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Guiding Family-Based Obesity Prevention Efforts in Low-Income Children in the United States. Part 2: What Behaviors Do We Measure?

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Abstract

Pediatric overweight prevention efforts require assessment of individual risk for developing overweight. Based on the previously identified 12 determinants of pediatric overweight, the objective was to systematically identify behaviors for each determinant for inclusion in an obesity risk assessment tool targeting families with young children in the United States. Emphasis was given to children living in low-income communities, children preschool age, and those participating in U.S. Department of Agriculture nutrition, food assistance and education programs. Reviewed were modifiable behaviors associated with 12 obesity-related determinants, and measurement tools used to assess these behaviors. Pubmed searches conducted for the period January 1965-April 2006 included both qualitative and quantitative studies of US populations. Extracted from each study were: behavior, income and low-income status, child age, assessment tool, its validation status and tool name. Twenty-two behaviors were reported in 37 studies. Eleven studies targeted preschool-age children; five included low-income preschoolers. Valid instruments for this low-income preschool-age child were available for behaviors associated with only two determinants: dietary fat and parenting style. Additional research to develop and validate assessment tools measuring behaviors associated with overweight determinants is needed to guide obesity prevention efforts in low-income children and their families. Results from the current review of behaviors and tools provide researchers with the necessary first steps toward the development of measurement tools for primary and secondary prevention interventions for pediatric overweight.

Keywords: Overweight, obesity, children, risk assessment, behaviors.

Introduction

Pediatric overweight prevention efforts require assessment of a child's risk for excessive weight gain and monitoring his progress in primary prevention interventions. Our previously reported evidence

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analyses resulted in the identification of 12 determinants of obesity (1). "Determinant" is defined here as a diet, activity or parenting factor related to obesity. This paper expands that review to include specific modifiable behaviors in the United States associated with each determinant and to identify existing measurement tools used to measure these behaviors. Development of a risk assessment tool first requires that the determinants be translated into measurable behaviors practiced by the target audience followed by scale development for each behavior or group of behaviors (2-4).

For this review, 'behavior' is defined as an action or something a person does, such as eating fruit for snacks, or eating cereal for breakfast, rather than a measure of the quantity (e.g., servings, cups or grams) consumed per day. We chose to focus on behaviors and not on, for example, intakes as assessed by 24-hr dietary recalls, diet records or food frequencies for several reasons. First, recalls, records, observational assessments or objective quantifiable measures are difficult to administer to a group in a community setting (5). Second, parents from low-income communities in the United States (U.S.) understand behavioral checklist formats (6,7). And third, on a behavior change continuum (8,9), behaviors precede intake, for example, therefore they are more sensitive to change (4,8). Our focus is modifiable behaviors that will guide both intervention and tool development with an emphasis on young children living in low-income (i.e., =185% of poverty) households in the U.S. Results from this review will provide the necessary research base for the development of assessment and evaluation tools for primary and secondary prevention interventions for pediatric overweight and obesity as well as the behavioral content for those interventions in the US.

Objectives

Specifically, our two objectives are to identify: 1) modifiable behaviors practiced by parents with children associated with each of the 12 previously identified obesity-related determinants, and 2) measurement tools used to assess these behaviors.

Methods

To guide pediatric prevention efforts, we systematically reviewed: 1) modifiable behaviors associated with previously identified determinants of obesity, and 2) tools used to assess these behaviors. For this review, we included 12 previously identified determinants of obesity: 8 diet-related (fat, dietary fiber, fruit/vegetables, calcium/dairy, sweetened beverage, restaurant-prepared food, breakfast, energy density); three activity-related (physical activity, TV viewing, sleep duration); and one parenting-related (parenting style). We conducted 23 independent searches: 11 for associated behaviors and 12 for measurement tools. Parenting style was the one determinant not associated with discrete behaviors.

Data Sources

The searches of databases were conducted for the 40-year period January 1965 through April 2006 and included PubMed, Medline and Agricola. Relevant papers were also gleaned from references cited in the literature. Basic search terms were 'children', 'behavior' and a specific determinant (i.e. 'fat'). Key words were added to narrow the search when findings were overly broad (e.g., 'not school' for the search of behaviors associated with sweetened beverage consumption). Specific foods or other relevant words were included as search terms (e.g., 'milk' or 'intake') if the original search did not produce workable findings.

