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Unique Perspectives and Struggles of Parents Rearing Children with Phenylketonuria with Unaffected Siblings

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by

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Dedication

I would like to dedicate this to my parents, my biggest supporters.

Acknowledgements

I would like thank my family for their continued support throughout my education. Thank you Mommy and Daddy for always being there, taking my phone calls, and encouraging me when I needed it most. Sabrina, Rodney, and Cameron, you can't pick your family, so I'm glad I got you.

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Abstract

Phenylketonuria (PKU) is an autosomal metabolic condition that is screened for via newborn screening. Individuals who are identified as having PKU require a protein-restricted diet to protect against neurological damage. Many parents who learn their child has PKU may already have children who are not affected, or may have children later who are not affected. This creates a unique situation in which parents are rearing children that require a strict protein-restricted diet with children who do not. Parents who are currently rearing children with and without PKU were surveyed to learn what unique perspectives and struggles they face, especially regarding meal planning, diet enforcement, and time management. Telephone interviews were performed to gain a wider scope of understanding from these parents. Nineteen surveys were eligible for use in the study; eleven surveys were completed through the end and five follow-up telephone interviews were performed. These families reported that the children with PKU have slightly more time spent on them per week in regards to doctor appointments, extracurricular activities, and one-on-one attention compared to their siblings without PKU. All survey respondents noted that they were the main preparer of homemade meals (n = 12), in which individuals with and without PKU ate about the same amount per week. Slightly more time was spent preparing homemade meals for individuals with PKU, and for families with more individuals with PKU less time was spent preparing a meal that everyone could enjoy. Telephone interviews collected information regarding everyday life. Parents in general agree that having a child with PKU does not prevent the family

from activities, but creates additional challenges to work around. Genetic counselors see these families for short pieces of time as they come to clinic, understanding the additional challenges that some families will face allows for better care and guidance to be given.

Keywords: parents, phenylketonuria, PKU, unaffected siblings

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List of Abbreviations

BBB..... Blood-Brain Barrier

MPKU..... Maternal Phenylalanine

NPKUA..... National PKU Alliance

Phe.....Phenylalanine

PAH..... Phenylalanine Hydroxylase

PKU..... Phenylketonuria

Chapter 1: Background

1.1 Phenylketonuria

Phenylketonuria (PKU) is a metabolic disorder where there is deficient activity in the enzyme phenylalanine hydroxylase (PAH). The consequence of this deficiency is that the amino acid phenylalanine (Phe) cannot be converted into tyrosine (Donlon, Levy, & Scriver, 2007). When this enzyme is not functioning, Phe builds up in fluids throughout the body. As this amino acid builds up in the body, it will cause damage to the central nervous system as it develops which may lead to intellectual disability (Nussbaum, McInnes, & Willard, 2007).

For individuals with PKU elevated levels of Phe leads to damage of the central nervous system that can result in intellectual disability, seizures and spasticity. Several amino acids, including Phe, are important precursors used by the brain to create neurotransmitters. For these amino acids to reach their destination, they must cross over the blood-brain barrier (BBB). To cross the BBB specific amino acid transporters are shared by a variety of amino acids. As the blood Phe level increases, Phe saturates the transporter, increasing the amount of Phe crossing the BBB as well as decreasing the amount of other amino acids that use the same transporter (Pardridge, 1998). Although it is understood how Phe builds up in the body, the process by which it causes damage to the central nervous system is still unknown (Nussbaum et al., 2007).

PKU is an autosomal recessive disorder. In recessive conditions, an individual needs to have two copies of a mutant allele to be affected. The gene affected in PKU is

the PAH gene which contains 13 exons. Mutations can occur anywhere within those exons or in splice sites or other regions that affect the function of the gene (Blau, van Spronsen, & Levy, 2010). If an individual only has one mutant allele and one normal allele, they are unaffected and are considered carriers. Since PKU is an autosomal recessive disorder, it can be inferred that the parents of affected individuals are obligate carriers. The risk for two carriers to have an affected child is 25%, which leaves a 75% chance with each pregnancy that their child will not be affected. Therefore, it is not uncommon for individuals who are affected to have unaffected siblings (Nussbaum et al., 2007), which can lead to unique circumstances for the parents rearing these children.

The occurrence of PKU varies worldwide, and varies within certain regions of the world. In Europe, the incidence is about 1/10,000 births, but ranges from 1/4,000 in Turkey, to 1/100,000 in Finland. In Asia, the rates vary from 1/15,000 to 1/105,000 within China, to less than 1/200,000 in Thailand. The rates in Latin American range from 1/25,000 to 1/50,000, and the incidence in the United States is about 1/15,000 live births (Blau et al., 2010).

Three different classifications of PKU are dependent upon the severity and the amount of Phe within an individual's blood before treatment has been started. The normal range of Phe in the blood is 50-110 µmol/L. Individuals with values of 120-600 µmol/L are considered to have mild hyperphenylalaninemia, those with a value of 600-1200 µmol/L are considered to have mild PKU, and those with values above 1200 µmol/L are considered to have classic PKU. It may not always be easy to identity an individual's classification because when newborns are first tested, their blood Phe levels may not have reached their highest value, potentially placing them in a different

classification group. Classifications can also be decided on one's tolerance of Phe, but this cannot always be accurately, or easily, determined. For those who have classic PKU, they are not able to tolerate more than 250mg of Phe, whereas those with mild PKU can have a tolerance that ranges from 250mg to 400mg of Phe (Blau et al., 2010).

A study that focused on the unaffected siblings' knowledge level about PKU found that while these siblings may know the biochemical basis of the disease, few had an understanding of why they were not affected or the genetic components of the disease (Pho, Zinberg, Hopkins-Boomer, Wallenstein, & McGovern, 2004). This same study also examined the unaffected siblings' psychosocial adjustment through standardized self-report measures of social adjustments; well-being and mental health; psychological distress and social support; and satisfaction with social support. The results of this study indicated that unaffected siblings tend to have less free time, fewer relationships outside the family, and fewer social activities as compared to norms. Additionally, the authors found that these siblings did not have as much social support as compared to normative data. This study examined the unaffected siblings' perspectives, but it ignored the perspectives of the parents rearing those children (Pho et al., 2004).

1.2 Dietary Management

Individuals who are diagnosed with PKU must follow a low Phe diet to prevent neurological damage from occurring. The diet that individuals with PKU have to abide by can be restrictive. Foods such as grain products, and all food derived from animals, need to be avoided, while others must be weighed before consumption, especially starchy vegetables. The diet does not only include making sure there are low levels of Phe being ingested, but also that proper levels of vitamins, minerals and essential fatty acids are

being consumed (Cleary, 2010). Adhering to a proper diet will allow individuals with PKU to have "optimal growth, development, and mental functioning while providing a nutritionally complete diet" (Macleod & Ney, 2010; p. 59).

The goal of the diet is to maintain plasma concentrations of Phe within an acceptable range. The acceptable, or target, range for Phe levels varies throughout the world (Macleod & Ney, 2010). The National Institutes of Health has recommended Phe blood levels for individuals with PKU who are younger than twelve and those who over twelve years of age. The normal value of Phe in an adult ranges from 43-80 µmol/L, the amount of Phe recommended for those under twelve is 120-360 µmol/L, and for those over twelve it is 120-900 µmol/L. Although the range for those over age twelve is 120-900 µmol/L, it is recommended that adolescents have their Phe remain in the range of 120-600 µmol/L (National Institutes of Health Consensus Development Panel, 2001).

For individuals who are on a low Phe diet, it is important for their Phe levels to be monitored to make sure they are remaining within their target zones. The monitoring of blood Phe levels is typically done through blood spot analysis (Cleary, 2010). While there are recommended ranges, the ideal range for an individual will depend on their age, height and weight, and their bodies' ability to handle Phe. During infancy adjustments to an individual's diet may need to be assessed weekly, whereas later, assessments will not have to occur as close together (Macleod & Ney, 2010)

Although there is data and support for the diet in individuals with PKU, there is limited knowledge on whether or not the diet is needed throughout their life. Those with PKU who were started early on with a low Phe diet are just now reaching middle age. The large majority of these individuals are neurologically healthy, but the possibility of

neurological decline cannot be ruled out (Cleary, 2010). In a study that looked at adult patients with PKU that claimed to be following their diet, it was found that 53% were above the target level (Modan-Moses et al., 2007). In another study that looked at adults with PKU whose Phe levels were above target range, they showed significantly improved reaction time and sustained attention after four to five weeks of strict diet control (Schmidt et al., 1994).

