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Dietary Management of Propionic Acidemia: Parent Caregiver Perspectives and Practices

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Abstract

Background: Propionic acidemia (PA), an autosomal recessive metabolic disorder, has an estimated incidence of 1:105,000–130,000 in the United States^{1,2}. Nutritional management is a main intervention for PA. Research in inborn errors of metabolism (IEM) such as phenylketonuria (PKU) has identified association of parental perceptions and practices with dietary outcomes. Parental perceptions and practices in the nutritional management of PA have not been investigated.

Objective: To assess the dietary perceptions and practices of parental caregivers having children affected by PA.

Methods: PA parents were surveyed about perceptions and practices associated with feeding their affected child(ren). The single page survey was anonymous and responses to survey items were not identifiable. Parents provided information on how often they followed the prescribed diet and rationale for any adjustments.

Results: Parents “always” or “most of the time” followed the prescribed diet for children 4–20 years of age; yet, open-ended responses indicated 71.4% made situational adjustments to their child’s diet for a variety of reasons including illness, iatrogenic effects, and, social events.

Conclusions: PA parents make situational adjustments to their child’s highly specialized diet. Uncertainty exists as to the situational adjustments being within the guidelines used by the metabolic health care team. We rely on parents to inform providers about dietary situational adjustments.

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Introduction

Propionic acidemia (PA), an inborn error of metabolism (IEM), has a United States (US) incidence of ~ 1:105,000–130,000^{1,2}. PA is caused by pathogenic variants in the metabolic pathway, specifically the *PCCA* and *PCCB* genes encoding α and β subunits of propionyl-CoA carboxylase, respectively; resulting in an accumulation of propionic acid derivatives which can lead to high morbidity and mortality rates.

Newborn screening profiles across the US include PA to facilitate early diagnosis and nutritional intervention which is the standard of care for most IEMs identified through newborn screening³. Nutritional interventions include protein restriction with or without the use of prescribed medical foods and/or supplementation of amino acids, vitamins, and minerals. Strict nutritional management, critical for metabolic stability to promote growth and development, may include reliance on a G-tube for bolus or continuous feeding or implementation of a “sick day” diet. Physiological stressors (intercurrent illnesses, trauma, and surgery), and dietary indiscretions are leading factors for metabolic decompensation associated with hospital admissions^{4,5} and may result in high morbidity, pronounced neurological deficits, and perhaps death⁶. While lifesaving, the specialized nutritional regimens and medications may be precursors of parental stress, impacting family lives^{6,7}. Little is known about parental perceptions and practices in the nutritional management of PA. Phenylketonuria (PKU), the first IEM to be included in state-based newborn screening programs, is oft cited as a classic IEM dietary adherence example^{3,8}. Other than PKU, limited studies have investigated IEM dietary adherence^{5,6}.

Methods

An anonymous one-page survey approved by the NIH’s Office of Human Subjects Research Protection assessed limited demographics with dietary perceptions and practices among parents having at least one child affected by PA (Appendix survey). The pen-and-paper survey was available at a national family-focused, support group-sponsored conference attended by 15 families as well as researchers and clinicians in the field. Two survey items were specific for diet: a multiple-choice question asking parents about the frequency with which they followed their child’s prescribed diet, and an open-ended question allowing them to expand on changes they make to their child’s diet and reasons for doing so; they were free to provide multiple reasons for such changes. Data were analyzed using descriptive statistics and thematic analysis.

Interview Analysis

Inductive thematic data analysis⁹ was used to identify, analyze, and capture patterns or themes that emerged as being important in dietary adherence. This involved multiple readings of the open-ended survey responses followed by initial coding. The aim of the initial stage of the analysis was to identify and reflect on themes within a broad framework and avoid single profession-centric interpretation of the survey responses. This was followed by discussions, coding refinement, and interpretation of the findings by the metabolic physician (O.S.) and a nurse (D.L.) with experience in adherence research. Identification, interpretation and summarization of the themes was a collaborative (O.S. and D.L.) effort.

