Nutrition Screening Tool for Every Preschooler

(NutriSTEP™):

A Review of the Literature

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Thursday, April 17, 2008

HHNS*6320 – Literature Review

Abstract

Increases in childhood overweight and obesity have become a major public health problem in industrialized nations. A significant jump in the prevalence of children at risk occurs between preschool (ages 2-5) and grade school (ages 6-11) years. By the time children are 3 or 4 years old, eating is no longer deprivation-driven, but is influenced by their responsiveness to environmental cues about food intake as well. Overall, childhood and adolescent overweight and obesity are not only related to long-term health risks and medical conditions, but may also be associated with an increased risk of adult obesity, with its own attendant effects on morbidity and mortality rates. The Nutrition Screening Tool for Every Preschooler (NutriSTEP™) is the first of its kind as it is the only screening tool that is both reliable and valid, and can be administered by a parent or guardian without the need for a health care or nutritional professional. The NutriSTEP tool can be used to screen preschoolers who may be at nutritional risk, as judged by their score on the questionnaire; the tool is further split into five constructs (food and nutrient intake; physical growth; developmental and physical capabilities; physical activity and sedentary behavior; and other factors affecting food intake and eating behaviors), all with their own influence on nutritional risk and outcomes in children. While research is limited in some areas and extensive in others, a number of social, economical, demographic, and environmental factors that may also influence the nutritional risk for preschoolers are discussed. Overall the NutriSTEP screening tool appears to be a very promising means for reducing both financial and time burdens on the health care system for nutritional screening and assessment, while concomitantly working to prevent the current rise in childhood overweight and obesity.

Introduction – The Development of Childhood Overweight and Obesity

Increases in childhood overweight and obesity have become a major public health problem in industrialized nations (Veugelers & Fitzgerald, 2005). It has been well documented that childhood nutrition may directly affect growth and development, health status, school readiness and academic performance, social well being, as well as future contributions to society (Nicklas & Johnson, 2004). In the long term, eating habits may also influence the occurrence of chronic diseases including diabetes, heart disease, obesity, and osteoporosis (Freedman, Dietz, Srinivasan, & Berenson, 1999; American Diabetes Association, 2000; Whiting, 2002; Nicklas, Johnson, & American Dietetic Association, 2003). In Canada, rates of overweight and obesity have more than doubled in past decades, with recent 2005 estimates indicating that about 30% of children are overweight or obese (Veugelers & Fitzgerald, 2005). In the United States (U.S.), the situation is very similar; according to 2003 data, 25% of children under the age of 18 are at risk for overweight, and 15% are overweight (Patrick & Nicklas, 2005). Looking more closely at trends of increasing childhood overweight and obesity, a significant jump in the prevalence of children at risk occurs between preschool (ages 2-5) and grade school (ages 6-11) years (Rhee, 2008). As a whole, the prevalence of overweight among 4- and 5-year-olds has more than doubled in the past 25 years, increasing from 5% to 10.4% from 1976 to 2000 (Whitlock, Williams, Gold, Smith, & Shipman, 2005; Patrick & Nicklas, 2005). Childhood overweight affects self-esteem and has negative consequences on cognitive and social development (Veugelers & Fitzgerald, 2005). Overall, childhood and adolescent overweight and obesity are not only related to long-term health risks and medical conditions, but may also be associated with an increased risk of adult obesity, with its own attendant effects on morbidity

and mortality rates (Whitlock et al., 2005). The purpose of this literature review is to outline the current status of childhood overweight and obesity; introduce some of the risk factors thought to contribute to the development of overweight; as well as discuss the need for an appropriate risk assessment tool for preschoolers in the context of the development of a recent nutritional risk questionnaire, NutriSTEP: Nutrition Screening Tool for Every Preschooler. Subsequently, a brief outline and discussion of some nutritional risk factors including parent feeding practices, television viewing, frequency of eating, and demographic factors such as gender, ethnicity, income, and language will all help outline the potential benefits for the implementation of NutriSTEP.

An Overview of Nutritional Risk Factors

Countless factors have been suggested as contributors to the development of childhood overweight and obesity. While the development of overweight and obesity has commonly been attributed to overeating or poor nutrition, combined with sedentary lifestyle or inactivity, a great deal of research has examined the possibility for other factors including socioeconomic status, parental background, parental feeding behaviors and attitudes, as well as external environmental cues (Patrick & Nicklas, 2005). Some risk factors appear to be age-specific or at least age-related; for example, the nutritional risk of 3-5-year-olds is often underrated (Patrick & Nicklas, 2005). By the time children are 3 or 4 years old, eating is no longer deprivation-driven, but is influenced by their responsiveness to environmental cues about food intake as well. Therefore, a wide variety of family and social factors begin to influence children's eating behaviors at this age (Patrick & Nicklas, 2005). There has been some evidence of this risk, as recent (2004) estimates for the prevalence of overweight placed U.S. children aged 2-5 years at

10%, whereas 19% are considered to be 'at risk' for overweight (Stang et al., 2004). The prevalence rates for this age group appear to vary among children according to sex, race/ethnicity, and socioeconomic status as well (Stang et al., 2004). With 30-60% of body weight thought to be caused by environmental factors (Stang et al., 2004), other suggested risk factors of childhood overweight have included increased parental adiposity, low parental education, social deprivation, infant feeding patterns, childhood diet, and time spent in sedentary behaviors (Whitlock et al., 2005).