Inclusion and Exclusion Criteria

For our first objective, studies involving diverse families with children ages 2-18 years were included. Of special interest was identification of findings for families living in low-income communities and those with young (preschool-age) children. Studies conducted in the US were targeted exclusively as other countries have different dietary behaviors and food procurement systems. Amount and frequency data were included only when behavior-specific data were not available. Intervention studies were not considered for review unless baseline behavior data were available.

For our second objective, searches were conducted as described above for behaviors, except that the words "tool OR surveys OR questionnaires" were added to the determinant word to complete the search term. Included were studies from the peer-reviewed literature identifying existing assessment and evaluation tools for families with children, ages

2–18 years, living in the US. We highlighted studies conducted with low-income audiences or focusing on young children. Tools designed to be self-administered by parents for their children or by older children for themselves were included. Tools requiring a registered dietitian or another professional to administer were excluded.

We specifically searched for validation studies of measurement questionnaires. Validation studies estimate the accuracy of these questionnaires. The search was not limited to a specific type of validity (e.g., face, content, convergent, criterion), recognizing that multiple approaches to the assessment of validity is advantageous and preferred (6).

Data Extraction and Synthesis

Articles were grouped into three determinant categories: diet, activity and parenting. Data extracted for each of the 12 determinants included behaviors of families with children for each determinant, income and low-income status of families, age of children, measurement tool (and name if available), and tool validation status.

Given that parenting styles describe the ways in which parents interact with their children across a wide-range of situations, rather than specific behaviors that parents exhibit (10), parenting styles cannot be adequately measured by discrete behaviors. More appropriate measures of parenting styles are long checklists, rating scales, or observational assessments. Parenting styles were therefore omitted from the "behaviors" portion of the present literature review. The search of measurement tools was limited to those studies specifically measuring parenting styles (authoritative, authoritarian, permissive/indulgent, neglectful/uninvolved), rather than parenting practices, attitudes, or behaviors. We searched for measurement tools of both general parenting styles and parenting styles specific to children's diet or physical activity. Studies were noted that validated these instruments and targeted low-income populations.

Results

Modifiable Behaviors - Overview

We found 35 references in our 11 independent searches of behaviors associated with the determinants of obesity (see tables 1,2). These 37 studies identified 22 modifiable behaviors (see table 3) associated with one or more determinants of obesity (1). Of special interest for the current review was empirical support for identification of behaviors specific to families living in low-income communities (see table 1). Seven studies with low-income participants covered modifiable behaviors for five of the 12 determinants: fat (11,12), calcium/dairy (13), fruit/vegetables (14), physical activity (15, 16), television (47). Eleven studies with preschool-age children covered behaviors for six determinants: fat (11,12,17-19), dietary fiber (17), fruit/vegetables (17,18), calcium/dairy (20), physical activity (15,16,21,22) and television (47). Of the 11 studies with preschool children and seven with low-income families, five studies emerged for behaviors of low-income families with preschool-age children and these studies applied to only three determinants: fat (11,12), physical activity (15,16) and television (47).

Behaviors for Diet-Related Determinants

Dietary fat. We found 11 reports of dietary fat behaviors (see tables 1,2) (11,12,17-19,23-28). Five studies targeted preschool-age children (11,12, 17-19) of which two focused on low-income preschool-age children (11, 12). Four behaviors were positively linked to increased fat intake: role modeling of high fat food intake by family members, eating fast food, eating at restaurants with family members, and skipping breakfast.

Four behaviors were linked to decreased fat intake: eating fruit, parental preparation of low-fat foods, eating ready-to-eat (RTE) cereal, and eating breakfast (see table 3).

Dietary fiber. Five papers addressed fiber intake in children and/or adolescents (see tables 1, 2) (17,25,29-31). No studies targeted low-income groups. One paper included girls only (29) and one targeted preschool-age children (17). Parental modeling of eating high fiber foods, eating fruit, eating RTE cereals and eating breakfast in general were behaviors positively linked with increased fiber intake. Being a "picky eater", eating an energy dense diet, and skipping breakfast were linked with decreased fiber intake (see table 3).