The full impact of adhering to the diet in adulthood may not yet be understood, but for women who are pregnant, the importance of maintaining the diet is well known. Phe can be transported across the placenta to the developing fetus, where concentrations are 1.25 to 2.5 times the concentration in the mother. Having elevated Phe levels in a pregnant woman is teratogenic to the developing fetus and is known as maternal phenylketonuria (MPKU) (Koch, Trefz, & Waisbren, 2010). MPKU can result in these women having children affected with birth defects, developmental delay, congenital heart disease, low birth weight and spontaneous miscarriage (Committee on Genetics, 2008). For women who have PKU, it is ideal for pregnancies to be planned, for them to have Phe levels under control before becoming pregnant, and maintaining a blood Phe level of 120-360 µmol/L for the duration of the pregnancy (Koch et al., 2010).A study found that women with PKU who start on a controlled diet before becoming pregnant and are able to reach control before eight weeks of pregnancy are able to significantly reduce the risk of congenital heart disease (Maillot, Lilburn, Baudin, Morley, & Lee, 2008). These authors also found that for optimal pregnancy outcomes, the Phe levels should not only be within the ideal range, but that they should also be kept as consistent as possible as

fluctuations, even within the ideal range, could cause negative outcomes (Maillot et al., 2008).

1.3 Newborn Screening

Newborn screening is a public health protocol that serves to identify and diagnose metabolic disorders so that medical intervention can intercede and reduce the risk of intellectual disability and clinical symptoms (Sweetman, 1996). Newborn screening is an important part of the health care field, but it was something that had to be developed and integrated into standard health care protocol. The occurrence of newborn screening came about because of a few independent events that allowed science to move forward together.

As healthcare and education have improved, the infant mortality rate has declined. The main causes of infant mortality used to be influenza, diarrheal disease, and other infectious diseases. This rate dropped, due to increased use of antibiotics, vaccines and improved sanitation, this allowed more time and energy to be dedicated to rare diseases. Around the same time, Dr. Asbjørn Følling in Norway had observed that some of his patients who were intellectually disabled had high levels of phenylpyruvic acid in their urine (Crowe, 2008). This finding was indicative of a deficiency in the enzyme needed to convert Phe to tyrosine. The treatment for these individuals was to have them placed on a low Phe diet. This diet was not without its risks. Phe is an essential amino acid needed for growth; deficiencies of this essential amino acid can lead to intellectual disability, the outcome the diet was trying to avoid. Even with these risks, younger siblings were placed on diets low in Phe. The results were encouraging. With the decline in infant mortality rates, and Dr. Følling's observations, there was research performed on PKU.

This research included developing a protein that was free of Phe and to find a way to test for PKU before it caused intellectual disability (Crowe, 2008).

In the early 1960's Dr. Robert Guthrie developed a test that was able to detect PKU before it become clinically symptomatic. This test could be performed on a newborn's blood sample. It was not a perfect test; it yielded false positives and subsequently some children were placed on a low Phe diet unnecessarily. There was also uncertainty about how much Phe needed to be removed from the diet once an individual with PKU was identified. Even though there were early struggles, the screening was considered a success, and led others to question for what else could we screen (Crowe, 2008). The first state that implemented newborn screening was Massachusetts in 1962. The first disorder they tested for was PKU (Fearing & Levy, 2003).

Screening for PKU was considered a success and screening infants for genetic diseases became a fixture of health care in the United States. As the practice grew, attention was attracted from both national and international groups who started to look at the morals of the practice; this lead to the World Health Organization commissioning Wilson and Jungner to create a report on screening. In this report, Wilson and Jungner tried to create a criteria for conditions in which screening would be acceptable (Andermann, Blancquaert, Beauchamp, & Dery, 2008). As technology and our genetic information continues to grow, the criteria has been adapted to fit within the context of the growing field while leaving the fundamental criteria the same (Andermann et al., 2008). This fundamental criteria that is used to determine if a disorder should be considered for newborn screening is that a disorder should have a relatively high

incidence rate, effective medical treatment, an inexpensive screening test, and a screening test that has a high sensitivity (Sweetman, 1996).

Newborn screening has become commonplace in the health care arena and many individuals do not think twice about the testing that is being done. A study was performed that talked to parents regarding their thoughts on newborn screening for a few diseases that are a part of the screening, including PKU (Campbell & Ross, 2003). Parents felt that the screening was beneficial, especially for the infant, as early treatment for the disorder is available. These parents also felt that newborn screening for PKU should be mandatory. The justification for having the screening be mandatory is the thought that given the choice, younger parents, or those with less education, might deny the test due to being unaware of the disorder (Campbell & Ross, 2003).

1.4 Family Routines and Rituals

Chronic illnesses, such as PKU, are long-lasting and require large quantities of time in both management and treatment. This level of attention can add anxiety and stress to the lives of the individuals with the illness and to the family as a whole. Family routines and rituals are thought to be related to the family identity and to the well-being of the children. One event that involves both routines and rituals is the family dinner time (Fiese, Foley, & Spagnola, 2006).The definition of family routines and rituals can range from religious observances and practices to the less mundane activities of everyday life (Markson & Fiese, 2000).

Family mealtimes help to create family identity and they allow an insight to the social interactions that play a role in the mental health outcomes of children (Fiese et al., 2006). It was found that families that had five or more meals together had children who

were less likely to have nutritional health issues, such as being overweight, having unhealthy eating, or having disordered eating. It was also found that adolescents associate having a family meal with eating healthier and that they feel they would eat healthier if more of their meals were eaten with the family (Hammons & Fiese, 2011).

Routines and rituals are both important parts of family mealtime, and each are composed of elements of communication, commitment and continuity (Fiese et al., 2002). Routines and rituals can be difficult to separate and they do not remain the same from family to family. Routines are elements that are observable while rituals are more symbolic elements of family life. Family mealtime is an opportune occasion to observe routines and rituals as they allow you to view the patterns of social interaction and they show the family identity (Fiese et al., 2006).

Communication is one category that routines and rituals have in common. For routines, the communication can be direct or indirect. Direct communication is unambiguous, and helps to keep the family on task. During mealtime this can include giving tasks to help prepare the table and to help clean up. Indirect communication does not give much guidance, which may leave some individuals confused in regards to their responsibilities. The communication in rituals is focused on more sensitive and emotional topics, such as a child being bullied at school (Fiese et al., 2006). Ritual communication also makes use of "insider information," such as nicknames for family members and the "knowledge of past experiences" (Fiese et al., 2006; p. 79). Studies have shown that families that make use of routine direct communication are less likely to have children with internalizing symptoms (Fiese et al., 2006). In contrast, routine indirect communication may increase the chance that children could develop a mental

health problem (Seifer et al., 1996). Ritual communication that discourages discussing sensitive topics and are constituted of ineffective problem solving are also associated with poorer outcomes (Fiese et al., 2006).

The second component that routines and rituals share is commitment. In routines the aspect of commitment is focused on having the meal begin and end, and on making sure that everyone is fed. For some families the routine commitment is also focused on the food that is being served, while others may focus on what happened throughout the day and planning of future events (Fiese et al., 2006). Routine commitment can be rigid, where it is focused on when the meal begins and ends, and on the food that children eat. This commitment can also be disordered and chaotic where there are no set guidelines for the beginning or the ending of the meal. Routines that are too rigid may be associated with "problematic child behaviors," (Fiese et al., 2006; p. 75) and routines that are too relaxed are associated with children that are disregarded or neglected. For rituals, commitment is focused on the emotional investments and in "maintaining a sense of group cohesiveness" (Fiese et al., 2006; p. 80).This includes talking about sensitive situations and how everyone is feeling. These discussions do not have to be long; they can be "folded seamlessly into the stream of the conversation" (Fiese et al., 2006; p. 81). When families show concern for each other's feelings and are interested in activities that others partake in, other family gatherings are considered special times (Fiese et al., 2006).

The final component of routines and rituals is continuity. Continuity is seen in routine in how often the meals occur. When families eat together three to four times a week children have fewer mental health problems and perform better in school. Continuity in rituals is seen in two main ways. The first is with group cohesion. This

involves planning of the meals and the understanding that those who are present have an understanding that the group will survive. The second is continuity between multiple generations. When rituals are passed down from generations it gives continuity a meaning across generations and influences thoughts about family relationships. When parents reflect on their dinners growing-up and consider them to have been warm and supportive, they were more likely to have positive experiences with their children at the dinner table, and for these families the children "are less likely to evidence problematic behaviors" (Fiese et al., 2006; p. 82).

