)	0	(0.0)	1	(0.8)
11. My child takes supplements (e.g. vitamins, minerals, etc ...).	94	(72.3)	36	(27.7)	0	(0.0)	0	(0.0)
12. My child usually refuses to eat.	118	(90.8)	0	(0.0)	3	(2.3)	9	(6.9)
13. My child usually eats too much.	125	(96.2)	2	(1.5)	3	(2.3)	0	(0.0)
14. My child drinks too much liquid every day.	115	(88.5)	14	(10.8)	1	(0.8)	0	(0.0)
15. My child drinks too little liquid every day.	120	(92.3)	3	(2.3)	5	(3.8)	2	(1.5)
16. My child refuses to drink liquid every day.	127	(97.7)	0	(0.0)	0	(0.0)	3	(2.3)
17. Over one week: My child does not eat enough milk & milk products such as milk, yogurt, pudding, and cheese.	122	(93.8)	1	(0.8)	4	(3.1)	3	(2.3)
18. Over one week: My child does not eat enough meat, chicken, fish, eggs, and beans.	119	(91.5)	4	(3.1)	4	(3.1)	3	(2.3)
19. Over one week: My child does not eat enough bread, cereal, rice, pasta, and crackers.	127	(97.7)	0	(0.0)	3	(2.3)	0	(0.0)
20. Over one week: My child does not eat enough vegetables (includes vegetable juices).	121	(93.1)	2	(1.5)	7	(5.4)	0	(0.0)
	124	(95.4)	2	(1.5)	4	(3.1)	0	(0.0)

(*continued*)

Table 2. Continued.

Scale Items	No problem N (%)		No concern N (%)		Moderate concern N (%)		Extreme concern N (%)	
21. Over one week: My child does not eat enough fruit (includes fruit juices).	80	(61.5)	20	(15.4)	20	(15.4)	10	(7.7)
22. Over one week: My child likes to eat a lot of unhealthy snack foods (e.g. candies, chips, pop) every day.	106	(81.5)	0	(0.0)	11	(8.5)	13	(10.0)
23. My child eats non-food items (e.g. paper, dirt, bugs, and sticks).	104	(80.0)	0	(0.0)	12	(9.2)	14	(10.8)
24. My child has appetite problems	115	(88.5)	1	(0.8)	9	(6.9)	5	(3.8)
25. My child usually throws food or makes trouble during meals.	119	(91.5)	0	(0.0)	2	(1.5)	9	(6.9)
26. My child has difficulty letting me know when he/she is hungry.	112	(86.2)	2	(1.5)	10	(7.7)	6	(4.6)
27. At mealtime, my child has difficulty letting me know when he/she likes to eat.	129	(99.2)	0	(0.0)	1	(0.8)	0	(0.0)
28. At mealtime, my child has difficulty letting me know when he/she is full.								

four factors were more than 1.50. Solutions for three, four, and five factors were each examined. The three-factor solution, which explained 31.6% of the variance, was selected based on the aforementioned criteria. An exploratory factor analysis was performed with 28 items based on the following criteria: (1) it was determined that 22 of the 28 items correlated 0.30 with at least one other item, suggesting reasonable factor structure, (2) the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.62, above the commonly recommended value of 0.60, (3) Bartlett's test of sphericity was significant (χ^2 (378) = 937.7, p = .0001), indicating that the scale items are correlated and can be summed to measure subscale scores, (4) the diagonals of the anti-image correlation matrix were 0.40 or greater for all items, and (5) the commonalities were all above 0.20 except for one item, confirming that each item shared some common variance with other items.

Table 3 shows the items loading in each factor (subscale) in addition to the final complete set of items according to each subscale. The three subscales were labeled based on the items of the major loading as following: *Food Intake Problems* which are related to intake of bread, fruits, vegetable liquids, and special diets; *Health Problems* which are related to swallowing, vomiting, constipation, tube feeding, and weight problems; and *Behavioral Problems* which are related to refusing to eat or drink, throwing food, and eating unhealthy food. Higher scores of each subscale indicate more food intake problems, more behavioral problems, and more health problems. Each of the 28 items had a factor loading greater than 0.30 on the rotated factor solution on one of the three subscales except the following items: "*Compared to other children the same age, my child is heavy (overweight)*", "*My child has problems with his/her teeth which makes it hard to eat*", "*My child is on a special diet (e.g. food allergies, diabetic, etc...)*", "*My child is on a*

