Research Article

Valid and Reliable Measure of Adherence to Satter Division of Responsibility in Feeding

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ABSTRACT

Objective: To examine the validity and psychometrics of sDOR.2-6y, a 12-item measure of adherence to the Satter Division of Responsibility in Feeding (sDOR).

Design: Cross-sectional survey.

Setting: Online respondents in central Pennsylvania.

Participants: 117 parents (94% female, 77% White, 62% in ≥1 income-based assistance program) of preschoolers aged 2−6 years (28% moderate/high nutrition risk).

Main Outcome Measures: The sDOR.2-6y and Nutrition Screening Tool for Every Preschooler (NutriSTEP), a measure of child nutrition risk and other validated measures of eating behavior and parent feeding practices.

Analysis: Relationships were evaluated with Pearson *r*, *t* tests, ANOVA, or chi-square. Factor structure was investigated using principal components analysis with varimax rotation. Binary logistic regression and general linear model controlling for low-income status compared with sDOR.2-6y and NutriSTEP scores. Linear regression predicted NutriSTEP and Satter Eating Competence Inventory 2.0 scores from sDOR.2-6y.

Results: The sDOR.2-6y ranged from 16−32 (mean, 25.9 ± 3.3; n = 114). Parents of youth at nutrition risk had lower sDOR.2−6y scores ($P = 0.004$). Each 1 point sDOR.2-6y increase decreased nutrition risk odds by 21% (95% confidence interval, 0.675−0.918; $P = 0.002$). The sDOR.2-6y scores were higher with less restriction and pressure to eat (both $P < 0.001$) and were associated with feeding style. Specificity was 87% with sDOR.2-6y cutoff ≥24; sensitivity was 66% with cutoff ≥26.

Conclusions and Implications: The sDOR.2-6y accurately and reliably indicated adherence of low-income mothers to sDOR. Larger, diverse samples for future studies are recommended.

Key Words: parent feeding practices, child nutrition risk, early childhood health, construct validity, survey development (*J Nutr Educ Behav.* 2021;53:211−222.)

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INTRODUCTION

In a position statement addressing nurturing healthy eating in children, 4 themes were identified that promote healthy feeding practices: positive parental feeding (eg, avoiding food restriction, letting children choose from food choices), eating together, a healthy home food environment, and pleasure of eating.[1] The Satter Division of Responsibility in Feeding (sDOR) melds these 4 themes with parent agency for the feeding experience categorized as parent leadership and autonomy support. As articulated in the writings and teachings of Ellyn Satter,[2,3] sDOR posits that parents are responsible for what is presented to the child to eat, the emotional and physical environment (where), and timing (when). Furthermore, parents provide autonomy support, meaning that they trust children to determine what, how much, and whether they eat from what is served in the environment in which it is presented. As a trust model, sDOR is unique because child competence usurps the usual child deficit approach, meaning that sDOR does not assume that children will overeat, get fat, or focus only on less nutrient-dense foods unless corralled into rules by well-intentioned parents. The sDOR is a theoretically grounded, research-supported[4−13] approach that is used in medical, public health, and early childhood health education venues.[14−19]

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The application of sDOR has been hampered by the lack of an evaluation tool that specifically measures adherence to the entire approach. Many parent feeding tools include elements of sDOR, but only 1, the sDOR.2-6y, addresses all the tenets of sDOR,[20,21] and few have been rigorously tested for validity and reliability.[21–23] The sDOR.2-6y is a 12-item measure of sDOR adherence for parents of children aged at least 2 years but not past their sixth birthday that has undergone testing with cognitive interviews and observational measures to identify face and content[24] and construct validity.[25] These stages of development are consistent with recommendations for developing health behavior scales,[23] including multi-staged processes that require time and patience.[22] Response mapping of cognitive interviews with 5 separate samples reduced an early version of the sDOR.2-6y from 38 to 15 items,[24] and comparisons by sDOR experts of video-captured family meals with parent responses to the 15-item sDOR.2−6y supported content and predictive construct validity for 12 of the items.[25] Subsequent methods in survey development and validation include testing for reliability (internal consistency reliability and test-retest reliability), criterion, and convergent or divergent construct validity.[23] Criterion validation relates performance on 1 instrument to that on another validated measure; concurrent criterion validation is when both measures are completed simultaneously. Convergent construct validity denotes performance on an operational measure of a nonobservable trait (ie, a construct) that is similar to that of another measure of a theoretically related construct. Additional investigation is crucial for understanding instrument validity. Relying on only 1 or 2 sources of evidence for validity is "...not in line with current recommendations provided by the large scientific and professional associations in the psychological and educational fields ...".[26] Messick's[27] seminal treatise on validity clarifies that "Validity is not a property of the test or assessment as such, rather of the meaning of the test scores....Validity is an evolving property and validation is a continuing process." Therefore, the purpose of this study was to continue the examination of construct validity, specifically concurrent criterion and convergent validity of the sDOR.2-6y.

METHODS

Study Design and Sample

This study used a cross-sectional design to assess criterion and convergent construct validity of the sDOR.2-6y with an online survey set including this and domain-related measures as well as 3 online 24-hour recalls to assess dietary quality. A subset of the sample completed a second survey administration to examine test-retest reliability. Inclusion criteria were being a Pennsylvania resident, being a primary caregiver of at least 1 child between 24 and 72 months who is not a ward of the state and without a disease diagnosis that could influence the child's intake, not working as or training to be a nutritionist, and having Internet access.

Recruitment

Participants were recruited through flyers and cards placed in public venues throughout central Pennsylvania (eg, YMCAs, public libraries, WIC offices, laundromats, free clinics). The sDOR.2-6y was available in English only, and hence, recruitment materials were in English. Recruitment materials described the study and included a link to the online survey. On accessing the link, to continue, participants responded to questions to affirm meeting the inclusion criteria. A paper survey option was available as an accommodation to those who expressed interest in the study but indicated having problems with Internet access.

A $10 e-gift card was provided after survey submission; $10, $15, and $20 e-gift cards were provided for completing the first, second, and third 24-hour dietary recalls, respectively. Recalls were completed over a period of <1 to 3 weeks and were from at least 1 weekday and 1 weekend day. The study was reviewed and approved by the Pennsylvania State University and Rochester Institute of Technology Institutional Review Boards for the Protection of Human Subjects. For eligible respondents, informed consent was available online with an option to print the consent form. Separate consents were provided for the survey, diet assessment, and retest components of the study.