Through several studies routines and rituals have been observed to be important parts of child well-being and the family identity as a whole (Fiese et al., 2006). Chronic illnesses add multiple challenges to the family unit, including challenging the family routine (Knafl, Breitmayer, Gallo, & Zoeller, 1996). Just as the routines and rituals vary from family to family, the way in which a family responds to anxiety and stress will also undoubtedly vary. For some children with chronic illnesses, like asthma, a family routine has been shown to help reduce the anxiety that is felt by the children (Markson & Fiese, 2000). By talking to these families, some of these variations will be observed, giving light to how some families handle the situations in which they find themselves.

1.5 Need for this Study

The benefits of newborn PKU testing and being on a low Phe diet are known and understood. It is also known that unaffected siblings of individuals with PKU may not cope as well when they are compared to their peers who do not have a sibling with PKU (Pho et al., 2004). What is unknown though is what these parents, who are rearing these siblings and those affected with PKU, have to deal with on a daily basis. By surveying

parents who are rearing children with and without PKU, the parents will be able to provide insights to their daily life. This information is valuable because as medical professionals and genetic counselors only a small portion of their life is observed in the clinic. The information that will be learned from these families will help medical professionals provide a higher standard of care to these families by providing relevant information that is targeted to their needs.

1.6 Hypothesis and Study Objectives

The purpose of this study is to compare and contrast the unique perspectives of parents and what they face when they rear a child with PKU and children who are not affected with PKU. Rearing children creates challenges that all parents face. Rearing a child that requires strict dietary management presents a new set of challenges. If parents are rearing multiple children there are always concerns as to whether all of their children are getting the attention and care that they need. If some of the children require more attention for daily care, it creates a unique set of circumstances with which the parents must cope. By looking at the parents, we believe we will get a unique look at their perspectives and struggles of rearing children with PKU with unaffected siblings. They will be able to give us an insight to meal planning, diet enforcement, and time management within these families.

Chapter 2: Manuscript

Unique Perspectives and Struggles of Parents Rearing Children with Phenylketonuria with Unaffected Siblings[1]

2.1 Abstract

Phenylketonuria (PKU) is an autosomal metabolic condition that is screened for via newborn screening. Individuals who are identified as having PKU require a protein-restricted diet to protect against neurological damage. Many parents who learn their child has PKU may already have children who are not affected, or may have children later who are not affected. This creates a unique situation in which parents are rearing children that require a strict protein-restricted diet with children who do not. Parents who are currently rearing children with and without PKU were surveyed to learn what unique perspectives and struggles they face, especially regarding meal planning, diet enforcement, and time management. Telephone interviews were performed to gain a wider scope of understanding from these parents. Nineteen surveys were eligible for use in the study; eleven surveys were completed through the end and five follow-up telephone interviews were performed. These families reported that the children with PKU have slightly more time spent on them per week in regards to doctor appointments, extracurricular activities, and one-on-one attention compared to their siblings without PKU. All survey respondents noted that they were the main preparer of homemade meals (n = 12), in which individuals with and without PKU ate about the same amount per week. Slightly

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more time was spent preparing homemade meals for individuals with PKU, and for families with more individuals with PKU less time was spent preparing a meal that everyone could enjoy. Telephone interviews collected information regarding everyday life. Parents in general agree that having a child with PKU does not prevent the family from activities, but creates additional challenges to work around. Genetic counselors see these families for short pieces of time as they come to clinic, understanding the additional challenges that some families will face allows for better care and guidance to be given.

2.2 Introduction

PKU is an autosomal recessive metabolic condition that results in a strict protein restricted diet for individuals who are affected. This diet is recommended to be life-long but is essential during youth as it protects against irreversible neurological damage caused by excess Phe in the blood (Cleary, 2010). As Phe builds up in the body it saturates the neutral amino acid transporters across the BBB creating an excess of Phe in the brain and lack of other needed amino acids (Pardridge, 1998). While it is known that this build up can lead to intellectual disability, the process in which that occurs is unknown (Nussbaum et al., 2007).

The incidence of PKU within the United States is about 1/15,000 live births (Blau et al., 2010). Starting in 1962, Massachusetts was the first state to implement newborn screening for PKU, and was then soon followed by the remainder of the United States (Fearing & Levy, 2003). Newborn screening is an important development in the treatment of PKU as it allows individuals who are affected to be identified early on so that proper dietary management can be started.

For individuals who are diagnosed with PKU dietary management is necessary to prevent neurological damage from occurring. The diet that individuals with PKU have to abide by can be restrictive. Certain foods should be avoided, such as all animal and grain products, and others should be weighed before consumption, especially starchy vegetables. Along with maintaining low Phe levels, the diet also includes making sure that a proper level of vitamins, minerals and essential fatty acids are being consumed. The goal of the diet is to maintain the Phe level in the blood within a target range, which is checked through blood spot analysis (Cleary, 2010). Ideal ranges vary not only by an individual's ability to handle Phe, but also by their age, height, and weight. Maintaining blood Phe levels within a target range over an individual's life requires adjustments to their diet. As infants these adjustments may need to be assessed weekly, whereas later, assessments will not have to occurs as close together (Macleod & Ney, 2010).

The nature of the inheritance pattern for PKU allows for individuals who are affected to have siblings who are not affected. This can lead to a unique situation at home where some individuals will have a restrictive diet and others will not. One study looked at unaffected siblings who do not have PKU and found that they tended to have less free time, fewer relationships outside the family, and fewer social activities as compared to the norms. This study focused on the unaffected siblings and their perspectives, but it ignored the perspectives of the parents rearing those children (Pho et al., 2004).

Chronic illnesses, such as PKU, are long-lasting and require large quantities of time in both management and treatment. This level of attention can add anxiety and stress to the lives of the individuals with the illness and to the family as a whole. Family

routines and rituals are thought to be related to the family identity and to the well-being of the children (Fiese et al., 2006). Chronic illnesses add multiple challenges to the family unite, including challenging the family routine (Knafl et al., 1996). The definition of family routines and rituals can range from religious observances and practices to the less mundane activities of everyday life (Markson & Fiese, 2000).Just as the routines and rituals vary from family to family, the way in which a family responds to anxiety and stress due to a chronic illness will vary undoubtedly also.

The benefits of newborn screening and a low Phe diet are known and understood for individuals who have PKU. The effect of having a sibling with PKU has also been examined, but one area in which there has been little research is the parents who are rearing these children. These parents have been placed in a unique category of having children who require strict lifelong dietary management as well as children who do not require the same dietary management. Understanding what these parents go through can give insight into what they need from healthcare professionals.

For this study information was gathered from parents who are rearing children with and without PKU regarding their perspectives and experiences dealing with meal planning, diet enforcement, and time management. This information may allow medical professionals to provide a higher standard of care to these families by providing relevant information that is targeted to their needs.

2.3 Materials and Methods

2.3.1 Measures. This research collected quantitative and qualitative data through surveys and follow up telephone interviews. An online survey tool, Survey Monkey, was used to create and post the online survey (Appendix E) via surveymonkey.com. The first

page was a letter to participants (Appendix A) where they were told the study was voluntary and they could withdraw their participation at anytime; by clicking to the next page consent was implied and the survey was started. The survey made use of multiple choice questions, Likert scale questions, true/false questions, and concluded with demographic questions.

The survey also contained questions that were adapted from the Family Routines and Rituals questionnaire (Fiese, 1992). The questionnaire had eight questions that dealt with Dinner Time which were adapted for use in this study. This measure has been shown to be reliable and valid.

To be eligible for the study participants needed to have multiple children having at least one child with PKU and one child without PKU. If they did not meet the study qualifications they were exited out of the survey. At the end of the survey an optional question asked participants if they would be interested in participating in a telephone interview. This question asked for contact information and what would be the most convenient time to contact them.

The principal investigator initiated the telephone calls to the participants who were interested in participating in this part of the study. The telephone interview followed a script with pre-established questions (Appendix F). Before the telephone interviews were conducted, the participants were told that the study was voluntary and confidential and that they could withdraw at any time. By agreeing to continue with the interview, consent was implied.

2.3.2 Participants. Participants for this study were parents who were rearing children with and without PKU. Individuals were recruited for this study through the

National PKU Alliance (NPKUA) and an online forum board, PKU Board (pkuboard.info). The NPKUA is an organization formed from adults, families, and regional and statewide PKU organizations. PKU Board is an online forum board that allows individuals to interact with others who have PKU, have a family member with PKU, know someone with PKU, or individuals who are interested in PKU.

