Brief Report

Poor Performance of Children Age 7 to 13 Years on the Newest Vital Sign

Carol J. Howe, PhD, RN, CDE; Christine Van Scoyoc, MEd; Gina K. Alexander, PhD, MPH, MSN, RN; and Jada L. Stevenson, PhD, RDN, LD

ABSTRACT

Valid and reliable instruments are needed to assess health literacy in children. Although the Newest Vital Sign (NVS) has been well established for use in adults, reports of its use in children have only recently received attention in the literature. Whereas some researchers have reported successful use of the NVS in children as young as age 7 years, others have suggested it is best used in children age 10 years and older. This analysis reports on the performance of the NVS in children age 7 to 13 years, adding to the growing evidence related to the use of the NVS in pediatric populations. Overall, children in this sample performed poorly on the NVS, which refutes previous reports. Differences in child samples and NVS administration procedures may provide some explanation for the lower-than-anticipated NVS performance in this sample. Interpreting the NVS based on educational standards and expectations may provide additional information to determine age-appropriate recommendations for NVS use in children. **[*HLRP: Health Literacy Research and Practice.* 2018;2(4):e175-e179.]**

Researchers and clinicians need a valid and reliable instrument to assess health literacy (HL) in children (Driessnack, Chung, Perkhounkova, & Hein, 2013). The Newest Vital Sign (NVS) is a validated and widely used measure of HL that uses an ice cream nutrition facts label with six accompanying questions to evaluate both numeracy and literacy skills (Weiss et al., 2005). Developed from the old version of the Nutrition Facts label (U.S. Food and Drug Administration, 2016) and tested extensively in adult samples (Shealy & Threatt, 2016), the NVS has only in recent years been used and tested in children (Chari, Warsh, Ketterer, Hossain, & Sharif, 2014; Driessnack et. al, 2013; Jang & Kim, 2015; Linnebur & Linnebur, 2016; Warsh, Chari, Badaczewski, Hossain, & Sharif, 2014).

Driessnack et al. (2013) first reported on the use of the NVS in 47 children age 7 to 12 years who were recruited at

Carol J. Howe, PhD, RN, CDE, is an Assistant Professor, Harris College of Nursing and Health Sciences, Texas Christian University. Christine Van Scoyoc, MEd, is an Assistant Principal, LISD STEM Academy at Donald Elementary. Gina K. Alexander, PhD, MPH, MSN, RN, is an Associate Professor, Harris College of Nursing and Health Sciences, Texas Christian University. Jada L. Stevenson, PhD, RDN, LD, is an Assistant Professor, Department of Nutritional Sciences, College of Science and Engineering, Texas Christian University.

Address correspondence to Carol J. Howe, PhD, RN, CDE, Harris College of Nursing and Health Sciences, Texas Christian University, TCU Box 298620, Fort Worth, TX 76129; email: carol.howe@tcu.edu.

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a local science center in the Midwest. NVS mean score was 4.8 (standard deviation [*SD*] = 1.5, with a maximum possible score 6), and 81% percent of children had adequate HL (NVS score >4). Children as young as age 7 years (38% of total sample) completed the NVS items successfully. In contrast, researchers exploring HL among children in primary and outpatient specialty care clinics reported a median NVS score of 1 for children age 7 to 11.9 years (Warsh et al., 2014). Similarly, Chari et al. (2014) reported a median score of 1 for children age 7 to 9 years and a median score of 3 for children age 10 to 17 years. Reported prevalence of adequate HL ranged from 40% in a sample of fifth and sixth graders in Korea (Jang & Kim, 2015) to 63% of sixth graders in a U.S. sample (Linnebur & Linnebur, 2016).

Driessnack et al. (2013) suggested that the NVS was a reliable instrument for children age 7 years and older. In contrast, Warsh et al. (2014) suggested that the NVS was valid only for children age 10 years and older. Although correlations between child NVS scores and age have been established (Chari et al., 2014; Driessnack et al., 2013), more studies using the NVS in children are needed to establish age-appropriate recommendations. The purpose of this analysis was to describe how children age 7 to 13 years performed on the NVS in a cross-sectional study in the southern U.S.