Measurements

To examine concurrent criterion validity, the authors compared sDOR.2-6y with validated and tested measures and items congruent with tenets of sDOR (eg, parental nonuse of restriction or pressure to manipulate intake, parent feeding style). In addition, decreased child nutrition risk and more healthful parent eating behaviors (eg, eating competence [EC] and lower emotional eating) are suggested outcomes of adherence to sDOR. Therefore, to examine convergent construct validity, the online survey set consisted of the sDOR.2-6y and 9 validated instruments, and demographic and food resource related items that could examine the performance of sDOR.2-6y in identifying these sDOR tenets. The order of instrument placement in the survey set was identical for all respondents; sDOR.2-6y was first in the survey set.

Satter Division of Responsibility. Adherence to sDOR was measured with the 12-item sDOR.2-6y.[24,25] Each item had 5 response options (always, often, sometimes, rarely, never) that were scored from 3 to 0. Six items were phrased so that a positive response indicated sDOR adherence; a disagreement with 5 items was interpreted as sDOR adherence; and 1 item denoted sDOR adherence as neither strong agreement nor disagreement, but rather a less frequent but apparent occurrence. To ensure congruence with sDOR elements, positively phrased items were assigned scores of 3 (always), 2 (often), 1 (sometimes), and 0 (rarely or never); reverse-scored items were assigned scores of 3 (rarely or never), 2 (sometimes), 1 (often), 0 (always); and responses to "I decide what foods to buy based on what my child eats" were assigned values of 3 (sometimes), 2 (often), 1 (rarely), and 0 (always, never). Possible scores were from 0 to 36.

Child nutrition risk. The validated and reliable Nutrition Screening Tool for Every Preschooler (NutriSTEP)[28–30] assessed child nutrition risk. The 17 items, which address 4 risk factors (dietary intake, physical growth, physical activity, and influences on eating behaviors), have 2–5 response options. Response options for an item each have an assigned value that is summed and categorized. Overall scores may range from 0 to 68; scores ≤20 indicate no nutrition risk, scores 21–25 indicate moderate nutrition risk, scores ≥26 indicate high nutrition risk. The NutriSTEP has been tested and found to be easy for parents to complete[31] and reliable for online use.[32] The sensitivity and specificity of sDOR.2-6y to identify child nutrition risk were established with NutriSTEP scores.

Quality of life. Child quality of life was measured with the Pediatric Quality of Life Inventory[33] for toddlers (aged 2–4 years). This validated instrument consists of 18 items with 5 response options summed to form 3 subscales: physical functioning (8 items), emotional functioning (5 items), and social functioning (5 items). Scores are transformed to percentiles with higher scores indicating higher quality of life for toddlers. Cronbach α in this sample was 0.87.

Perceived stress. Parent perceived stress was assessed by a single item that is from the Community Health Database.[34] The visual analog scale is anchored by 1 (no stress) and 10 (extreme stress).

Three-Factor Eating Questionnaire-R18 (TFEQ). Parent eating behavior was assessed with the validated 18-item TFEQ.[35] This survey consists of 18 items, each with 4-point response options, grouped into 3 scales: cognitive restraint (6 items, possible score 6–24); uncontrolled eating (9 items, possible score 9–36); and emotional eating (3 items, possible score 3–12). For each scale, lower scores indicate less congruence with the eating behavior. Cronbach α in this sample was 0.75 for cognitive restraint, 0.71 for uncontrolled eating, and 0.78 for emotional eating.

Eating competence. Eating competence was measured with the 16-item validated and reliability-tested Satter Eating Competence Inventory (ecSI2.0).[36,37] Each item has 5 response options assigned values ranging from 3 to 0 so that possible scores range from 0 to 48, with higher numbers indicating greater EC. Scores ≥32 indicate EC. The following 4 subscales align with the EC construct: eating attitudes, food acceptance, internal regulation, and contextual skills. Cronbach α in this sample was 0.89.

Parent feeding styles. Parent feeding behaviors were categorized with the validated Caregivers Feeding Style Questionnaire.[38] Each of the 19 items had 5 response options that were summed and averaged to determine levels of parent demandingness and responsiveness. Predetermined cutoffs for low-income samples were applied to identify parent feeding styles as indulgent, uninvolved, authoritarian, or authoritative.

Child feeding. The Child Feeding Questionnaire (CFQ) is a tested, 31-item tool with 5 response options per parent feeding attitude and practices item.[39] Responses form 7 scales: perceived responsibility, perceived parent weight, concern about child weight, restriction, pressure to eat, and monitoring. Scale scores are averaged so that each ranges from 1 (less frequent) to 5 (more frequent).

Sleep quality. Subjective sleep quality, and 6 sleep practice domains (eg, sleep latency, sleep duration, daytime dysfunction) were measured using the validated Pittsburgh Sleep Quality Index (PSQI).[40] Scales were scored according to analysis directions and were then summed to generate a global index sleep score that can range from 0 to 21; a global score ≥5 indicated poor quality sleep.

General health. The General Health Questionnaire (GHQ) assessed anxiety and mood-related symptomatology with 12 items scored on a 4-point Likert scale from 0 (not at all) to 3 (much more than usual). Possible scores of this tool range from 0 to 36, with higher scores indicating greater problems with health, stress, and emotional problems.[41] A bimodal scoring strategy for each of the 12 items has been suggested, with a threshold of 4 or higher indicating concerns with anxiety and mood disorders. Cronbach α for this sample is 0.89.

Dietary intake. Dietary intake was assessed from a minimum of 2 out of 3 possible 24-hour recalls collected with the National Cancer Institute online Automated Self-Assessment 24-hour dietary assessment tool.[42]

Data Collection

Survey data were collected using the Qualtrics online survey platform (Provo, UT). On seeing research staff in the clinic, a few parents requested and completed paper surveys because of Internet access issues; their responses were entered into the Qualtrics platform and verified by research personnel. After completing the survey set, respondents indicating an interest in the dietary assessment were reported to the Pennsylvania State University Diet Assessment Center and then emailed instructions to access the automated self-assessment 24-hour dietary collection platform for the 3 24-hour recalls. The Diet Assessment Center managed the dietary data collection and analysis process. The 24-hour recall requests were unannounced and included opportunities to report intake on weekends and weekdays. Weight and height were self-reported; a self-reported prepregnancy weight was used for pregnant or lactating women. To assess test-retest reliability, researchers emailed a survey link to complete the sDOR.2-6y a second time to respondents indicating interest in having an in-home meal captured by video. Pilot testing verified survey flow and online functionality.

