Patient Preference and Adherence Dovepress

ORIGINAL RESEARCH

A Qualitative Investigation into the Determinants of Unfulfilled Needs in Caregivers of Patients with Phenylketonuria

Yu-Juan Zheng[1], Yong-Chao Hou[2], Hua Zhao[3], Xiao-Yun Wang[4], Yu-Dan Liu[3], Li Li[5], Liang Yu[6], Ming-Mei Guo[1]

[1]Department of Cardiology, Shanxi Provincial People's Hospital, Taiyuan, 030012, People's Republic of China; [2]Department of Emergency, Shanxi Provincial People's Hospital, Taiyuan, 030012, People's Republic of China; [3]College of Nursing, Shanxi University of Chinese Medicine, Jinzhong, 030619, People's Republic of China; [4]Department of Endocrinology, Shanxi Provincial People's Hospital, Taiyuan, 030012, People's Republic of China; [5]Department of Gynecology, Shanxi Provincial People's Hospital, Taiyuan, 030012, People's Republic of China; [6]Neonatal Disease Screening Center, Shanxi Provincial Children's Hospital, Taiyuan, 030013, People's Republic of China

Correspondence: Ming-Mei Guo, Department of Cardiology, Shanxi Provincial People's Hospital, No. 29 Shuangtasi Street, Yingze District, Taiyuan, 030012, People's Republic of China, Tel +86 13934533989, Email guomingmeigmm@126.com

Objective: To conduct an in-depth exploration of the factors influencing unfulfilled needs in caregivers of patients with phenylketonuria.

Methods: A rapid qualitative analysis approach was used to conduct semi-structured interviews with 16 caregivers of patients with phenylketonuria undergoing specialized dietary interventions, along with 5 medical professionals, within a designated phenylketonuria diagnosis and treatment center in Shanxi Province. Interview data were systematically organized, analyzed, and thematically extracted.

Results: Four primary themes were extracted: self-imposed constraints (including insufficient caregiver engagement, economic limitations, and stigma); interpersonal constraints (encompassing social isolation, inadequate social support networks, and lack of doctor-patient interactions); structural limitation factors (inadequate provision of specialized professional support systems, lack of medical dietary supplements, and deficiencies in national policies); and experiential limitation factors (encompassing sensory perceptions of medical dietary supplements and insufficient continuity in psycho-emotional care).

Conclusion: The unfulfilled needs of caregivers of patients with phenylketonuria primarily manifest across four dimensions. Greater emphasis on addressing these needs is warranted, necessitating increased attention to patients with phenylketonuria and their caregivers. Specifically, the focus should be directed toward addressing their emotional requirements, along with proactive development of the medical service infrastructure. Such measures are imperative for reducing unfulfilled needs among caregivers of patients and enhancing their prognosis.

Keywords: caregivers, influencing factors, phenylketonuria, qualitative research, rare diseases, unmet needs

Introduction

Phenylketonuria (PKU) is an autosomal recessive disorder characterized by a deficiency of phenylalanine hydroxylase (PAH) due to chromosomal gene mutations, leading to disrupted phenylalanine (Phe) metabolism and subsequent accumulation of Phe within the body. This accumulation leads to a series of Phe toxicity symptoms.[1]

The notice issued by the Ministry of Health of China regarding the Technical Specifications for Neonatal Disease Screening (2010 Edition) stipulates that for diagnosing phenylketonuria (PKU), heel blood should be collected between 72 hours and 7 days after birth, following sufficient breastfeeding, and the laboratory should provide results within 5 working days of receiving the sample. If the results of two tests exceed the positive threshold, follow-up confirmation is required.[2]

At the time of initial diagnosis, many caregivers of affected children lack adequate awareness of the disease and often feel uncertain about the effectiveness of treatment. Some caregivers may even experience feelings of inferiority, anxiety,

Received: 7 June 2024
Accepted: 19 October 2024
Published: 8 November 2024

or panic.[3] Since PKU treatment requires long-term strict dietary management, which is both difficult and prolonged, it places a heavy burden on caregivers. This burden leads to various health-related needs, including emotional, financial, and informational support. When these needs are unmet, it can negatively impact treatment outcomes, adherence to the treatment plan, daily life, mental health, and social interactions. This not only reduces the quality of life for both caregivers and patients but also increases the strain on healthcare and society as a whole.[4,5]