Nutritional Assessment and Screening

A major limitation for clinicians addressing overweight among children, most of whom are not morbidly overweight, is the uncertain criteria for determining clinically significant overweight (Whitlock et al., 2005). While body mass index (BMI) is a measure of relative weight and does not consider body composition, it is widely recommended for use among children and adolescents to determine overweight, and is currently the preferred measure (Whitlock et al., 2005). In general, nutritional screening is the process of identifying characteristics known to be associated with nutrition problems (Posthauer, Dorse, Foiles, Escott-Stump, Lysen, & Balogun, 1994). In order to be effective and practical according to the American Dietetic Association, the screening process must be able to be completed in any setting; must facilitate the completion of early intervention goals; must include the collection of relevant data on risk factors; must determine the need for a nutritional assessment; and must be cost-effective (Posthauer et al., 1994). Nutritional assessment, unlike screening, is a comprehensive approach completed by a registered dietitian (RD) to define nutritional status (Posthauer et al., 1994). In 2002, a review by Jones et al. of current nutritional screening and assessment tools found that the majority of tools

were published with insufficient details regarding their intended use and method of derivation, and with an inadequate assessment of their effectiveness (Jones, 2002). Therefore, there appears to be a need to ensure that nutritional screening and assessment tools are developed using procedures based on good design and sound statistical practice (Jones, 2002). Further, most nutritional researchers would agree that for a tool to be of value, it must be reliable and valid (Jones, 2004). Based on this belief, Jones made a number of recommendations for creating a reliable screening tool: subjects must be a representative sample of the target populations; each subject should be assessed independently; nutritional risk assessments should be categorical, either having two categories (dichotomous) or ordered categories (ordinal data); and reliability should be statistically measured (Jones, 2004). In terms of validating a nutritional screening or assessment tool, Jones (2004) also recommended that the publication of results should include the mean and standard deviation of nutritional variables in each category, together with sample size; and that methods for measuring sensitivity and specificity are used to assess the validity of the tool (Jones, 2004). The importance of these criteria should be considered later in this discussion, when examining the recently validated NutriSTEP questionnaire.

Developing a Nutritional Screening Tool

While most interventions for reducing childhood overweight and obesity are aimed towards treatment of the root factors for its development, there is also a need for programs aimed towards the prevention of childhood overweight altogether, which may have great implications for decreasing the prevalence of adult overweight and obesity as well. However, there are a number of unanswered questions that must be considered when attempting to design a nutrition screening or assessment tool. For example, appropriate standards for

overweight in childhood, the availability of clinical screening tests, adverse effects of screening or interventions, and whether weight control interventions lead to intermediate or health outcomes, must all be considered (Whitlock et al., 2005). There are also a number of complex factors that may be involved. Recently, Veugelers and colleagues (2005) investigated the association between childhood overweight and obesity, and risk factors relating to dietary habits, activities, parents, and schools (Veugelers & Fitzgerald, 2005). They found that children who often purchased lunch at school were at an increased risk of being overweight, whereas those who ate dinner with their family three or more times per week were at decreased risk for overweight. Having two or more physical education classes per week was also associated with decreased risk. Interestingly, children in high-income neighborhoods were half as likely to be obese as their peers living in low-income neighborhoods (Veugelers & Fitzgerald, 2005). These are just some of the examples of the factors that may be involved in the development of childhood overweight and obesity. Overall, parents and schools provide important opportunities for public health initiatives for reducing childhood overweight and obesity. Considering income as a risk factor, for example, it is thought that children and schools in low-income neighborhoods should receive priority in public health initiatives in order to help reduce socioeconomic inequalities in health (Veugelers & Fitzgerald, 2005). Veugelers and colleagues (2005) also studied the effects of school-based intervention programs in regard to actually preventing excess body weight (Veugelers & Fitzgerald 2005). In a survey of 5200 grade 5 students, they found that school programs were effective in preventing childhood obesity, and therefore support the need for broader implementation of successful programs (Veugelers &

Fitzgerald, 2005). This may in turn help to reduce childhood obesity and, in the longer term, co-morbid conditions and health care spending (Veugelers & Fitzgerald, 2005).

The Need for a Parent-Administered Nutritional Screening Tool

In general, nutrition risk can be defined as the presence of characteristics or risk factors that can lead to impaired nutritional status (American Diabetes Association, 2000). For preschoolers, nutrition risk runs the spectrum from under- to over-nutrition, and occurs to those in poverty as well as those living in relative affluence (Alaimo, Olson, Frongillo, & Briefel, 2001; Whitaker & Orzol, 2006). Systematic screening systems that identify these characteristics or risk factors before school entry may be an efficient means of identifying children who require services and preventive interventions (ADA, 1994; Whitlock et al., 2005). While some of the school programs mentioned above are geared towards the prevention and slowing the development of childhood overweight and obesity, it is also important to consider the methods for such interventions. For example, nutritional screening or assessment tools often require the use of a professional in the field (RD) to ensure accurate interpretation of the nutritional risk for the child. While this is beneficial and ideal, registered dietitians are not always available, and are certainly limited in terms of time and financial burden for assessing large groups of children. Subsequently, school programs aimed at nutritional intervention or assessment may also require a great deal of time, financial investment, and professional input, and may not always be specific to the children at increased risk for poor nutrition, or those children who are already overweight or obese. Therefore, a preventative screening tool that can be implemented by the parent or caregiver themselves, would ideally be simple, accurate if validated, and may ultimately place less financial and temporal burden on large public or community health

programs. Currently, there are no valid and reliable preschool nutrition screening tools that can be readily completed by parents (Randall Simpson, Keller, Rysdale, & Beyers, 2007). The PEACH survey (Parent Eating and Nutrition Assessment for Children with Special Needs) (Campbell & Kelsey, 1994) was developed in the U.S. for use with children with developmental delays and disabilities. Other screening tools have been developed for clinical, in-patient hospital settings (Boutry & Needlman, 1996; Sermet-Gaudelus et al., 2000), including two questionnaires from Canadian settings (Richards & Wilkinson, 1998; Yeung, 1998), however these still require some completion or interpretation by health or nutrition professionals, and have not been validated or deemed reliable. For the past decade, researchers at the University of Guelph have been in collaboration with registered dietitians from across Canada in an attempt to develop such a nutritional screening tool that is community-based, and parent-administered. Since preschool children appear to be at a higher risk for nutrition as mentioned previously in this discussion, they named the questionnaire "NutriSTEP: Nutrition Screening Tool for Every Preschooler".