Data Analysis

All surveys were scored according to published guidelines, and participant characteristics were reported using descriptive statistics.[28,33–42] Low-income status was identified as often or always worrying about money for

food or participation in an income-based assistance program. Nutrition Screening Tool for Every Preschooler scores were categorized using previously defined ranges[28] into low, moderate, or high nutrition risk and grouped as low vs moderate/high risk. Tenets of EC were examined by comparing ecSI 2.0 scores to BMI, Healthy Eating Index (HEI), TFEQ, PSQI, GHQ, Pediatric Quality of Life Inventory, stress scale, and NutriSTEP responses. Associations between or among items from separate surveys were assessed with Pearson correlation or ANOVA as appropriate. Psychometrics of sDOR.2-6y were examined with Cronbach α to measure internal consistency and factor analysis using principal components analysis and varimax rotation to examine if items clustered by sDOR constructs.

To examine concurrent criterion and convergent construct validity, sDOR.2-6y scores were compared with NutriSTEP scores using binary logistic regression and univariate general linear models to control for low-income status. Linear regression was used to predict NutriSTEP and ecSI 2.0 scores. The NutriSTEP risk categories, sDOR.2-6y groupings and other survey categories (eg, parent feeding style or sleep quality), were compared with *t* tests, 1-way ANOVA, or Pearson chi-square, as appropriate. $P < 0.05$ was considered statistically significant. Significant ANOVA tests were followed by a Scheffe *post hoc* test to account for unequal group sizes. Chi-square values from contingency testing were examined *post hoc* with adjusted standardized-residuals.[43,44] Significance levels from multiple comparisons were adjusted with the Bonferroni method. Sensitivity and specificity were calculated comparing sDOR.2-6y scores against NutriSTEP risk categories. Dietary data from at least 2 recalls were averaged and analyzed using HEI 2010 guidelines.

A priori power calculations used pilot study findings with a mixed-income sample in the same geographic region. Pilot study sDOR.2-6y mean was 26.2, with an SD of 3.68. The sample size needed to detect a clinically significant difference of 3 points between 2 groups with a power of 0.9 was 60 (30 per group). To detect this difference between 4 groups with a power of 0.8 required a sample of 120 (30 per group). Observed power was reported with unequal group sizes. Assumptions of normality, homogeneity of variance, equality of errors variance, and multicollinearity were tested and met for all pertinent analyses. Data were analyzed with IBM SPSS Statistics for Macintosh (version 25.0; IBM Corporation, Armonk, NY, 2018)

RESULTS

Of the 175 clicks on the survey link, 117 submitted a survey (Figure), but the sample size ranged from 102−117 because of missing responses for some items; the PSQI was completed by 82. Of the 117 surveys, 109 were completed online, and 8 surveys used a paper format. Participants were mostly mothers (90%; fathers 5%; grandparents 4%; significant other to parent 1%), under the age of 35 years, White, with some post−high school training (Table 1). Ethnicity and race, which were asked as 2 separate questions, were self-reported by the children's parents. After selecting Hispanic or non-Hispanic, parents checked all that applied from a list, including American Indian/Alaskan Native, Asian, Black/African American, Native Hawaiian/other Pacific Islander, and White. At least 60% were overweight or obese; a majority used ≥1 income-based assistance programs. On average, parents reported a high level of stress as well as poor sleep quality. Using bimodal scoring, the GHQ indicated that 19% possibly had some issues with anxiety and mood disorders (score ≥4). Two thirds of families included 2 or more children. More than one fourth of the referenced children were at some level of nutrition risk; however, the pediatric quality of life was above the 90th percentile. At least 2 24-hour recalls were completed by 53% (n = 62) of the responders (Figure). Diet assessment participants reported a higher pediatric quality of life overall and in the areas of social and physical functioning. In addition, they reported a lower tendency to pressure their child to eat more food. Education and race were different between dietary responders and nonresponders, with 53% of the responders and only 27% of the nonresponders reporting a college degree or postgraduate training ($P = 0.005$). Of the White participants, 60% (n = 54) participated in the dietary assessment, compared with 17% (n = 2) of the Black participants in the sample; no participation differences were noted by Hispanic ethnicity. Diet assessment attriters (n = 10) did not differ from completers (n = 62) in age; BMI; sDOR.2-6y, NutriStep, or ecSI 2.0 scores; parent feeding style; education level; Hispanic ethnicity; or low-income. However, attriters included a greater proportion of Black participants (40%) and fewer White participants (3%) than completers (6% and 87%, respectively).

Reported tenets of EC relating ecSI 2.0 to weight, eating behaviors, stress, and sleep quality were affirmed (Table 2). Higher ecSI 2.0 scores were associated with lower BMIs and less emotional and uncontrolled eating, better quality sleep, less stress, higher pediatric quality of life, better general health, and higher dietary quality. Lower NutriSTEP scores, indicating less child nutrition risk, were significantly associated with higher EC ($r = 0.29$, $P = 0.004$). In addition, ecSI 2.0 subscale comparisons supported EC concepts (Supplementary Table 1).

Comparisons of similarly worded items from differing surveys supported respondent consistency (ie, relative validity) across the survey set. (Supplementary Table 2) For example, responses to the item about worrying about having enough money for food was highly correlated with the NutriSTEP "I have difficulty buying food to feed my child because food is expensive" ($|r| = 0.76$, $P < 0.001$, n = 109) and with the number of income-based assistance programs ($|r| = 0.28$, $P = 0.003$, n = 109).