The leisure limitation theory delineates the impact of leisure preferences, decision-making processes, and leisure experiences of an individual, which may lead to an inability, unwillingness, or reduction in participation in leisure activities. This theory categorizes the influencing factors that restrict individual leisure preferences and participation into four distinct dimensions: self-limitation, interpersonal limitation, structural limitation, and experience limitation. Self-limitation refers to the internal factors affecting the leisure preferences or participation of an individual, while interpersonal limitation encompasses factors emerging from interactions with others. Structural limitation involves constraints imposed by the external environment, whereas experience limitation refers to personal realizations, feelings, or inner perceptions induced by external circumstances.[6] The leisure constraints theory can be seen to explain the inherent mechanisms that restrict individual leisure behaviors across the four dimensions mentioned above. Initially applied to leisure sports behavior, its application has expanded and gradually extended to the realm of health behaviors, particularly in exploring the reasons for behavioral compliance.[7] Caregivers of PKU patients face limitations in their own activities as well as in interpersonal, structural, and experiential aspects due to the nature of the patient's illness.

This theory serves as a valuable framework to assess the reasons why patients adhere to treatment regimens. Building upon this theoretical foundation, the present study uses a semi-structured interview method to assess the influencing factors contributing to the unfulfilled needs of caregivers with PKU. The priority is to reduce the level of unfulfilled needs among this caregiver population, thereby providing insights to enhance patients' quality of life and inform future research endeavors in this domain.

Participants and Methods

Research Participants

Research participants for this study were selected using the purposive sampling method. Caregivers of PKU patients who received specialized dietary treatment and medical staff at a designated phenylketonuria diagnosis and treatment center in Shanxi Province from January to March 2024 were included. The inclusion criteria for caregivers were as follows: (1) caregivers of patients diagnosed with classical PKU who had received specialized dietary treatment and were followed up for a minimum of six months at the specified diagnosis and treatment center in Shanxi Province.[8] (2) Participants with effective communication and comprehension skills. (3) Those who were duly informed and voluntarily consented to participate in the study. Exclusion criteria were: (1) caregivers receiving financial compensation. (2) participants with impaired communication abilities. For medical staff, the inclusion criteria comprised of (1) professionals engaged in PKU-related roles. (2) those with a minimum of five years of experience in relevant fields. Exclusion criteria involved trainees and interns affiliated with the hospital.

The sample size was determined by the criterion of reaching "saturation" in interview data, indicating the point at which no new topics emerged during data analysis. A total of 16 caregivers and 5 medical staff were interviewed for this study. The demographic details of the respondents are presented in Tables 1 and 2.

Research Methods

Investigators

The research team members are experienced in PKU clinical and scientific research, along with substantial theoretical and practical expertise. The interviewers have accumulated significant experience in conducting various types of qualitative research interviews and data analysis, enabling them to establish trust with the interviewees and obtain comprehensive and objective interview data.

Table 1 General Data About the Interviewed Caregivers (n=16)

No.	Data About the Primary Caregiver					Data About the Child	
	Age	**Occupation**	**Education**	**Place of Residence**	**Relationship with the Child**	**Age (Years)**	**Diagnostic Method**
C1	27	Public official	Bachelor	Town	Mother-son	3	Newborn screening
C2	34	Employee of enterprises	Junior college	Town	Mother-daughter	5	Newborn screening
C3	38	Technical personnel	Postgraduate student	Town	Mother-daughter	10	Newborn screening
C4	30	Unemployed	High school	Rural area	Mother-son	4	Newborn screening
C5	33	Farmer	Middle school	Rural area	Father-son	6	Newborn screening
C6	67	Retired	Junior college	Town	Mother-daughter	38	Clinical diagnosis
C7	37	Employee	Bachelor	Town	Father-daughter	10	Newborn screening
C8	35	Farmer	Technical secondary school	Rural area	Mother-son	11	Newborn screening
C9	36	Freelancer	Vocational school	Town	Mother-daughter	9/6	Newborn screening
C10	32	Employee	Junior college	Town	Mother-daughter	7	Newborn screening
C11	36	Public officials	Bachelor	Town	Mother-son	1	Newborn screening
C12	28	Freelancer	High school	Rural area	Mother-daughter	2	Newborn screening
C13	56	Retired	Technical secondary school	Town	Mother-daughter	28	Clinical diagnosis
C14	37	Employee	Bachelor	Town	Mother-son	8	Newborn screening
C15	29	Farmer	Middle school	Rural area	Mother-son	5	Clinical diagnosis
C16	25	Employee	Junior college	Town	Mother-son	0.5	Newborn screening

Table 2 General Data About the Interviewed Medical Staff (n=5)