Table 1. Behaviors associated with diet and lifestyle determinants of pediatric obesity

Determinant [a,b]	Reference	Behaviors (direction of relationship with determinant)	Age (y) Low-income [c]
Dietary fat	Dennison, 2001 (11)	Family modeling of milk type intake (-)	1 – 5 [c]
	Basch, 1992 (12)	Eat or drink high-fat milk products (+)	4 – 7 [c]
	Dennison, 1998 (17)	Eat fruit (-)	2, 5
	Fisher, 2002 (18)	Eat fruits and vegetables (-)	5
	Albertson, 2003 (19)	Eat RTE [d] cereal (-)	4 – 12
	Paeratakul, 2003 (23)	Eat fast food (+) Drink soda (+)	≤ 9
	Lee, 2001 (24)	Eat fruit (-)	5 – 7
	Morgan, 1981 (25)	Eat RTE [d] cereal for breakfast (-) Skip breakfast (+)	5 – 12
	Cullen, 2004a (26)	Prepare low-fat foods (-), eat breakfast (-), eat snacks	8 – 10
	Zoumas-Morse, 2001 (27)	Eat at restaurants (+)	7 – 17
	Tibbs, 2001 (28)	Parental modeling of healthful dietary behavior (-)	0 – 3
Dietary fiber	Dennison, 1998 (17)	Eat fruit (+)	2, 5
	Morgan, 1981 (25)	Eat RTE [d] cereal for breakfast, especially non-sweetened RTE [b] cereal (+)	5 – 12
	Galloway, 2005 (29)	Be a "Picky eater" [e] (-)	7
	Saldahna, 1995 (30)	Eat RTE [d] cereal for breakfast (+) Eat breakfast (+)	2-18
	Affenito, 2005 (31)	Days eating breakfast (+)	9 – 19
	Reimer, 2004 (14)	Parents eat fruit and vegetables. (+) Prepare and plan meals (+)	< 12 [c]
Fruit/ vegetables	Dennison, 1998 (17)	Eat fruit (+)	2, 5
	Fisher, 2002 (18)	Increased intake of fruit and vegetables by parents (+)	5
	Tibbs, 2001 (28)	Parental modeling (+)	0 – 3
	Galloway, 2005 (29)	Be a "picky-eater" [c] (-) Mother eats more fruits and vegetables. (+)	7
	Hearn, 1998 (32)	Availability and accessibility at home (+)	~8 – 9
	Reynolds, 1999 (33)	Make fruits and vegetables available in the home (+)	~8 – 9
	Kratt, 2000 (34)	Fruit and vegetables made available and accessible at home (+)	~9 – 10
	Cullen, 2000 (35)	Parental modeling of fruit and vegetable intake. (+) Make fruits and vegetables available at home. (+)	9 – 12
	Cullen, 2003 (36)	Fruit and vegetables made available and accessible at home. (+)	9 – 12
	Sampson, 1995 (13)	Skip breakfast (-)	~7 – 11 [c]
	Fisher, 2000 (20)	Maternal and child intake of soda (-) Maternal and child intake of milk (milk and calcium) (+)	5
	Paeratakul, 2003 (23)	Eat fast food (-)	≤ 9