Psychometric Profile

Of 117 completing the sDOR.2-6y 114 completed all 12 items. Scores on the sDOR.2-6y ranged from 16−32 (possible range 0−36) with a median score of 26 and a mean score of 25.9 ± 3.3. Scores were normally distributed. Using principal components analysis

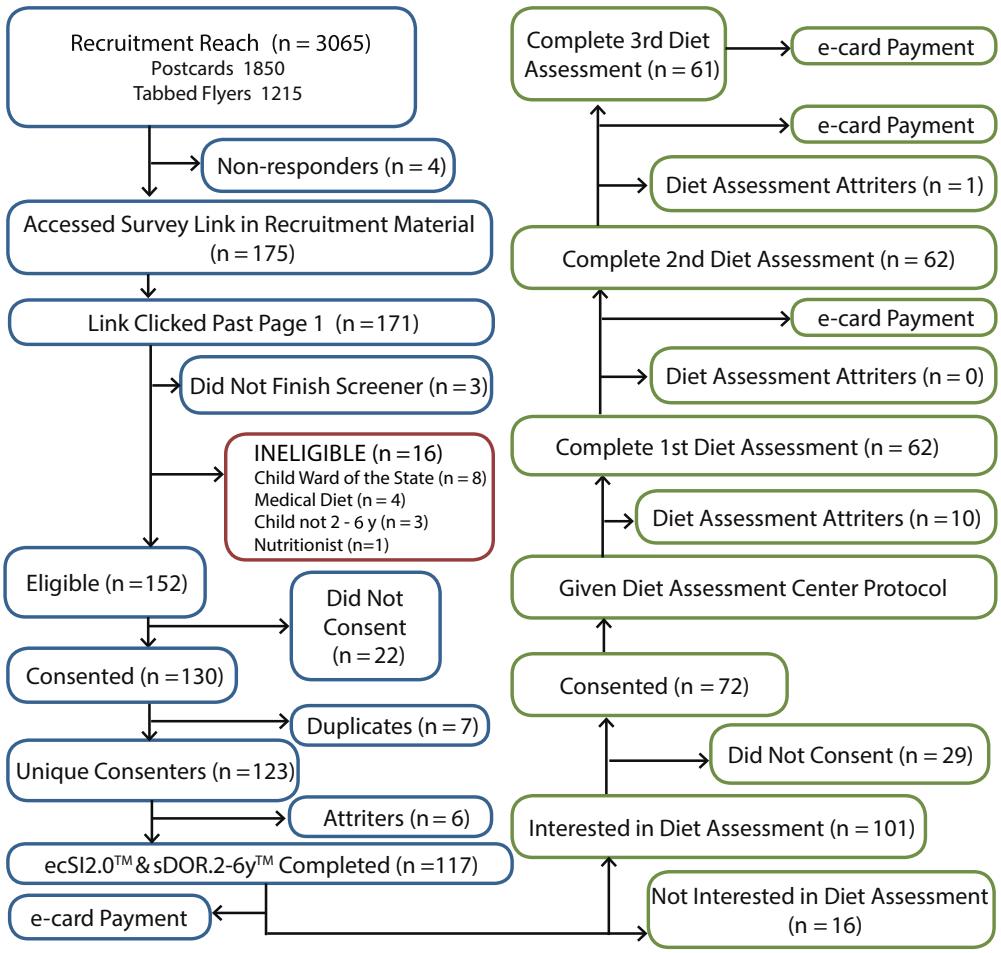

Figure. Participant recruitment, online access, eligibility, completion of the online survey, and participation in dietary assessment components to examine the validity of the sDOR.2-6y to measure adherence to the Satter Division of Responsibility in Feeding. Modified with permission from Lohse and Satter.[25]

with varimax rotation, researchers distributed the 12 survey items into 5 factors accounting for 59.2% of the variance. Factor loadings ranged from 0.47 to 0.81, and each factor contributed evenly to the variance ranging from 12.9%, 12.6%, 11.6%, 11.4%, and 10.8%, respectively, for Factors 1–5. The 5 factors described in Table 3 accurately depicted the theoretical underpinnings of sDOR, with 2 focused on child autonomy support concepts and 3 addressing parent leadership.

The 12 sDOR.2-6 items were not highly correlated. Only 9 of the possible 66 correlations had an absolute value greater than 0.2, and the only correlation greater than 0.3 was between "My family has meals at about the same times every day" and "When I am home at mealtimes, I sit down and eat with my child" ($r = 0.37$), both of which factored on the mealtime structure factor (Table 3). Five of the 8 correlations with Pearson's r between 0.20 and 0.30 involved the item: "I let my child have drinks (other than water) whenever s/he wants them." Cronbach α of the sDOR.2-6y was 0.32 (standardized 0.36) and ranged from 0.17–0.55 for the 5 factors, which is congruent with the independence of the 12 sDOR.2-6 items. The sDOR.2-6y was completed a second time by 18 parents 1–16 weeks after the first administration; 50% repeated the survey within 4 weeks of the first completion. Repeat respondents, like the nonrepeat respondents, were also female (90%), White (95%, 5% Hispanic), with evidence of constrained food resources (65% worried about money for food or use an income-based assistance program). Repeat respondents were slightly older (35.3 ± 6.4 years vs 31.5 ± 7.9 years, $P = 0.05$) with more having a 4-year college or postgraduate education (70% vs 35%, $P = 0.05$). Time 1 scores (26.8 ± 3.4) were highly correlated ($r = 0.71$, $P < 0.001$) with retest scores (26.4 ± 3.4). Test-retest means were not significantly different.

The Satter Division of Responsibility in Feeding approach considers both never and rarely as equal responses; however, because respondents had the option to select either, the psychometrics of items scored from 0 to 4 (ie, never and rarely having separate scores) were examined. The findings (eg, factor structure, interitem correlations, Cronbach α) when items were scored 0–3 were affirmed.

Table 1. Characteristics of Total Sample, Diet Assessment, and Nondiet Assessment Participants[a]