No.	Sex	Age	Professional Titles	Years of Service	Department	Highest Academic Qualifications
D1	Female	59	Chief physician	35	Department of Childcare	Bachelor
D2	Female	55	Chief physician	30	Department of Newborn Screening	Bachelor
D3	Female	47	Associate chief physician	23	Department of Newborn Screening	Postgraduate
D4	Male	42	Attending	15	Laboratory Medicine	Bachelor
D5	Female	33	Resident	5	Department of Newborn Screening	Postgraduate

Data Collection Method

In this study, a rapid qualitative research approach was adopted, and data was collected using semi-structured interview methods.[9] Before the study, relevant literature was reviewed, and an interview outline was developed based on advice from PKU experts. Pre-interviews were conducted with two caregivers and one PKU physician, after which the formal interview outline was revised and finalized based on the results. The caregiver interview outline included the following questions:

1. Can you describe the treatment and management of your child since the diagnosis was confirmed?
2. What have been the effects of adhering to the treatment?
3. What challenges and needs have you encountered throughout the treatment process?
4. Does the current treatment and management guidance provided by medical staff meet your needs? What additional support and help do you require? Do you have any other advice regarding the current situation of your child?

The medical staff interview outline included the following questions:

1. What is your perspective on the current status of patient treatment and management? Have the needs of caregivers been met? How can this needs be better addressed?
2. What do you believe are the reasons for the unfulfilled needs of caregivers?
3. What suggestions do you have for ensuring patients and caregivers receive more scientific and effective treatment and management?

Before the interviews, the purpose, significance, and content of the research, as well as the confidentiality of the information, were explained to the interviewees. Consent was obtained, and informed consent forms were signed. A quiet and private room was selected as the interview location. During the interviews, interviewees were encouraged to express their true feelings and experiences. Also, subtle changes in non-verbal behaviors and emotions were observed and recorded. Each interview lasted approximately 30 minutes.

Data Collation and Analysis

This study employed a rapid qualitative analysis method.[10] An interview team was established, and interview data were transcribed into text within 24 hours after each session. Weekly analysis and discussion meetings were held in a trial classroom. NVivo 11.0 software was used to code, extract, and compile the data, allowing for the quick identification of potential categories of needs, which were ultimately refined into themes.

Ethics

This study was reviewed and approved by the Ethics Committee of Shanxi Provincial People's Hospital (Approval No.: (2024) SYKLSZ No. 17). The interviewees signed informed consent forms for participation, which included consent for the publication of anonymized responses and direct quotes. They were informed of the purpose of the study, with the assurance that they could withdraw from the study at any time and any stage. The personal information of the interviewees was kept strictly confidential.

Results

A total of four themes and twelve sub-themes were identified in this study. The themes include:

1. Self-limitation factors: insufficient activation level of caregivers, economic ability limitations, and stigma
2. Interpersonal limitation factors: social distancing, inadequately established social networks, lack of doctor-patient interaction
3. Structural limitation factors: inadequate allocation of relevant professional support systems, lack of special medical foods, national policies
4. Experience limitation factors: the sensory experience of special medical foods and lack of continuity of psycho-emotional care

The four major factors influencing unmet needs among caregivers of PKU patients are shown in Table 3.

Table 3 Key Factors Influencing Unmet Needs Among Caregivers of PKU Patients

Theme	Subtheme	Number of Unmet Needs/ Total	Representative Statements from Interviews
Self-limitation factors	Insufficient activation level of caregivers	3/16	C10: "My child needs three meals of formula and two of protein powder daily to meet protein requirements. It's exhausting for their kidneys to work nonstop day and night. I'm not sure they can handle it."
	Economic ability limitations	3/16	C8: "The special food costs over 20,000 yuan per year, and it's for life. It's a bottomless pit, and as farmers, we simply can't afford it!"
	Stigma	2/16	C13: "Now that my child is at the age for marriage, we feel very shamed about her condition. We are hesitant to introduce her to potential boyfriends for fear they might reject her or worry about passing the condition to the next generation."
Interpersonal limitation factors	Social distancing	2/16	C9: "Since the diagnosis of my two kids, I quit my job to focus on preparing meals. I've lost all social contact and feel disconnected from society."

(*Continued*)

Table 3 (Continued).