Calcium/dairy	**Morgan, 1981 (25)**	**Eat RTE cereal for breakfast, especially non-sweetened RTE [d] cereal (calcium) (+)**	**5 – 12**
	Affenito, 2005 (31)	**Days eating breakfast (calcium) (+)**	**~9 – 19**
	Nicklas, 1998 (37)	**Eat RTE [d] cereal (milk) (+)**	**10**
	Rajeshwari, 2005 (38)	**Medium to high intake of sweetened beverages (-)**	**10**
	Lee, 2003 (39)	**Eat breakfast. (+)** **Encouraged to drink milk. (+)** **Like cheese. (+)**	**~11 – 14 [c]**
	Striegel-Moore, 2006 (40)	**Availability of high-calcium foods (calcium). (+)** **Intake of regular soda, fruit drinks and coffee/tea (-)**	**9 – 19**
Sweetened beverage	**Paeratakul, 2003 (23)**	**Eat fast food. (+)** **Drink sodas. (+)** **Eat high fat foods. (+)** **Eat cereal. (-)** **Eat fruit. (-)** **Drink milk. (-)**	**≤ 9**
	Cullen, 2004a (26)	**Availability of high-fat foods, eat snacks. (+)**	**8 – 10**
Restaurant-prepared foods [f]	**Paeratakul, 2003 (23)**	**Eat fast food. (+)** **Drink sodas. (+)** **Eat high fat foods. (+)** **Eat cereal. (-)** **Eat fruit. (-)** **Drink milk. (-)**	**≤ 9**
Breakfast	**Albertson, 1993 (43)**	**More frequent intake of RTE[d] cereal for breakfast (+)**	**7 – 12**
Energy density	**Resnicow, 1991 (44)**	**Skip breakfast (+)**	**9 – 19**
Television viewing	**Robinson, 1999 (46)**	**View TV in bedroom (+)** **Eat (meals, snacks) in front of TV (+)**	**8-10**
	Dennison, 2002 (47)	**View TV in bedroom (+)**	**1-4 [c]**
Physical activity	**Sallis, 1988 (15)**	**Parents spend time in vigorous activity (+)**	**~3 – 5 [c]**
	McKenzie, 1992 (16)	**Be less physically active at home (+)**	**4 [c]**
	Klesges, 1990 (21)	**Spend more time outdoors (+)**	**~3 – 5**
	Burdette, 2005 (22)	**Spend more time playing outdoors (+)**	**~2 – 5**
	Klesges, 1984 (45)	**Parents encourage physical activity (+)**	**1 – 2**

[a] Because sleep is assessed as duration, it is not considered a behavior, and therefore is not part of this table.

[b] Parenting style cannot be described as discrete behaviors, but as a general approach to parenting. Therefore it is not part of this table.

[c] 'Low-Income' defined as a large majority of subjects from low-income homes as determined by the authors or by participant characteristics such as WIC or Food Stamp Program participation.

[d] RTE = Ready-to-eat.

[e] Picky-eater = classified by three positive responses to items in the Child Feeding Questionnaire (Birch, 2001).

[f] Include food from fast food, take-out and restaurant outlets regardless of where eaten.

Table 2. Summary of child behavioral studies by target audience for each determinant. [a b]

Determinant	All audiences	Low-income [c]	Low-income preschool age 3 – 5 y
DIET			
Fat	**11**	**2**	**2**
Fiber	**5**	**0**	**0**
Fruit/vegetables	**10**	**1**	**0**
Dairy (calcium)	**9**	**2**	**0**
Sweetened beverages	**2**	**0**	**0**
Restaurant prepared foods	**1**	**0**	**0**
Breakfast	**1**	**0**	**0**
Energy density	**1**	**0**	**0**
LIFESTYLE			
Physical activity	**5**	**2**	**2**
Television viewing	**2**	**1**	**1**

[a] Because sleep is assessed as duration, it is not considered a behavior, and therefore is not part of this table.

[b] Parenting style cannot be described as a discrete behavior, but as a general approach to parenting. Therefore it is not part of this table.

[c] 'Low-Income' defined as a large majority of subjects from low-income homes as determined by the authors or by participant characteristics such as WIC or Food Stamp Program participation.

Fruit and vegetables. Ten papers addressed fruit and vegetable behaviors in children (see tables 1,2) (14,17,18,28,29,32-36). One study focused on low-income families (14). One study targeted the preschool-age child (18) with no studies targeting low-income preschool-age children. Six behaviors were associated with increased fruit and vegetable intake for low- and middle-income adolescents: parental role modeling of fruit and vegetable intake, eating fruit, availability of fruits and vegetables at home, preparing fruits and vegetables at home, parental meal planning, and having family mealtimes (see table 3).

Calcium/dairy. Nine papers identified calcium and/or dairy behaviors (see tables 1,2) (13, 20, 23, 25, 31,37-40). Two papers included primarily low-income children (13,39). No study targeted the preschool-age child. Five behaviors were positively associated with increased dairy/calcium consumption: parental modeling of and encouragement of dairy food intake, drinking milk, eating RTE cereals, eating breakfast, and availability of dairy foods at home. Behaviors negatively associated with dairy consumption include: drinking soda, skipping breakfast, eating fast foods and eating at restaurants (see table 3).

Sweetened beverages/soda. Two studies reported information about behaviors associated with sweetened beverage intake (see tables 1,2) (23, 26). No study targeted the preschool-age child. Sweetened beverage intake was positively associated with increased frequency of fast food consumption, availability of high fat foods at home and eating snacks (see table 3).