Personal Characteristics	n	All Participants	n	Diet Assessment	n	No Diet Assessment
Child age, y	116	3.4 ± 1.0	62	3.5 ± 1.0	55	3.3 ± 1.0
Child sex-female	110	66 (60)	62	33 (53)	48	33 (69)
NutriSTEP scale[b]	100	17.6 ± 6.0	59	16.8 ± 5.6	41	18.7 ± 6.5
Low risk	72 (72)	14.7 ± 3.9		46 (78)		26 (63)
Moderate risk	19 (19)	22.7 ± 1.6		9 (15)		10 (24)
High risk	9 (9)	29.6 ± 2.4		4 (7)		5 (12)
PedsQL[c,*]	111	97.1 ± 8.6	62	99.2 ± 1.5	49	94.5 ± 12.3
Physical Functioning Scale[**]	111	95.7 ± 15.3	62	99.4 ± 1.8	49	90.9 ± 22.1
Emotional Functioning Scale	111	98.6 ± 5.5	62	98.9 ± 3.4	49	98.3 ± 7.4
Social Functioning Scale*	111	98.0 ± 6.4	62	99.2 ± 3.0	49	96.4 ± 8.8
Parent age, y	109	32.2 ± 7.8	62	32.1 ± 7.0	47	32.3 ± 8.8
Parent BMI[d]	110	28.5 ± 8.0	62	27.4 ± 6.3	48	29.9 ± 9.6
Parent BMI categories[e]	110		62		48	
Underweight		4 (4)		2 (3)		2 (4)
Normal		40 (36)		24 (39)		16 (33)
Overweight		28 (26)		17 (27)		11 (23)
Obese		38 (35)		19 (31)		19 (40)
Parent sex-female	110	103 (94)	62	59 (95)	48	44 (92)
Parent ethnicity[f]	110		62		48	
Hispanic		9 (8)		5 (8)		4 (8)
Asian		5 (4)		3 (5)		2 (4)
Black		12 (10)		2 (3)		10 (18)
American Indian/Alaskan Native		3 (3)		1 (2)		2 (4)
White		90 (77)		54 (87)		36 (66)
Parent education[**]	111		62		49	
Less than high school		6 (5)		1 (2)		5 (10)
High school/diploma		25 (23)		9 (15)		16 (33)
2-y college/training		34 (31)		19 (31)		15 (31)
4-y college degree		23 (21)		17 (27)		6 (12)
Postgraduate degree		23 (21)		16 (26)		7 (14)
Assistance program use	117		62		55	
≥ Assistance program		73 (62)		39 (63)		34 (62)
SNAP		34 (29)		16 (26)		18 (33)
WIC		47 (40)		25 (40)		22 (40)
Food pantry		13 (11)		5 (8)		8 (15)
TANF		10 (9)		1 (2)		9 (16)
Medical assistance		36 (31)		20 (32)		16 (29)
No. programs used	117	1.7 ± 1.9	62	1.5 ± 1.7	55	1.8 ± 2.0
Worry about food money	111		62		49	
Sometimes		29 (26)		13 (21)		16 (33)
Often/always		14 (13)		8 (13)		6 (12)
Low-income[g]	111	78 (70)	62	43 (69)	49	35 (71)
Stress level[h]	102	6.7 ± 2.1	62	6.4 ± 2.1	40	7.2 ± 2.1
Cognitive restraint[i]	107	13.6 ± 3.6	61	13.8 ± 3.4	46	13.4 ± 3.9
Uncontrolled eating[j]	109	18.3 ± 4.1	60	18.3 ± 4.2	49	18.3 ± 3.9
Emotional eating[k]	111	6.2 ± 2.5	62	6.0 ± 2.5	49	6.5 ± 2.4
Eating competence[l]						
Total ecSI 2.0 score	114	31.7 ± 8.1	61	32.8 ± 7.1	53	30.4 ± 9.0
Eating competent		58 (51)	61	34 (56)	53	24 (45)
Child feeding style	114		62		52	
Uninvolved		22 (19)		10 (16)		12 (23)
Indulgent		42 (37)		23 (37)		19 (37)
Authoritarian		26 (23)		17 (27)		9 (17)
Authoritative		24 (21)		12 (19)		12 (22)
Pregnant	103	11 (11)	59	5 (9)	44	6 (14)
Family size	111		62		49	
1 child		34 (31)		15 (24)		19 (39)
≥2 children		77 (69)		47 (76)		30 (61)

(continued)

Table 1. (*Continued*)

Personal Characteristics	n	All Participants	n	Diet Assessment	n	No Diet Assessment
CFQ[m]						
Perceived responsibility	114	4.4 ± 0.7	62	4.4 ± 0.6	52	4.4 ± 0.7
Perceived parent wt	112	3.2 ± 0.4	61	3.2 ± 0.4	51	3.2 ± 0.5
Perceived child wt	114	2.9 ± 0.3	62	3.0 ± 0.3	52	2.9 ± 0.2
Concern child wt	112	1.8 ± 1.0	61	1.8 ± 1.1	51	1.8 ± 1.0
Restriction	112	3.4 ± 0.8	60	3.4 ± 0.7	52	3.5 ± 0.9
Pressure to eat*	113	2.8 ± 1.1	61	2.6 ± 1.1	52	3.0 ± 1.0
Monitoring	114	4.1 ± 0.9	62	4.2 ± 0.8	52	4.1 ± 1.0
PSQI[n]	82	6.3 ± 3.7	43	5.5 ± 3.4	39	7.3 ± 3.9
GHQ total[o]	111	11.4 ± 5.5	61	10.8 ± 5.2	50	12.2 ± 5.9
Psychological distress	111	6.5 ± 2.8	61	6.2 ± 2.4	50	6.9 ± 3.1
Social dysfunction	114	4.9 ± 3.0	62	4.7 ± 3.0	52	5.3 ± 3.1
Dietary information						
Healthy Eating Index			62	51.7 ± 12.9		
Energy, cal			62	1949 ± 520		
Total protein, g			62	77.7 ± 21.5		
Total fat, g			62	77.1 ± 24.8		
Total sugar, g			62	105.7 ± 52.6		

CFQ indicates Child Feeding Questionnaire; ecSI, Satter Eating Competence Inventory; GHQ, General Health Questionnaire; PedsQL, Pediatric Quality of Life Inventory; PSQI, Pittsburgh Sleep Quality Index; SNAP, *Supplemental Nutrition Assistance Program*; TANF, *Temporary Assistance to Needy Families*; WIC, *Special Supplemental Nutrition Program for Women, Infants, and Children*.

[a]Total participants = 117; diet participants = 62; numbers vary based on missing survey responses. Table entries are frequency (%) except for mean ± SD for child age; NutriStep scale scores; PedsQL; parent BMI, age, and stress level; cognitive restraint, uncontrolled eating, emotional eating scores; CFQ subscales; PSQI; GHI subscales; Dietary information: Healthy Eating Index, total protein, fat, and sugar; [b]NutriSTEP consists of 17 items with a possible score of 0–68. Risk categories: Low, ≤20; Moderate, 21–25; High, ≥26. The sample range was 4–33; median 17.5; [c]PedsQL survey included 18 items; Physical functioning scale (8 items): Emotional Functioning Scale and Social Functioning Scale (5 items each). Scores were transformed to percentiles; higher scores indicate a higher quality of life; [d]Parent BMI based on self-report height and nonpregnant weight; [e]Underweight BMI <18.5; normal weight BMI 18.5–24.9; overweight BMI 25.0–29.9; Obese BMI ≥30; [f]Some parents selected more than 1 ethnicity (% of total sample). Values reflect the number selecting the specific choice; [g]Low income defined as often or always worrying about money for food or participation in a means-tested assistance program; [h]Visual analog scale; scores range from 1 (no stress) to 10 (extreme stress); [i]The possible Three-Factor Eating Questionnaire-R18 Cognitive restraint scores are 6 (low) to 24 (high); [j]The possible Three-Factor Eating Questionnaire-R18 Uncontrolled Eating scores are 9 (low) to 36 (high); [k]The possible Three-Factor Eating Questionnaire-R18 Emotional Eating scores are 3 (low) to 12 (high); [l]ecSI 2.0 scores range from 0 (low) to 48 (high). Scores ≥32 denote being eating competent; [m]CFQ subscale scores range from 1–5; higher scores reflecting greater feeding practice frequency; [n]PSQI is a subjective measure of sleep quality consisting of 18 items. Possible scores range from 0–21. A global score of ≥5 indicates a poor sleeper; [o]GHQ consists of 12 items with a possible score of 0 to 36. The Psychological Distress Scale consists of 7 items with a possible score of 0–21, and the Social Dysfunction Scale consists of 5 items with a possible score of 0–15; higher scores indicate worse health.