METHODS

Sample

A convenience sample of 251 children and their parent(s) was recruited at a local children's museum. Inclusion criteria were children age 7 to 13 years and their parent/guardian who spoke sufficient English to participate in research activities. Exclusion criteria included children or parents who were not cognitively able to participate in the research activities. The research team collected data during regular museum hours and also during Family Night, when school groups attended free of charge with bus transportation provided.

Measurements

Demographics. Basic demographic characteristics were recorded, including child age, grade in school, race/ethnicity, and parent income and education level.

Newest Vital Sign. The HL of both children and parents was assessed with the NVS. NVS scores range from 0 to 6, with scores of 0 to 1 interpreted as high likelihood of limited literacy, scores of 2 to 3 as the possibility of limited literacy, and scores of 4 to 6 as adequate literacy (Weiss et al., 2005). The NVS has demonstrated adequate reliability (alpha = .71) in a sample of children age 7 to 12 years (Driessnack et al., 2013).

Procedure

The larger study protocol has been described elsewhere in detail (Howe, Alexander, & Stevenson, 2017). Briefly, after completing parent consent and parent permission/child assent forms, each parent completed the demographic survey and the NVS, and the children completed the NVS. The research team gave a laminated NVS nutrition label for parents and children to hold and refer to while administering the NVS verbally. Participants used mental math skills to respond to the numeracy items. In accordance with the NVS directions (available online at https://www.pfizer.com/files/health/nvs_flipbook_english_final.pdf), research personnel presented the 6 items in order, giving a score of 0 if the child/parent could not answer the first few questions within a few minutes. The study procedures were approved by the Texas Christian University Institutional Review Board. To adhere to the museum guidelines, no incentives were provided to parents or children to participate in the study.

Data Analysis

Descriptive statistics were used to describe the frequency of children with high likelihood of limited literacy, possibility of limited literacy, and adequate literacy. In addition, the use of Spearman rank correlations revealed the relationship between child NVS and child age and grade. SPSS version 23.0 was used for all statistics. Statistical significance was set at $p \leq .05$. Data are reported as mean ± *SD* unless otherwise specified.

RESULTS

Participants included 251 children representing a racially and socioeconomically diverse sample with a mean age of 9.0 ± 1.6 years (range, 7-13 years) and mean school grade of 3.7 ± 1.6 (range, 1st-8th grade). Parents had a mean age of 39 ± 9.9 years. Children's mean NVS score was 0.65 ± 1.28 (range, 0-6), median score was 0, and 4.4% were assessed with adequate HL (**Table 1**). Of the small proportion of children with adequate HL, 70% were age 10 years or older. Child NVS score was modestly correlated with age (r = .20, p = .001) and grade (r = .24, p = .00). Parent mean NVS score was 3.7 ± 2.0 (range, 0-6) and was not correlated to child NVS score.

DISCUSSION

The aim of this analysis was to describe how children age 7 to 13 years performed on the NVS. We found that the median NVS score for children in this sample was 0, compared to median scores of 1 to 2 in previous samples (Chari et al., 2014; Warsh et al., 2014). Furthermore, the *SD* was greater than the child mean NVS score, indicative of the positively skewed distribution of scores, with 72% of children with an NVS score of 0.

Only 4.4% of children in this study were assessed as having adequate HL, which was much lower than the previously reported 8% to 81% of children with adequate HL (Chari et al., 2014; Driessnack et al., 2013; Jang & Kim, 2015; Linnebur & Linnebur, 2016).

Children came from homes where 63% of the parents were assessed with adequate HL, which does not support an explanation of low HL levels seen in the children. We, therefore, offer several plausible explanations for the lower-than-anticipated NVS performance in this sample of children.

Children's Age and NVS Performance

The children in this study may be younger than previous samples. Driessnack et al. (2013), however, in a sample with similar proportions of 7- and 8-year-old children, reported that children at age 7 years had a mean NVS score of 4.2 and perfect scores of 6 were seen in children age 8 years and older. In contrast, Warsh et al. (2014) reported that children age 7 to 10 years did not perform well on the NVS and that cut-off scores used to interpret scores in adults were similar for children age 10 years and older.