There were a total of twenty-four surveys that were started and nineteen that were eligible for use in the study. All eligible responses were accepted yielding a range of eleven to nineteen answers per question. A response rate for the study cannot be calculated because participants were recruited through e-newsletters sent out by NPKUA and through members of PKU Board; a total number of people who received information about the study is unknown. For the surveys completed the majority had one child with PKU (n = 14/19, 74%) and one child without PKU (n = 15/19, 79%). The ages for the children with PKU ranged from 5 months to 52 years (M =17.7, SD = 14.4) and the ages for the children without PKU ranged from 6 months to 54 years (M = 17.8, SD = 15.8 years). All respondents were female (n = 11) and Caucasian (n = 11), the majority were married (n = 10/11, 91%), and their education ranged from some college to professional school with the majority being college graduates (n = 8/11, 73%).

2.3.3 Procedures. The survey was advertised in three monthly e-newsletters sent out by NPKUA to its members. The advertisement included a link to the survey where the first page was a letter to participants. A thread was created on PKU Board describing the study and asking individuals who were interested to follow the provided link (Appendix B). The description noted that the survey was conducted in English and asked that only residents of the United States participate. Members of the forum board were

also searched and a message was sent to users who may have qualified for the study to bring their attention to the thread (Appendix C). An additional message was sent out two weeks before the end of the collection date to once again call attention to the survey (Appendix D).

Participants who completed the survey and left contact information for the telephone interviews were contacted by the principal investigator. Telephone calls were made over the internet using Google Voice and a headset. The telephone calls were recorded with the use of the program Audacity, version 2.0.2. All interviews were transcribed for analysis by the principle investigator. Once telephone interviews were transcribed, all identifying information was discarded.

All information collected was maintained as confidential and no identifying information was used in the data analysis. Quantitative analysis was performed on the data collected from the survey through the use of Statistical Package for Social Sciences (SPSS) version 21.0 statistical software (SPSS Inc., Chicago, IL). Data collected from individuals who did not meet the qualifications for the study were discarded. The survey allowed for participants to skip questions if they were not comfortable answering them. This resulted in a varying number of responses per question; all answers provided for a specific question were used as long as the participant met the qualifications of the study. The survey had several different question types including multiple choice, Likert scale, true/false, and questions that were adapted from the Dinner Time scale (Fiese, 1992). Demographic questions were asked at the conclusion of the survey. Descriptive statistics were performed on each type of question, and crosstabs were performed to evaluate for the presence of trends. Qualitative analysis was performed on the open-ended interview

questions asked during the telephone interviews. No demographic data was collected from the participants of the telephone interview, but all participants were female (n = 5). The data was transcribed and categorized into groups due to similarities by the principal investigator. Common themes were identified when two or more groups fit into a single category.

2.4 Results

2.4.1 Quantitative Results. There were a total of twenty-four surveys that participants began and nineteen were eligible for use in the study (N = 19). The survey allowed participants to skip questions they may have been uncomfortable answering, yielding a varying number of responses per question. All eligible responses were accepted generating a range of eleven to nineteen answers per question. A series of questions related to the amount of time that was spent in relation to different activities and one-on-one was asked for children with PKU and children without PKU. On average, the amount of time spent with the children who had PKU was greater than for the children without PKU. In regards to the time spent on teacher conferences there was no difference (Table 2.1).

Table 2.1 Average Time Spent with Children (*N* = 12)

		n	Mean	Range	Std. Deviation
How much time on average is spent per week on each child with PKU in regards to:	Doctor Appointments	12	0.07	0-1	0.267
	Teacher Conferences	12	0.00	0	0.000
	Extracurricular Activities	11	1.62	0-3	1.121
	Other	2	1.00	0-2	1.000
How much time on average is spent per week one-on-one with each child with PKU?		10	1.09	0-3	1.300
How much time on average is spent per week on each child without PKU in regards to:	Doctor Appointments	12	0.00	0	0.000
	Teacher Conferences	10	0.00	0	0.000
	Extracurricular Activities	11	0.91	0-3	1.044
	Other	2	0.50	0-1	0.707
How much time on average is spent per week one-on-one with each child without PKU?		9	0.70	0-3	1.252

Scale: Time spent for activities 0 = 0 to 1 hour per week, 1 = 1 to 3 hours per week, 2 = 4 to 6 hours per week, 3 = 7+ hours per week. Time spent one-on-one 0 = 1-10 hours per week, 1 = 11-20 hours per week, 2 = 21-30 hours per week, 3 = 31+ hours per week.

All participants indicated that they were the main preparer of homemade meals (*n* = 12). They were asked a series of questions related to how many homemade meals individuals ate and the amount of time spent preparing those meals. There was a minor difference in the number of homemade meals eaten by those with PKU and those without PKU and one mother noted that the main difference for them was that their unaffected child ate school lunches. While everyone did not tend to eat the same entrée (*M* = 0.85) they did eat dinner together (*M* = 2.75) (Table 2.2). It was also noted that the more individuals in the family that had PKU the less time was spent on preparing meals that everyone could enjoy (Table 2.3).

Table 2.2 Homemade Meals (*N* = 13)

	n	Mean	Range	Std. Deviation
How many does the individual(s) with PKU eat per week?	13	2.77	0-4	1.363
How many do the individuals without PKU eat per week?	13	2.62	0-4	1.193
How often does everybody enjoy the same entrée per week?	13	0.85	0-3	1.068
How often per week does everyone eat dinner together even if they are not eating the same entrée?	12	2.75	1-3	0.622
How much time on average is spent per day preparing meals for the individual(s) with PKU?	12	1.50	0-3	1.087
How much time on average is spent per day preparing meals for the individuals without PKU?	12	1.17	0-3	0.835
How much time on average is spent per day preparing meals that everyone can enjoy?	12	0.75	0-3	0.866

Scale: Meals eaten per week 0 = <5 meals per week, 1 = 5-10, 2 = 11-15, 3 = 16-20, 4 = 21+. Dinner eaten together 0 = 0-1, 1 = 2-3, 2 = 4-5, 3 = 6-7. Time spent preparing 0 = <30 mins, 1 = 30mins-1hr, 2 = 1-1.5hrs, 3 = 1.5-2hrs, 4 = 2-3hrs, 5=3+hrs

Table 2.3 Time spent preparing meals versus number of children with PKU (*N* = 12)

		How many of your children have PKU?	
		1	2
How much time on average is spent per day preparing entrees that everyone can enjoy?	<30 mins	*n* = 2	*n* = 3
	30 mins - 1 hr	*n* = 6	*n* = 0
	1 - 1.5 hrs	*n* = 0	*n* = 0
	1.5 - 2 hrs	*n* = 1	*n* = 0

Parents were asked a series of questions dealing with awareness of PKU, restaurant habits and some household habits dealing with diet compliance. On average parents agreed that their child with PKU understood their diagnosis (*M* = 3.33) and that their unaffected children also had an understanding of what PKU was (*M* = 3.25).

Choosing a restaurant that everyone could eat at was important to parents (M = 3.75). They would not go to a restaurant if there was not food for their child/children with PKU to eat (M = 3.33), and they would not bring food with them (M = 1.50). While parents did not feel strongly about storing the food for their child with PKU in a different location (M = 2.17), they did feel strongly about not using different dishes or utensils (M = 0.50). Most parents felt that the diagnosis of PKU did not affect their decision to have more children (M = 1.17), and the majority had not heard of PKU before their child's diagnosis (75%). When asked if the household abided by a low phenylalanine diet all parents disagreed or strongly disagreed (M = 0.25) even though their children ate diet approved food (M = 2.83) (Table 2.4).

Table 2.4 Habits (*N* = 12)

	n	Mean	Range	Std. Deviation
My child/children without PKU have an understanding of what PKU is.	12	3.25	1-4	1.138
My child/children with PKU have an understanding of their diagnosis.	12	3.33	1-4	1.155
Choosing a restaurant that everyone can eat at is important to me.	12	3.75	3-4	0.452
I always bring food for my child/children with PKU to eat when we go out to a restaurant.	12	1.50	0-3	1.087
I will not go to a restaurant if they do not serve food that my child/children with PKU can eat.	12	3.33	2-4	0.778
The food for my child/children with PKU is stored in a different location than the families' food.	12	2.17	0-3	1.193
Different dishes and utensils are used for eating and preparing the food for my child/children with PKU.	12	0.50	0-3	1.000
My child being diagnosed with PKU played a role in my decision to have more children.	12	1.17	0-4	1.337
I knew what PKU was before my child's diagnosis.	12	0.92	0-3	1.379
Everyone in my household abides by a low phenylalanine diet.	12	0.25	0-1	0.452
My child/children with PKU only eat(s) a low phenylalanine diet approved food.	12	2.83	2-4	1.030

Note: Likert scale questions where 0 = Strongly Disagree and 4 = Strongly Agree.