Note: Difference between diet and nondiet participants: $^{*}P < 0.05$; $^{**}P \leq 0.01$.

The sDOR.2-6y Compared With Measures of Health and Nutrition Risk in Children

Parents of low nutrition risk children (n = 70), based on NutriSTEP scores, reported more alignment with sDOR tenets than parents with youth at moderate or high nutrition risk (n = 28) (26.7 ± 2.9 vs 24.3 ± 3.5; t = 3.42, $P = 0.001$). This relationship persisted even when controlling for low-income status (26.9 ± 0.4 vs 24.3 ± 0.6, $P = 0.001$). The sDOR.2-6y scores were significantly different ($F = 5.80$, $P = 0.004$) when the 3 NutriSTEP risk categories were compared separately. Observed power when conducting these analyses was 0.9. *Post hoc* analyses revealed higher sDOR.2-6y scores between parents of low risk and moderate risk (n = 19) children (26.7 ± 2.9 vs 24.3 ± 3.7; $P = 0.02$). Only 9 children were identified as high risk and their parents had sDOR.2-6y scores identical to moderate risk. sDOR.2-6y and NutriSTEP scores were significantly correlated ($r = -0.43$, $P < 0.001$, n = 98) and sDOR.2-6y score predicted the NutriSTEP score (β, −0.8; 95% confidence interval [CI], −1.14 to −0.46, constant 38.3; $P < 0.001$).

Binary logistic regression showed that for each 1-point increase in sDOR.2-6y, the odds of being in the NutriSTEP moderate or high nutrition risk category decreased by 21% (95% CI, 0.675–0.918, $P = 0.002$).

If sDOR adherence is designated as a score of ≥24, sensitivity to detect moderate or high nutrition risk is

Table 2. Comparison of Eating Competence Status With Selected Measures to Demonstrate Congruence With Eating Competence Tenets

Measure	Eating Competent[a]	Not Eating Competent	*P*
BMI	26.1 ± 7.1, n = 53	30.1 ± 7.7, n = 54	0.008
Three-Factor Eating Questionnaire-cognitive restraint	13.7 ± 3.6, n = 53	13.3 ± 3.5, n = 52	0.51
Three-Factor Eating Questionnaire-emotional eating	5.7 ± 2.3, n = 55	6.8 ± 2.5, n = 54	0.02
Three-Factor Eating Questionnaire-uncontrolled eating	17.1 ± 3.8, n = 54	19.5 ± 4.0, n = 53	0.002
Pittsburgh Sleep Quality Inventory	5.5 ± 3.6, n = 38	7.0 ± 3.7, n = 43	0.09
Stress scale	6.1 ± 2.2, n = 49	7.2 ± 2.0, n = 50	0.01
General Health Questionnaire			
Total score	10.0 ± 4.6, n = 55	12.7 ± 6.0, n = 53	0.01
Psychological distress scale	5.8 ± 2.1, n = 55	7.2 ± 3.2, n = 53	0.01
Social dysfunction scale	4.2 ± 2.8, n = 56	5.5 ± 3.0, n = 55	0.02
Pediatric Quality of Life Inventory	n = 54	n = 54	
Total score	98.6 ± 6.1	95.6 ± 10.5	0.07
Social functioning scale	98.6 ± 6.2	97.2 ± 6.7	0.27
Emotional functioning scale	99.8 ± 1.0	97.4 ± 7.7	0.03
Physical functioning scale	97.8 ± 10.0	93.4 ± 19.3	0.14
NutriSTEP	15.9 ± 6.1, n = 49	19.1 ± 5.6, n = 50	0.007

BMI indicates body mass index; NS, not significant; NutriSTEP, Nutrition Screening Tool for Toddlers and Preschoolers.
[a]Eating Competence is defined as Satter Eating Competence Inventory 2.0 score ≥32.
Note: Values are mean ± SD.

Table 3. Latent Variable Analysis of the sDOR.2-6y Using Principal Components Factor Analysis With Varimax Rotation[a]

Factor[b]	sDOR.2-6y Items	Factor Loading
1. Parent leadership with feeding: mealtime structure[c]	My family has meals at about the same times every day.	0.770
	When I am home at mealtimes, I sit down and eat with my child.	0.789
2. Parent leadership with feeding: what is available to the child.	I decide what foods to buy based on what my child eats.	0.809
	I make something special for my child when s/he won't eat.	0.708
3. Parent leadership with feeding: how food is available to the child.	I let my child feed him/herself.	0.727
	I am comfortable with providing meals for my family.	0.472
	We have food leftover after meals.	0.479
4. Child autonomy: respect for child autonomy in eating.[d]	If I think my child hasn't had enough, I try to get him or her to eat a few more bites.	0.607
	I struggle to get my child to eat.	0.602
5. Child autonomy: who controls what, when, or how much is eaten.[c,d]	I let my child eat until s/he stops eating and doesn't want more.	0.650
	I let my child eat whenever s/he feels like eating.	0.774
	I let my child have drinks (other than water) whenever s/he wants them.	0.533

sDOR indicates Satter Division of Responsibility.
[a]sDOR.2−6y A measure of adherence to the Satter Division of Responsibility; [b]sDOR.2−6y Cronbach $\alpha = 0.32$. Factor-specific Cronbach $\alpha = 0.55$ (Factor 1), 0.43 (Factor 2), 0.27 (Factor 3), 0.17 (Factor 4), and 0.19 (Factor 5); [c]Correlation between 2 factors: $r = 0.19$, $P = 0.04$, n = 114; [d]Correlation between 2 factors: $r = 0.23$, $P = 0.01$, n = 114.