Nutrition Screening Tool for Every Preschooler (NutriSTEP™)

Introduction to NutriSTEP™

Because little is known about the relationship of nutritional problems or nutritional risk in preschoolers to parental/family demographic factors such as marital status, education, income, language or ethnicity, any gain in knowledge of family characteristics or life situations associated with nutrition problems would certainly help to target interventions. However, as mentioned above, nutrition data are limited for preschool children due to the complexity of

nutrition assessment, especially in community living populations (Edington, 1999). There is also a lack of identification of nutrition problems in preschool children by health professionals, mainly because regular physician visits for preschoolers are not mandated, and are less common as the children exit from infancy. Therefore, few preschool children have the opportunity for a full nutritional assessment by a trained health professional (registered dietitian). It is apparent that there is a potential for nutrition problems and risk in this age group and therefore the identification of these problems and risk in association with related factors at an earlier stage may help prevent and combat the development and prevalence of childhood overweight. Therefore, screening questionnaires to identify nutritional risk that can feasibly be used in a community setting may help to identify children who should receive treatment in an effort not only prevent the development of nutrition problems, but also to help bridge the knowledge gap of nutrition problems in this age group.

Development of the NutriSTEP Screening Tool

Initial steps in the 7-year development process (following the methodological template of Keller and colleagues (2000)) began with the identification of five constructs of nutrition risk for preschoolers (Randall Simpson et al., 2007). The constructs of nutrition risk were defined as: food and nutrient intakes, including the quantity and quality of food and beverages consumed, food preferences, and acceptance; physical growth, including weight, height, and growth patterns; development and physical capabilities that influence food intake, including oral motor skills (chewing, swallowing), social, intellectual, and emotional maturity and skills, and food restrictions due to food allergies and intolerances; physical activity and sedentary behavior; and finally a component titled other factors affecting food intake and eating behaviors, which

includes family food and eating preferences, culture and ethnicity, parental concerns, nutrition knowledge, beliefs and practices, food security, and finally the feeding environment including adult role models and a supportive, nurturing atmosphere (Randall Simpson et al., 2007). NutriSTEP development, in both English and French, has been inclusive, with cultural consideration in examples given for foods and in terminology used (Randall Simpson et al., 2007). Some of the cultural groups from across Canada included in the development were: First Nations, Chinese, Middle Eastern, and European (Randall Simpson et al., 2007). The version of NutriSTEP used in the 2007 validation study was extensively refined and then pilot tested with 80 preschoolers to ensure that it could be readily completed by parents with minimal administrative guidance (Randall Simpson et al., 2007). NutriSTEP includes 17 items: five questions are focused on food group intake while the remaining 12 cover the aspects of the above-noted nutrition risk constructs (Randall Simpson et al., 2007). Each question has two to five response options – responses range in score from 0 (no risk) to 4 (risk). Question responses are then summed to provide an index where an increased score indicates increased nutrition risk; the maximum score is 68 (Randall Simpson et al., 2007). The nutrition risk components of NutriSTEP, and their corresponding questions and item stems from the NutriSTEP questionnaire, are summarized in **Figure 1** below. A more extensive examination of some of the risk factors and relationships contained within the NutriSTEP questionnaire will take place later on in this discussion.

Nutrition Risk Components	Item Stems from NutriSTEP™ Questionnaire
Food and nutrient intakes	• My child usually eats grain products (question 1) • My child usually has milk products (question 2) • My child usually eats fruit (question 3) • My child usually eats vegetables (question 4) • My child usually eats meat, fish, poultry or alternatives (question 5) • My child usually eats "fast food" (question 6) • My child is ***not*** hungry at mealtimes ***because*** he/she drinks all day (question 9) • My child usually eats [*number*] times per day (question 10) • My child usually takes supplements (question 13)
Physical growth	• I am comfortable with how my child is growing (question 16) • My child: weighs [*too little/much*] (question 17)
Developmental and physical capabilities	• My child has problems chewing, swallowing, gagging or choking when eating (question 8)
Physical activity and sedentary behaviour	• My child [*gets enough/needs more*] physical activity (question 14) • My child usually watches TV, uses the computer, and plays video games (question 15)
Other factors affecting food intake and eating behaviours	• I have difficulty buying food to feed my child because food is expensive (question 7) • My child usually eats [*number*] times per day (question 10) • I let my child decide how much to eat (question 11) • My child eats meals while watching TV (question 12)

Figure 1- Nutrition risk components and corresponding item stems from the NutriSTEP 17-item questionnaire (adapted from NutriSTEP Implementation Toolkit 1 by Keller et al.?)

Validation of the NutriSTEP Screening Tool

In 2007, Randall Simpson and colleagues set out to not only validate the NutriSTEP questionnaire by comparing scores to an expert rating (RD), but also to demonstrate the test-retest reliability of NutriSTEP (Randall Simpson et al., 2007). In the validation phase, parents of 269 preschoolers completed the NutriSTEP questionnaire. Following completion, a registered dietitian (RD) assessed the nutritional status (based on medical and nutritional history, 3 days

of dietary recall and anthropometric measurements) of these preschoolers and rated their nutritional risk from 1 (low) to 10 (high) risks. Receiver operating characteristics (ROC) curves were then used to establish validity and determine appropriate cut points based on sensitivity and specificity (Randall Simpson et al., 2007). The scores on the NutriSTEP questionnaire and the RD rating were well-correlated. A 'moderate risk' cut point of >20 and 'high risk' cut point of > 25 were identified for the total NutriSTEP scores (Randall Simpson et al., 2007).

In the second phase to determine the test-retest reliability of NutriSTEP, parents of 140 preschoolers completed the NutriSTEP questionnaire on two occasions. Intra-class correlation (ICC) and K statistics were used to assess reliability (Randall Simpson et al., 2007). The NutriSTEP score was statistically reliable between administrations, and most items on the questionnaire had adequate or excellent statistical agreement (Randall Simpson et al., 2007). Overall, the NutriSTEP questionnaire appears to be valid, based on the best alternative to a 'gold standard', the clinical assessment of children by RDs, and has great test-retest reliability (Randall Simpson et al., 2007).