Restaurant prepared foods. One study reported behaviors associated with restaurant prepared foods (23). Drinking sodas and eating high fat foods were behaviors associated with eating restaurant prepared foods. Parents influenced menu choice based on cost issues, but few parents reported guiding children to select vegetables or salad for health reasons (41). Low-income parents chose restaurants for their kid friendliness, cleanliness, price, and service (41,42).

Breakfast. Only one paper addressed breakfast behaviors and then among 7-12 year old children (43). Those eating RTE cereal ate breakfast more frequently. Two foods commonly consumed for breakfast were RTE cereal and milk (see table 3) (11).

Energy density. One paper specifically addressed energy dense behaviors in children (44). No study targeted preschool-age children (see tables 1,2). Skipping breakfast was associated with eating an energy dense diet (see table 3) (44).

Behaviors for Activity-Related Determinants

Physical activity. Five papers addressed physical activity in young children (see tables 1,2) (15,16,21,22,45). No studies targeted low-income children. Four studies targeted the preschool-age child

(15,16,21,22). Time spent outdoors was shown to be positively associated with the amount of physical activity in preschoolers (21,22). Parental role modeling of vigorous physical activity was associated with child activity during free-play periods (15). Children with limited opportunities for physical activity and sedentary home environments were reported being less physically active (15,16,22). Children who were less physically active at home were less physically active during school recess (see table 3) (16).

Television viewing and sleep. The presence of a television in the child's bedroom and watching television, while eating meals and snacks were associated with increased viewing time (46). Children with a television in the bedroom spent more time watching compared to those without a bedroom TV in a study of low-income preschool children in New York state (47). This study found that 40% of the low-income children had a television in their bedroom. Measurement of the total number of hours viewing television each day was identified as the primary method of behavioral assessment for the television viewing determinant. However, three behaviors were associated with more television viewing: having a television in the child's bedroom, eating in front of the television, and parents not monitoring the child's viewing.

Measurement of the number of hours sleeping was identified as the current method of behavioral assessment for the sleep determinant (48,49). This is done by asking three questions: How long does your child sleep at night? At what time does your child go to bed? And at what time does your child wake up? Problems sleeping correlated with total sleep time and hence with child overweight. Watching television at bedtime had a negative effect on total sleep time (49).

Behavioral Measurement Tools

Studies identified tools to assess 22 modifiable behaviors associated with the 12 determinants. These tools (i.e. scales or individual questions) ranged in length from one question to 64. Four tools included measurements of behaviors for more than one determinant (28,50-52). Ten tools were developed specifically for the preschool-age child (22,42,47,53-56,60,61,69). Seven tools were designed for low-income children for behaviors associated with five determinants: restaurant-prepared foods (42), dietary fat (53,54,57,58), fiber (57), television (47,55), parenting styles (56) (see table 4). No tool included behaviors for all 12 determinants for any age group.

Tools for Diet- and Activity-Related Determinants

Of the tools in table 4, six were validated to assess diet behaviors associated with obesity (28,50,53,54,57,58). In all cases, these validation studies estimated convergent validity with a self-reported indicator, e.g. multiple 24-hour dietary recalls. We found no validation studies of criterion validity with a non-self-report indicator such as a biomarker or meal observation. For activity determinants, Anderson validated a television measurement tool using a video lapse camera (59) and Burdette (22) validated her Outdoor Playtime Checklist with an accelerometer. Of the six diet-related validation studies, four focused on low-income children (53,54,57,58). Some authors provided no evidence of efforts to validate the tool, scale or item (42,51,60).

Problematic in terms of incorporating energy density into a tool is that its accurate determination requires a comprehensive assessment and analysis of the diet; behavior-based questions are not likely to capture this construct completely. Not surprisingly, we did not identify a tool designed to assess a group of behaviors associated with dietary energy density.

Television viewing was measured in terms of duration on weekdays and weekend or just per day (51,52,55,59-62). Parents were accurate reporters of child TV time (see table 4) (59,62,63).