0.29, and specificity is 0.87. Sensitivity and specificity are 0.66 and 0.64, respectively, if the sDOR adherence cutoff is adjusted to ≥26. sDOR.2−6y scores were not related to the pediatric quality of life overall, social functioning, or physical functioning scores.

The sDOR.2-6y Compared With Measures of Health and Nutrition of Parents

Parents who had greater adherence to sDOR reported lower levels of stress ($r = 0.21$, $P = 0.02$, n = 100). Higher Sleep quality (as measured by PSQI) was associated with greater adherence to sDOR ($r = 0.33$, $P = 0.003$, n = 81). The sDOR.2-6y scores were significantly greater ($P = 0.04$) in parents with responses congruent with better sleep quality (27.1 ± 3.7, n = 29) compared with poorer sleep quality (25.5 ± 3.2, n = 52). Observed

power for comparing sDOR.2-6y scores between better and poorer sleep quality was 0.54.

The sDOR.2-6y scores were significantly inversely related to cognitive restraint ($r = -0.19$; $P < 0.05$; n = 105). Uncontrolled eating and Emotional eating scales were not related to sDOR.2-6y scores or the risk category scores.

Parent adherence to sDOR was related to their EC (r = 0.27; $P = 0.005$; n = 111). sDOR.2-6y scores were able to predict ecSI2.0 scores ($P = 0.005$) using the equation, 14.4 + 0.67 (sDOR.2-6y value). Eating competence was higher in sDOR.2−6y categories associated with lower child nutrition risk, although the differences did not reach statistical significance (32.6 ± 7.2 vs 29.4 ± 10.0 sDOR.2-6y scores ≥24 vs <24, respectively, $P = 0.07$; 32.9 ± 7.4 vs 30.2 ± 8.9 sDOR.2-6y scores ≥26 vs <26, respectively; $P = 0.09$).

Of the 12 sDOR.2−6y items, significant differences between parents with (n = 21) and without (n = 90) mood and anxiety concerns as denoted by the GHQ were noted for only 1 item: "My family has meals at about the same times every day" ($P = 0.04$). This sDOR.2-6y item was significantly correlated with 7 of 12 GHQ items (all $P \leq 0.02$). Items included those relevant to being able to have regular meals (eg, "Been able to concentrate on whatever you're doing, Felt constantly under strain, Been able to enjoy your normal day-to-day activities, and Been losing confidence in yourself"). Of 2 sDOR.2-6y items (ie, "I struggle to get my child to eat and I am comfortable with providing meals for my family"), considered *a priori* likely to be associated with some GHQ items, only the comparison between "I am comfortable with providing meals for my family" and the GHQ item, "Been feeling unhappy and depressed," was significant ($r = 0.20$, $P = 0.02$, n = 114). Parent BMI was not related to sDOR.2-6y scores. The only significant correlation with parent Healthy Eating Indices was with NutriSTEP scores ($|r| = 0.28$, $P = 0.03$; n = 59), which addresses child dietary quality. However, HEI and HEI components were not related to sDOR.2-6y scores and did not differ among caregiver feeding styles.

The sDOR.2−6 Compared With Measures of Parent Feeding Behavior: CFQ and Caregiver Feeding Styles Questionnaire

Adherence to sDOR was associated with less use of restriction ($r = 0.34$, $P < 0.001$, n = 110) and lower pressure to eat ($r = 0.47$, $P < 0.001$, n = 111) as assessed by the CFQ.

The sDOR.2-6y scores were significantly different according to parent feeding style ($P = 0.03$), with lower scores in the authoritarian parents (n = 26) than in the uninvolved (n = 21), indulgent (n = 41), and authoritative (n = 24) parents (24.4 ± 3.1, 26.1 ± 3.2, 26.8 ± 3.6, 26.0 ± 2.5, respectively); observed power to detect sDOR.2-6y differences in parent feeding style was 0.70. *Post hoc* analyses revealed a significant difference between authoritarian and indulgent parents ($P = 0.035$). More parents using an authoritarian feeding style had an sDOR.2-6y score associated with a child being at nutrition risk when a score of 26 was used as the cutoff score (65% vs 38%, 27%, and 27% for authoritarian, uninvolved, indulgent, and authoritative, respectively; $P = 0.02$).

DISCUSSION

This study revealed that sDOR.2-6y demonstrated concurrent criterion, convergent construct validity in a predominantly White sample of resource-constrained but educated parents because it could identify preschool age youth at nutrition risk as indicated by parent responses to the NutriSTEP survey.

Psychometric Findings

Although higher sDOR.2-6y scores indicated greater adherence to sDOR, identification of cutoffs for sDOR adherence is useful for screening purposes. Cutoffs were determined on the basis of the balance of sensitivity and specificity of sDOR.2-6y to detect youth, not in a low NutriSTEP risk category. Denoting sDOR adherence by a score of 24 or more has a specificity of 87%, which means that only 13% who adhered to sDOR would be incorrectly labeled as nonadherent and identified for unnecessary intervention. A cutoff of 26 or more has a lower specificity of 64% but a higher sensitivity at 66%, meaning that about one third of those who do not adhere to sDOR will not be identified. These levels of sensitivity and specificity are congruent with the NutriSTEP values of 53% and 79%, respectively,[28] and with other health behavior measures.[41,45] Messick[27] includes score interpretation or consequential aspect as a validity issue. Inherent in score interpretation are value implications, which can have social relevance. For example, changing values placed on child nutrition risk, parent feeding education, and sDOR concepts may suggest alternative cutoffs than those obtained from these sensitivity and specificity analyses.

Factor analysis identified 5 distinct but equal latent variables, unique from each other, descriptive of sDOR tenets, and in sync with the perspective that sDOR is multifaceted and complex. More specifically, a mosaic of parent feeding behaviors is necessary to define sDOR adherence.[2,3] The parsing of these items into 5 distinct factors and the limited correlation among the 12 sDOR.2-6y items are consistent with the low Cronbach α.[46] Critical examination of Cronbach α as a measure of reliability or internal consistency suggests that a low value does not delimit an instrument's usefulness or acceptance, but may highlight the heterogeneity of the construct being measured.[46–49] Of the 12 items, 10 correlations were 0.31 or higher with the total score; 2 items correlated at 0.11 and 0.022. Removing these items either alone or together did not raise Cronbach α above 0.44. Cortina[47] suggests an expected Cronbach α of 0.52 with 12 items and 3 dimensions when the item intercorrelation (similar to the 0.32 in this study) is 0.30; the sDOR.2-6y had 5 dimensions; thus, a lower Cronbach α would be expected. Taber[48] suggests that there are limited grounds

for adopting the heuristic that Cronbach α must be at least 0.70 and notes "...instruments with quite a low value of alpha can still prove useful in some circumstances" (eg, tests, diagnostic tools, and concept inventories), especially when studies of their agreement, calibration, or validity support their use.