The participants were asked a series of questions related to stress and time management. All participants agreed on two points, that they have a routine first thing in the morning (*M* = 1.00), and that when their family makes plans, those plans are able to be accomplished (*M* = 0.00). Most participants agreed that they are able to hear themselves think in their home (*M* = 0.08) and that the telephone does not take up much time at their home (*M* = 0.08). Most participants also agreed that they can usually find

things when they need them (*M* = 0.92) and that their home is a good place to relax (*M* = 0.92). Participants also felt that their home was not a zoo (*M* = 0.17) and that there was not a fuss going on at home (*M* = 0.17) (Table 2.5).

Table 2.5 Stress and Time Management (*N* = 12)

	n	Mean	Range	Std. Deviation
There is very little commotion in our home.	12	0.42	0-1	0.515
We can usually find things when we need them.	12	0.92	0-1	0.289
We almost always seem to be rushed.	12	0.42	0-1	0.515
We are usually able to stay on top of things.	12	0.75	0-1	0.452
No matter how hard we try, we always seem to be running late.	12	0.33	0-1	0.492
It's a real zoo in our home.	12	0.17	0-1	0.389
At home we can talk to each other without being interrupted.	12	0.67	0-1	0.492
There is often a fuss going on at our home.	12	0.17	0-1	0.389
No matter what our family plans it usually doesn't seem to work out.	12	0.00	0	0.000
You can't hear yourself think in our home.	12	0.08	0-1	0.289
I often get drawn into other people's arguments at home.	12	0.33	0-1	0.492
Our home is a good place to relax.	12	0.92	0-1	0.289
The telephone takes up a lot of our time at home.	12	0.08	0-1	0.289
The atmosphere in our home is calm.	12	0.75	0-1	0.452
First thing in the day, we have a regular routine in the home.	12	1.00	1	0.000

Note: True/False Scale with True = 1 and False = 0.

A series of questions the participants answered were adapted from the Dinner Time Scale (Fiese, 1992). These questions focused on the routines and rituals these families had around dinner time. Most participants felt strongly about their family eating dinner together (*M* = 0.36), that their families regularly ate dinner together (*M* = 0.45),

and that everyone was expected to be home for dinner (M = 0.55). They also felt that dinner was planned in advance (M = 2.36), that it held special meaning (M = 2.18), and that it was at the same time everyday (M = 2.09) (Table 2.6).

Table 2.6 Dinner Time Scale (N = 11)

	n	Mean	Range	Std. Deviation
Some families regularly eat dinner together; but other families rarely eat dinner together.	11	0.45	0-2	0.820
In some families, everyone has a specific role and job to do at dinnertime; but in other families, people do different jobs at different times depending on needs.	11	1.64	0-3	1.027
In some families, dinnertime is flexible; people eat whenever they can. But in other families, everything about dinner is scheduled; dinner is at the same time every day.	11	2.09	1-3	0.831
In some families, everyone is expected to be home for dinner, but in other families, you never know who will be home for dinner.	11	0.55	0-1	0.522
In some families, people feel strongly about eating dinner together; but in other families, it is not that important if people eat together.	11	0.36	0-1	0.505
In some families, dinnertime is just for getting food; but in other families, dinner time is more than just a meal; it has special meaning.	11	2.18	1-3	0.751
In some families, dinnertime is pretty much the same over the years; but in other families, dinnertime has changed over the years.	10	1.40	0-3	0.843
In some families there is little planning around dinnertime; but in other families, dinnertime is planned in advance.	11	2.36	1-3	0.674

Note: Adapted from Family Routines and Rituals questionnaire.
Four answer choices were coded 0 to 3.
0 = Really true for our family (1st part of question) and 3 = Really true for our family (2nd part of question).

2.4.2 Qualitative Results. There were a total of nine individuals who said they would be willing to participate in a telephone interview and provided their contact information. A total of five phone interviews were conducted and they ranged in length from five to twenty-four minutes. The average length of the interviews was 12 to13 minutes. No demographic information was collected regarding age, education, ethnicity, or number of children with or without PKU. All participants were female and all of their children were diagnosed via newborn screening with the exception of one child.

During the telephone interview participants were asked questions regarding initial reactions to learning their child had PKU, how they share this information with others, what they find challenging, and how it impacts their unaffected children. Three main themes were identified from the responses given by the participants. These themes were dealing with the diagnosis, impact on the family, and what I have learned by having a child with PKU. These themes were then broken down into two or three subcategories.

Dealing with the diagnosis was the first of three major themes identified. It was then broken down into initial reaction, acceptance of the diagnosis, and the effect on children. Initial reactions ranged from shock and fear, to doubt about being able to take care of their child, and even confusion, "I remember just being very foggy and trying to be calm and do active listening, repeating what I was being told." Acceptance of the diagnosis focuses more on the parents coming to terms with their child's diagnosis and accepting that it is a part of their family. The effect on children was not limited to children with PKU or children without PKU, but is reflective of how the diagnosis affects all children. It includes feelings of guilt and resentment for children who were not

affected to feeling like an imposition on the family for the children who were affected. One mother commented on the feelings of her affected daughter with these words:

> …but I think the child with PKU feels that they are an imposition on the family even though you try not to have that, it's just complicated, it's not as free spirited, it just takes more coordination and more management than if they didn't have it, if you didn't have a child with a medical condition.

The impact on the family due to the diagnosis creates the second theme that is then broken down into the subcategories of daily life, interaction with siblings, and adherence to diet. When looking at daily life most responses focus on how more planning was required and how it changed that way that the family worked. Interaction with siblings concentrated on the interaction between children with PKU and children without PKU. Parents would comment on how their children without PKU watched out for the children with PKU, including helping them find food that was appropriate to eat, tattling when they were getting into inappropriate food, and even not playing a role in their siblings PKU at all. A mother described the role her unaffected daughter played with her daughters PKU, "…we never made her, her sister's keep, in the sense of policing her…" Adherence to diet had parents sharing what was important in helping their children to maintain compliance with the diet, and what to do if a pattern of non-compliance was noted. One mother advised seeking therapy if a pattern of non-compliance was noted, "…if they start to see a pattern of non-compliance with the diet, is definitely to see some kind of…therapy…"

The final theme that was identified was what parents had learned from having a child with PKU. This was broken down into the knowledge that these parents have

gained and then the knowledge that they share with others who do not know what PKU is. The knowledge that parents have learned was focused on tips that they had to share. These tips were for other parents regarding general maintenance of PKU, and then tips from one parent to another who is raising a child with PKU. The knowledge that most parents felt was important to tell others was simple; simply stating that their child had a metabolic disorder and they could not eat protein, several even explained it as being similar to diabetes. One mother described how she explained PKU to others:

> I said my children had a metabolic disorder, they couldn't eat protein. For them to think of it like a diabetic who has exchanges to eat, against a person with PKU who has the same but its protein, rather than carbs.

2.5 Discussion

Rearing a child with PKU that is on a lifelong restrictive diet with children who are not is a unique experience that some parents find themselves in. When parents are rearing multiple children, there is always the concern as to whether all their children are getting the attention and care that they need. When some children require more attention for daily care, it would be expected that the other children may feel left out or not receive as much attention. Parents did report that on average their children with PKU had more time spent on them per week and had more one-on-one attention. Parents also commented on this difference and how it affected their children. One parent noted that her unaffected son had conflicting emotions, "I think my son feels a number of conflicting emotions, I think he resented the extra attention they got, I think he felt guilty about resenting them, sort of a survivor guilt or something, so it was mixed emotions." Another mother mentioned the jealousy that unaffected children can feel, "…the other

child obviously gets jealous and feels left out because he doesn't have all these problems…"

Since the management of PKU is focused around food, differences were expected to be found in meal planning and the time it takes to prepare the food for these individuals. While there were no statistically significant differences found, trends were noted. All survey participants noted that they were the main preparer of the homemade meals. There were minor differences in the number of homemade meals that individuals with and without PKU ate per week; those with PKU eating more. One mother made note of the difference being due to the lunch meal during the week, "The big difference is that our child without PKU eats school lunch." It was also noted that slightly more time was spent on average preparing meals that the individuals with PKU could eat compared to the individuals without. This was not unexpected, as their diet is more restrictive and can require the weighing of some foods, as one mother mentioned, "Ate same meal...minus [main] entree for PKU child and his fruits and veggies were measured." The previous parent mentioned that her family would eat the same meal, but that the entrée would be different for the individual with PKU. This was also noted by several other parents, including one parent noting that the child with PKU always had a slightly different version of the meal, even if it was only the pasta or cheese. One trend that was noted in particular, was that in families with more individuals with PKU, less time was spent preparing entrées that everyone was able to enjoy. This was an unexpected finding. Cooking for individuals with PKU can be time consuming(Awiszus & Unger, 1990). If there are multiple individuals requiring a strict diet it may be easier to cook a separate

meal that is suited to their needs, compared with trying to cook something everyone can enjoy.

