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School Readiness among U.S. Children: Development of a Pilot Measure

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Abstract No single U.S. data source supports a multidimensional, population-based assessment of young children's readiness to start school. This changed with the 2016 National Survey of Children's Health (NSCH). This study provides an overview of the process by which content related to multiple domains of school readiness was identified, refined and selected for inclusion in the NSCH; describes the analytic processes and resultant outcomes associated with the development of domain-specific and summary measures of school readiness; and discusses opportunities to refine and validate these pilot measures to provide a national portrait of young children's progress towards timely mastery of skills and competencies needed to be "Healthy and Ready to Learn." The NSCH, an annual, address-based, self-administered survey, produces national- and state-level data on the physical and emotional health of children ages 0–17 years. In 2016, 22 items were added to assess school readiness among 3–5 year-olds and pilot summary measures of "Healthy and Ready to Learn" were developed. Four distinct domains were identified: Early Learning Skills, Self-Regulation, Social-Emotional Development, and Physical Health/Motor Development. Over four in ten children were "On Track" across all four domains while another three in ten were on track in three of the four domains. One

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in ten are reported to be "On Track" in ≤ 1 domain. New NSCH content and related summary measures of "Healthy and Ready to Learn" present a unique opportunity to extend what is known about young children's school-readiness at both the national and state levels. Continued measure development and validation is required.

Keywords School readiness · Early childhood development · Early childhood education · Indicators · National Survey of Children's health

1 Introduction

The educational success of young children is shaped by a multitude of factors, many of which impact them long before they enter kindergarten (Child Trends 2013, 2015). Because children begin to develop the skills and competencies needed to succeed in school during the first years of life, it is important for policymakers and parents to understand the breadth of skills encompassed in school readiness and to recognize that a minority of children require additional support to enter school healthy and ready to learn (Hair et al. 2006). Importantly, while opportunities to learn both in the home and in preschool settings influence school readiness and later educational success, factors such as physical health, motor development, social competence (Fantuzzo et al. 2004), and emotional development – including self-regulation (Eisenberg et al. 2010; Ursache et al. 2012) – may also each contribute to success in formal school settings (McClelland et al. 2017; Shonkoff and Phillips 2000). This awareness has enriched programming in preschools (National Association for the Education of Young Children 2009) and broadened parents' understanding of how to prepare young children for kindergarten and elementary school. While such awareness has been positive, researchers, policy makers and program developers in the U.S. continue to lack a multidimensional, population-based measure that provides aggregate estimates of young children's health and development across social, emotional, cognitive, and physical/motor domains. Such data may help educators, healthcare professionals, and social service providers, as well as policy makers in states, Tribal, and local communities, assess the specific supports needed for children within their communities.

A significant body of research exists around the characteristics, contextual considerations, and timing of such supports that may enhance the impact of investments to promote young children's development of key skills and abilities associated with school success. First, the critical influence of parental or caregiver knowledge and literacy practices as well as parent-child interactions (Brooks-Gunn and Markman 2005; Radesky et al. 2016) within the context of family and community resources cannot be overstated. For example, parental practices related to at-home reading and implementation of regular sleep schedules and routines have been associated with multiple measures of cognitive development overall and literacy and language outcomes specifically (Hoyniak et al. 2018; Mindell and Williamson 2017; Council on Early Childhood and Council on School Health 2016; Hutton et al. 2015). Heckman and Mosso (2014) extend this understanding to argue that successful and cost-effective early childhood interventions "scaffold the child and *supplement* parenting" [emphasis added] rather than replace family investments (Heckman and Mosso 2014).

Second, complementing our appreciation for the role that parents and caregivers can play in promoting school readiness is our growing understanding of the ways that

exposure to factors such as poverty, maltreatment and other adverse childhood experiences (ACEs), can negatively impact early childhood development – independently and in tandem. For example, childhood exposure to ACEs (ranging from parental divorce to family substance abuse to witnessing intimate partner violence) has been associated with attendance and behavioral problems, grade repetition, and lower academic engagement and achievement (Blodgett and Lanigan 2018; C. Bethell et al. 2014; Moore and Ramirez 2016). Sometimes assessed as an ACE, child maltreatment has also been associated with lower school readiness in multiple domains (Bell et al. 2018). Additionally, the impact of ACEs can be multigenerational with parental ACE exposure associated with greater risk of developmental delays among offspring as young as 2 years of age (Folger et al. 2018).

Approaches to fostering early childhood development have been further informed by analyses specifically focused on the impacts associated with poverty and attendant conditions and consequences. A robust body of literature has found poverty to be negatively associated with school achievement through manifold and dynamic mechanisms (Sirin 2005; American Psychological Association 2018), including, but not limited to: increased risk for mental, behavioral and emotional problems (Yoshikawa et al. 2012) as well as deficiencies in concentration and memory which may impact readiness to learn (American Psychological Association 2018); inadequate nutrition with the potential for both health and developmental consequences including increased rates of chronic illness and decreased learning readiness (Holben and Marshall 2017); and increased exposure to neighborhood crime and violence (Evans 2004) which has been associated with lower academic achievement among elementary school students (McCoy et al. 2013; Ruiz et al. 2018).

Finally, particularly among children who have experienced such disadvantages, econometric research also suggests that the return on investment is higher for interventions targeted towards skills development among young children, when compared to adolescents (Heckman and Mosso 2014). These analyses further delineate between the development of cognitive skills and non-cognitive (or social-emotional) skills, supporting the existence of a "critical period" in early childhood wherein the development of cognitive skills, in particular, may be maximized (Cunha et al. 2010). The early attainment of these skills lays a subsequently critical foundation for the optimal development of non-cognitive skills as well as the extension of cognitive abilities (Cunha and Heckman 2007).

Taken together, research to-date highlights not only the importance of understanding the proportion of young children that need additional support to enter school ready to learn, but also the need to address both contextual factors that may impact the development and maintenance of these skills, and the interplay between different, yet complementary and mutually reinforcing competencies and abilities. Until recently, no U.S. population-based assessment of school readiness has existed at the national and state levels that addresses the multiple dimensions making up a "Healthy and Ready to Learn" (Health Resources and Services Administration et al. 2014) concept. Further, what data that do exist on this topic often lack information on other family, community and systems of care critical to evaluate associations and guide policy and practice improvement.

