



Picky Eating and the Associated Nutritional Consequences

Loomis Theresa*, Timmons Mary, Hogan Kendra, Jacobson Heather, Lebarron Rachel and Narzabal Sydney

Department of Human Ecology, SUNY College, USA

*Corresponding author: Dr. Theresa Loomis, Director, M.S.-Nutrition and Dietetics Program, Department of Human Ecology, SUNY Oneonta, Room 104D, USA, Tel: 607-436-2808; Fax: 607-436-2141; E-mail: Theresa.Loomis@oneonta.edu

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Abstract

Picky eating is a general term to identify individuals who have powerful food preferences, a limited food intake, a restricted consumption of vegetables and who are averse to try new foods. The epidemiology of picky eating is challenging to account for, because there is no universally approved definition. However in 2015, a study conducted in the Netherlands involving 4,018 individuals revealed the prevalence of picky eating was 26.5% at 18 months old, 27.6% at 3 years old, and it has been decreased to 13.2% at 6 years old. The concluding data of that study stated that picky eating is commonly a temporary behavioral trait that is normal in preschool children. This review paper addresses the possible causes of picky eating, the nutrient gaps associated with a picky eater's diet, the long term health outcomes of picky eating, and the potential treatments, specifically for children.

Keywords: Picky eating; Nutritional consequences; Autism spectrum disorders; Food allergies

Introduction

There is no specific etiology for picky eating. However, as there are various factors such as autism spectrum disorders (ASD), food allergies and prematurity which can cause this type of behavior. Children who are diagnosed with disease states such as Autism Spectrum Disorders (ASD) are often characterized as picky or selective eaters. ASD is a series of developmental disorders characterized by impaired communication skills, difficulty with social interaction, and uncontrollable repetitive behaviors. The problems and behaviors experienced with ASD have created challenges for children to function in daily life activities, especially during mealtimes. Parents of children with ASDs have classified their children to be highly selective eaters with poor food acceptance to certain foods. Food selectivity, which is also identified as picky eating, leads to the concern of parents that children with ASDs have a restricted diet causing them to receive inadequate nutrition. A reason why food selectivity occurs is thought to be due to the sensitivity of the texture, taste, smell, color and temperature of food [1-3].

Gastrointestinal symptoms such as bloating, constipation, diarrhea, abdominal pain, and others have been recognized in child with ASDs. These symptoms and abnormal stool consistency has been increasingly noticed by parents with children with ASDs. The implementation of gluten or casein-free diets and supplements as interventions has been

used to alleviate gastrointestinal symptoms [4-6]. However, there is little evidence to support their use and they may lead to an unnecessarily restrictive diet in a population which is already limited in their intake.

Levy et al. [7] investigated dietary intake in children with ASDs and the correlation of stool consistency and Gastrointestinal (GI) symptoms related to dietary intake. The study involved children from 170 families separated into two treatment groups, receiving the treatment (synthetic secretin) or the placebo. Human synthetic secretin has been hypothesized to relieve behavioral issues associated with autism and improved GI function. The children's parents or caregivers completed a three-day diet record and stool samples. From the stool samples, bacteria cultures, ova and parasites, reducing substances, and pH measurements were measured and recorded. Examination of these factors ruled out other possible medical causes of GI symptoms. Additionally, dietary intake patterns were observed by gathering the diet history of the children. The source of calories included 59% carbohydrate, 30% fat, and 11% protein. GI symptoms were monitored with dietary intake and a total of 54% complained of GI symptoms. Forty-four percent of the subjects indicated abnormal stool patterns [7].

Historical data by Hammer et al. [8] reported children with ASDs have selective diets leading to a higher consumption of carbohydrates. This study indicated how a high intake of carbohydrates causes diarrhea due to an increase in osmotic load. The data in a study by Levy et al. [7] contradicts this concept and it also demonstrates how more consumption of carbohydrates is linked to firmer stools. Results indicated GI symptoms are not associated with irregular dietary intake of carbohydrates, protein, and fats. All subjects had adequate intake of carbohydrates, fats, and increased proteins. There was no indication of stool consistency and nutrient intake. Further research was suggested on the relationship between GI symptoms and food intake, risk factors associated with children with ASD and on specialized diets, and the etiology of GI dysfunction in children with ASD [7].