Interpreting NutriSTEP Validation Data

The crucial need for such a tool was demonstrated by the prevalence of risk in the NutriSTEP validation data. More than one-third of the validation sample of preschoolers was considered by the RDs to be at moderate or high risk for nutrition problems (Randall Simpson et al., 2007). If the suggested moderate risk cut point of > 20 for NutriSTEP is used, the prevalence of nutrition risk was 23.5% and 33.2% in the test-retest and validation samples, respectively (Randall Simpson et al., 2007). There are currently no other data with estimates of nutrition risk in this age group, however it is known that the prevalence of nutritional problems

such as overweight and obesity in this age group is 26.5% in the U.S. (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006) and 21% in Canada (Shields, 2005), compared to 21% in this sample (Randall Simpson et al., 2007). NutriSTEP questions have undergone extensive development and refinement, and the development of the tool in a diverse population across two languages makes this tool applicable for use across Canada and in similar populations such as the U.S., the United Kingdom and Europe (Randall Simpson et al., 2007).

Construct Factors for Potential Nutritional Risk

Food and Nutrient Intakes

Consumption of Milk Products

There are a total of 9 questions from the NutriSTEP questionnaire that are related to food and nutrient intakes. The first two questions (question 1 and 2) deal with frequency of consumption of grain and milk products. Nutritional risk stemming from the consumption of milk products is actually more related to other beverage consumption when milk consumption is low, however such beverage consumption will be discussed in greater detail to come. One study has looked at the consumption of milk specifically and examined various factors associated with total calcium intake and percent adequate intake (%AI) of calcium by children and adolescents, with respect to age, gender, race/ethnicity, and diet and beverage choices (Storey, Forshee, & Anderson, 2004). It was found that consumption of milk products was strongly and positively associated with calcium intake.

Fruit and Vegetable Consumption

The next two questions of the NutriSTEP questionnaire are closely related and have been the center of heated discussion and debate for several years – they deal with contributing factors for frequency of fruit and vegetable consumption (Questions 3 and 4). Diets high in fruits and vegetables have been associated with multiple health benefits including a reduced risk of obesity, cardiovascular disease, stroke, diabetes, and cancer (Cooke et al., 2004). The World Health Organization recommends at least five servings (approx. 400 g/day), however, consumption in most countries is thought to be well below this guideline, especially in children (Cooke et al., 2004). As mentioned previously, improving the diet of children is particularly important because many eating behaviors that are initiated in childhood persist into adults. Therefore, it is also important to identify the target groups or demographics at higher risk for poor nutrition, especially for low fruit and vegetable consumption. In a recent study by Cooke and colleagues (2004), some of these demographic domains, parental feeding practices, and personality traits were examined as predictors of fruit and vegetable intakes in children aged 2-6 years (Cooke et al., 2004). According to questionnaires returned by 564 parents or caregivers, several significant predictors of children's fruit and vegetable intake were present and included the mothers' education level and the child's age and gender (Cooke et al., 2004). Only ethnicity was significantly associated with fruit consumption. Parental consumption, breast-feeding and early introduction to fruit and vegetables were all related to the intake of both fruits and vegetables (Cooke et al., 2004). Family mealtimes were also associated with higher intake of vegetables and both the child's enjoyment of food and food neophobia (fear of trying new foods) were strongly related to consumption (Cooke et al., 2004).

Previously, Lindstrom and colleagues (2001) aimed to investigate whether social network and social support factors can explain socioeconomic differences in the risk of consuming low amounts of vegetables, fruit and fruit juices (Lindstrom, Hanson, Wirfalt, & Ostergren, 2001). For both sexes, unskilled manual workers had a twice as high risk of low vegetable and fruit juice consumption as higher non-manual employees. Overall, social participation seemed to be a strong determinant for food choices, but this was independent of socioeconomic differences (Lindstrom et al., 2001). While these data include eating behaviors of adults, they may ultimately affect children's food intake through parental feeding practices.

Frequency and Type of Beverage Consumption

Question 9 from the NutriSTEP questionnaire has also been an area of controversy as of late, as it examines the frequency of beverage consumption, and how that might subsequently relate to both quantity and quality of food consumption. In the 2007 NutriSTEP validation study by Randall Simpson and colleagues, 18% of parents/caregivers reported that their child usually drinks throughout the day and is not hungry at mealtimes; the type of drink, however, was not specified in the questionnaire (Randall Simpson et al., 2007). Excess consumption of juice, in particular, has been reported to be inversely related to milk consumption (Marshall, Gilmore, Broffitt, Stumbo, & Levy, 2005). Some controversy exists surround the effects of excess juice consumption, with some researchers reporting an association with short stature and obesity (Dennison, Rockwell, & Baker, 1997), whereas others have documented no such effects (Skinner & Carruth 2001). In fact, the original Dennison study in 1997 sought to evaluate, in a population-based sample of healthy children, fruit juice consumption and its effects on growth parameters during early childhood (Dennison et al., 1997). They found that the consumption of

greater or equal to 12 ounces/day of fruit juice by young children was associated with short stature and obesity, and therefore set a recommendation to reduce children's fruit juice intake to less than 12 ounces/day (Dennison et al., 1997). Shortly thereafter, Skinner and colleagues became deeply involved with the fruit juice controversy as well. Results of their work consistently indicated no statistically significant differences in children's height or BMI based on fruit juice consumption (Skinner et al., 1999). The consistent lack of relationship between children's fruit juice intake and growth parameters in their experiences do not support previous recommendations to limit fruit juice intakes (Skinner et al., 1999). After following the subjects for an additional two years, Skinner and colleagues found that longitudinal juice intake again was not associated with either short stature or overweight, although as juice consumption decreased, the intakes of less nutritious beverages did increase (Skinner et al., 2001).