This changed in 2016, with the addition of 22 new items assessing multiple domains of early childhood development to the redesigned National Survey of Children's Health (NSCH). Primarily funded and directed by the Health Resources and Services

Administration's Maternal and Child Health Bureau (HRSA MCHB) since 2003, the NSCH produces both national and state-representative estimates for key indicators of the physical, emotional and behavioral health of American children 0–17 years old as well as related health care systems, family and community factors. To this breadth and depth of content has now been added the capacity to estimate the percentage of preschoolers in America who are optimally developing the skills and behaviors needed to be ready for kindergarten.

Within the construct of a significant survey redesign (Ghandour et al. 2018), the impetus to add "Healthy and Ready to Learn" content to the NSCH was driven by state-level stakeholders, researchers and practitioners from around the country, and concomitant revisions to the Title V Maternal and Child Health Services Block Grant program's (Title V) National Outcome Measures (NOMs) (U.S. Department of Health and Human Services et al. n.d.; Kogan et al. 2015). Among the 22 newly-developed Title V NOMs selected in 2014 was NOM 13 – Percent of Children Meeting the Criteria Developed for School Readiness (Health Resources and Services Administration and Maternal and Child Health Bureau 2017). HRSA's MCHB, state Title V leaders, and other stakeholders identified this as a key area for progress due to the absence of a standard, comprehensive measure or data source to assess young children's readiness to start and succeed in school.

As a first step to meeting this need, HRSA's MCHB undertook the identification, refinement and addition of content related to "Heathy and Ready to Learn" within the 2016 NSCH. To assure the acceptability of proposed measures, we used a well-established framework developed by the National Educational Goals Panel and adopted by the U.S. Department of Education to identify the five domains of school readiness: Language Development and Literacy; Cognition and General Knowledge; Approaches Toward Learning; Physical Well-being and Motor Development; and Social and Emotional Development (Kagan et al. 1995). Individual survey items were identified based on previous work by the National School Readiness Indicators Initiative (NSRII), a 17-state initiative convened between 2001 and 2004 to identify a set of school-readiness indicators from birth through age 8, with a central focus on building state data capacity to inform public policy (Rhode Island KIDS COUNT 2005). NSRII selected these domains based upon the robust literature across the child development and early education fields which indicate that children's readiness for school is shaped by their development in multiple unique, yet reinforcing developmental domains (i.e., cognitive, social, emotional, and physical development) (Child Trends 2001).

New survey items, chosen using this framework, were designed to be used in concert with health and behavioral content traditionally covered by the survey. Using this expanded content, HRSA MCHB sought to produce a first-of-its kind data source to provide both national- and state-level estimates of young children's overall readiness to succeed in school – also termed "Healthy and Ready to Learn". Work toward this goal continued in partnership with Child Trends, a nonprofit research organization focused on children, youth, and their families, and focused on conducting analyses of the preliminary 2016 data with the goal of specifying one or more summary measures of young children's readiness to succeed in school.

The goals of this paper are three-fold: 1) provide an overview of the process by which content related to these five domains of school readiness was identified, refined and selected for inclusion in the 2016 NSCH; 2) describe the analytic processes and

resultant outcomes associated with the development of a pilot NOM for "Healthy and Ready to Learn"; and 3) discuss future plans and opportunities to build on this work to further refine and extend our ability to provide a national portrait of young children's progress towards timely mastery of the skills and competencies needed to be "Healthy and Ready to Learn."

2 Methods

2.1 Survey Design, Procedures, and Data

The NSCH is an address-based, self-administered survey funded and directed by HRSA's MCHB and conducted by the U.S. Census Bureau. Between July 2016 and February 2017, the 2016 NSCH randomly sampled approximately 365,000 households resulting in a total of 50,212 questionnaires completed by either web or paper for children ages 0–17, of which 7565 were completed for children ages 3–5 years. The overall weighted response rate was 40.7% and the interview completion rate, defined as the proportion of screened households known to include children that then completed the topical questionnaire, was 69.7%. The sample was drawn from the Census Bureau's Master Address File, a complete listing of all known living quarters in the 50 U.S. states and the District of Columbia, and supplemented with an administrative flag to identify households most likely to include children. An adult who was familiar with the child's health and health care served as the respondent; one child was randomly selected to be the subject of the questionnaire in households with more than one child. Questionnaires were available in English and Spanish. Both the confidentiality of data provided, protected under Title 13 of U.S. Code, and the voluntary nature of the data collection process were addressed on the front page of all data collection instruments. Additional information about the design and operation of the survey is available elsewhere (U.S. Census Bureau and U.S. Department of Health and Human Services 2017; Ghandour et al. 2018).

2.2 Measures

The initial process of identifying candidate items for the 2016 NSCH was guided by the five domains of school readiness identified in leading frameworks as noted previously (Rhode Island KIDS COUNT 2005). With this foundation, final items were identified, selected and refined through multiple processes between 2012 and 2015, including: 1) review of content fielded on existing surveys from the U.S., Canada, and Australia, such as the National Household Education Survey on School Readiness (National Center for Education Statistics 2007), the Early Childhood Longitudinal Study (National Center for Education Statistics 2010-2011), the Early Development Instrument (Offord Centre for Child Studies 2012–2013), the Australian Early Development Census (Commonwealth of Australia 2012), previous iterations of the NSCH and its "sister" survey, the National Survey of Children with Special Health Care Needs (U.S. Department of Health and Human Services et al. 2015), and the Well Visit Planner based on Bright Futures guidelines for promoting early childhood development (C. Bethell 2008); 2) consultation with researchers, Federal partners, and stakeholders

through an iterative combination of individual communications, small workgroup meetings, and consensus meetings; and 3) cognitive and usability tests, as well as a national pretest of the NSCH. The degree to which the selection, development, and refinement of both target content areas and related items was recursive in nature cannot be adequately emphasized. In the absence of a "gold-standard" for measuring "Healthy and Ready to Learn" and in light of the limited amount of space available for new content on the NSCH, HRSA's MCHB adopted an approach that emphasized the research and programmatic *potential* of the new content and an expectation that content would *evolve* over time.