Differences in meal planning were expected due to the needs of the management of the condition, but struggles with diet enforcement were also expected to be found. It was not expected for the entire household to eat a low Phe diet, but for the children with PKU to eat according to their diet, which was supported by the data. Although the children affected with PKU follow their diet, some parents talked about the difficulties in getting their children to drink all of their formula, "She always had issues drinking her formula through at school, she just never really did that." One parent even shared how she would make pudding with the formula and would not allow her unaffected children to make negative comments regarding the diet their siblings had to follow. Another mother commented on her unaffected children and the diet:

> …occasionally they [her unaffected children] had gotten something that was made with the formula and it did not taste well. They would sometimes get that. In the beginning I made pudding with the formula, and it was not very tasty, so they would taste it and say 'Oh gosh, that's gross,' things like that. I would tell them no matter what they could not say that because it was hard enough for my two children to adhere to it without having the other children saying anything that would make them dislike what they drank.

As the parent above expressed, having children who did not have PKU and did not adhere to the diet affected how well the children with PKU did adhere to their diet. Many parents remarked on the role that their unaffected children played in the dietary

management for their children with PKU. Some parents stated that their other children were 'watch-dogs', "My other children were kind of watch dogs, so to speak. They did watch and didn't want them to eat other food, so I guess they were a little bit snitching on their brother and sister." Other parents remarked that they would help their siblings find food that was acceptable for them to eat. Another parent reflected on the role her unaffected son plays in his sibling's PKU:

> …he pretty much takes a big brother attitude towards it, he looks out for them and will help them determine if something is, we call it high Phe and low Phe food, so he'll help them find things that are low Phe that they can eat. And he'll help them you know, say 'No those are high Phe so don't have those ones,' he very much takes a helper big brother attitude.

For some families, their unaffected children did not play a role in the dietary management for their affected children. One parented reported that her unaffected daughter simply supplied sisterly support, "…just treat your sister like your sister. The bully on the block is picking on your sister, punch him in the nose. So, just any sisterly support, just normal." Another parent plainly stated that her unaffected children played no role in the management of her other children's PKU. She went on to state that her unaffected child was the youngest, therefore being the reason why he did not play a role.

Learning that your child has screened positive for a disorder via newborn screening can increase parental anxiety (Hall & Michel, 1995). This can be especially true since the child appears to be a 'well-child' without any medical problems. When these parents reflected on learning their child's diagnosis of PKU they reported a variety of emotions, including fear, shock, and insecurity. One mother remembered feeling

shocked "...I asked how to spell phenylketonuria because I didn't even know what it was…So it was kind of, I would say, I didn't even have enough information to panic, it was more like shock," while another remembers her insecurity, "…the biggest thing I remember was my panic or insecurity, like, what if I can't do this for my child, whatever it takes, what if I can't do this." One mother experience mixed emotions when she learned of her child's diagnosis at the age of three.

> It was just being discovered at the time, there was very little newborn screening, and I had just read an article about it so I said 'Oh my god! The diet!' and I said 'Oh no, it's too late. It has to be started by age two.' So I had mixed emotions. First, happy to find out what the problem was, second, realizing that you had to follow the diet to a 'T' for optimal results.

The emotions that parents feel towards a diagnosis are not limited to the moment they receive the news. For news such as learning your child has PKU, and that it is something they will have for the rest of their life, may require time for some parents to accept. One parent reflected on how she had to deal with her own personal feelings regarding the diagnosis:

> …the one thing I had to get over as a parent was people greeting 'Oh what a cute little baby', and my next thought was 'Yeah, but you have PKU.' I had to come to terms with it, that's not who she is.

While the parents had emotional responses to the news that their child had PKU, there were still emotional responses from the individuals with PKU, and the unaffected

children. One parent expressed that her child with PKU felt guilt due to the extra planning and care that had to be centered on the disorder:

> I think they feel the guilt of this, they might have held it back, because it wasn't as easy just to go on vacation, we would always have to pack food, plan food... So I think, unfortunately what happens… [is]the child with PKU feels that they are an imposition on the family even though you try not to have that, it's just complicated…

Another parent remarked that she hoped the diagnosis had made her other children more empathetic, "I think it has made them a little more empathetic to people who …might be a little bit different from the ordinary."

As the parent above remarked, having to plan around dietary requirements can change how everyday activities are done. When parents were asked about going out to eat, most responded that they would not choose restaurants if there was not food available for their child with PKU to eat, and that they did not want to bring food with them. One parent in particular remarked on going out to restaurants, "Going out to dinner wasn't as spontaneous; well what restaurant can we go to because they have to be able to have such and such. We didn't really have it hold us back, but it just complicated things." Many parents discussed the fact that their child having PKU complicated things. They never expressed that PKU prevented them from doing things, but more that it just changed the way in which things had to be done. Many parents also talked about what works for them and their family may not work for everyone, and that each family has to find what works best for them. One mother's perspective is recounted here:

> I don't think there is one easy answer for everyone, I don't think there is one right answer, I think different families are going to work differently.…we try and make it just how our family lives, try not to make it about the other kids, or about the fact that they have PKU. We just make it that that's how our family works so it doesn't seem like the other kids are more important or something because they have PKU. But it just changed how our family works.

Although many parents commented on the challenges of PKU, not all parents feel that PKU is challenging. For one mother in particular, she simply stated that she did not find PKU that challenging at all.

Many of these families have found what works for them through trial and error. Many parents shared how they talked with other families when they first learned of their child's diagnosis, but then how they have also talked with other families when they too had a child diagnosed with PKU. One mother suggested learning as much as you can about PKU and to do everything you can to make their diet interesting. Another shared to just do what you are told to do in clinic, stay away from negative listservs, and that everything would be okay. While they shared things about how to take care of the children, one mother in particular had information for parents with children who have PKU. She expressed that it was important for parents not to feel guilty for eating food that their children could not, because that was how their life was going to be:

> …realize that through their [children with PKU] life the people they are around are going to be eating other food, and never feel guilty about eating other food in front of them because that is going to be the way of their life.

A limitation of this study is that its distribution and data collection were performed only via internet. As it was only available online, the participants of the survey likely represent a higher socioeconomic status. Due to the distribution of the survey, another limitation is that the sample represents one of convenience. The survey was available online to whomever was interested in taking it, or whoever had the time. This also resulted in a small sample size, precluding statistically significant results. Participants were allowed to skip questions or exit the survey before they had completed it, resulting in a dwindling sample size in later questions. There was also limited cultural diversity. The participants were all Caucasian females with at least some college education. The majority were also married. There were also no questions exploring what other social support may have been available to these families. If some families had regular contact with social support outside their immediate family they may have different experiences than those without that additional support. Without questions exploring what was available to these families, no comparisons could be made.

2.6 Conclusion

This study looked at parents who were rearing children with and without PKU to gain an understanding of the unique perspectives and struggles that they face. How parents dealt with diet enforcement, meal planning and time management were examined. It was found that individuals with PKU tend to eat more homemade meals and that more time is spent making a meal that everyone can enjoy, especially when there are fewer individuals with PKU living in the home. It was also found that children with PKU on average receive slightly more attention than children without PKU. This study also found that there were different ways that families helped to maintain the diet for the children

with PKU. In some families other siblings helped in making sure that the diet was followed, while for some families, unaffected siblings played no role. By understanding the many different dynamics that surround the lives of these families, genetic counselors and other healthcare professionals can start to provide care that may be more appropriate for these families.