Comparisons With Measures of Child Nutrition Risk

Similar to these respondents, the NutriSTEP validation sample, which was Canadian, was mostly female and educated but had less evidence of constrained food resources.[28] The NutriSTEP findings paralleled those of the validation samples. For example, in a sample of 269 parents, scores ranged from 4–46 with a median of 18,[28] which compares to the range (4–33) and median (17.5) of this study. The NutriSTEP means for a much larger Canadian sample (n = 1,076), 15.0 ± 6.6[50] and a trial using online administration (n = 63),[32] 17.7 ± 6.9, also corresponded with this study mean of 17.6 ± 6.0. Similarly, the risk category means of Simpson et al[28] (16.1 ± 5.7, 21 ± 6.4, 28.5 ± 9.6 for low, medium, and high risk, respectively) mirrored those of this sample (Table 1).

The specificity of NutriSTEP to detect a clinically-derived nutrition risk was 0.69–0.79,[28] which reflected the specificity of sDOR.2-6y to detect moderate or high nutrition risk (as denoted by NutriSTEP) when the risk cutoff of sDOR nonadherence is <24. In addition, the sensitivity of NutriSTEP to detect a clinically-derived nutrition risk (0.53–0.69)[28] was similar to the sensitivity of the sDOR.2-6y to detect NutriSTEP moderate or high nutrition risk when the risk cutoff was <26. Thus, inadvertent, costly, or emotionally disturbing labeling of healthy preschoolers as being at nutrition risk can be minimized without neglecting to identify at least half of them who are at nutrition risk. The administration of NutriSTEP to Canadian preschool parents who were educated, mostly White, and mothers (n = 437) identified nutrition risk as high for 7% of youth, moderate for 19% and low in 74%,[51] aligning with the distribution within risk categories of the smaller sample of American parents in this study (Table 1).

Comparisons With Measures of Parent Health and Nutrition

Although unhealthy feeding practices have been associated with parent psychological distress,[52] GHQ total and subscale scores were not related to sDOR.2-6y scores. The usefulness of the GHQ as a screener for psychiatric morbidity related to anxiety and mood disorders has been challenged by some reports of item response bias and measurement error related to dimensionality.[1,53–55] However, the GHQ individual item correlations and less frequent mealtime regularity among parents with psychiatric distress suggest that adherence to sDOR may be related to caregiver emotional health. Further examination, using additional tested measures of caregiver emotional health, is supported to determine its potential as a confounder in future sDOR.2-6y validation studies.[52]

Healthy Eating Index and HEI component scores were not related to sDOR.2-6y responses. Although the impact on and relation of parent feeding practices and styles with child dietary intake has been extensively studied,[1] comparison of parent dietary intake and their parent feeding styles and practice are not apparent. In addition to the possibility that parent HEI scores may not equate with parent feeding behaviors, the small sample size may have contributed to the inability to observe any HEI and sDOR.2-6y association.

The strong relationship between NutriSTEP and sDOR.2-6y scores suggested that parent adherence to sDOR is related to lower child nutrition risk. The sDOR.2-6y scores were associated with greater caregiver EC and less cognitive restraint in eating and caregiver feeding style that was less authoritarian, less restrictive, and less pressuring, all-important sDOR tenets,[56] congruent with other studies of caregiver feeding styles and mealtime practices.[57] These eating and feeding associations supported the criterion validity of sDOR.2-6y to measure adherence to sDOR. Instituting sDOR enhances family lifestyles[58]; lifestyle qualities of better sleep and fewer feelings of stress were associated with higher sDOR.2-6y scores.

Important strengths of this study were that the sDOR.2-6y items were previously tested for comprehension and were congruent with observed parent behaviors. The use of multiple validated surveys facilitated a more circumspect measure of how child health, parent emotional health, feeding practices, and dietary intake relate to sDOR.2-6y responses. Study conclusions must consider several limitations. Recruitment was from programs and venues serving low-income persons resulting in a predominantly resource-constrained sample. Cross context equivalence of findings was limited because the sample also lacked ethnic and racial diversity. The generalization of test-retest results is limited by the small sample size. However, the results from the ecSI 2.0 and NutriSTEP paralleled those previously reported with general samples, tempering this limitation.[28,31,36,37] Surveys were all self-reported and completed online-factors that could compromise data integrity. However, IP addresses and emails were monitored, and follow-up emails were used to investigate identity (eg, asking height, weight, child age) before sending online payments. In addition, 101 of 117 respondents expressed interest in the dietary assessment, an activity requiring additional interaction with study personnel and the opportunity to identify a duplicate respondent; such an action was not likely to be completed by an imposter.

Furthermore, congruence between similar items from different surveys throughout the survey set (Supplementary Table 2) supported relative validity. Child weight was neither reported nor assessed, limiting its use as a descriptor or statistical control. The sDOR.2-6y administration assumed English literacy. Although the ability to read and understand English was not tested, recruitment was not from sites that encounter many non-English speaking clients. Future studies with a Spanish version of the sDOR.2-6y will be required to determine validation in samples that primarily speak Spanish. This sample consisted of children without serious health concerns, therefore, results cannot be extended to parents of

youth living with serious health concerns without further study.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The 12-item sDOR.2-6y, like Nutri-STEP, can indicate child nutrition risk but has the benefit of being able to convey parent feeding behaviors in greater detail, making it useful for caregiver education and counseling, in addition to screening. Additional studies of sDOR.2-6y validity will benefit from larger and more diverse samples that include measured child weight and height and more robust measures of parent depression and emotional stability to assess generalizability. In addition, comparison of findings in children aged 2–3 years with 4- and 5-year-olds may lead to more targeted application and knowledge of sDOR. Future studies are suggested that incorporate clinical examination and health record data to substitute for reliance on self-report to affirm the status of nutrition risk screening tools.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2020.11.007.

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