Like previous reports, our data suggest a modest positive correlation between child NVS score and child age and grade (Chari et al., 2014) but less robust than the strong correlations reported in other studies (Driessnack et al., 2013; Perry et al., 2017; Warsh et al., 2014). The predominantly low performance on the NVS in this sample, with its resulting low variability in scores, possibly explained the less robust correlations.

Numeracy and Literacy Skills by Age and Grade Expectations

The numeracy and literacy demands of the NVS may exceed the educational performance expected of young children. Young children may be unfamiliar with a nutrition facts label, which is not quite a table, a diagram, or a chart. Because of this, children may find it difficult to organize and synthesize information to respond to items on the NVS. In Texas public schools, children are introduced to nutrition facts labels in fourth grade at age 9 or 10 years and learn how to identify information on labels. Children in fifth grade (typically age 10 or 11 years) progress to examining and analyzing nutrition facts labels for nutritional content (**Table 2**). The NVS nutrition facts label and items include nutrition terms that younger children may not know, such as calories, cholesterol, sodium, carbohydrates, protein, grams, servings, daily value, and "sat" fat (one item asks about saturated fat, which children may not identify as "sat" fat on the label).

TABLE 1

Characteristics of Children and Parents in the Study

Child Characteristics	Number (%)
Mean age	8.9 ± 1.6 years
Gender	
Female	130 (61%)
Male	83 (39%)
Race/ethnicity	
Caucasian	152 (71.4%)
Hispanic	67 (32.5%)
African American	34 (16%)
Asian	11 (5.2%)
Other	16 (7.5%)
Newest Vital Sign score	
0-1	206 (82.1%)
2-3	34 (13.6%)
4-6	11 (4.4%)
Parent/Family Characteristics	
Household income	
<$25,000	26 (12.2%)
$25,000-$34,999	32 (15.0%)
$35,000-$49,999	33 (15.5%)
$50,000-$74,999	28 (13.1%)
$75,000-$99,999	52 (24.4%)
>$100,000	42 (19.7%)
Parent education	
Some high school	6 (2.8%)
High school graduate	29 (13.6%)
Trade/some college	69 (22.5%)
College degree	67 (31.5%)
Graduate degree	42 (19.7%)
Newest Vital Sign score	
0-1	48 (19.1%)
2-3	44 (17.6%)
4-6	156 (62.9%)

Differences in NVS Administration Procedure

There were notable differences in NVS administration procedures across studies, which may partially explain the differences in scores among samples. In previous studies examining the psychometrics of the NVS, researchers presented children with every item on the NVS either verbally (Driessnack et al., 2013) or by self-administration as a worksheet at home (Linnebur & Linnebur, 2016). In both of these

TABLE 2

NVS Items and Texas State Standards of Skills Acquired by Grade and Age

NVS No.	NVS Item	Math and Reading Skills Required	Grade Acquired	Age Acquired (years)
1	If you eat the entire container, how many calories will you eat?	Multiply up to a 4-digit number by a 1-digit number	4th	9-10
2	If you are allowed to eat 60 g of carbohydrates as a snack, how much ice cream could you have?	Collect data by observing and measuring using the metric system	3rd	8-9
		Multiply 2-digit number by 1-digit number	3rd	8-9
		Add fractions, same denominator	4th	9-10
3	Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?	Locate saturated fat on label	5th	9-10
		Subtract 2-digit numbers using mental math	2nd	7-8
4	If you usually eat 2,500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?	Calculate percentage, move decimal over one	4th	9-10
5	Pretend that you are allergic to the following substances: penicillin, peanuts, latex gloves, and bee stings. Is it safe for you to eat this ice cream?	Look and scan ingredient list (Flesch Kincaid, grade 6.2/SMOG, grade 8)	6th-8th	12-14
6	Why not? (ask only if child responds "no" to question 5)	Know that peanut oil is related to peanut allergy and makes it unsafe to eat	5th-6th	10-12