Theme	Subtheme	Number of Unmet Needs/ Total	Representative Statements from Interviews
	Inadequately established social networks	2/16	C5: "We live far from the provincial capital and have to go there to buy special food. I wish there was an option to purchase it locally online."
	Lack of doctor-patient interaction	3/16	C15:"Every hospital visit means long queues, and when I finally get to see the doctor, there's no time to ask questions because there are so many patients."
Structural limitations factors	Inadequate allocation of relevant professional support systems	3/16	C16: "My child is transitioning to solid food, and just as we figured out breastfeeding and formula, we have to start all over. A family doctor's guidance would be so helpful."
	Lack of special medical foods	3/16	C7: "The imported formula often gets delayed or runs out of stock due to various issues."
	National policy	4/16	D2: "Our hospital operates under a self-financed model, and if the budget is exceeded, we have to cover the cost of PKU patients' special food. I hope the government will offer more policy and financial support."
Experience limitation factors	Poor sensory experience of special medical foods	3/16	D5: "Many parents report their children refuse to eat the special food and formula because they find it unpalatable and the taste is unpleasant."
	Lack of continuity of psycho-emotional care	3/16	C1: "When my baby was diagnosed with PKU, it felt like my world collapsed. If not for my love for the child, I might have ended my life."

Theme 1: Self-Limitation Factors

Insufficient Activation Level of Caregivers

Caregiver activation refers to the level of knowledge, skills, and confidence demonstrated by caregivers in providing support.[11] In this study, caregivers lacked sufficient knowledge of PKU-related diseases, resulting in an inability and lack of confidence in raising patients. C10: "Three meals of milk powder and two meals of protein powder a day provide just enough protein for one day. The patient would have another three meals, and the stomach would remain full every day. The required protein intake is only met by bedtime at night, causing the kidneys to work continuously. I do not know if it is tolerable?" C12: "Our understanding of PKU is very limited, and I hope the hospital can conduct health education seminars, create informative videos, and provide dietary guidance." C14: "We parents are part of a chat group for children with PKU, where most of the knowledge and news about the disease are obtained from these non-governmental organizations. There is uncertainty about the accuracy and reliability of the information and acquisition channels."

Economic Ability Limitations

Patients diagnosed with PKU require lifelong dietary therapy, and the high cost of special medical foods imposes a significant financial burden on caregivers and their families.[12] C8: "The cost for children to consume special food exceeds RMB 20,000 annually, and this must be sustained for a lifetime, creating a financial black hole. Farmers cannot afford to eat!" C3: The imported milk powder that the children drink costs RMB 2,000 (7 barrels) per month. Including the protein powder and special rice noodles, the total expense exceeds RMB 3,000 monthly, which is an immense economic burden for the average wage-earning family.

C1: "Every year, health insurance reimburses our PKU family up to 10,000 yuan. However, the costs for genetic screening, prenatal checkups, and IVF for having a second child all come out of our own pockets, making it impossible for us to afford another child."

Stigma

Due to the rarity of the disease, caregivers of PKU patients often exhibit behaviors and psychological responses like shame and avoidance, deliberately concealing the disease. C14: There is an old saying in China: 'Family disgrace should not be aired.' Since our child was born with this genetic condition, we find it difficult to speak about it and prefer not to let others know. C13: "Now that my child is at the age for marriage, we feel very shamed about her condition. We are hesitant to introduce her to potential boyfriends for fear they might reject her or worry about passing the condition to the next generation."

Theme 2: Interpersonal Limitation Factors

Social Distancing

Patients with PKU are often reluctant to socialize due to dietary restrictions, leading to significant social withdrawal.[13] C3: "My child is now in elementary school. She cannot share even a small meal with others and can only eat at home. She does not play much with her classmates, fearing they will discover she eats special food and treat her differently." C9: "Since the birth of my two children with the disease, I have been working at home so I can cook full-time. I have no social interaction and feel isolated from society."

Inadequately Established Social Networks

Currently, the medical security system in China for rare diseases is not comprehensive, resulting in patients generally lacking relevant social support systems. Consequently, they often feel isolated and helpless when it comes to seek medical treatment and care. C9: "Both my daughters have PKU, and I wish the hospital could establish a platform for children who cannot consume regular food. Holding regular patient meetings would allow everyone to exchange and share parenting experiences." C5: "My home is located far from the provincial capital, where I must go to obtain special food. I hope that a local network for purchasing special food can be established."

Lack of Doctor-Patient Interaction

Due to limited medical resources in China and the high workload of clinical medical staff, there is insufficient time available to discuss disease conditions with patients.[14] C15: "Whenever I visit the hospital, I have to endure long waiting times, and although I want to ask the doctor more questions, the high volume of patients allows only for brief conversations." C3: "Since the doctor seems to have recently graduated, he lacks experience in treating PKU. In each visit, he just calculates the protein intake of the child based on textbook theory without providing explanations." C14: "Throughout the growth stages of the child, changes in special milk and food occur without doctor follow-up. Also, contact information for the doctor, like phone numbers or WeChat, are not provided."