Once identified, candidate items were grouped to comprise a new survey section within the 2016 NSCH titled, "This Child's Learning". The section was designed to be completed by parents and caregivers of children ages 3–5 years and included 22 items, all but three of which were considered to be candidate items, leaving 19 items for the calculation of a composite "Healthy and Ready to Learn" measure. Items not considered candidate items included one screener item designed to identify children who may have already started school; one item included for analytic purposes: "How confident are you that this child will be successful in elementary or primary school?"; and one item on preschool suspension and expulsion which was included in the survey section due to the age-specificity of the content. Where possible, questions were drawn from an existing data collection system; in some cases, adaptations were required to ensure consistency in framing and formatting across items. Importantly, because all survey items included on the NSCH must be in the public domain, it was not possible to use previously fielded and/or validated items from proprietary instruments. In addition to newly added items, six extant items were identified from other NSCH survey sections to address physical health (two items), approaches towards learning (two items), and emotional competence (two items), respectively. Taken together, the redesigned NSCH included 25 items (19 new and 6 existing) designed to address competencies and skills across the five domains of school readiness. Item wording, source, and original hypothesized domain are provided in Table 1; complete survey content, including item order and response options, is available online: https://mchb.hrsa.gov/data/national-surveys/questionnaires-datasets-supporting-documents.

2.3 Analyses

Between June and August 2017, HRSA's MCHB partnered with Child Trends to develop a pilot composite NOM for "Healthy and Ready to Learn" based on preliminary data from the 2016 NSCH. Five primary activities were undertaken: First, a detailed item-level analysis was conducted to identify gaps, weaknesses, and strengths of each of the 25 survey items and to determine whether the distribution of the responses for each item allowed meaningful distinctions to be drawn between responses. This process focused on: 1) assessing data quality, including the skew, kurtosis, and degree of missingness for each item; 2) conducting descriptive analyses to calculate the mean, standard deviation and response frequencies; and 3) exploring concurrent validity through an examination of the associations among items and patterns within each item by child age and respondent education. Table 2 illustrates findings from this item-level analysis. Based on these analyses, four survey items were removed from consideration for inclusion in the NOM due to limited variation in the

Table 1 "Healthy and Ready to Learn" items selected for inclusion on the 2016 National Survey of Children's Health and Source, by hypothesized domain of school readiness

1. Language Development and Literacy
   - Item G4: How often can this child recognize the beginning sound of a word? *(Source: 2007 NHES-SR)*
   - Item G5: About how many letters of the alphabet can this child recognize? *(Source: 2007 NHES-SR)*
   - Item G6: Can this child rhyme words? *(Source: 2007 NHES-SR)*
   - Item G7: How often can this child explain things he or she has seen or done so that you get a very good idea what happened? *(Source: 2008/2009 NLSCY)*
   - Item G8: How often can this child write his or her first name, even if some of the letters aren't quite right or are backwards? *(Source: 2007 NHES-SR)*
2. Cognition and General Knowledge
   - Item G9: How high can this child count? *(Source: 2007 NHES-SR)*
   - Item G10: How often can this child identify basic shapes such as a triangle, circle, or square? *(Source: 2012/2013 EDI)*
3. Approaches to Learning
   - Item A3-C: This child shows interest and curiosity in learning new things. *(Source: 2011/2012 NSCH)*
   - Item G2: Are you concerned about how this child is learning to do things for him or herself? *(Source: 2011/2012 NSCH)*
   - Item G12: How often does this child keep working at something until he or she is finished?* (*Source: Social Rating Scale in ECLS-K)*
   - Item G13: When he or she is paying attention, how often can this child follow instructions to complete a simple task?* *(Source: 2008/2009 NLSCY)*
4. Physical Well-Being and Motor Development
   - Item A1: In general, how would you describe this child's health? *(Source: 2011/2012 NSCH)*
   - Item A2: How would you describe the condition of this child's teeth? *(Source: 2011/2012 NSCH)*
   - Item G14: When this child holds a pencil, does he or she use fingers to hold, or does he or she grip it in his or her fist? *(Source: 2007 NHES-SR)*
5. Social-emotional Development

   a) Social Competence:
   - Item G15: How often does this child play well with others? *(Source: Well-Visit Planner, CAHMI)*
   - Item G20: Compared to other children his or her age, how much difficulty does this child have making or keeping friends? *(Source: 2009/2010 NS-CSHCN)*

   b) Emotional Competence:
   - Item A3-A: This child is affectionate and tender with you. *(Source: 2011/2012 NSCH)*
   - Item A3-B: This child bounces back quickly when things do not go his or her way. *(Source: 2011/2012 NSCH)*

Table 1 (continued)

- Item A3-D: This child smiles and laughs a lot.
  (Source: 2011/2012 NSCH)
- Item G16: How often does this child become angry or anxious when going from one activity to another?*
  (Source: Emotion Regulation Checklist)
- Item G17: How often does this child show concern when others are hurt or unhappy?
  (Sources: Emotion Regulation Checklist and Strengths and Difficulties Questionnaire)
- Item G18: How often can this child calm down when excited or all wound up?*
  (Source: Social Competence Scale)

c) Behavior Problems:

- Item G16: How often does this child become angry or anxious when going from one activity to another?*
  (Source: Emotion Regulation Checklist)
- Item G19: How often does this child lose control of his or her temper when things do not go his or her way?*
  (Source: Social Competence Scale and Devereux Early Childhood Assessment)

d) Self-Regulation:

- Item G11: How often is this child easily distracted?
  (Source: 2008/2009 NLSCY)
- Item G12: How often does this child keep working at something until he or she is finished?*
  (*Source: Social Rating Scale in ECLS-K)*
- Item G13: When he or she is paying attention, how often can this child follow instructions to complete a simple task?*
  (Source: 2008/2009 NLSCY)
- Item G18: How often can this child calm down when excited or all wound up?*
  (Source: Social Competence Scale)
- Item G19: How often does this child lose control of his or her temper when things do not go his or her way?*
  (Source: Social Competence Scale and Devereux Early Childhood Assessment)
- Item G21: Compared to other children his or her age, how often is this child able to sit still?
  (Source: 2007 NHES-SR)

e) Executive Function:

- Item G12: How often does this child keep working at something until he or she is finished?*
  (*Source: Social Rating Scale in ECLS-K)*
- Item G13: When he or she is paying attention, how often can this child follow instructions to complete a simple task?*
  (Source: 2008/2009 NLSCY)

*Some items could not be definitively categorized and are noted under multiple domains/sub-domain

distribution of responses, including: 1) This child is affectionate and tender with you; 2) This child smiles and laughs a lot; 3) This child shows interest and curiously in new things; and 4) How well is this child learning to do things for him or herself? For example, when asked to describe whether the child "is affectionate and tender with you", 94.4% of parents/caregivers responded "definitely true", significantly limiting the ability to draw meaningful distinctions between children using this item (data available upon request).