Table 3. Nineteen behaviors associated with each of 12 diet, lifestyle and parenting-related determinants [a,b]

BEHAVIOR	Model behavior	Eat fruit	Eat fast food	Eat at restaurants	Eat cereal	Eat nutrient dense/low fat diet	Eat breakfast	Eat energy dense/high fat diet	Picky eater	Availability at home	Prepare food	Plan meals	Family meals	Drink milk	Drink sodas	Skip breakfast	Snacking	Limited PA at home	Time outdoors	TV in bedroom	TV monitored by adult	Eat in front of TV	Direction of relationship with obesity [f]
DIET																							
Fat	x [c]	x	x	x	x		x				x					x							+
Dietary fiber	x [d]	x			x	x	x	x	x							x							-
Fruit/vegetable	x [d]	x								x	x	x	x										-
Dairy (calcium)	x		x	x	x		x			x				x	x	x							-
Sweetened Beverage		x	x		x			x						x	x		x						+
Restaurant pre- ...pared foods		x	x	x	x			x				x	x										+
Breakfast					x																		-
Energy density							x	x								x	x						+
LIFESTYLE																							
Physical activity	x																	x					-
Television [e]	x																			x	x	x	+
PARENTING																							
Parenting style																							

[a] Because sleep is assessed as duration, it is not considered a behavior, and therefore is not part of this table.

[b] PA = physical activity; fruit/veg = fruit and vegetables

[c] Modeling intake of high fat foods.

[d] Parental modeling intake of fruit.

[e] includes video viewing and video gaming time.

[f] This column indicates the direction of the relationship between the determinant of obesity and the specific behavior. (+) indicates a positive association; (-) indicates a negative association.

Table 4. Tools assessing behaviors associated with determinants of pediatric obesity in the United States

Determinant	Reference	Validated[a]	Age ~3-5 y[b]	Low-income[c]	Tool Name (if applicable) or comment
Dietary fat	Tibbs, 2001 (28)	√			Harvard Service Food Frequency Questionnaire[d]
	Cullen, 2004b (50)	√			
	Ariza, 2004 (51)				Multiple determinants: Dairy/Calcium, physical activity, television, fat.
	Frank, 1991 (53)	√	√	√	Fat Avoidance Scale
	Dennison, 2000 (54)	√	√	√	Child Dietary Fat Questionnaire
	Blum, 1999 (57)	√		√	Food Preparation for Daughters questionnaire
	Yaroch, 2000 (58)	√		√	Qualitative dietary fat questionnaire
Dietary Fiber	Blum, 1999 (57)	√		√	Food Preparation for Daughters questionnaire
Fruit/vegetable	Tibbs, 2001 (28)	√			Harvard Service Food Frequency Questionnaire[d]
	Cullen, 2004b (50)	√			
Calcium/dairy	Ariza, 2004 (51)				Multiple determinants: dairy/calcium, physical activity, television, fat.
Sweetened beverage	No tools				
Restaurants-prepared foods	Elder, 1999 (42)		√	√	Eating Out Scale
	Ihmels, in press (52)				Multiple determinants: breakfast skipping (1 question), fruits and vegetables (2 questions), sweetened beverages (1 question), physical activity (4 questions), television (5 questions) restaurant (1 question), sleep (1 question).
Breakfast skipping	Ihmels, in press (52)				Multiple determinants: breakfast skipping (1 question), fruits and vegetables (2 questions), sweetened beverages (1 question), physical activity (4 questions), television (5 questions) restaurant (1 question), sleep (1 question).

Table 4. (Continued)

Determinant	Reference	Validated[a]	Age ~3-5 y[b]	Low-income[c]	Tool Name (if applicable) or comment
Energy density	No tools				
Physical activity	Burdette, 2004 (22)	√	√		Outdoor Playtime Checklist
	Ihmels, in press (52)				Multiple determinants: breakfast skipping (1 question), fruits and vegetables (2 questions), sweetened beverages (1 question), physical activity (4 questions), television (5 questions) restaurant (1 question), sleep (1 question).
Television	Robinson, 1999 (46)				TV in bedroom (1 question)
	Dennison 2002 (47)		√	√	TV in bedroom (1 question), Meals, snacks in front of TV (2 questions)
	Ariza, 2004 (51)				Multiple determinants: dairy/calcium, physical activity, television, fat
	Ihmels, in press (52)				Multiple determinants: breakfast skipping (1 question), fruits and vegetables (2 questions), sweetened beverages (1 question), physical activity (4 questions), television (5 questions) restaurant (1 question), sleep (1 question).
	Burdette, 2003 (55)		√	√	1 question
	Anderson, 1985 (59)	√			Parent's report of television time is accurate.
	Certain, 2002 (60)		√		National Longitudinal Survey of Youth
	Cheng, 2004 (61)		√		1 question
	Schmitz 2004 (62)	√			Eating and Activity Questionnaire (5 items) +Youth Risk Behavior Survey (YRBS) (1 item)
	Ihmels, in press (52)				Multiple determinants: breakfast skipping (1 question), fruits and vegetables (2 questions), sweetened beverages (1 question), physical activity (4 questions), television (5 questions)