William et al. [9] conducted a study to examine food selectivity in children with ASD by asking parents about their child's eating habits. The study included gathering information from 100 parents of children suffering from ASDs from 22 months to 10 years. Parents believed that food selectivity was influenced by: texture (69%), appearance (58%), taste (45%), smell (36%), and temperature (22%). The most frequent eating and oral behavior problems to be observed were reluctance to try new foods (69%), resistance to medication (62%), eating less foods (60%), mouthing objects (56%) and traditional eating (46%). Based on the findings of this study, sensitivity towards foods appearance to be an underlying reason why children with ASDs are classified as picky eaters. Schreck et al. [10] also concluded similar results when observing food selectivity in children with ASDs. His study examined how restricted food intake was due to food presentation. This included how the food was presented on the child's plate and if the food items were touching and whether or not utensils were required. Both these studies concluded that food selectivity is a primary issue in this population; however, further research relating to behavior issues, family mealtimes and parental preferences is needed.

Feeding difficulties relating to food allergies in healthy children has been a growing concern in recent years. Food Protein-Induced Gastrointestinal Allergies (EPIGA) is commonly found in children of different ages and has caused gastrointestinal symptoms and

elimination of foods from the diet. Feeding difficulties as a result of food allergies has been associated with long-term effects on weight, growth and cognitive development [11].

Meyer et al. [12] performed an observational analysis at Great Ormond Street Children's Hospital of all patient records from 2002-2009 with non-IgE-mediated allergies and with various gastrointestinal conditions. Elimination of diets and combinations were noted, which included cow's milk; cow's milk and soy; cow's milk, soy and egg; cow's milk, soy, egg, and wheat. Additional information included gathering information from parents about feeding habits with the food allergy and if there was still an exclusion of foods from the diet. An assessment between gastrointestinal symptoms in children with and without feeding difficulties was recorded. Children with more feeding difficulties experienced more abdominal distention and bloating, vomiting, weight loss, rectal bleeding, and constipation. Significantly higher amount of foods were eliminated such as milk, soy, egg, and wheat (41.7%) in children with feeding difficulties. This study indicates food allergies can be related to picky eating as a result of symptoms initiated from non-IgE-mediated allergies. Children may not be able to tolerate specific foods due to food allergy conditions that result in food refusal. Having a food allergy as a child can be traumatizing as normal feeding practices are altered to treat symptoms of food allergies [12].

Prematurity has been linked to a wide range of physical and cognitive and difficulties. Additional risks can lead to the development of eating disorders, which can affect growth and eating habits in adulthood [13]. Both fetal life and early childhood are crucial periods of time when food preferences, food habits, and eating behaviors are established. Genetics, environmental factors, and an early exposure to foods all have a role in the development of behavior towards food acceptability. Migraine et al. [14] conducted a study to determine the difference between the eating habits and eating behaviors of two-years old children amongst children born preterm compared to those born full term. Neonatal and maternal characteristics were also evaluated to determine if there was an effect on eating behaviors later in life. The study included 243 preterm-born and 245 full term children. A questionnaire given to parents evaluated neophobia, pickiness, low appetite, and low food enjoyment about their child. Additional data included frequencies of consumption and preferences of the two-year olds. It was recorded that preterm children had less appetite, less enjoyment of food, had a greater pickiness for food, and neophobia when compared to full term children. It was recorded that less educated mothers, the female sex, and poor intrauterine growth were related to feeding difficulties in children of two-years old. Overall, two-year old children's feeding difficulties had a lower growth rate and development.

Dietary Gaps

The impact of picky eating tendencies on the adequacy of an individual's diet has been evaluated extensively [15-17]. Due to the selective decisions regarding which food item is avoided by individual, the probability of nutrient gaps is predicted. These anticipated nutrient gaps are individualized between picky eaters, which are correlated to the individualized food items being restricted.

Li et al. [15] studied the diet of 1,414, 6-35 month old infants in eight Chinese cities regarding the prevalence of picky eating behaviors for this population. Results were collected based on a questionnaire that collected information regarding the child's eating behaviors,

rejected food groups, dietary intake via 24 hour recall, anthropometric data as well as the parents perception of the child's weight status. The results revealed that picky eating was more common in the 24-35 month olds (36%) compared to the 6-11 month-olds (12%). Nutrient gaps identified were predominately in the 6-11 month olds and 12-23 month olds and less evident in the 24-35 month olds. Specific nutrients with apparent differences between the picky eating and non-picky eating groups included biotin, vitamin E, phosphorous, magnesium, iron, and selenium. Macronutrient gaps found in picky eaters between 6-11 and 12-23 month year-olds included protein and the indigestible form of carbohydrates, dietary fiber. The study concluded that there was evidence of nutrient gaps between the two groups however they were not consistent between all age groups studied.