Second, Confirmatory Factor Analyses (CFAs) were conducted to assess the factorial validity of each of the five originally hypothesized domains of "Healthy and Ready to Learn". In general, CFA allows researchers to test whether a hypothesized relationship exists between observed or measured variables and an underlying or latent construct (Thompson 2004). For the purposes of this project, this step determined the degree to which selected survey items could be used to measure the distinct constructs (or domains)

hypothesized to comprise "Healthy and Ready to Learn." Within CFA, estimates of model fit provide information regarding whether the hypothesized model aligns with the data. Estimates that indicate that the model has "good fit" suggest that the hypothesized relationships between the items and the latent construct are plausible. To determine the extent to which a set of items were acceptable measures of a domain, we examined factor loadings and the following model fit indices: chi-square estimates, Comparative Fit Index (CFI) estimates, Tucker Lewis Index (TLI) estimates, and Root Mean Square Error of Approximation (RMSEA). For each model, cutoffs of ≥0.95 for both the CFI and TLI and a cutoff of ≤0.08 for RMSEA were used as the criteria for acceptable model fit (Byrne 2013). In addition, a cutoff of 0.40 was used for factor loadings.

CFAs were conducted for four of the originally hypothesized domains of "Healthy and Ready to Learn": (1) Language Development and Literacy; (2) Cognition and General Knowledge; (3) Approaches Toward Learning; and (4) Social and Emotional Development. We did not conduct a CFA for the domain of Physical Health and Motor Development, as this domain was conceptualized as an index rather than a scale and we did not expect the components of the index to necessarily represent a single latent trait, skill or characteristic. The CFA models were refined, as needed, based on information obtained from model parameters and the modification indices until the models met the above stated criteria for "good fit". Through the modeling procedures, three additional items were removed from consideration as the inclusion of each reduced model fit statistics or factor loadings fell below the established criteria (CFI ≥ 0.95, TFI ≥ 0.95, and RMSEA ≤0.08 and Factor Loadings >0.4). These included: 1) How often can this child calm down when excited or all wound up? 2) How often does this child lose control of his or her temper when things do not go his or her way? 3) How often does this child become angry or anxious when going from one activity to another? After all exclusions, data from a total of 18 survey items remained upon which the summary measures described below were based.

Based on these analyses, four distinct, yet complementary, domains were identified: 1) Early Learning Skills, 2) Self-Regulation, 3) Social-Emotional Development, and 4) Physical Health and Motor Development. Although similar to the initially specified domains (Language Development and Literacy; Cognition and General Knowledge; Approaches Toward Learning; Physical Well-being and Motor Development; and Social and Emotional Development (Rhode Island KIDS COUNT 2005)), these four domains differ from the five hypothesized domains of school readiness in three important ways. First, the Language Development and Literacy and Cognition and General Knowledge domains were combined due to high correlation ($r = .97$, $p < .001$) into a single domain titled Early Learning Skills. Second, two of the four items hypothesized to comprise the Approaches to Learning domain were removed from the analysis due to skew (This child shows interest and curiosity in learning new things?; How well is this child learning to do things for him or herself?), leaving only two items in this domain. As both of the remaining items were also originally hypothesized to fall within the Social-Emotional Development domain, they were moved accordingly and the separate Approaches Toward Learning domain was removed. Third, and finally, the Social-Emotional Development domain was originally hypothesized to be comprised of multiple sub-domains (including self-regulation, social-competence, and emotional competence). The results of the CFA analyses ultimately found that the related survey items mapped onto two distinct, yet

Table 2 Descriptive Statistics for "Healthy and Ready to Learn" Items in the 2016 National Survey of Children's Health

			Unweighted						Weighted					
Item	Min	Max	Mean	SD	Median	N	Skew	Kurtosis	Mean	SD	Median	N	Skew	Kurtosis
1. How often can this child recognize the beginning sound of a word?	1	4	1.7	0.9	1	7328	1.1	3.2	1.7	0.9	1	11,538,758	1.1	3.2
2. How many letters of the alphabet can this child recognize?	1	4	1.7	0.9	1	7342	0.9	2.6	1.8	0.9	1	11,556,513	0.8	2.5
3. Can this child rhyme words?	1	2	1.3	0.4	1	7322	1.1	2.2	1.3	0.4	1	11,482,215	1.0	2.0
4. How often can this child explain things he or she has seen or done so that you get a very good idea of what happened?	1	4	1.6	0.7	1	7339	1.1	3.9	1.6	0.8	1	11,520,850	1.2	4.1
5. How often can this child write his or her first name, even if some of the letters aren't quite right or are backwards?	1	4	2.2	1.3	1	7336	0.5	1.5	2.2	1.3	2	11,535,307	0.4	1.4
6. How high can this child count?*	1	6	4.3	1.2	4	7344	−0.1	2.5	4.2	1.2	4	11,531,959	−0.1	2.7
7. How often can this child identify basic shapes, such as a triangle, circle, or square?	1	4	1.3	0.6	1	7328	2.2	7.8	1.4	0.7	1	11,528,143	2.0	6.6
8. This child shows interest and curiosity in learning new things.	1	3	1.0	0.2	1	7526	4.7	25.8	1.1	0.3	1	11,880,583	4.1	20.3
9. How well is this child learning to do things for him or herself?	1	4	1.1	0.4	1	7336	3.0	13.6	1.1	0.4	1	11,510,607	3.1	14.8
10. How often does this child keep working at something until he or she is finished?	1	4	2.2	0.6	2	7357	0.1	3.0	2.2	0.7	2	11,548,899	0.1	2.9
11. When he or she is paying attention, how often can this child follow instructions to complete a simple task?	1	4	1.7	0.6	2	7338	0.5	2.8	1.7	0.7	2	11,541,052	0.6	3.0
12. In general, how would you describe this child's health?	1	5	1.4	0.6	1	7539	1.9	6.9	1.4	0.7	1	11,989,041	1.9	6.9
13. How would you describe the condition of this child's teeth?	1	6	1.6	0.9	1	7541	1.8	6.8	1.7	1.0	1	11,984,069	1.5	4.9
14. When this child holds a pencil, does he or she use fingers to hold, or does he or she grip it in his or her fist?	1	3	1.2	0.4	1	7337	1.8	5.2	1.2	0.4	1	11,523,208	1.8	5.1
15. How often does this child play well with others?	1	4	1.7	0.6	2	7340	0.3	2.7	1.6	0.6	2	11,542,464	0.6	3.2
16. Compared to other children his or her age, how much difficulty does this child have making or keeping friends?	1	3	1.2	0.4	1	7330	2.6	9.5	1.2	0.4	1	11,489,236	2.7	10.0
17. This child is affectionate and tender with you.	1	3	1.1	0.2	1	7518	4.5	23.8	1.1	0.3	1	11,876,404	3.8	17.5