Results

Fourteen individuals representing 11 families of the 15 families present (73% family response rate) completed the survey. Eleven respondents were mothers; mean parental age was 42.4 years (range 29–52 years); and the affected child mean age was 9.6 years (range 4–20 years). Ten of 14 (71.4%) parents reported they “always” and four of 14 (28.6%) reported “most of the time” for following nutritional guidelines from their health care provider (HCP). Open-ended survey responses were provided by eleven parents; seven parents provided at least one or more rationale for making dietary adjustments. Thematic analysis revealed four reasons for dietary adjustment: 1) illness; (2) dietary needs or requirements incongruent with the prescription; (3) accounting for other dietary behaviors or needs; and (4) social events. Five parents indicated “sick day” adjustments “within prescription for handling those situations” or after speaking with the doctor; and indicated a variety of methods to encourage metabolic stability while adjusting the diet for illness, i.e., “...extra fluids/Pedialyte”. Other adjustments were made due iatrogenic effects, food allergies, and social schedules. Parents adjusted their child’s diets due to “isoleucine rashes on [the] face” and because “[My child] was also irritable and not sleeping well (atypical for [my child]).” When parents perceived the diet was incongruent with other aspects of their child’s life, they reported “reducing a bit sugar if kid eats more by mouth or [my child] is getting fat quickly with new formula adjustments” and adjusting for food “allergies.” The “PROP Guidelines”¹⁰ available on the internet were referenced as a source of information when one parent shared, “I read prop guidelines and I was trying to get [my child] to drink regular milk so I gradually reduced the formula/milk ratio.” One parent described their family approach to dietary management as a multi-level target that shifts depending on the child’s current context: *“I view my [my child’s] diet like a target with a bow/arrow. The target is a goal of amount of oral protein [my child] eats through whole protein and medical formula. [My child] helps guide the arrow as do my husband & I – we are the bow and help provide the structure & delivery method. At times of illness we may agree that it is okay to not aim for the bullseye, but to aim for a ring around the bullseye (lower protein side) and we make decisions about how long / many days / it is okay to be outside bullseye. Also; decisions for outside bullseye would be- times [my child] felt ill, social reasons (i.e.: we are traveling / out to dinner) and needed a modified schedule, etc. Protein goal we give feedback to dietician”*.

Discussion

Dietary interventions are utilized across multiple acute and chronic disease states in pediatric, adolescent, adult, and elderly populations; with deteriorating adherence occurring at approximately 10 years of age⁶. In this regard, IEM affected children may have adherence issues similar to other chronic conditions requiring dietary interventions such as insulin-dependent diabetes or cystic fibrosis⁶. Yet, unlike these diagnoses, many IEM children are prescribed specific medical foods and the poor palatability of many amino acid formulas and burden of the diet are known barriers to optimal dietary adherence⁵; these precursors to nonadherence in PA patients can be life threatening due to diet-related metabolic decompensation and subsequent hospital admissions¹¹. Our results indicated that some parents make proactive, conscious decisions to adjust their child’s diet to account for situational conditions in their daily lives. Schlundt et al., has discussed situational obstacles

to dietary adherence in diabetic patients but did not operationalize or use the term situational adjustment in response to a situational obstacle¹². Our PA sample did not report making adjustments due to self-identified obstacles in this way. While such adjustments may unintentionally affect the efficacy of the prescribed diets, no parents in our study indicated adverse health impacts of dietary situational adjustments for their children.

Most parents made dietary situational adjustments in concert with their metabolic health care provider when they perceived their child was ill or becoming ill. This proactive practice potentially obviated metabolic decompensation which could have resulted in hospitalization. Iatrogenic effects of medical foods have been reported elsewhere¹³ and was a factor for nutritional adjustments in our survey. One parent accessed the PROP guidelines¹⁰ via the internet to inform decisions related to their child's nutritional management. These guidelines are accessible by anyone with internet access and intended for use by metabolic dietitians, physicians, other health members of the care team and researchers who collaborate to provide care and advice for individuals with PA and their families, advocates, and others¹⁰; parental access and use of the guidelines substantiated the role and use of online resources to obtain advice related to situational dietary adjustments.

It was not known if parents reported iatrogenic effects and their successful dietary adjustments to their health care team. Additionally, parental practices involved modifying a feeding schedule due to social events or travel and eliminated some foods due to food allergies. Given our inability to conduct dietary adherence randomized controlled trials in this population, conversations between parents and providers are important: the dialogue will aid in our understanding of dietary situational adjustments in families affected by PA. It is our hope that these preliminary findings will encourage open dialogue among caregivers of children affected by propionic acidemia and multidisciplinary providers.

Several limitations are relevant to this study. This study was limited by a small sample size, not uncommon in studies of inborn errors of metabolism, particularly propionic acidemia. The one-page pen-and-paper survey limited responses by parental caregivers to self-reports. Further, while the open-ended responses about the prescribed medical diet were salient, they were limited in number and scope. Large-scale studies would provide insights into the effects of adherence related to differing psychosocial, economic and medical/nutritional conditions. Yet, these large-scale studies are not feasible in rare disorders, such as PA. There is much to be learned when investigating adherence and outcome through community studies of actual dietary practices and outcome measures.

We propose refining the dietary adherence paradigm in the PA population and encourage use of a *situational adjustment concept*. A *situational adjustment* is not intentional non-adherence. There is no willful attitude on behalf of the parents to not participate in carrying out the mutually agreed plan of care. Rather, a *situational adjustment* appears to be a unique form of cooperation with a healthcare provider, and seems to highlight the temporary nature of dietary adjustments that pursue the mutual nutritional goals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Relevancy Statement

A dietary adherence randomized controlled trial in the PA home environment is not feasible. We rely on parents to inform providers about dietary adjustments. We propose refining the PA dietary adherence paradigm and encourage a *situational adjustment concept* which is a unique form of cooperation with a healthcare provider, highlighting the temporary nature of dietary adjustments that pursue mutual nutritional goals.

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