The dietary intake of Chinese and Hong Kong children with picky eating habits between the ages of 2.5-5 years old was studied by Volger et al. [16]. In which the dietary intake of the children was calculated using a dietary analysis software utilizing data from a collected three-day food record from 151 participants. Data was then compared to the Chinese Recommended Nutrient Intakes (RNI) [18]. The results concluded participants' intake met 52-73% of the RNI for calcium, iron, zinc and vitamins C and E. Vitamin D intake only met 37% the RNI, total fat 10%, and sodium 56%. The study concluded that children of this population with picky eating behaviors had suboptimal dietary intakes of specific nutrients compared to their age group recommendation [16].

The determination of specific nutrient gaps in individuals with picky eating behaviors is unclear. Evidence has shown that specific nutrient gaps do exist for this population; however it is not consistent within each study. Picky eating is individualized in food items avoided by the person, and it will help in identifying nutrient gaps. Zickgraf et al. [17] studied the willingness to consume specific food groups in 139 picky eating adults and found fruits (64.38%) and vegetables (57.63%) to be the two most common. However, Li et al. [15] determined vegetables and meats to be the most avoided groups, and Volger et al. [16] recognized fruits and vegetables as well as milk, grains and cereal. Though it can be concluded that nutrient gaps do exist, there is no clear evidence regarding which specific nutrients are consistently inadequate in the picky eating population.

Nutritional Consequences of Picky Eating

There is limited research on the long-term consequences of picky eating. Current research is being conducted regarding effects on weight status, growth and eating behaviors in adults who were picky eaters as children. Due to the selective eating habits in this population, it is hypothesized that growth and weight would be suppressed [19].

Vane Tine et al. [20] organized a study analyzing the risk of a childhood picky eater developing an eating disorder as an adult. The observation consisted of 61 participants from the Stanford Infant Growth study [21]. The first assessment of selective eating was established at age two from parent reports. Parents completed questionnaires for their child at age of two, seven, nine and eleven. Questions pertained to selective eating habits and responses were ranked on a scale from one (never) to five (always). A follow up assessment was held when the children reached 23 years old. Participants self-reported their eating habits and behaviors. Questions presented included behaviors associated with eating disorders (fasting, purging, dieting and excessive exercise) [20]. Between ages two and 23,54% (n=33) of the 61 participants were classified as picky eaters at

one of the assessment points (ages two, seven, nine, 11 and 23). The presence of picky eating peaked at age six and declined in the age between seven and nine [20]. However, after age of 11, the rate of picky eating increased with six new cases by age 23. At age three, there were 10 children that were reported with selective eating habits. Of this group, six children remained selective at age 23. The Mann-Whitney test was used to observe the relationship between picky eating and development of eating disorder behaviors in adults. The results showed no significant differences in regards to weight ($p=0.27$), weight concern ($p=0.89$), and eating habits ($p=0.34$) between picky eaters and non-picky eaters. The criteria selected for eating disorder diagnosis is traditional.

As a parent, struggling with a child who is a selective eater can be stressful [1]. Mascola et al. [1] witnessed these circumstances during their study on persistence and characteristics of picky eating in children at ages 2 to 11. Researchers assessed 120 participants (61 males and 59 females) at ages two, 9.5 and 11 years old. Data included parental demographic information, picky eating behaviors, anthropometrics along with child and parent feeding behaviors [1]. If a parent reported their child as a picky eater "Often" or "Always" at ages two, 9.5 and 11 years old they were included in the observation. The Stanford Feeding Questionnaire was used to assess children's behaviors while eating. Results showed that between 13% and 22% of children at any given age (from three to 11 years old) were reported as picky eaters. At age of 11, 22% ($n=26$) of the population consisted as picky eaters. They ate a limited variety of foods ($p=0.001$), required food to be prepared in specific ways ($p=0.001$), had strong likes ($p=0.009$), dislikes of food ($p=0.001$), and were less likely to accept new foods ($F[1,115]=40.5$, $p=0.001$). There was an increased prevalence of parents who reported struggles with feeding their child (62%) than those who had non-picky eaters (12%). The study of Mascola et al. [1] indicated an increased rate of picky eating during the ages 2.5-4.5. By age of 6, extent of picky eating started reducing. Those who remained picky eaters at age six continued to practice selective eating habits. Children who are picky eaters for more than two years have an increased risk of adhering to strong food preferences in the future. In addition, these children have parents who struggle more with feeding a well-balanced meal with a high degree of variety.