Table 2 (continued)

Item	Min	Max	Unweighted						Weighted					
			Mean	SD	Median	N	Skew	Kurtosis	Mean	SD	Median	N	Skew	Kurtosis
18. This child bounces back quickly when things do not go his or her way.	1	3	1.3	0.5	1	7515	1.2	3.5	1.4	0.6	1	11,837,220	1.1	3.1
19. How often does this child become angry or anxious when going from one activity to another?*	1	4	3.4	0.6	3	7345	−0.7	3.9	3.4	0.6	3	11,563,407	−0.9	4.6
20. How often does this child show concern when others are hurt or unhappy?	1	4	1.7	0.7	2	7357	0.6	2.9	1.8	0.8	2	11,563,010	0.7	3.0
21. How often can this child calm down when excited or all wound up?	1	4	2.0	0.6	2	7337	0.1	3.0	2.0	0.7	2	11,527,354	0.2	2.9
22. How often does this child lose control of his or her temper when things do not go his or her way?*	1	4	3.0	0.6	3	7344	−0.8	5.6	3.0	0.6	3	11,538,185	−0.9	5.0
23. How often is this child easily distracted?	1	4	2.9	0.6	3	7351	−1.1	6.1	2.9	0.6	3	11,549,455	−1.1	5.4
24. Compared to other children his or her age, how often is this child able to sit still?	1	4	2.1	0.7	2	7345	0.2	2.8	2.1	0.7	2	11,535,572	0.2	2.7
25. This child smiles and laughs a lot.	1	3	1.0	0.2	1	7530	6.0	41.4	1.1	0.2	1	11,890,578	4.4	22.9

* Denotes items for which a lower value indicates better functioning.

complementary, domains of Self-Regulation and Social-Emotional Development, which were subsequently adopted as separate domains for the purposes of this project.

Third, building on the information garnered through the CFA process, separate scales were developed for Early Learning Skills, Self-Regulation, and Social-Emotional Development as well as an index for Physical Health and Motor Development that addressed variability in item response categories, variation in the number of items included in each domain, and expected age differences in children's ability to master each of the skills reflected in the survey items. This was achieved by coding the response categories for each item within these domains according to age-specific expectations for a child's ability to attain the related competency or skill. For example, a three-year-old who could identify the three shapes listed in the item "How often can this child identify basic shapes, such as a triangle, circle, or square" "All" or "Most of the time" was coded as being "On Track" and was assigned a score of 2 points while a three-year-old who could identify these shapes only "Some of the time" was coded as "Needing Support" and assigned a score of 1 point; a three-year-old who could not identify these shapes (response "None of the time") was coded as "At risk" and assigned a score of zero. This coding scheme was developed by Kristin Anderson Moore and was reviewed and confirmed by HRSA's MCHB as well as two Child Trends researchers (David Murphey and Kristen Darling) who were external to the project. The final list of 18 items utilized in the calculation of both the domain-specific indices and the composite measure as well as the corresponding rating for each response*age combination ("On Track" "Needs Support" "At Risk") are presented in Table 3.

Fourth, a summative score was developed for each domain and recoded so that children were rated on a three-point scale (0 = At-Risk, 1 = Needs Support, 2 = On-Track) for each domain. A single, summative index measure for "Healthy and Ready to Learn" was then constructed based on each of these four domain indices scored from the final 18 items. This overall index was thus based on microdata; information about each child was coded for each of the four domains and then aggregated to yield a summary measure of how many children may be described as "Healthy and Ready to Learn" or "On- Track" for their age across all four domains (Moore et al. 2008).

Fifth and finally, in order to examine concurrent validity, the ability of the proposed NOM to distinguish between groups that were theoretically expected to be different was assessed. Specifically, the extent to which the distributions of the developmental NOM varied by parents' confidence their child was ready for school (very confident, mostly confident, somewhat confident, and not confident at all) and by the parent's highest level of education (less than high school, high school graduate [including vocational, trade, and business school] and more than high school) were assessed.

All data were obtained from the preliminary public use NSCH data file provided by the U.S. Census Bureau. Item-level analyses were conducted using Stata 14 (StataCorp. 2015. Stata Statistical Software. College Station, TX: StataCorp LP) in order to adjust for the multistage sample design, and CFA were conducted using Mplus, version 7 (Muthén and Muthén 1998-2012). For the CFA, a robust weighted least squares estimate (WLSMV) was used and missing data were handled through Full Information Maximum Likelihood (FIML). Survey weights supplied by the U.S. Census Bureau were applied to account for noncoverage and nonresponse and to be representative of the non-institutionalized US population of children ages 0–17.