Table 3. Factors loadings of the Arabic - *Parent Nutrition Assessment Scale.*

Item Number	Scale Items	Factor		
		Food Intake Problems	Health Problems	Behavioral Problems
19	Over one week: My child does not eat enough bread, cereal, rice, pasta, and crackers.	**.873**	.026	-.195
16	My child refuses to drink liquid every day.	**.616**	-.005	-.101
21	Over one week: My child does not eat enough fruit (includes fruit juices).	**.587**	-.001	.036
24	My child has appetite problems.	**.510**	.160	.509
20	Over one week: My child does not eat enough vegetables (includes vegetable juices).	**.475**	-.008	-.100
18	Over one week: My child does not eat enough meat, chicken, fish, eggs, and beans.	**.425**	.127	.321
9	My child is on a special diet (e.g. food allergies, diabetes, etc ...).	**-.064**	-.023	-.030
8	While eating, my child usually has difficulty swallowing or choking.	.056	**.722**	.075
4	My child vomits or throws up a lot.	.055	**.575**	-.052
1	Compared to other children the same age, my child is thin (underweight).	.149	**.526**	.077
7	While eating, my child usually has difficulty sucking or chewing.	-.098	**.485**	-.007
5	My child has problems with bowel movements (e.g. constipated or too watery).	.152	**.447**	-.168
11	My child takes supplements (e.g. vitamins, minerals, etc ...).	.054	**.422**	-.266
3	My child takes medications to treat his health problems.	.202	**.381**	-.186
15	My child drinks too little liquid every day.	-.029	**.336**	-.019
28	At mealtime, my child has difficulty letting me know when he/she is full.	-.028	**.278**	-.080
2	Compared to other children the same age, my child is heavy (overweight).	-.054	**-.142**	-.034
10	My child is on tube feeding.	-.011	**.114**	-.097
25	My child usually throws food or makes trouble during meals.	.503	.079	**.550**
12	My child usually refuses to eat.	.488	.128	**.541**
22	Over one week: My child likes to eat a lot of unhealthy snack foods (e.g. candies, chips, pop) every day.	.038	-.108	**.485**
26	My child has difficulty letting me know when he/she is hungry.	-.018	.406	**.428**
23	My child eats non-food items (e.g. paper, dirt, bugs, and sticks).	-.073	.201	**.354**
27	At mealtime, my child has difficulty letting me know when he/she likes to eat.	.097	.090	**-.228**
13	My child usually eats too much.	-.039	.077	**-.124**
14	My child drinks too much liquid every day.	-.046	-.045	**.123**
17	Over one week: My child does not eat enough milk & milk products such as milk, yogurt, pudding, and cheese.	.039	-.027	**.119**
6	My child has problems with his/her teeth which makes it hard to eat.	.026	.055	**-.061**

tube feeding", "*My child usually eats too much*", "*My child drinks too much liquid every day*", "*Over one week: My child does not eat enough milk & milk products such as milk, yogurt, pudding, and cheese*", and "*At mealtime, my child has difficulty letting me know when he/she likes to eat*". None of the items were excluded from the final factor solutions because they reflect unique clinical constructs that are not being measured by other items.

Table 4. Internal consistency and test-retest reliability.

Subscales	No. of items	Internal consistency (n = 130)	Test-retest reliability (n = 30)			
		ά	ICC	95% CI	SEM	MDC
Food intake problems	7	0.61	0.96	0.92 – 0.98	0.13	0.36
Health problems	11	0.67	0.98	0.96 – 0.99	0.10	0.27
Behavioral problems	10	0.38	0.96	0.91 – 0 .98	0.10	0.28

NOTES. ICC = Interclass correlation coefficient; 95% CI = 95% confidence interval; SEM = Standard error of the measure; MDC = Minimal detectable change; ά = Cronbach's alpha.

Internal Consistency

Table 4 shows Cronbach's alphas for the three subscales. The Cronbach's alphas indicate acceptable internal consistency for *Food Intake* and *Health Problems* subscales and poor internal consistency for the *Behavioral Problems* subscale. No substantial increases in alpha for the *Food Intake* and *Behavioral Problems* subscales were achieved by eliminating any of the items. An increase from 0.67 to 0.70 (indicating acceptable to good internal consistency) could be achieved by eliminating the item "*compared to other children the same age, my child is heavy (overweight)*" for the *Health Problems* subscale; yet, the item was not removed because it measures "overweight" which is an important health problem related to nutrition of children with CP.

Discriminant Validity between Known-Groups

After conducting the factor analysis, we compared between the concerns reported by parents of children with CP and parents of children with typical development to examine the known-groups discriminant validity of the A-PNAS. We hypothesized that children with CP would have higher scores on the three scales of the A-PNAS (food intake problems, health problems, and behavioral problems) compared to the children with typical development.