Overall there is no substantial evidence that picky eating is particularly harmful to one's health in the future. Recent findings have concluded that a child with selective eating habits is more likely to continue these behaviors into early adulthood. Extensive research needs to be organized focusing on long-term consequences such as weight, chronic illness and nutritional status in childhood picky eaters.

Treatment

While there is currently no defined evidence-based treatment for picky eating, many interventions have been explored. Those that result in reduced picky eating behaviors among children and adolescents often include a multidisciplinary approach that focuses on behavioral, psychosocial and parental interventions. The value of caregiver-child interventions has been displayed in multiple studies. Chao and Chang [22] scrutinized the differences between picky and non-picky eaters by interviewing caregivers and examining the strength of the children's mental development. Picky ($n=371$) and nonpicky ($n=229$) caregiver-child pairs were used in the study. Caregivers were interviewed and reported methods they used during meal time when their child was displaying picky eating behavior. Compared to caregivers of picky eaters, those to non-picky eaters were shown to utilize methods

labeled as "appropriate" when feeding a child (change in food preparation, repeated attempt >10 times, persuasion, and encouragement) while significantly more caregivers of the picky eating group were shown to utilize methods labeled "inappropriate" (threatening [forced], awarding, snacking, and nutrient supplementation). Examination of the children's mental health showed that picky eaters displayed higher incidences of learning disability ($p<0.001$) and poor interpersonal relationships ($p<0.004$).

The effect of using negative reinforcements was also explored in two studies done by Sanders et al. [23] and Galloway et al. [24]. Both studies contain groups of children who were either threatened to eat or given encouragement while eating. The results from each study showed that forcing a child to eat interferes with normal pleasures of eating. Those children who were not pressured to eat were shown to consume a significantly larger amount of food and make fewer negative comments regarding the food. High controlling practices (i.e. restriction) also correlated with a negative environment in the presence of food in a study done with parents ($n=305$) with children between ages 6 and 12 years old [25]. In this study, eating enjoyment was shown to be a central factor in picky-eating behavior and resulted in increased intake of healthy food and decreased picky eating among the subjects. Each of these findings suggests the importance of child-caregiver interventions from a young age. It is necessary to emphasize appropriate feeding techniques and avoid negative feeding techniques when overcoming picky eating behaviors.

Many clinical trials have focused on picky eating patients with a condition labeled as avoidant/restrictive food intake disorder (AFRID), a more severe case of picky eating, which is defined by the Diagnostic and Statistical Manual of Mental Disorders as a pervasive and disruptive pattern of food refusal and/or severe food selectivity. One study conducted by Murphy and Zlomke [26] explored the effectiveness of a behavioral feeding intervention using parent involvement in the treatment of a 6-year-old girl with AFRID. This study targeted an intervention to be used by clinicians and patients in the outpatient setting. In this study, the subject's parents were taught and then coaching was given on the use of differential reinforcement and directive strategies which combined contingency management, gradual exposure, psychoeducation, parent modeling and non-removal of the feeding demand. The intervention consisted of one pre-treatment session followed by 18 treatment sessions conducted over 6 months. Post intervention, the subject showed increased dietary repertoire, increased acceptance of novel foods, decreased disruptive mealtime behaviors and she was no longer classified as having AFRID.

Another study examining a male adolescent AFRID patient combined clinic and in-home treatment [27,28]. In the clinic setting, the subject worked one-on-one with a clinician who used behavioral treatment (BT) in combination with cognitive-behavioral treatment (CBT). The CBT component of the treatment was also used at home and included diaphragmatic breathing, positive self-statements, and visualization to address the subject's anxiety when consuming food. The combination of clinic and in-home treatment was effective in increasing his consumption of foods previously rejected and decreasing anxiety during meal times.

There is no single method to treating picky eating, but multidisciplinary team approaches have exemplified positive results in the reduction of picky eating behaviors in both picky eating and AFRID populations. There are often underlying developmental issues that need to be addressed alongside picky eating behavior, which is why a team approach is most beneficial. The vitality of caregiver

inclusion has also been displayed in each of these interventions. This population would likely benefit from the exploration and development of multidisciplinary interventions that include a focus on cognitive behavior and caregiver interactions.

In conclusion, there are many potential precipitating factors that may lead certain children to be at higher risk for being selective eaters including, children with ASD, food allergies and those who are born premature. Nutrient gaps in the diets of children who are picky depend on the foods they avoid but are most commonly protein, Iron, Zinc, Fiber and Vitamin D however long term complications of picky eating are yet to be identified. Treatment for picky eating behaviors should emphasize a relaxed environment that avoids coercion and employs a team environment including the caregiver when feasible.

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