Table 3 Coding scheme utilized to develop summary measure for "Healthy and Ready to Learn" domain indices, 2016 National Survey of Children's Health

Domain	Items	At-Risk			Needs Support			On-Track		
		3 Years	4 Years	5 Years	3 Years	4 Years	5 Years	3 Years	4 Years	5 Years
Early Learning Skills	1. How often can this child recognize the beginning sound of a word?	None of the time	Some/None of the time	Some/None of the time	Some of the time	Most of the time	Most of the time	Most/All of the time	All of the time	All of the time
	2. How many letters of the alphabet can this child recognize?	None of the them	Some/None of the them	Some/None of the them	Some of the them	Most of the them	Most of the them	Most/All of the them	All of the them	All of the them
	3. Can this child rhyme words?	–	No	No	No	–	–	Yes	Yes	Yes
	4. How often can this child explain things he or she has seen or done so that you get a very good idea of what happened?	None of the time	Some/None of the time	Some/None of the time	Some of the time	Most of the time	Most of the time	Most/All of the time	All of the time	All of the time
	5. How often can this child write his or her first name, even if some of the letters aren't quite right or are backwards?	–	None of the time	Some/None of the time	None of the time	Some of the time	Most of the time	Some/Most/All of the time	Most/All of the time	All of the time
	6. How high can this child count?	Not at all	Not at all/Up to 5	Not at all/Up to 5/Up to 10	Up to 5	Up to 10	Up to 20	Up to10/up to 20/up to 50/up to 100 or more	Up to 20/up to 50/up to 100 or more	Up to 50/up to 100 or more
	7. How often can this child identify basic shapes, such as	None of the time	Some/None of the time	None /Some/Most of the time	Some of the time	Most of the time	–	Most/All of the time	All of the time	All of the time

Table 3 (continued)

Domain	Items	At-Risk			Needs Support			On-Track		
		3 Years	4 Years	5 Years	3 Years	4 Years	5 Years	3 Years	4 Years	5 Years
	a triangle, circle, or square?									
Physical Health and Motor Development	8. In general, how would you describe this child's health?	Fair/Poor	Fair/Poor	Fair/Poor	Good	Good	Good	Very good/ Excellent	Very good/ Excellent	Very good/ Excellent
	9. How would you describe the condition of this child's teeth?	Fair/Poor	Fair/Poor	Fair/Poor	Good	Good	Good	Very good/ Excellent	Very good/ Excellent	Very good/ Excellent
	10. When this child holds a pencil, does he or she use fingers to hold, or does he or she grip it in his or her fist?	Cannot hold pencil	Cannot hold pencil	Cannot hold pencil/grips in fist	Grips in fist	Grips in fist	–	Uses fingers	Uses fingers	Uses fingers
Social-Emotional Development	11. How often does this child play well with others?	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	All/Most of the time	All/Most of the time	All/Most of the time
	12. Compared to other children his or her age, how much difficulty does this child have making or keeping friends?	A lot of diffi-culty	A lot of difficulty	A lot of difficulty	A little difficul-ty	A little difficul-ty	A little difficul-ty	No difficulty	No difficulty	No difficulty
	13. This child bounces back quickly when things do not go his or her way.	Not true	Not true	Not true	Somewhat true	Somewhat true	Somewhat true	Definitely true	Definitely true	Definitely true

Table 3 (continued)

Domain	Items	At-Risk			Needs Support			On-Track		
		3 Years	4 Years	5 Years	3 Years	4 Years	5 Years	3 Years	4 Years	5 Years
	14. How often does this child show concern when others are hurt or unhappy?	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	All/Most of the time	All/Most of the time	All/Most of the time
Self-Regulation	15. How often is this child easily distracted?	All of the time	All of the time	All of the time	Most of the time	Most of the time	Most of the time	Some/ None of the time	Some/ None of the time	Some/None of the time
	16. Compared to other children his or her age, how often is this child able to sit still?	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	All/Most of the time	All/Most of the time	All/Most of the time
	17. How often does this child keep working at something until he or she is finished?	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	All/Most of the time	All/Most of the time	All/Most of the time
	18. When he or she is paying attention, how often can this child follow instructions to complete a simple task?	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	All/Most of the time	All/Most of the time	All/Most of the time

This table does not include items that were not included in the recommended NOM ("This child smiles and laughs a lot;" "How often does this child lose control of his or her temper when things do not go his or her way?," "How often does this child become angry or anxious when going from one activity to another?;" "How often can this child calm down when excited or all wound up?;" "This child is affectionate and tender with you;" "This child shows interest and curiosity in learning new things;" and "How well is this child learning to do things for him or herself?")

3 Results

As noted above, each domain index was scored separately to ensure consistency and equity among the domains and the summative score for each domain was recoded so that children were ranked on a three-point scale within each domain (0 = At-Risk, 1 = Needs Support, 2 = On-Track). Estimates for the proportion of children ages 3–5 years in the U.S. who fell within "At-risk," "Needs Support," or "On-Track" for each of the four domains are displayed in Fig. 1. Figure 2 depicts the proportion of children based on the number of domains in which they were reported to be "On Track" – 0-1, 2, 3, or 4. Overall, we found that approximately 91% of US children were considered to be "On Track" in two or more domains and 42% were "On Track" in all domains, or "Healthy and Ready to Learn" based on this pilot measure.

3.1 Early Learning Skills

The Early Learning Skills domain contained seven items resulting in a score range of 0 to 14 as each item could be scored 0 (At-Risk), 1 (Needs Support), or 2 (On-Track). Ratings of At-Risk, Needs Support, or On-Track for the summative scores were assigned using the following cut points: On-Track was defined as scoring between 12 to 14 points. To attain this score, a child needed to have received a score of 2 ("On-Track") on most items in the index—with an allowance to get up to two scores of 1 ("Needs Support"). At-Risk was defined as 0–6 points because a score in this range indicated that, on average, the child did not receive at least 1 point on all of the items. The remaining children fell in the middle and were considered "Needs Support." Using this approach, 58.4% of children ages 3–5 years were "On-Track" in this domain while 32.7% "Need Support" and 8.8% were "At-Risk". (Fig. 1).