Theme 3: Structural Limitations Factors

Inadequate Allocation of Relevant Professional Support Systems

The medical resource security system is a crucial support for PKU families, but China lacks adequate medical personnel and infrastructure for the treatment of rare diseases. C16: "My child is at the age where we try to introduce solids in his diet. I have just figured out the feeding ratio of breast milk to milk powder, and now I have to start over. I wish there were a family doctor to provide guidance." D3: "The screening for PKU in the province started relatively late, and most medical personnel lack experience in treating a rare disease such as PKU. Thus, the training and education of medical personnel in relevant knowledge should be strengthened." D1: "Management of PKU requires a multidisciplinary team. Optimal treatment can only be achieved with the cooperation of professional doctors, metabolism experts, psychologists, and nutritionists. I hope the state can provide us with more human, material, and financial support."

Lack of Special Medical Foods

Special medical foods are the main source of nutrition for patients suffering from PKU, but all caregivers report difficulties in purchasing these foods. C11: "Every time we buy the special food, the hospital prescribes only a month's supply. We need to spend a full day traveling to the provincial capital, and when we request to get more, the doctor refuses." C4: "There is only one type of domestic protein powder available, Weisiduo, which has an unpleasant smell. We cannot choose another option which might have a better taste." C7: "Imported milk powder needs to be shipped from abroad, and it is often out of stock for various reasons."

National Policy

Currently, the relevant system for PKU introduced in China is not perfect. C2: "There are injections for the treatment of PKU abroad (Kuvan), allowing patients to have a normal diet after treatment However, in our country, each injection costs more than RMB 8,000, which we cannot afford. I hope this injection can be covered by medical insurance." C4: "My eldest child is normal, but my second child was diagnosed with PKU at birth. I hope that the country can introduce policies for disease screening before birth so that we can know if it is possible to have such a child, and potentially avoid this tragedy." D2: "Currently, our hospital is self-financed, and we have to pay out of pocket to prescribe special food for patients with PKU if it exceeds the budget. I hope that the country will provide more policy preferences and financial support." C6: "At present, national policies and subsidies are inclined toward children diagnosed through screening. There is no support for those who have not been screened. My child was not screened and has been affected intellectually, and sometimes this makes him very short-tempered. I am over 70 years old, and my partner has passed away. I cannot take good care of this child. What will my child do when I die (frown)?"

Theme 4: Experience Limitation Factors

Poor Sensory Experience of Special Medical Foods

Some free amino acids in special medical foods cause a sour and unpleasant taste. C10: "The child said, 'My protein powder tastes so bad that I want to vomit when I drink it'. "C14": My child often tells me, Mom, your food looks, smells, and tastes good, but mine tastes bad, and the rice is so hard". D5: "Many parents report that their children experience varying degrees of dietary resistance, and are unwilling to eat special foods and drink special milk due to its bad taste and unpleasant smell".

Lack of Continuity of Psycho-Emotional Care

PKU is a disease that requires lifelong dietary treatment. Due to the heavy economic and caregiving burdens borne by the family, negative emotions like anxiety and depression are common. C1: "When the child was diagnosed with PKU at birth, it felt like our world had collapsed. I would have jumped off a building a long time ago if I was not reluctant to leave my child alone. C13: "I want to have a second child, but I am afraid of having another child with PKU. The doctor told me that I could try in vitro fertilization (IVF). I know that undergoing IVF will be very difficult, and it may not succeed in the end. I feel extremely agonized (forced smile)." C9: "My eldest child is a PKU patient, and when I was pregnant with my second child, I had the hopeful thought that I would not be so unlucky. However, the second child was also born with PKU. It feels so unfair."

Discussion

Enhance the Activation Levels of Caregivers and Enhance Their Social Cognitive Behaviors

The activation level of caregivers emphasizes the degree of initiative and readiness of the caregivers to manage the health and medical needs of the patient. Patients diagnosed with PKU require lifelong dietary management, and the impact of knowledge and skills on dietary cognition is particularly important. This study revealed that most caregivers severely lack the knowledge, skills, and confidence that is needed in caring for patients, which is consistent with the findings of Öztürk and Caprile et al[15,16] The reason for this may be the lack of medical knowledge in the public domain about PKU as a rare disease. Therefore, it becomes imperative for medical staff to pay more attention to PKU families and provide regular training for patients and caregivers on diseases and diet. This approach will help control protein intake, boost confidence in dietary therapy, enhance the competency of the caregivers, reduce the caregiving burden, and enhance the quality of life.