Note. NVS = Newest Vital Sign; SMOG = Simplified Measure of Gobbledygook. Adapted from "Content Builder Resources" by Lead4ward, 2018, http://lead4ward.com/resources/, and "Texas Essential Knowledge and Skills for Health Education," by Texas State Board of Education, (2013), http://ritter.tea.state.tx.us/rules/tac/chapter115/ch115a.html.

studies, children performed well on the NVS, with the majority of children attaining a score of >4, which is interpreted as adequate HL. In contrast, research personnel in our study administered the NVS verbally, presenting all 6 items in order as indicated by the directions for NVS administration. If the child could not answer the first few questions, the team gave the child a score of 0, effectively skipping the last two reading skills questions for many children.

Children use numeracy skills to answer the first 4 NVS questions and use reading skills to answer the last 2 questions. Given the opportunity, more children can answer these last reading skill questions correctly compared to the first 4 numeracy questions (83% vs. 18% correct, respectively), as reported by Perry et al. (2017). One other procedural difference was that some researchers provided children with scratch paper and pencil (Linnebur & Linnebur, 2016) or a calculator (Driessnack et al., 2013) to complete the NVS. Because the NVS directions did not specify the use of calculators or scratch paper and pencil, children in the current study relied on mental math skills only. However, the presumption that calculator use may improve children's performance on the NVS is made with caution. In one adult study, participants who used a calculator had a higher NVS score than those who did not use a calculator, although this difference was not statistically significant (NVS score 3.9 vs. 3.4, respectively) (Miser, Wallace, & Ryan, 2013).

STUDY LIMITATIONS

This study has several limitations. First, a convenience sample of children was recruited from a children's museum, raising the possibility of selection bias and decreasing generalizability. Secondly, the researchers indicated in the inclusion criteria the need for children and parents to speak/understand English but did not ask specifically about English proficiency, whether children were bilingual, or if they had a learning disability, all of which could be confounding.

Lastly, there was a limitation in the administration of the NVS. Because this study was not originally designed as a psychometric analysis of the NVS, we did not provide children the opportunity to complete each item. Instead, we followed the NVS instructions, which state that "if a patient [child] is still struggling with the first or second question after 2 or 3 minutes, the likelihood is that the patient has limited literacy and you can stop the assessment." Although this accommodated the time constraints of conducting a study in a busy museum setting, the researchers realize in hindsight that children were not given the chance to respond to all items equally. Because questiona 5 and 6 are more likely to be answered correctly, children in this study may have had higher NVS scores if they had responded to these items. Weiss et al. (2005) reported that a score of 1 had a 4-fold increase in the high likelihood of inadequate literacy compared to a score 2, yet few children in our study were given the opportunity to answer 2 questions correctly. Despite these limitations, the strength of this study was the sample size, perhaps the largest to date to report use of the NVS in children.

Implications

Several revisions could be considered to develop a more child-friendly NVS. For example, the reading skills questions (5 and 6) could be moved earlier, asking these easier questions first. The original NVS lists a number of allergies in question 5. To decrease the literacy demand, it may suffice to simplify the question to: "Is it safe to eat ice cream if you are allergic to peanuts?" Similarly, the numeracy questions were presumably designed to assess high-level mental math skills, but they could be simplified to decrease the numeracy demand. For example, the serving size could be changed from 0.5 cup to 1 cup, and the subtraction problem could subtract 10 rather than 9.

One further implication is for researchers to come to consensus on how to administer the NVS (i.e., stop assessment if child cannot answer the first few items within a few minutes vs. provide opportunity to answer each item, use of calculators, use of scratch paper and pencil), so that HL assessments are done consistently, allowing equitable comparison of NVS scores across samples.

CONCLUSION

The NVS was originally designed and validated for use in adults. Although Driessnack et al. (2013) reported that the NVS was a valid tool for assessing HL in children as young as age 7 years, the present findings from this study may indicate otherwise. Overall, we found that the NVS did not accurately assess children's HL. Interpreting the NVS based on educational standards and expectations may provide additional information to determine age-appropriate recommendations for NVS use in children. Future studies are needed to investigate the use of validated instruments to adequately assess children's HL.

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