3.2 Self-Regulation and Social-Emotional Development

A similar strategy was employed for both the Self-Regulation and Social-Emotional Development domains. Each of these indices was comprised of four items, resulting in a maximum possible score for each index of eight. A score of 7 to 8 was used as a cut point for "On Track" as this score implies a child was scored as "On Track" (2 points) for

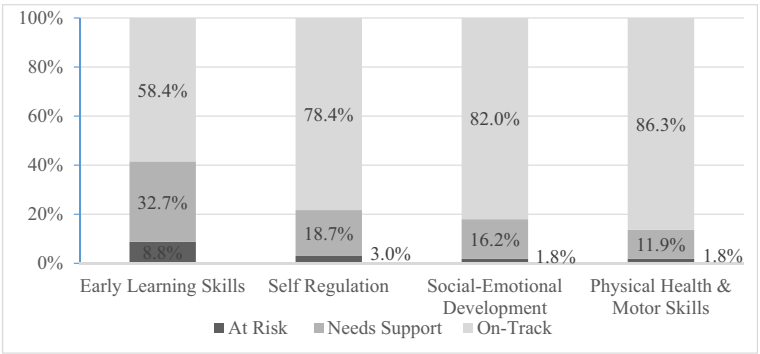

Fig. 1 Proportion of U.S. children aged 3–5 scoring "On-Track," "Needs Support," or "At-Risk" for each Healthy and Ready to Learn domain, 2016 National Survey of Children's Health

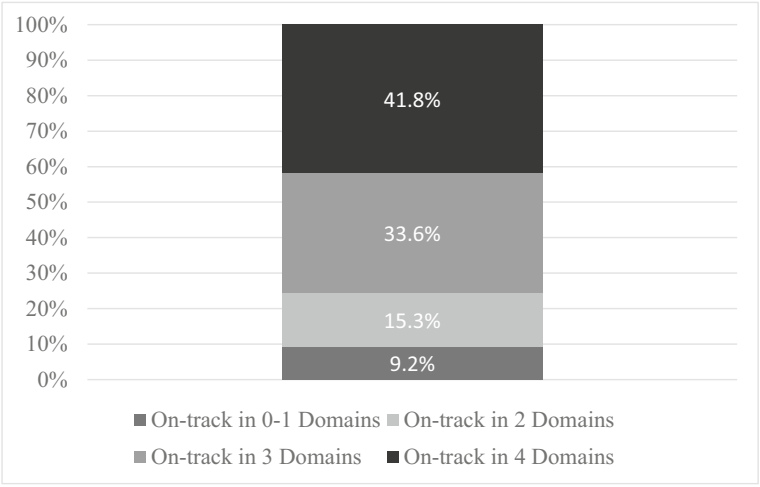

Fig. 2 U.S. Children Ages 3-5 years "On-Track" in 0-4 domains of Healthy and Ready to Learn, 2016 National Survey of Children's Health

most items in the index, with an allowance to get up to one score of "Needs Support" (1 point). An overall score of four implies that a child received a score of "Needs Support" (1 point) for each item, thus children who had an index score below 4 points were coded as "At-Risk," and scores between 4 and 6 points were coded as "Needs Support." Based on this rubric, 78.4 and 82.0% percent of three-to-five year olds were reported to be "On Track" with respect to Self-Regulation and Social Emotional Development, 18.7 and 16.2% were reported to "Need Support", and 3.0 and 1.8% were reported to be "At Risk" with respect to each domain, respectively. (Fig. 1).

3.3 Physical Health and Motor Development

The Physical Health and Motor Development index was comprised of three items, with a maximum score of six points. For this index, a score of 0–2 points was defined as "At-Risk," while a score of 3–4 points was defined as "Needs Support," and a score of 5–6 points was defined as "On-Track." Over 85% of children were "On Track" in this domain while 11.9% were considered to "Need Support" and 1.8% were "At Risk".

3.4 Proposed National Outcome Measure for "Healthy and Ready to Learn"

Based on the age-specific indices developed for each of the four individual domains, which ranked children as "At-Risk," "Needs Support," or "On-Track", the proportion of children who were "On-Track" across all four domains, "On-Track" in three domains, "On-Track" in two domains, or "On-Track" in one or zero domains was calculated for the pilot measure. Although the definition of "On-Track" varies somewhat based upon children's age and the number of items within each index, generally, a child who was ranked "On-Track" in all or most of the four Healthy and Ready to Learn domains was hypothesized to be developing the skills and competencies needed to be ready for school. Using this approach, 41.8% of three- to five-year-olds were estimated to be "On-Track" in all four domains and therefore considered to be "On-Track" overall, while 15.3% and 33.6% and were "On-Track" in two

and three domains, respectively. Finally, 9.2% were "On-Track" in zero or in one domain and therefore considered to be "At Risk" overall.

4 Discussion

While significant work remains to validate the proposed pilot measures and refine survey content, these analyses suggest that just over four in ten children aged 3-5 years are "On Track" across all four domains of "Healthy and Ready to Learn" identified through this study, while another three in ten are on track in three of the four domains. On the other hand, one in ten are reported to be "On Track" in ≤ 1 domain, while 15 percent are on track in two domains. We now have the opportunity to further explore how to best utilize these data to provide states and the nation with a first-ever composite measure of young children's early development and readiness to succeed in school. Without question, work remains to determine the extent to which the proposed NOM and the four domain-specific indices provide users and stakeholders with useful and actionable information to target efforts towards children who may need support in preparing for kindergarten entry as well as to inform school and community efforts to support children once they enter the school system. Research suggests that the "quality and character of school life" (Cohen et al., page 182) can positively impact a wide range of outcomes for children, including school achievement (Cohen et al. 2009). While the focus of this paper is on skills development *prior to* kindergarten entry, opportunities to promote healthy development and academic achievement *after* school entry are important too. In addition, work is ongoing to identify opportunities to refine or expand the survey items for future iterations of the NSCH and to consider different applications for the items that were omitted from the calculation of summary measures through the modeling process. The conduct of this work will be supported by data from the 2016 NSCH, which were publicly released on September 5, 2017, and the 2017 NSCH due for release in Fall 2018.