Due to economic limitations and dietary restrictions, the family of the patient is prone to psychological problems like inferiority, anxiety, and stigma as indicated by this study. These issues further lead to alienation from the group and social interaction, consistent with the results of Ford et al.[17] Hence, in the PKU treatment process, it is crucial to enhance the level of social care for these patients, establish a correct understanding of the patients and their families, and reduce discrimination and stigma against them. Also, organizing sharing and exchange meetings with other patients can promote the self-efficacy of these patients, fully mobilize their enthusiasm to overcome psychological barriers, create a supportive social atmosphere, and help patients actively integrate into society and grow up healthy and happy. Nurses can also adopt international practices by providing caregivers with self-learning resource kits[18] to enhance their knowledge and practical skills. The program consists of two sessions, each lasting 30–40 minutes. The first phase focuses on teaching foundational knowledge, including the definition, causes, signs and symptoms of PKU, as well as prevention of potential complications and various treatment methods. The second phase emphasizes practical skills, covering growth monitoring (such as weight, height, and BMI), dental care, and physical activity. Each session incorporates group discussions and guidance from healthcare professionals to facilitate learning. The third phase involves assessing the knowledge and behaviors of PKU caregivers. By providing self-learning resources, the program aims to improve caregiver engagement and cognitive behaviors.

Enhance the Social Support System and Facilitate Effective Doctor-Patient Communication

The findings of this study reveal that there is a shortage of professionals involved in treating this disease, and this is compounded further by their lack of professional expertise. This scarcity is attributed to the rarity of PKU, limited social resources, and insufficient social attention. Also, the absence of relevant professional knowledge, learning opportunities, and training impedes medical staff from effectively convincing caregivers of treatment plans. For patients receiving treatment at home, there is a noticeable absence of extended follow-up services for families, leading to a deficiency in long-term dietary management tracking and needs assessment, aligning with the report by Mardani.[19]

To address these challenges, it is recommended that China develops its social service support system and content, drawing from both domestic clinical expertise and international best practices. This effort should aim to gradually transition patients from children's hospitals to community-based care as they age, establishing a three-tier support system linking hospitals, communities, and families. Management of these patients should involve collaboration among their families, dietitians, and metabolic specialists. Thus, it is imperative to cultivate treatment experts equipped with relevant professional knowledge and optimize the allocation of medical human resources accordingly.[20] Regular follow-up should be conducted under the guidance and supervision of specialists.

In traditional Chinese culture, caregivers who are concerned about the disease often conceal information from physicians, with parents assuming the role of spokespersons for patients. Consequently, patients become overly reliant on caregivers, reducing opportunities for direct communication with doctors and limiting their understanding of the disease, which can lead to compliance with dietary therapy. Therefore, it is essential to encourage active communication and information sharing between healthcare providers and patients. Various methods should be employed to strengthen the education and dissemination of relevant knowledge, such as the Teach-Back health education model.[14] Through explanations, effect assessments, and feedback, caregivers can reiterate the information they have grasped, thereby enhancing their understanding of the disease. This approach can improve the cooperation of both caregivers and patients, ensuring that their needs are met in a timely and effective manner.

Enhance the Medical Security System and Bolster Policy Support

In this study, caregivers highlighted that only a fraction of the expenses incurred in purchasing special food each year are eligible for reimbursement. Furthermore, genetic screening, prenatal examinations, IVF costs, and treatment-related drug expenses for PKU families seeking to have another child are not covered by medical insurance, resulting in a substantial economic burden. Also, acquiring special food and milk poses significant challenges, with demand often outstripping supply. Many families express a preference for imported special milk, but its availability is uncertain and it is often "out of stock." Thus, limitations on the purchase of domestic special food due to hospital losses under existing medical insurance policies further compound these issues.

Consequently, we urge the government to prioritize support for patient groups with rare diseases. We also recommend incorporating special medical foods and drugs into medical insurance coverage, reforming existing reimbursement policies to increase reimbursement rates, and broadening the scope of eligible expenses. This would enable PKU families, particularly those in rural areas, to fully benefit from the support and protection offered by medical insurance.[21] The National Health Commission of China recently issued the "Birth Defect Prevention and Treatment Capacity Improvement Plan (2023–2027)", which calls for strengthening public awareness and health education on birth defect prevention. It also guides local regions in implementing premarital health checks for reproductive-age individuals, standardizing prenatal checkups, expanding newborn screening programs, enhancing the development of clinical and specialized personnel, and establishing a national network for rare disease diagnosis and treatment. The plan emphasizes the importance of multidisciplinary genetic counseling to protect the health rights of patients with rare diseases.[22]

Enhance the Sensory Experience of Special Medical Foods and Address the Need for Psychological Support