Not only has fruit juice been implicated in poor nutrition habits and increased nutritional risk, but the consumption of soft drinks as well. In 1999, Harnack and colleagues examined the potential for nutritional consequences of soft drink consumption among U.S. children and adolescents (Harnack, Stang, & Story, 1999). Specifically, they sought to determine whether carbonated soft drink consumption was associated with consumption of milk, fruit juice, and the nutrients concentrated in these beverages. They found that energy intake was positively associated with consumption of non-diet soft drinks; in other words, those school-aged children who were regular consumers of soft drinks (> 9 ounces/day) had significantly greater daily caloric intake (Harnack et al., 1999). Further, those in the highest soft drink consumption category consumed less milk and fruit juice compared to those in the lower consumption category – based on these data, they concluded that nutrition education messages

should target children and/or their parents to encourage limited consumption of soft drinks (Harnack et al., 1999).

Frequency of Consumption

Question 10 from the NutriSTEP questionnaire provides information regarding the frequency of eating of the preschool child by having the parent simply report the number of times per day that the child eats. Recently, the American Dietetic Association (2004) released a document with some meal pattern and frequency data, however very little research has examined how the frequency of consuming relates specifically to the nutritional risk for preschool children. Of concern, however, is that if the child is already practicing poor nutrition habits or dietary choices, then increasing the frequency of poor consumption will exacerbate the potential for nutritional risk. However, frequency of meal consumption may be more related to factors such as parental feeding practices or the use and viewing of television, both of which are discussed later.

The Use of Dietary Supplements

Question 7 from the NutriSTEP questionnaire deals with another hot topic in childhood nutrition – the use of dietary supplements such as multi-vitamins and minerals. The recent prevalence of dietary supplement use (defined as at least one dietary supplement in the previous month) in preschool children in the U.S. has been reported to be between 40.4% (NHANES 1999-2000) (Briefel & Johnson, 2004; Ervin, Wright, & Kennedy-Stephenson, 1999) and 56.1% (CSFII 1994-1996) (USDA, 1998). Fortunately, several other authors have examined vitamin and mineral supplement use in children. For example, in 2005, Gilmore and colleagues performed a prospective study to report longitudinal patterns of nutrient supplementation in

children, as well as quantify nutrient intakes and attempt to discover sociodemographic factors involved (Gilmore, Hong, Broffitt, & Levy, 2005). They believe that, unfortunately, many people who were taking nutrient supplements received recommendation from non-health care providers, and therefore accidental overuse of supplements may serve no benefit and could even lead to medical complications (Gilmore et al., 2005). In preschoolers aged 1-5 years, they found that 42-51% were taking supplements (Gilmore et al., 2005). Radimer and colleagues (2005), however, have suggested some limitations in dietary supplement use data, and therefore caution when interpreting is necessary (Radimer, 2005). Interestingly, Birch and colleagues also examined multivitamin mineral supplement use, but from the perspective of differences between mothers' and daughters' use (Birch & Lee, 2002). They evaluated 192 girls aged 5-7 years and found that their multivitamin and mineral (MVM) use was predicted by the mothers' use and the mothers' beliefs and attitudes towards child feeding practices (Birch & Lee, 2002). Mothers who gave daughters supplements reported greater monitoring of daughters' intake and were more likely to pressure their daughters to eat (Birch & Lee, 2002). In terms of diet, MVM users consumed less fat and sweets, had vitamin and mineral intakes exceeding the RDA, but had food group servings fall below recommended levels (Birch & Lee, 2002). Taken together, this pattern may encourage mothers to foster healthier patterns of food intake in daughters, rather than to provide multi-vitamin and mineral supplements (Birch & Lee, 2002).

Physical Growth

Questions 16 and 17 of the NutriSTEP questionnaire assess physical growth of the preschooler, but are based on the perspectives of the parent. The parents' perceptions for how their child is growing and whether or not they are of ideal weight may be involved in the

nutrition risk of the preschooler. One major study evaluated the attitudes, practices, and concerns about child feeding and weight status from the perspectives and perceptions of the parents, and did this across a socioeconomically diverse sample (Sherry et al., 2004). With the belief that parents play an important role in the development of their child's eating behaviors, Sherry and colleagues (2004) conduced 12 focus groups of 2-5-year-old children to explore maternal attitudes, concerns and practices related to child feeding and perceptions about child weight (Sherry et al., 2004). Overall, all 12 groups wanted to provide good nutrition, and most wanted their children to avoid eating too many sweets and processed foods (Sherry et al., 2004). From these, 12 groups prepared foods their children liked, but also accommodated specific requests, and used bribes or rewards to accomplish their feeding goals (Sherry et al., 2004). Overall, the common use of strategies that may not promote healthful weight suggests that work is needed to develop culturally and socioeconomically effective overweight intervention and prevention programs (Sherry et al., 2004).

Developmental and Physical Capabilities

Only one question on the NutriSTEP screening tool examines actual developmental and physical capabilities (Question 8). The prevalence of problems chewing, swallowing, gagging, or choking when eating may not be very common, but remains a cause for concern when interpreting nutritional risk in preschoolers.

Physical Activity and Sedentary Behavior

While a small construct on the questionnaire of only two questions, physical activity and sedentary behavior clearly has an enormous impact on the nutrition risk of preschool children, and subsequently competes with general lifestyle behaviors, dietary intake patterns, attitudes

and beliefs already associated with the development of overweight and obesity. In 2002, Finn and colleagues concluded that sex, history of preterm birth, child-care center, and father's BMI all influenced the daily physical activity of young children (Finn, Johannsen, & Specker, 2002). Interestingly, they found a greater activity level in boys compared with girls, and found a consistent relationship between the child's activity level with the father's BMI, in that more active children were more likely to have a father with a lower BMI (Finn et al., 2002). In this target age group of 3-5-year-olds, parental influence is thought to be the most modifiable factor in increasing children's physical activity (Finn et al., 2002). However, there are certainly some factors, such as TV viewing, computer and video game use, that make it more difficult to increase physical activity.