Pending this additional analysis, several previous estimates of the proportion of children ready for school offer a useful lens through which to view the proposed NOM. The Young Child Risk Factor, developed by the National Center for Children in Poverty, has reported that 16% of U.S. children aged three to five experience three or more risk factors (e.g., living in poverty or with a single parent), and are at the highest risk for poor health, educational, and developmental outcomes, while 44% experience 1 to 2 risk factors, and 40% experience no risk factors. These numbers, though drawing on very different variables tell a similar story as the "Healthy and Ready to Learn" measures set forth here with its estimate of 42% of three- to five-year-olds "On-Track" in all four domains. Other national estimates of children's readiness for school include work by the Brookings Institution using data from the Department of Education's Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) to examine the associations between risk factors, such as living in poverty, and maternal education on children's readiness for school. Based on these analyses, 65% of five-year-olds were considered "ready for school" (Issacs and Magnuson 2011). This estimate, derived solely for 5 year-olds, is higher than the estimate proposed in this study; however, it was based on thresholds rather than age-salient competencies and may be less discriminating as a result. Also, using the 2003 NSCH, Moore and colleagues mapped four domains of child well-being: Physical Health Status, Psychological Health, Social Health, and Cognitive/ Educational Health. Their analyses found that 24% of children ages 6–11 years had positive

well-being in 0–1 domains, 19% had positive well-being in two domains, 25% had positive well-being in three domains, and 31% had positive well-being in all four domains. These proportions are somewhat aligned with the NOM estimates and are closer in concept to the "Healthy and Ready to Learn" NOM discussed here, though these older children were slightly less likely to be doing well in multiple domains (Moore et al. 2011).

Several limitations of this work should be noted. First, based on expert review of the preliminary 2016 data, survey content in at least three topical areas may need to be either expanded or refined: early literacy, executive functioning, and children's physical health and motor development. With respect to the latter, despite a wealth of health-related information collected through the NSCH, as currently specified the Physical Health and Motor Development domain includes only three items: General physical and oral health status and pencil grip. These items, particularly the latter two, may be limited in that parents' perceptions of their children's physical health may be driven by perceptions of their child's social-emotional well-being. As such, the identification of additional items under this domain may be warranted in future iterations of the composite measure or the survey. Several existing items and content areas have been considered, including the presence and type of special health care needs, the extent and frequency of activity limitations, selected birth outcomes, and/or the presence and severity of a wide range of physical, emotional, and/or behavioral conditions. However, while research links these factors to school engagement and missed school, it is unclear if they predict a child's readiness to succeed in school, per se, as a child can succeed in school with an array of health problems if adequately and appropriately supported. We expect to explore this further in subsequent analyses using various measures of health to stratify findings from the "Healthy and Ready to Learn" summary measures. Results from these analyses may better inform next steps with respect to expanding and refining the items used to track this domain. Second, the proposed NOM's psychometric properties may be further bolstered by conducting additional analyses, such as subgroup analyses by age, in particular. Third, all data in the NSCH are parent or caregiver reported without confirmation from an educational professional or teacher that may provide a different assessment particularly of the child's early learning skills. It is possible that reports by parents and caregivers on the skills and competencies assessed in the NSCH may be biased by either the social desirability to overestimate or overstate their child's abilities or by a lack of knowledge around which skills and competencies to look for and encourage. Such biases may be more likely to yield optimistic reports making the "Healthy and Ready to Learn" measure conservative in its identification of children falling into the "At Risk" or "Needs Support" categories. Fourth, it is important to note that both the child's primary language (and/or discordance with that of parents/caregivers) and the presence of certain conditions, e.g., hearing disorders, may impact both the timing and accuracy of young children's mastery of the skills in question. Future research is needed to assess limitations in the application of the proposed measures to diverse groups of children.

Finally, it is important to note that we remain keenly aware of the questions and criticisms that have been raised about the concept of school readiness, and note that being ready for school extends beyond the child's readiness to include the readiness of the child's school, community, and family to engage and teach the child in age-appropriate ways (Child Trends 2013). We also acknowledge the diverse range of skills and abilities that constitute normal childhood variation among 4- and 5-year olds and the cautions against using school readiness testing inappropriately. In particular, given the early life disparities that prevail among children, identifying any specific set

of skills as a standard for school readiness could have unintended negative consequences without a concomitant commitment to promoting universal readiness among all children (High et al. 2008). We recognize the importance of these critiques and acknowledge that the proposed pilot measures do not assess the readiness of the school for the child. In the absence of that, we suggest that identifying the range of skills that U.S. children come to kindergarten with may be helpful to the schools who teach them and the communities and families that care for them.

In the absence of national norms or a "gold standard" composite measure for young children's early development, a priority for further work is the validation of both the survey items and the proposed summary indices across diverse populations of children. The scope and direction of such efforts may vary. Depending on the availability, quality, and content of state-level population data about young children ages 3–5 years, opportunities to validate the NSCH items and measures may be possible using extant data. Alternatively, smaller studies using primary data collection may be able to use comparative standardized assessments yielding important information about the validity of the NSCH items and pilot measures. Importantly, these longer-term efforts will be complemented, in the short term, by ongoing work to refine and revise survey content. The 2017 NSCH was launched in August 2017. Based on expert review of the 2016 items and preliminary data analyses from the 2015 pretest, the 2017 items in this section were edited prior to this project, as follows: 1) an item on color recognition was added to expand the General Cognition subsection; and 2) response options were expanded across the survey Section to include 5 choices rather than 4. The 2017 survey instruments can be accessed at: https://mchb.hrsa.gov/data/national-surveys/questionnaires-datasets-supporting-documents. A complete cognitive review of the 2017 NSCH content was undertaken with sample respondents in both English and Spanish by the Census Bureau in preparation for 2018, which yielded additional suggestions for improvement of measures throughout the survey. The value of making changes to the survey items used to assess "Healthy and Ready to Learn" will be weighed against the challenges associated with reducing comparability between items and indicators over time. Consistent with our understanding that the "Healthy and Ready to Learn" items and related composite measures are still a work in progress and we expect to strengthen both over time.

Taken as a whole, these data represent an important resource for policy makers, program providers, and parents working to understand factors influencing young children's readiness to start school. The items included in the NSCH go beyond measures of cognitive attainment to address varied aspects of the skills and competencies children need to be ready for school—recognizing that being ready for school reflects social, emotional, and physical readiness, as well as approaches to learning and general knowledge. Moreover, they are nested in a survey with considerable information about the child's environment to provide a more nuanced, understanding of the factors that influence school readiness. For these reasons, the addition of content to the NSCH and the developmental NOM provide an important and unique opportunity to better understand the degree to which young children in the US are "Healthy and Ready to Learn".

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Compliance with Ethical Standards

Disclaimer The views expressed in this article are those of the authors and do not necessarily reflect the official policies of the U.S. Department of Health and Human Services or the Health Resources and Services Administration, nor does mention of the department or agency names imply endorsement by the U.S. government.

Conflict of Interest The authors have indicated they have no potential conflicts of interest to disclose.

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