Amino acid metabolism disorder formula powder for special medical purposes can provide essential nutrients that are otherwise lacking in regular food due to dietary restrictions. However, some free amino acids impart a sour taste and unpleasant flavor.[23] Most caregivers reported that patients exhibit resistance to medical food in dietary therapy, leading to decreased dietary compliance as reported in this study. Currently, only one type of formula powder approved for registration in China is suitable for patients with PKU aged 1–10 years (British Periflex), and no domestic special medical formula powder has been approved.[24] It is recommended to intensify efforts in the research and development of special medical foods. The goal of future initiatives should be to achieve comprehensive coverage of product categories, expand the supply chain, enhance palatability, and improve the sensory experience for patients with PKU, thereby promoting better therapeutic effects. The study also indicated that PKU families have varying degrees and types of psychological needs.[25] The study[26] found that family empowerment programs can improve the life expectancy and quality of life of patients with common genetic disorders such as thalassemia, hemophilia, or PKU. Therefore, it is recommended to develop family-centered empowerment training programs, establish empowered intervention teams, and implement empowerment intervention projects to enhance the knowledge and coping abilities of PKU families, reduce caregiver burden and psychological stress, and maintain their mental health status.

Advantages and Limitations

Due to the significant difficulty and prolonged duration of PKU treatment, caregivers often have various health requirements. Currently, research on PKU in China is in its early stages, and there is a lack of qualitative studies on the unfulfilled needs of PKU caregivers. This study sampled caregivers of patients of different ages, disease courses, and education levels. Through in-depth interviews, the goal of this study was to understand their unfulfilled needs at various levels and assess the unique thoughts, feelings, and life experiences of caregivers. This approach provides a reference for formulating more personalized treatment and management plans. However, the interviewees in this study were all from the same diagnosis and treatment center, which posed geographical and cultural limitations. Future research should build on this study by conducting multi-center, large-sample quantitative studies.

Conclusion

This study identified numerous obstacles impacting the unfulfilled needs of the caregivers of patients with PKU. Medical staff should actively communicate with families having PKU-afflicted patients to understand their needs in a timely and comprehensive manner, paying attention to their psychological experiences and feelings. This approach ensures that each such family fully recognizes the key role and significance of lifelong dietary therapy. Also, efforts should be made to help caregivers actively understand the disease, participate in disease management, and enhance their self-efficacy and treatment compliance with the patient. Ultimately, the objective of these measures was to enhance the quality of life for both caregivers and patients.

Abbreviations

PKU, phenylketonuria; AH, phenyl alanine hydroxylase; Phe, phenylalanine.

Data Sharing Statement

All data related to the results are presented in the manuscript. Due to the sensitivity of the data, interview transcripts cannot be made public.

Ethical Approval Statement

This study was reviewed and approved by the Ethics Committee of Shanxi Provincial People's Hospital (Approval No.: (2024) SYKLSZ No. 17). This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

Consent for Publication

All participants involved in the study signed an informed consent form for the publication of their anonymized responses and direct quotes.

Acknowledgment

Thank you to all the family caregivers who participated in the study and shared their time and experiences.

Funding

No funding was received in this article.

Disclosure

All authors declare that they have no conflict of interest.