Television (TV) Viewing, Computer, and Video Game Use

While question 15 examines TV viewing, computer, and video game use as a whole, there are many confounding factors involve with these variables. Television (TV) viewing and other sedentary activities such as computer and video game use not only reduce time spent on more physical activities, but can also affect children's food consumption patterns. For starters, television is the largest single media source of messages about food, and the vast majority of money spent on food advertising comes from branded food manufacturers or fast food franchises (Coon, Goldberg, Rogers, & Tucker, 2001). Food products advertised most on TV tend to be overconsumed relative to federal dietary guidelines, whereas fruits and vegetables, which are almost never advertised, are underconsumed (Coon et al., 2001). Because children learn TV-viewing habits, as well as eating habits, primarily from their parents, the choices parents make about the use of TV during meals may be associated with choices they make

regarding foods they buy and make available for their children (Coon et al., 2001). In 2001, a study by Coon and colleagues examined the relationships between the presence of television during meals and children's food consumption patterns, in order to test whether children's overall food consumption patterns, including foods not normally advertised, vary systematically with the extent to which television is a part of normal mealtime routines (Coon et al., 2001). They found that children from families with high television viewing while eating derived 6% more of their total daily energy intake from meats; 5% more from pizza, salty snacks, and soda; and about 5% less of their energy from fruits, vegetables, and juices, compared to low television users (Coon et al., 2001).

Regardless of the effects of TV viewing on dietary consumption patterns, many feel that it is a significant nutritional risk because of its documented effects on decreased physical activity or poor body composition. In fact, media use including TV viewing has often been implicated as one of the causative factors of the current 'obesity epidemic'. TV viewing may contribute to obesity through either reduced energy expenditure from displacement of physical activity, or through increased dietary energy intake, either during viewing or as a result of TV advertisements (Robinson, 1999). In Canada, it has been estimated that as much as 33% of preschool children have 'sedentary activities', such as TV viewing, that exceed 3 hours per day (Randall Simpson et al., 2007). A recent meta-analysis by Marshall and colleagues (2004) documented a statistically significant relationship between TV viewing and body fatness in children and youth; however, it is unknown whether this relationship would be clinically relevant (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004).

In order to show whether TV viewing is clinically relevant, some trials have attempted to intervene with TV viewing and media use to track obesity patterns. In 1999, Robinson gave children in one elementary school a 6-month classroom curriculum to reduce television, videotape, and video game use (Robinson, 1999). Compared with controls, children in the intervention group had statistically significant relative decreases in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio (Robinson, 1999). Relative to controls, intervention group changes were accompanied by statistically significant differences in children's reported TV viewing and meals eaten in front of the television (Robinson, 1999). Very recently, in 2008, Epstein and colleagues published the results of a randomized trial measuring the effects of reducing TV viewing and computer use on actual BMI in young children (Epstein et al., 2008). The children were randomized to an intervention to reduce their TV viewing and computer use by 50% compared to a monitoring control group that did not reduce use (Epstein et al., 2008). The reduced-TV viewing group showed greater reductions in targeted sedentary behavior, zBMI, and energy intake compared with the control group (Epstein et al., 2008). Interestingly, the experimental intervention worked better among families of lower socioeconomic status (Epstein et al., 2008). Overall, excess sedentary activity, particularly in the form of TV viewing, presents the potential for nutritional risk, especially in young children (Veugelers & Fitzgerald, 2005).

Other Factors Affecting Food Intake and Eating Behaviors

Introduction to Demographic Variables

According to a review of family and social determinants of children's eating patterns and diet quality, research has demonstrated that children's eating patterns are strongly influenced by characteristics of both the physical and social environment (Patrick & Nicklas, 2005). With regard to the physical environment, children are more likely to eat foods that are available and easily accessible, and they tend to eat greater quantities when larger portions are provided (Patrick & Nicklas, 2005). Additionally, characteristics of the social environment, including various socioeconomic status-related factors such as parents' education, time constraints, and ethnicity, may all influence the type and quantity of foods that children consume (Patrick & Nicklas, 2005). Mealtime structure also appears to be an important factor related to children's eating patterns, and may include social and physical characteristics of mealtimes such as where the family eats, TV-viewing during meals, and the source of foods (Patrick & Nicklas, 2005). Subsequently, parents also play a direct role in children's eating patterns through their own behaviors, attitudes, and feeding styles (Patrick & Nicklas, 2005). These 'other factors affecting food intake and eating behaviors' can be complex and interact with more than one aspect of the child's diet and behavior, but a brief description of surrounding research is discussed below.

Parental Feeding Practices

In the feeding domain, parental control is defined as an attempt to monitor the child's eating by restricting the child to eat other foods (Moens, Braet, & Soetens, 2007). There are two primary aspects of parental feeding control: restriction, which involves restricting children's

access to junk foods or restricting the total amount of food; and pressure, which involves pressuring the children to eat healthy foods or in higher quantities (Johannsen, Johannsen, & Specker, 2006). At any point, parents may use a combination of these techniques to obtain a desired result. Pressuring a child to eat healthy foods by using bribes such as sugary desserts, for example, may lead to increased desire for and overconsumption of restricted foods when children are allowed free access to them, and may result in poorer eating regulation due to a child's focus on external cues (ie. food portion size, 'cleaning the plate') as opposed to allowing internal cues (hunger and satiety) to regulate their intake (Johannsen et al., 2006).

In the NutriSTEP validation study by Randall Simpson and colleagues (2007), one of the NutriSTEP items was designed to determine parental control over feeding (Question 11). They found that 37% of parents reported that they often do not let their children decide how much to eat (Randall Simpson et al., 2007). There is an accumulating body of evidence to suggest that strict parental control over how much a child eats, particularly food restriction, may play a role in the development of childhood overweight and obesity (Johnson & Birch, 1994; Fisher & Birch, 1999; Birch & Fisher, 2000). Specifically, Fisher and colleagues (2002) sought to evaluate parents' fruit and vegetable intake and their use of pressure to eat in child feeding as predictors of their 5-year-old daughters' fruit and vegetable, micronutrient, and fat intakes (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002). They found that girls' fruit and vegetable intake was positively related to their parents' reported fruit and vegetable intake (Fisher et al., 2002). Also, parents who consumed fewer fruits and vegetables tended to report greater pressure on child feeding and had daughters who consumed fewer fruits and vegetables (Fisher et al., 2002). As expected, the girls' reported fruit and vegetable intakes were positively correlated to their

micronutrient intakes and negatively associated with fat intake (Fisher et al., 2002). Overall, Fisher and colleagues appropriately concluded that parents' own fruit and vegetable intake may encourage fruit and vegetable intake in their daughters, leading to higher micronutrient intakes and lower dietary fat intakes (Fisher et al., 2002); therefore, setting a good example for fruit and vegetable intake would appear to be more effective than pressure to eat.