Sleep					**restaurant (1 question), sleep (1 question).**
	Sadeh, 1996 (64)				
	McLaughlin-Downs 2005(65)				
	Montgomery-Downs, 2004 (66)	√			**Questionnaire**
	Power , 2002 (56)	√	√	√	**Parenting Dimensions Inventory-S (PDI-S)**
Parenting style	**Buri, 1991 (67)**				**Parent Authority Questionnaire**
	Robinson, 2001 (68)				**Parenting Styles and Dimensions Inventory**
	Hughes, 2005 (69)	√	√	√	**Caregiver's Feeding Styles Questionnaire (CFSQ)**

[a] Validation study conducted and psychometric properties reported in this or a separate peer-reviewed publication.
[b] Children, ages 3-5 years, were the focus of the study and were a large majority of the subjects in the sample.
[c] 'Low-Income' defined as a large majority of subjects from low-income homes as determined by the authors or by participant characteristics such as WIC or Food Stamp Program participation.
[d] While the food frequency questionnaire has been validated, no validation citations for the behavior questions were found.

Sleep was typically measured as duration using questionnaires in which caregivers reported what was typical for the child (52,64-66). Some studies queried about weekdays vs. weekends, while others asked about "usual" sleep. Questions addressed duration, bed time and/or wake-up time. Parents were reasonably accurate when asked to report sleep behavior in their infants (64). Questions addressing sleep duration have been validated for 5-7 year old children (65,66), but not for 3-5 year old preschoolers.

Tools for Parenting-Related Determinants

Our search identified four self-administered tools measuring parenting styles (56,67-69), three for general parenting styles (56,67,68) and one for parenting styles in the context of a child's diet (69). The tools were validated through various techniques and used with preschool-age children. The tools range in length from 30 to 62 items. The Parenting Dimensions Inventory-S (PDI-S) (56) and the Caregiver's Feeding Styles Questionnaire (CFSQ) (69) were specifically designed for low-income parents of young children. The CFSQ was developed from and validated against the PDI-S and observations of parent-child mealtime interactions and should therefore adequately measure parenting styles in the context of child diet rather than discrete parent feeding practices (e.g., rewarding children with sweets) (69).

Discussion

Of special interest for the current review was empirical support for behaviors specific to children living in low-income families (see table 1) (11-16,39,47). Also of interest were studies with families with preschool-age children (11,12,15-18,20-22,47). Unfortunately, only four studies included low-income families with preschool-age children, the most vulnerable group, and these studies applied to only three determinants: fat (11,12), physical activity (15,16) and television (47). The behaviors most characteristic of low-income families and low-income families with preschool-age children for the identified determinants of obesity cannot be stated with certainty given the few studies.

We set out to find parent/caregiver-administered tools for children with a special interest in tools for low-income, 3-5 year old children, the audience for two large federal programs: Head Start and Special Supplemental Program for Women, Infants and Children (WIC). Valid instruments, scales or individual items were available for behaviors of this low-income preschool-age target audience for only two of the 12 determinants: dietary fat (53,54) and parenting styles (56) (see table 4). No valid tools were identified for 10 determinants of pediatric overweight for low-income preschool-age children, the targets of

these two large Federal programs. Importantly, we found no pediatric overweight risk assessment tools covering most or all 12 determinants in the diet, activity and parenting categories. Also, missing were brief parent-administered tools appropriate for community settings where literacy is a concern for parents and caregivers completing the measurement tools. Given that WIC and Head Start jointly spend $12 billion dollars annually on program implementation ($5.2 billion for WIC and $6.8 billion for Head Start in FY2007) (70), it is startling that so few studies with this audience serve as the research base for the interventions and measurement tools.