References

1. van Spronsen FJ, van Wegberg AM, Ahring K, et al. Key European guidelines for the diagnosis and management of patients with phenylketonuria. *Lancet Diabetes Endocrinol*. 2017;5(9):743–756. doi:10.1016/S2213-8587(16)30320-5
2. Bulletin of the Ministry of Health of the People's Republic of China. Notice from the Ministry of Health on Issuing the Technical Specifications for Newborn Disease Screening (2010 Edition), 2011, (01): 12–22.
3. Mu WJ, Hao LT, Yang JP, Zhu L. Analysis of factors influencing the intelligence of 277 children with phenylketonuria in Shanxi province. *Chin Matern Child Hlth Res*. 2023;34(03):63–68.
4. Irannejad F, Dehghan M, Mehdipour Rabori R. Stress and quality of life in parents of children with phenylketonuria. *J Child Adolesc Psychiatr Nurs*. 2018;31(2–3):48–52. doi:10.1111/jcap.12207
5. He XH, Chen YY, Ji JF. Analysis of the Correlation Between Unmet Needs of Primary Caregivers of Elderly Breast Cancer Patients and Negative Emotions. *Mod Med Health*. 2023;39(05):771–775.
6. Zhou WQ. Research on the Influencing Factors of Outdoor Sports Tourism of Students in Shanghai Colleges and Universities. *Shanghai Sport Ins*. 2021;2021:1. doi:10.27315/d.cnki.gstyx.2021.000059
7. Tang ZJ, Sun GZ, Gao M, et al. Wang Q.A qualitative study of the reasons for refusal of exercise rehabilitation in patients after radiofrequency ablation of atrial fibrillation in the context of digital healthcare. *Chin Gen Med*. 2024;27(18):2218–2224.
8. Wang XH. Current status of neonatal phenylketonuria screening and diagnostic methods and treatment. *Chin J Pract Pediatr*. 2023;38(07):520–524.
9. Thomas SP. Resolving tensions in phenomenological research interviewing. *J Adv Nurs*. 2021;77(1):484–491. doi:10.1111/jan.14597
10. St George SM, Harkness AR, Rodriguez-Diaz CE, Weinstein ER, Pavia V, Hamilton AB. Applying Rapid Qualitative Analysis for Health Equity: lessons Learned Using "EARS" With Latino Communities. *Int J Qual Methods*. 2023;22:16094069231164938. doi:10.1177/16094069231164938
11. Bakker EM, Witkamp FE, Luu KLN, et al. Caregiver activation of relatives of patients with advanced cancer. *Eur J Cancer Care*. 2022;31(6): e13656. doi:10.1111/ecc.13656
12. MacDonald A, Smith TA, de Silva S, Alam V, van Loon JM. The personal burden for caregivers of children with phenylketonuria: a cross-sectional study investigating time burden and costs in the UK. *Mol Genet Metab Rep*. 2016;9:1–5. doi:10.1016/j.ymgmr.2016.08.008
13. Mcmullan J, Lohfeld L, McKnight AJ. Needs of informal caregivers of people with a rare disease: a rapid review of the literature. *BMJ Open*. 2022;12(12):e063263. doi:10.1136/bmjopen-2022-063263
14. Liu YQ, Guo YL, Xu J, et al. Shared Decision-Making in Hemophilic Arthropathy Rehabilitation: a Qualitative Study. *Patient Prefer Adherence*. 2023;17:249–257. doi:10.2147/PPA.S394095
15. Öztürk FÜ, Bülbül SF, Alpcan A. Assessment of parents´ knowledge regarding phenylketonuria and its affecting factors: a cross-sectional study. *Pan Afr Med J*. 2022;41:308. doi:10.11604/pamj.2022.41.308.25936

16. Caprile C, Campistol J, Puigcerver L, et al. Subtle visuomotor deficits and reduced benefit from practice in early treated phenylketonuria. *J Clin Exp Neuropsychol*. 2017;39(10):931–940. doi:10.1080/13803395.2017.1281381
17. Ford S, O'Driscoll M, MacDonald A. Living with Phenylketonuria: lessons from the PKU community. *Mol Genet Metab Rep*. 2018;17:57–63. doi:10.1016/j.ymgmr.2018.10.002
18. Khalil A, Amin E, Alrafay SSE, Khalifa OA. The effects of a self-learning package on mothers' knowledge and practices towards caring for their children with phenylketonuria. *J Med Life*. 2023;16(2):215–219. doi:10.25122/jml-2022-0258
19. Mardani-Hamooleh M, Heidari H. Life story of Iranian parents of a child with phenylketonuria: a qualitative study. *J Community Genet*. 2023;14(4):419–427. doi:10.1007/s12687-023-00653-z
20. Liu XH, Chen HF, Han WX, Jiao ZZ, Yu J, Liu HX. Caregiving experiences with dietary therapy for patients with methylmalonic acidemia. *Chin Murs Manag*. 2023;23(04):608–612.
21. Wang L, Zou H, Ye F, et al. Household financial burden of phenylketonuria and its impact on treatment in China: a cross-sectional study. *J Inherit Metab Dis*. 2017;40(3):369–376. doi:10.1007/s10545-016-9995-0
22. Bulletin of the National Health Commission of the People's Republic of China. Notice on the Issuance of the Birth Defect Prevention and Control Capacity Improvement Plan (2023–2027) Office of the National Health Commission of the People's Republic of China. 2023, 08: 4–8.
23. Forestell CA. Flavor Perception and Preference Development in Human Infants. *Ann Nutr Metab*. 2017;70(3):17–25. doi:10.1159/000478759
24. Wang YC. Analysis of the current status of dietary supplementation in children with phenylketonuria. *Chin Diary Ind*. 2022;10:104–110.
25. Thiele AG, Spieß N, Ascherl R, et al. Psychological well-being of early and continuously treated phenylketonuria patients. *JIMD Rep*. 2021;59(1):69–80. doi:10.1002/jmd2.12202
26. Rahgoi A, Sojoodi T, Fallahi Khoshknab M, Rahgozar M, Shahshahani S. Effects of Empowerment Program on the Burden of Care in Mothers of Children with Phenylketonuria. *Iran J Child Neurol*. 2019;13(2):53–60.