Recently, Wardle and colleagues (2005) reported similar findings in both preschool girls and boys. Their objective was to replicate the finding of a negative association between parental control and fruit and vegetable consumption in girls, as well as extend the investigation to boys and examine sex differences through the hypothesis that children's food neophobia explains the association (Wardle, Carnell, & Cooke, 2005). They found that parental control was correlated with children's (2-6-year old) fruit and vegetable consumption and found no significant gender differences (Wardle et al., 2005). Parental fruit and vegetable consumption and children's food neophobia were also strong predictors of children's fruit and vegetable consumption, and both were associated with parental control (Wardle et al., 2005); again, this suggests a possible association between parental control over feeding practices, and subsequent dietary consumption patterns of children.

Parental Eating Behaviors

As suggested previously, parental eating habits themselves may act as an example to influence child behaviors. In 2004, Cooke and colleagues found that the most influential aspect of a young child's environment is likely to be the family, and food-related behaviors of the parents, especially mothers (Cooke et al., 2004). Parents can further influence their young children's eating habits by controlling where meals are eaten and with whom. For example,

companionship at mealtimes has been shown to increase children's intake of the basic food groups and regular 'family dinners' have been associated with healthier dietary patterns such as increased fruit and vegetable consumption in 9-14-year-olds (Cooke et al., 2004). The root causes for this may be unclear, however it has been suggested that meals served at a family dinner are less likely to be ready-to-eat foods often lacking in nutritional value, or that families eating together allows for conversations and practical demonstrations of healthy eating (Cooke et al., 2004). Neumark-Sztainer and colleagues (2003) also found sociodemographic characteristics to be associated with more frequent family meals, including gender (boys), school level (middle school), and race (Asian American).

Parental Food Restriction

Other studies have revealed that actual parental restriction of certain high-preference snack foods has been positively associated with children's preference for these foods, a higher intake of these foods, higher child weight status, and daughters' inability to regular energy intake (Sherry et al., 2004). Previously, in 1999, Fisher and colleagues evaluated maternal restriction of children's access to snack foods as a predictor of children's intake of those foods when they were made freely available (Fisher & Birch, 1999). For girls only, child and maternal reports of restricting access predicted girls' snack food intake (Fisher & Birch, 1999), as expected. While restricting children's access to palatable foods may appeal to parents as a straightforward means of promoting moderate intake of foods high in fat and sugar, it has been suggested that restricting access to palatable foods may also have unintended effects on children's eating behaviors (Fisher & Birch, 1999). Overall, restricting access to palatable foods may focus children's attention on restricted foods, while increasing their desire to obtain and

consume those foods (Fisher & Birch, 1999), as opposed to simply positively encouraging the intake or consumption of healthier food options.

Summary of Parental Feeding Practices

For both adults and children, changes in eating environments may be implicated in the obesity epidemic, and current environments may be characterized by the ready availability of inexpensive, palatable foods, high in energy content but low in nutrient density (Birch, 2006). Among adults, personal responsibility plays a role in determining food choice, intake, and weight status in such environments; however, infants and young children are dependent on parents and other caregivers to provide food that will promote healthy diets, growth, and development (Birch, 2006). Child feeding practices determine the foods and portion sizes that children are offered, the frequency of eating occasions, and the social contexts in which eating occurs (Birch, 2006). As Johannsen and colleagues (2006) reported, children's weight status may be more strongly related to maternal BMI than paternal BMI, a finding consistent with other literature (Johannsen et al., 2006). However, while parenting behaviors may influence child outcomes, it is also possible that children's weight status influences parents' feeding practices; consequently, any influence of feeding practices on the child's weight status will again be mediated by the child's eating behavior, which may in turn influence their weight status further (Birch, 2006). Understanding this phenomenon further requires a closer look at the eating behaviors of children themselves.

Child Eating Behaviors

While parental feeding practices clearly play an integral role in the dietary intake patterns of children, and thus the development of childhood overweight and obesity, it is

interesting to examine how child eating behaviors and preferences may also be of influence. In 1998, Carruth and colleagues began to examine the phenomenon of the 'picky eater', in an attempt to determine whether toddlers considered who were 'picky eaters' actually had lower dietary scores than non-picky eaters, and whether family environment or socioeconomic status was related (Carruth et al., 1998). They found that picky eaters had lower dietary variety and diversity, and that mothers of picky eaters were more likely to use persuasion for child eating (Carruth et al., 1998). As a result, it has been suggested that mothers who use rewards, prodding or punishment to encourage eating specific amounts or types of foods may actually be contributing to the 'picky eater phenomenon'. In 2003, Galloway and colleagues assessed whether food neophobia and pickiness contributed to low vegetable intake in school-aged girls, and if there are distinct predictors for neophobia or pickiness (Galloway, Lee, & Birch, 2003). By definition, children with food neophobia are reluctant to eat new foods, whereas 'picky eaters' simply resist to eat many familiar foods (Galloway et al., 2003). In their examination, they found that girls with both food neophobia and pickiness consumed fewer vegetables than girls with neither neophobia nor pickiness. Interestingly, picky girls had mothers with less variety in their vegetable intake and mothers who perceived their family to have little time to eat healthful foods (Galloway et al, 2003). Two years later, they found that mothers consuming more fruits and vegetables were less likely to pressure their daughters to eat and had daughters who were less picky and consumed more fruits and vegetables (Galloway, Fiorito, Lee, & Birch, 2005).