Table 5 shows the results of known-groups comparisons. The paired-samples *t*-tests showed that there was a significant difference in the *Food Intake Problems* scores for the children with CP (M = 0.15, SD = 0.30) compared to the children with typical development (M = 0.07, SD = 0.16); t (129) = 2.79, p = .006, d = 0.24. There was also a significant difference in the *Health Problems* scores for the children with CP (M = 0.33, SD = 0.37) compared to the children with typical development (M = 0.33, SD = 0.37); t (129) = 7.40, p = .0001, d = 0.64. Also, there was a significant difference in the *Behavioral Problems* scores for the children with CP (M = 0.29, SD = 0.30) compared to the children with typical development (M = 0.15, SD = 0.16); t (129) = 5.03, p = .0001, d = 0.37. As expected, parents of children with CP reported that their children had more food intake, health, and behavioral problems compared to parents of children with typical development. The mean difference effect sizes indicated moderate to high practical significance for *Health Problems* subscale and small practical significance for *Food Intake* and *Behavioral Problems* subscales.

Test-Retest Reliability

Table 4 shows the interclass correlation coefficients for a two-way mixed effect model to examine test-retest reliability. The results indicate excellent test-retest reliability for

Table 5. Paired samples t-test results for the known group comparisons.

Subscales	Group	Mean	SD	Between-group *t*-test value	*df*	*p*-value	Effect Size[c]
Food Intake Problems	CP[a]	0.15	0.30	2.80	129	.006	0.24
	TD[b]	0.07	0.16				
Health Problems	CP	0.07	0.14	7.40	129	.0001	0.64
	TD	0.33	0.37				
Behavioral Problems	CP	0.29	0.30	5.03	129	.0001	0.37
	TD	0.17	0.16				

[a]CP = cerebral palsy.
[b]TD = typical development. [c]Cohen's *d* mean difference size of effect.

the three subscales of the A-PNAS. The values of the ICC were 0.96 (95% CI = 0.91, 0.98), 0.98 (95% CI = 0.96, 0.99), and 0.96 (95% CI= 0.91, 0.98) for food intake, health, and behavioral problems, respectively. The MDC's were 0.36 for food intake problems, 0.27 for health problems, and 0.28 for behavioral problems, indicating that changes beyond these values can be considered true changes and not attributed to measurement error.

Discussion

This study describes the development of the first parent-reported Arabic scale to assess nutritional problems in children with CP. Parent-reported measures for nutritional problems can ensure the active participation of parents in the management of their children and guide the provision of family-centered services. Our findings provide support for construct validity, internal consistency, known-groups discriminant validity between known-group, and test-retest reliability of the developed A-PNAS. Between 25% and 39% of the participants reported at least one nutritional problem for their children which highlights the need to have a valid and reliable assessment of nutritional problems for children with CP.

Construct Validity

Exploratory factor analysis revealed three underlying subscales in the A-PNAS: *Food Intake Problems*, *Health Problems*, and *Behavioral Problems*. The three subscales explained 31.6% of the variance in nutritional problems of children with CP indicating the need to examine different types of Eating related problems in children with CP. The *health problems* subscale of the A-PNAS has the highest number of items with significant loading followed by *Food Intake Problems*, and then by *Behavioral Problems* subscales. This indicates a need for more focus on problems related to health conditions such as swallowing than problems related to food intake and child behaviors which might have a detrimental effect on the nutritional status of children with CP. The subscales of the A-PNAS could be useful to assess different types of concerns that might lead to nutrition problems in children with CP.

The large percentage of mothers who reported underweight as a problem for their children is consistent with previous studies examining nutritional problems of children with CP (Adamu et al., 2018; Almuneef et al., 2019; Huysentruyt et al., 2020; Trivić & Hojsak, 2019) but not with the findings from Hurvitz *et al.* (Hurvitz et al., 2008) who reported a high prevalence of obesity among ambulatory children and adolescents with CP. CP is a heterogeneous disorder with a variety of clinical presentations which might lead to either overweight or underweight problems based on the children's ages and

levels of function. Around half of our participants were children less than 3 years of age who might be too young to have developed obesity problems. Also, 69% of the participant children were in Levels I-III of the GMFCS-E&R and were able to walk alone or with assistive devices and therefore might be at low risk of being overweight (Huysentruyt et al., 2020; Martínez et al., 2019). Inconsistent research findings related to the effect of children's GMFCS-E&R levels on their weight warrant further studies with older children and those who depend on a wheelchair for mobility to support our findings. Future studies are also needed to support the inclusion of overweight or underweight problems or both as part of the Health problems construct of the A-PNAS.

Internal Consistency

Acceptable internal consistency for the *Food Intake* and *Health Problems* subscales of the A-PNAS were found but not for the *Behavioral Problems* subscale. This can be explained by the low number of items with significant loading on the *Behavioral Problems* subscale in addition to the low correlations between the items on this subscale due to the heterogeneous nature of the behavioral problems (Tavakol & Dennick, 2011). Behavioral problems that are related to nutritional problems might be caused by communication, social interaction, and daily living skills problems (Weber et al., 2016). For example, throwing food or making troubles during meals might be caused by a child with CP inability to express himself/herself, an inability to participate in social activities with other family members such as mealtime, or by an inability to perform activities of daily living such as feeding due to the motor disorder caused by the CP. Thus, internal consistency might be inappropriate for assessing the impact of behavioral problems on children with CP as the subscale might include a variety of items that are related based upon clinical grounds rather than psychometric theory (Fayers & Hand, 2002).