Future studies would include having a larger and more diverse sample size. A larger study would allow further exploration into themes that have already been identified and having a more diverse sample would allow for a more complete picture of how these families handle everyday life. In addition, the sample in future studies could be more randomly sampled. This could be accomplished by contacting families through other means, and not strictly over the internet, including clinic, camps, and conferences. Incorporating questions regarding more psychosocial aspects and coping would be beneficial to future studies. This would allow more information to be collected regarding how the families are doing emotionally and provide better information for the medical professionals serving these families.

Chapter 3: Conclusions

This study looked at parents who were rearing children with and without PKU to gain an understanding of the unique perspectives and struggles that they face. How parents dealt with diet enforcement, meal planning and time management were examined. It was found that individuals with PKU tend to eat more homemade meals and that more time is spent making a meal that everyone can enjoy, especially when there are fewer individuals with PKU living in the home. It was also found that children with PKU on average receive slightly more attention than children without PKU. This study also found that there were different ways that families helped to maintain the diet for the children with PKU. In some families other siblings helped in making sure that diet was followed, while for some families, unaffected siblings played no role. By understanding the many different dynamics that surround the lives of these families, genetic counselors and other healthcare professionals and start to provide care that may be more appropriate for these families.

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References

Andermann, A., Blancquaert, I., Beauchamp, S., & Dery, V. (2008). Revisiting Wilson and Jungner in the genomic age: a review of screening criteria over the past 40 years. *Bulletin of the World Health Organization, 86*(4).

Awiszus, D., & Unger, I. (1990). Coping with PKU: results of narrative interviews with parents. *European Journal of Pediatrics, 149,* S45-51.

Blau, N., van Spronsen, F. J., & Levy, H. L. (2010). Phenylketonuria. *Lancet, 376*(9750), 1417-1427. doi: 10.1016/s0140-6736(10)60961-0

Campbell, E., & Ross, L. F. (2003). Parental attitudes regarding newborn screening of PKU and DMD. *American Journal of Medical Genetics, 120A*(2), 209-214. doi: 10.1002/ajmg.a.20031

Cleary, M. A. (2010). Phenylketonuria. *Paediatrics and Child Health, 21*(2), 61-64.

Committee on Genetics. (2008). Maternal phenylketonuria. *Pediatrics, 122*(2), 445-449. doi: 10.1542/peds.2008-1485

Crowe, S. (2008). *A Brief History of Newborn Screening in the United States*. http://bioethics.georgetown.edu/pcbe/background/newborn_screening_crowe.html

Donlon, J., Levy, H., & Scriver, C. (2007). *Metabolic and Molecular Basis of Inherited disease*. New York, New York: McGraw-Hill.

Fearing, M. K., & Levy, H. L. (2003). Expanded newborn screening using tandem mass spectrometry. *Advances in Pediatrics, 50,* 81-111.

Fiese, B. H. (1992). Dimensions of family rituals across two generations: relation to adolescent identity. *Family Process, 31*(2), 151-162.

Fiese, B. H., Foley, K. P., & Spagnola, M. (2006). Routine and ritual elements in family mealtimes: contexts for child well-being and family identity. *New Directions for Child and Adolescent Development, 2006*(111), 67-89.

Fiese, B. H., Tomcho, T., Douglas, M., Josephs, K., Poltrock, S., & Baker, T. (2002). Fifty years of research on naturally occuring rituals: cause for celebration? *Journal of Family Psychology, 16,* 381 - 390.

Hall, D. M. B., & Michel, J. M. (1995). Screening in infancy. *Archives of Disease in Childhood, 72*(1), 93-96.

Hammons, A. J., & Fiese, B. H. (2011). Is frequency of shared family meals related to the nutritional health of children and adolescents? *Pediatrics, 127*(6), e1565-1574. doi: 10.1542/peds.2010-1440

Knafl, K., Breitmayer, B., Gallo, A., & Zoeller, L. (1996). Family response to childhood chronic illness: description of management styles. *Journal of Pediatric Nursing, 11*(5), 315-326. doi: http://dx.doi.org/10.1016/S0882-5963(05)80065-X

Koch, R., Trefz, F., & Waisbren, S. (2010). Psychosocial issues and outcomes in maternal PKU. *Molecular Genetics and Metabolism, 99 Suppl 1*, S68-74. doi: 10.1016/j.ymgme.2009.10.014

Macleod, E. L., & Ney, D. M. (2010). Nutritional management of phenylketonuria. *Annales Nestle, 68*(2), 58-69. doi: 10.1159/000312813

Maillot, F., Lilburn, M., Baudin, J., Morley, D. W., & Lee, P. J. (2008). Factors influencing outcomes in the offspring of mothers with phenylketonuria during pregnancy: the importance of variation in maternal blood phenylalanine. *The American Journal of Clinical Nutrition, 88*(3), 700-705.

Markson, S., & Fiese, B. H. (2000). Family rituals as a protective factor for children with asthma. *Journal of Pediatric Psychology, 25*(7), 471-480.

Modan-Moses, D., Vered, I., Schwartz, G., Anikster, Y., Abraham, S., Segev, R., & Efrati, O. (2007). Peak bone mass in patients with phenylketonuria. *Journal of Inherited Metabolic Disease, 30*(2), 202-208. doi: 10.1007/s10545-007-0462-9

National Institutes of Health Consensus Development Panel. (2001). National institutes of health consensus development conference statement: phenylketonuria: screening and management, October 16-18, 2000. *Pediatrics, 108*(4), 972-982.

Nussbaum, R. L., McInnes, R. R., & Willard, H. F. (2007). *Thompson & Thompson genetics in medicine* (7 ed.). Philadelphia, PA: Saunders Elsevier.

Pardridge, W. (1998). Blood-brain barrier carrier-mediated transport and brain metabolism of amino acids. *Neurochemical Research, 23*(5), 635-644.

Pho, L. T., Zinberg, R. E., Hopkins-Boomer, T. A., Wallenstein, S., & McGovern, M. M. (2004). Attitudes and psychosocial adjustment of unaffected siblings of patients with phenylketonuria. *American Journal of Medicial Genetics, 126A*(2), 156-160. doi: 10.1002/ajmg.a.20577

Schmidt, E., Rupp, A., Burgard, P., Pietz, J., Weglage, J., & de Sonneville, L. (1994). Sustained attention in adult phenylketonuria: the influence of the concurrent phenylalanine-blood-level. *Journal of Clinical and Experimental Neuropsychology, 16*(5), 681-688. doi: 10.1080/01688639408402681

Seifer, R., Sameroff, A. J., Dickstein, S., Keitner, G., Miller, I., Rasmussen, S., & Hayden, L. C. (1996). Parental psychopathology, multiple contextual risks, and one-year outcomes in children. *Journal of Clinical Child Psychology, 25*, 423-425.

Sweetman, L. (1996). Newborn screening by tandem mass spectrometry (MS-MS). *Clinical Chemistry, 42*(3), 345-346.

Appendices

Appendix A – Letter to Participants

Dear Potential Participant,

I am a graduate student at the University of South Carolina and I am working on a Master of Science degree in genetic counseling. I would like to invite you to participate in a study looking at the perspectives and struggles that parents face when they are rearing children with and without PKU.

By talking with parents who are rearing children with and without PKU I hope to see some of the unique challenges that these parents face. If you are a parent of multiple children, with at least one affected with PKU and one unaffected, you are invited to participate.

This study is constructed of two parts, both of which are voluntary. The first part is an online survey that may take 15-20 minutes to complete. At the end you will be invited to participate in a phone interview that may take 15-20 minutes and will occur at your convenience. You may participate in both the online survey and the telephone interview or just the online survey. The goal of the phone interview is to gain more information than can be collected through the online survey. The telephone interview will be recorded and transcribed for the study, but all information will remain confidential.

To participate, just begin the online survey. If you are interested in participating, please complete the survey by January 31, 2013. By starting the online survey you are giving your consent to participate in this research study. You many withdraw your participation at any time by not completing the survey.

Your time and involvement would be greatly appreciated. If you would like more information or have any questions please feel free to contact me or the faculty advisor with the contact information below. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at (803) 777-7095.

Sincerely,

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Appendix B – Forum Posting About Survey

Subject: PKU Thesis

Hi! My name is Cassandra and I am a graduate student at the University Of South Carolina School Of Medicine in the Genetic Counseling Program. I am writing my thesis on the unique situation of rearing a child or children with PKU with siblings that do not have PKU. I would greatly appreciate if those of you with multiple children, including those with and without PKU would fill out my survey. The survey is anonymous and may take 15-20 minutes. I will place the link below that will take you to a page that explains more about the survey before you are asked to begin. If you have any questions please feel free to contact me here, or to send me an email at cassandra.hollinger@yahoo.com.