Food Security and Household Income

Another important issue related to the potential for nutritional risk in preschoolers stems from the possibility that a significant number of parents may not be able to provide a

wide variety of foods for their children simply because of the high expense of food, and limited household income. Crawford and colleagues previously reported that the percentage of calories from fat was inversely related to parental education and family income levels (Crawford et al., 1995), two key variables of socioeconomic status. In addition, there is some evidence that food preferences are influenced by food availability and accessibility (Campbell et al., 2002), and therefore the ability of parents to buy healthier foods may be limited by income. Reidpath and colleagues also recently described a potential dose-response relationship between socioeconomic status and the density of fast food outlets, with people living in areas from the lowest socioeconomic status category having over twice the exposure to fast food franchises (Campbell et al., 2002); this would obviously have an impact on the dietary intake of this population. Future income-oriented interventions, such as the U.S.-based Food Stamp program (Rose, Habicht, & Devaney, 1998) should be considered to limit socioeconomic inequality of health.

Education Level of the Parents or Caregivers

Parental education, one indicator of socioeconomic status, appears to be an important determinant of dietary intake and family behavior (Campbell et al., 2002). For example, Coon and colleagues found that televisions were more likely to be on during meals in households with the least educated mothers (Coon et al., 2001). In the UK and Belgium, mother's education level has been associated with consumption of vegetables (Cooke et al., 2004) and fruit and vegetables (Vereecken, Keukelier, & Maes, 2044) in preschool children. In 2004, Vereecken and colleagues sought to examine whether differences in mothers' food parenting practices by educational level could explain differences in food consumption in preschoolers (Vereecken et

al., 2004). Using a self-administered questionnaire, they found differences by educational level in children's and mothers' consumption frequencies of fruit, vegetables, and soft drinks, and in the use of restrictions, verbal praise, negotiation, discouragement of sweets and restraining from negative modeling behavior (Vereecken et al., 2004).

Gender Differences in Consumption and Behavior

As Johannsen and colleagues (2006) suggested, mothers may exert a strong influence over their children's weight and seem to be more concerned about their children's eating behaviors; however, fathers play a role in imposing child feeding practices (Johannsen et al., 2006). Therefore, gender bias may be present in child feeding, as suggested by dissimilar effects of parent practices on the weight status of girls and boys (Johannsen et al., 2006). In 1999, Reynolds and colleagues found that girls tended to eat more fruit, more vegetables, and more fruit and vegetables combined than did boys (Reynolds et al., 1999). While perhaps not the most significant contributor to nutritional risk, there are still clearly some gender differences in child eating behaviors that warrant further investigation.

Ethnic Differences in Consumption and Behavior

Low frequency of consumption of fruits and vegetables has been associated with ethnicity similar to reports in British preschoolers for fruit consumption (Cooke et al., 2004) Previously, in 1996, Bronner conducted a literature review to explore the relationship between nutritional status outcomes among ethnically diverse children and cultural and environmental contexts (Bronner, 1996). According to the review, children from underserved, ethnically diverse population groups were at increased risk for obesity and poor dietary consumption patterns (Bronner, 1996). Although the prevalence of overweight is high for Black children and

adolescents, it appears to be even higher among American Indians and Hispanics of the same age group (Bronner, 1996). Overall, several factors that appear to be associated with overweight in relation to ethnic differences may include the number of hours reported watching television; the percentage of daily energy intake from total fat; the degree of sedentary lifestyle; and intrafamilial obesity (Bronner, 1996).

In Canada, overweight affects Aboriginal children disproportionately as the rate of diabetes in Aboriginals is four times greater than the national average (Receveur, Morou, Gray-Donald, & Macaulay, 2008). Unfortunately, its causes are multifactorial and include food intake, physical inactivity, genetics, and physical/social factors (Receveur et al., 2008). Several mechanisms or causes for this have been suggested, including passive overconsumption, high intake of sweetened beverages, as well as increased intake of high-energy-dense foods (Receveur et al., 2008). Most recently, Receveur and colleagues (2008) aimed to identify differences in selected dimensions of diet quality and quantity across BMI categories for children in grades 4-6 from a Canadian First Nations community (Receveur et al., 2008). Using a new method comparing only the most-frequently-consumed food items to BMI categories, they found that children at risk of overweight consumed more potato chips, while overweight children consumed larger portions of French fries (Receveur et al., 2008). With the use of a valid and reliable screening tool such as NutriSTEP, some of these consumption patterns may be evaluated further.

Conclusions

Overall, the nutritional risks that threaten many preschool-aged children are apparent, and are of great cause for concern. With recent validation and reliability testing, the Nutrition Screening Tool for Every Preschooler (NutriSTEP) is the first community-based, parent-administered questionnaire of its kind that is backed by the opinions of a registered dietitian, yet can be used by any parent or guardian to screen their child for nutritional risks. The five constructs of NutriSTEP (food and nutrient intake; physical growth; development and physical capabilities; physical activity and sedentary behavior; and other factors affecting food intake and eating behaviors) represent a plethora of factors that may influence not only the dietary intake of a preschooler, but the overall social and environmental structures that they experience and learn from on a daily basis. Several demographic factors including gender, family income, parents' educational level, and ethnicity also appear to be involved, and warrant further research. Some other issues, including television viewing, parental feeding practices versus child eating behaviors, and the 'picky eater phenomenon', remain controversial, but may clearly implicate the dietary consumption patterns of both children and adults. It is also evident that the behaviors of parents themselves may appear to influence the habits of their children, and vice versa. Consequently, it may be the poor dietary and lifestyle habits as children that are becoming responsible for the development of childhood overweight and obesity, and the exacerbation of both childhood and adult-related adverse health effects. Additional and immediate investigations of the relationships between total NutriSTEP™ score, nutritional risk, and questionnaire construct scores, as well as the demographic and social factors outlined in this discussion, is recommended for the benefit of childhood health, both now and in the future.

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