Our findings are supported by other reviews of evaluation tools for nutrition education interventions. Although not specifically for obesity prevention, Contento et al. in 2002 and McClellan et al in 2001 reported that appropriate valid measurement tools are sorely needed, particularly for low-income and low-literacy audiences (71,72).

Of particular importance are behaviors that span multiple determinants, in that, these behaviors may provide robust assessment of children's risk status and be particularly important for primary prevention interventions. For example, eating at restaurants was a behavior linked with increasing dietary fat, decreasing dairy, and increasing sweetened beverages (see table 3). In addition, while breakfast was a determinant itself, eating breakfast was a behavior influencing intakes of fat, fiber, dairy/calcium and energy dense foods. Finally, parental modeling was specifically identified as an important behavior for six diet and activity determinants: fiber, fruit and vegetable, dairy, fat, physical activity and television viewing (see table 3). Each of these behaviors is modifiable and could be the target of prevention efforts. For example, parental incentives could be provided to encourage eating home-cooked meals for meeting three nutrition objectives: increasing intake of fruit and vegetables, dairy, and low-fat foods. Likewise, parents, daycare providers and schools could provide healthful cereals with lowfat or nonfat milk in the morning to stimulate breakfast consumption for the same three nutritional benefits.

Gaps in Research

The few existing studies to support obesity prevention interventions and measurement tools in families with children demonstrate a gap in research. Of special concern is the lack of research specific to low-income families with young children, given that this group is at an increased risk of developing overweight in adolescence and adulthood (73) and a primary target of two large USDA programs. To fill the void, assumptions about behaviors would need to be made from studies of other audiences.

Research is essential to validate items and scales for behaviors of identified determinants and to test them with parents. Of particular concern is the minimal research of tools for low-income families with children eligible to participate in USDA's food, nutrition and/or education programs.

Next Steps

We will use the currently available studies identified in this review to guide development of an assessment tool aimed at early identification of low-income children at risk of pediatric overweight in the United States. While more robust behavioral research is certainly needed and recommended, escalating rates of obesity and their corresponding health care costs warrant action now (74). Our findings highlight the behaviors corresponding to the broad determinants that should be included in such measurement tools as well as the content of the primary prevention intervention. Using these corresponding behaviors is advantageous in that behaviors are easily measured and with relatively few items (4,6). The items can be written in clear and simple language generating a parent-administered tool appropriate for use with low-literate readers participating in USDA programs such as WIC, Head Start, Expanded Food and Nutrition Education Program (EFNEP) and Food Stamp Nutrition Education (FSNE) (75). This approach circumvents the limitations of traditional nutrition data collection methods (ie, 24-hour dietary recalls and food frequency questionnaires) or methods used to quantify physical activity (ie, accelerometers, physical activity diaries or doubly labeled water), which are difficult and costly to administer and analyze, invasive, and/or require substantial respondent burden and training (4-6). Assessing parenting styles within a brief parent-administered tool, however, may be more challenging, as this construct is currently measured by scales with at least 30 items.

A critical next step involves developing and further validating such tools targeting children in the US and for us specifically, for low-income preschool-age children. The results of this and our previous review (1) will determine the content of this measurement tool and serve as an evaluation of its content validity (6).

The next step, assessment of face validity, will begin with the content of tables 3 and 4 and will be accomplished via a series of client interviews using a standardized protocol for cognitive interviewing with four key questions and probes for text and visuals (6,76-78). Using visual information processing theories, the text will be enhanced by the addition of client-driven visuals to improve validity, reliability and readability for this low-income audience (75-77,79,80).

Pediatric overweight prevention efforts require assessment of individual risk for developing overweight. Results from the current review of American behaviors and tools provide researchers with the necessary first steps for the development of measurement tools for primary and secondary prevention interventions for pediatric overweight. Researchers in other countries could consider conducting similar reviews using local (i.e. country-specific) behaviors. As such, this review represents an integral step to providing preventive intervention efforts with tools to identify children at risk of developing overweight, and moreover, to identify behaviors sensitive to change. Practitioners could use the latter to track client progress throughout interventions. In addition, researchers and funding agencies should consider conducting studies to fill the identified research gaps.

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