I am interested in surveying **parents**, who are **rearing children with PKU** *and* **children without PKU**.
The survey is being conducted in English, United States residents only please.

http://www.surveymonkey.com/s/PKU

Appendix C – Message to Forum Board Users

Subject: PKU Research

Hi! My name is Cassandra, I am a student at the University of South Carolina, and I am currently working on getting my Master's degree. I am interested in doing research with PKU by surveying parents who are rearing children with PKU. I think you may be able to participate in my study and was hoping you would read a post I have made about my research on the forum. The link to the posting is below. Any help would be greatly appreciated and if you have any questions please feel free to ask. Thank you so much for your time!

PKU Thesis

Appendix D – Reminder Message to Forum Board Users

Subject: RE: PKU Research

Hi! I don't know if you had a chance to participate in my study, but I just want to send a friendly reminder as the deadline to participate is coming up. The last day that answers can be submitted for the survey is January 31, 2013. I have placed a link below that takes you to a posting about the survey that includes more information and a link to follow if you were interested in participating. Thank you for your time!

PKU Thesis

Appendix E – Online Survey

Inclusion Criteria

1. How many of your children have PKU?
    - 0 → Thank you for participating but you do not qualify for this study.
    - 1
    - 2
    - 3
    - 4+

2. How many of your children do not have PKU?
    - 0 → Thank you for participating but you do not qualify for this study.
    - 1
    - 2
    - 3
    - 4+

3. What are the ages of your children without PKU?
    - _____

4. What are the ages of your children with PKU?
    - _____

Thinking about your child/children *with* PKU:

1. How much time on average is spent per week on each child **with** PKU in regards to:
    a. Doctor appointments:
    b. Teacher conferences:
    c. Extracurricular activities:
    d. Other:

2. How much time on average is spent per week one-on-one with each child **with** PKU?

3. Additional comments regarding the above questions:

Thinking about your child/children *without* PKU

4. How much time on average is spent per week on each child **without** PKU in regards to:
    a. Doctor appointments:
    b. Teacher conferences:
    c. Extracurricular activities:
    d. Other:

5. How much time on average is spent per week one-on-one with each child **without** PKU?

6. Additional comments regarding the above questions:

Thinking about homemade meals:

7. How many does the individual(s) **with** PKU eat per week?
    a. <5
    b. 5-10
    c. 11-15
    d. 16-20
    e. 21+

8. How many do the individuals **without** PKU eat per week?
    a. <5
    b. 5-10
    c. 11-15
    d. 16-20
    e. 21+

9. How often does **everybody** enjoy the same entree per week?
    a. <5
    b. 5-10
    c. 11-15
    d. 16-20
    e. 21+

10. How often per week does everyone eat dinner together even if they are not eating the same entree?
    a. 0-1
    b. 2-3
    c. 4-5
    d. 6-7

11. Are you the main preparer of the homemade meals?
    a. If yes:
        1. How much time on average is spent per day preparing meals for the individual(s) **with** PKU?
            - <30 mins
            - 30mins-1hr
            - 1-1.5hrs
            - 1.5-2hrs
            - 2-3hrs
            - 3+hrs

2. How much time on average is spent per day preparing meals for the individuals **without** PKU?
    - <30mins
    - 30mins-1hr
    - 1-1.5hrs
    - 1.5-2hrs
    - 2-3hrs
    - 3+hrs

3. How much time on average is spent per day preparing meals that **everyone** can enjoy?
    - <30mins
    - 30mins-1hr
    - 1-1.5hrs
    - 1.5-2hrs
    - 2-3hrs
    - 3+hrs

b. If no, continue to the next question.

12. Additional comments regarding the above questions:

Likert Questions [Strongly Disagree – Disagree – Neither Agree or Disagree – Agree – Strongly Agree]

13. My child/children **without** PKU have an understanding of what PKU is.
14. My child/children **with** PKU have an understanding of their diagnosis.
15. Choosing a restaurant that everyone can eat at is important to me.
16. I always bring food for my child/children **with** PKU to eat when we go out to a restaurant.
17. I will not go to a restaurant if they do not serve food that my child/children **with** PKU can eat.
18. The food for my child/children **with** PKU is stored in a different location than the families' food.
19. Different dishes and utensils are used for eating and preparing the food for my child **with** PKU.
20. My child being diagnosed with PKU played a role in my decision to have more children.
21. I knew what PKU was before my child's diagnosis.
22. Everyone in my household abides by a low phenylalanine diet.
23. My child **with** PKU only eats low phenylalanine diet approved food.
24. Additional comments regarding the above questions:

True/False Questions

25. There is very little commotion in our home
26. We can usually find things when we need them.
27. We almost always seem to be rushed.

28. We are usually able to stay on top of things.
29. No matter how hard we try, we always seem to be running late.
30. It's a real zoo in our home.
31. At home we can talk to each other without being interrupted.
32. There is often a fuss going on at our home.
33. No matter what our family plans, it usually doesn't seem to work out.
34. You can't hear yourself think in our home.
35. I often get drawn into other people's arguments at home.
36. Our home is a good place to relax.
37. The telephone takes up a lot of our time at home.
38. The atmosphere in our home is calm.
39. First thing in the day, we have a regular routine in the home.
40. Additional comments regarding the above questions:

Thinking about dinnertime:

41. Some families regularly eat dinner together; but other families rarely eat dinner together.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

42. In some families, everyone has a specific role and job to do at dinner time; but in other families, people do different jobs at different times depending on needs.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

43. In some families, dinner time is flexible. People eat whenever they can; but in other families, everything about dinner is scheduled; dinner is at the same time every day.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

44. In some families, everyone is expected to be home for dinner; but in other families, you never know who will be home for dinner.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

45. In some families, people feel strongly about eating dinner together; but in other families, it is not that important if people eat together.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

46. In some families, dinnertime is just for getting food; but in other families, dinner time is more than just a meal; it has special meaning.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

47. In some families, dinnertime is pretty much the same over the years; but in other families, dinnertime has changed over the years.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

48. In some families, there is little planning around dinner time; but in other families, dinnertime is planned in advance.
    a. The first part is really true for our family
    b. The first part is sort of true for our family
    c. The second part is sort of true for our family
    d. The second part is really true for our family

49. Additional comments regarding the above questions:

Demographic Questions

1. Gender
    - Male
    - Female

2. Marital status
    - Single
    - Married
    - Divorced
    - Separated
    - Widowed

3. Ethnicity
    - Caucasian
    - African-American
    - Hispanic/Latino
    - Native American
    - Middle Eastern
    - Other

4. Highest level of education completed
    - High school/GED
    - Vocational/technical training
    - Some college
    - College graduate
    - Graduate school
    - Professional school (MD, JD, etc.)

5. What is your gross annual household income?
    - _____

If you would be interested in participating in a phone interview to help gather more information than can be collected through the online survey, please leave your contact information below. Your information will remain confidential and only be used for the purposes for this study.

Name:
Phone number:
Best time to contact you at the provided phone number:

Morning: 9am - noon
Afternoon: noon - 4pm
Evening: 5pm - 8pm

Appendix F – Telephone Interview

Hi, may I please speak with _____?

My name is Cassandra Hollinger and I am a genetic counseling student at the University of South Carolina. You recently completed an online survey about rearing children with and without PKU. I'm calling in regards to the telephone interview that you agreed to participate in. Would this be a convenient time to talk to you for 15-20 minutes about your thoughts on rearing children with and without PKU?

This interview is completely voluntary and you may decide not to participate or to stop the interview at any time. This interview will be recorded and transcribed and used only for the purpose of this research study. All information in this study will remain confidential and your personal contact information will be discarded after the interview is analyzed.

Phone Interview Questions

1. What were your first thoughts when you heard that your child had PKU?

2. What do you tell others, like family members, care givers and teachers, about PKU?

3. What do you feel is the biggest challenge of having children with and without PKU?

4. What are your suggestions to other parents in a similar situation?

5. How has having a sibling with PKU affected your children without PKU?

6. What role do your unaffected children play in the management of your child's PKU?

I want to thank you for participating in this research study; your answers will be beneficial to genetic counselors and to other families in similar situations. Do you have any questions for me? . . . Thank you for your time and I hope you have a good morning/afternoon/evening.