Known-Groups Discriminant Validity

The A-PNAS known-groups discriminant validity was supported by our results. Mothers of children with CP expressed significantly more concerns relate to *Food Intake*, *Health*, and *Behavioral Problems* than mothers of matching children with typical development. This indicates the ability of the three subscales of the A-PNAS to detect the presence of nutritional problems in children with CP to determine a need for nutritionist consultation and intervention. The known-groups analysis had a medium effect size for the *Health problems* whereas small effect sizes were found for *Food Intake* and *Behavioral Problems*. This indicates that the difference between children with CP and children with typical development was more apparent for *Health Problems* than for the other two subscales.

Test-Retest Reliability

The A-PNAS test-retest reliability was excellent for the three subscales over a 2- to 3-week period of time. Our findings indicate the ability of the A-PNAS to obtain consistent responses from parents of children with CP about their nutritional status. Also, our

results suggest a minimum change of 0.36 for the score of the *Food Intake Problems* subscale, 0.28 for the score of the *Behavioral Problems* subscale, and 0.27 for the score of the *Health Problems* subscale to indicate improvement or decline in the nutritional status of children with CP that exceeds measurement error.

Implications for Practice

The assessment of nutritional problems should be a major component of the regular clinical evaluation of children with CP. The A-PNAS is a comprehensive parent-report measure that can be used to identify the needs for clinical nutritional consultation for children with CP. The heterogeneous clinical presentations of children with CP might lead to a wide spectrum of nutritional problems that require comprehensive assessments and interventions. A comprehensive nutritional assessment should include different types of nutritional problems in children with CP such as oral motor dysfunction, food-intake, behavioral, and communication problems (Couriel et al., 1993; Pinto et al., 2016; Speyer et al., 2019).

The use of parent-reported assessment of nutrition problems in children with CP is important to facilitate a collaborative and family-centered nutritional consultation (Kuperminc et al., 2013). Health professionals are encouraged to consider a caregiver's perspective of the nutritional problems of their children due to their impact on family functioning and quality of life (Verrall et al., 2000). The findings of the study have implications for using the A-PNAS for early detection of any nutritional problems, monitoring the nutritional status of children with CP over their life span, and evaluating nutritional interventions.

At this point in the development of our scale, it seems appropriate to use the guidelines recommended by Schlenker et al. (2003) for assessing the need for a nutritional evaluation pending further analysis of our scale. According to Schlenker et al. (2003), a scoring system can be used based on the level of concern. The child would need nutritional intervention if one of the following criteria is met: (1) a total score for level of concern more than 5, or (2) a score of 2 for one of the three highest nutritional risk questions (covering weight, special diets or tube feeds) (Schlenker et al., 2003).

Limitations of the Study

The findings from this study should be considered in light of several limitations related to sample selection. Almost half of the participant children were less than 3 years old of age, where only 3% were between 13 and 18 years old indicating possible sampling bias. Besides, all the participant children were receiving rehabilitation services in outpatient settings, where the children who are receiving services in rehabilitation hospitals, inpatient settings, or schools might have a different spectrum of nutritional problems. A random sampling procedure would have provided a more representative sample of study participants. Furthermore, the lack of valid and reliable measures to assess nutritional problems in children with CP in the literature restricted our ability to compare our results to other validated measures. Future studies that include both mothers' and fathers' may present different perspectives about the nutritional problems of their

children. Despite these limitations, this study can serve as a basis for future studies to further refinement of the A-PNAS.

Conclusions

Although nutritional problems are common in children with CP and require professional management by nutritionists, assessment of nutritional problems is commonly overlooked. Health and food intake problems remain undetected due to a lack of valid and reliable measures of nutritional problems in children with disabilities. The results of this study provided evidence for validity and reliability of the A-PNAS. The A-PNAS is the first Arabic scale that was developed and validated to be used in the assessment of nutritional problems in children with CP. Health professionals who work with children with CP and their families are encouraged to use the A-PNAS for early detection of nutritional problems and for evaluating interventions. Future studies with larger sample sizes are needed to refine the *Behavioral Problems* subscale of the Arabic-PNAS.

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Authors' Contributions

NAA, CJD and MS conceived this research and designed experiments; RT participated in the design and interpretation of the data; NAA performed the analysis; NAA and CJD wrote the paper and participated in the revisions of it. All authors read and approved the final manuscript.

Disclosure statement

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