

Insights for Change:



Findings from the XLH Community Impact Survey

Table of Contents

3	Introduction
4	Understanding XLH <ul style="list-style-type: none">Symptoms of XLH
5	About the Survey <ul style="list-style-type: none">Respondent Overview
8	Physical, Mental, and Social Impacts <ul style="list-style-type: none">Physical BurdensDental IssuesMental Health and Personal Relationships
11	Access to Expert, Quality Medical Care <ul style="list-style-type: none">Getting a DiagnosisXLH Care ExperienceDental CareTransitioning to Adult Care
17	Financial Burden
19	Key Takeaways



The **XLH Network** and **Kyowa Kirin** wish to extend our sincere appreciation to XLHers—the name people with this condition choose to call themselves—and caregivers of child XLHers who took part in the survey.

Thank you for your time and for helping us learn more about the true impact of XLH.

Introduction

X-linked hypophosphatemia (XLH) is a progressive, lifelong, often debilitating genetic condition.^{1,2}

The majority of prior research into the patient experience of XLH focused on the physical symptoms. More efforts are needed to understand how the disease impacts the lives of XLHers and their families more broadly.

The XLH Community Impact Survey fills this gap by exploring the rollercoaster that is a year in the life of XLHers. An XLHer may reach peaks by connecting with a supportive community or finding a physician who is knowledgeable about XLH. At other times, they may experience valleys when navigating mental health challenges or long drives to receive care.

The results of this survey suggest that XLH touches many aspects of life. It is difficult enough to manage access to necessary care, including appointments with specialists, pain management, and advanced dental care. Add the effects of XLH on life, work, personal relationships, and finances, and the negative impacts of the disease can be substantial.

Challenges aside, the results of the survey show real progress being made for XLHers. By looking at the experiences of children included in this survey compared to adults, who were likely diagnosed as children, we're able to see the different eras of XLH care. For example, the age at diagnosis for children in this survey was around 5 years earlier than for adults, suggesting that adults were diagnosed in an era when much less was known about XLH. In addition, medical trauma was reported as less burdensome among children compared with the adults, potentially reflecting more awareness and better overall care.

We're hopeful that the momentum for change continues to improve the experiences for XLHers. We encourage you to share this report with anyone who can benefit from knowing more about the challenges XLHers experience. These include family, friends, care providers, teachers, employers, policymakers, and more.

Sincerely,



Susan Faitos, MA, LMFT
Executive Director
The XLH Network



Liz Parlett Butcher, MPA
Associate Director, Public Affairs
Kyowa Kirin

Understanding XLH

X-linked hypophosphatemia, or XLH, is caused by a genetic variant that is often hereditary, meaning it is passed from parent to child.^{1,3} In some cases, however, the change in the gene can occur spontaneously.³

This genetic variant leads to the body producing too much fibroblast growth factor 23 (FGF23), a protein involved in maintaining an appropriate amount of phosphorus in the blood.⁴ Too much FGF23 causes hypophosphatemia, a condition in which the blood doesn't have enough phosphorus, and results in weakened bones and teeth and decreased muscle function.^{2,3}

Since there are 206 bones in the human body in addition to the teeth, it makes sense that bone and dental health would be such an important issue for XLHers.⁵

Symptoms of XLH

XLH is often discussed as a bone disease. Its first symptoms in children are a delay in starting to walk, short stature for age, bowed legs or knock knees, and rickets.^{1,3} The disease typically progresses with varied and often painful symptoms including⁶:

- Muscle and bone pain
- Low energy levels
- Tooth loss
- Dental abscesses (pockets of pus in the tooth caused by cavities and infection⁷)

XLHers and their families are often told they will grow out of the disease, but adults can continue to experience these symptoms in addition to others:

- Hearing loss³
- Osteoarthritis⁸ (the loss of cushioning cartilage between bones⁹)
- Bone fractures or pseudofractures (a type of stress fracture)⁸

About the Survey

The XLH Community Impact Survey sought to quantify and deepen understanding of the lived experiences of adult and child XLHers in the United States. The survey focused on filling the knowledge gap in three areas:



Physical, mental,
and social impacts



Access to expert,
quality care



Costs of living
with XLH

XLH Community Impact Survey Team

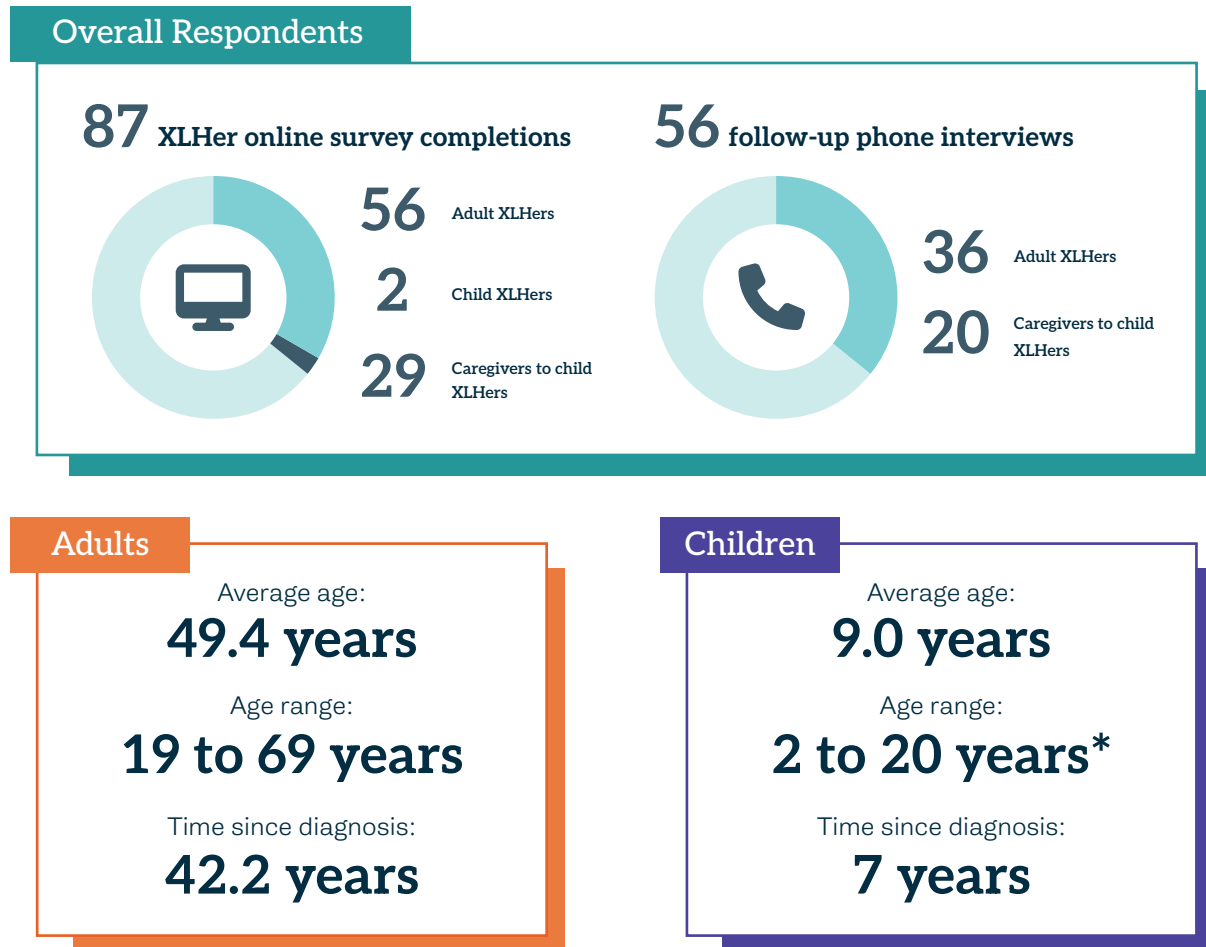
The survey was conducted as a collaboration between The XLH Network and Kyowa Kirin, Inc. A multi-disciplinary advisory board guided survey development and interpretation of the results and included members of Kyowa Kirin, Inc. and The XLH Network, a member of the XLH community: Bryan Stearns, and two physician experts in XLH: Dr. Thomas Carpenter and Dr. Jill Simmons.

Engage Health designed, fielded, and conducted analysis of the survey with analytic and editorial support from SmithSolve and input from The XLH Network and Kyowa Kirin, Inc. The survey was fielded between November 2023 and February 2024.

Respondent Overview

Respondents varied by age, income, geography, insurance status, and length of time living with XLH.

► **Figure 1: Overview of Survey Respondents**



* Children as defined in this survey consist of individuals whose caregivers responded on their behalf, in addition to two young adults aged 15 to 17 who responded for themselves. Adults are individuals who responded to the survey themselves. As a result, two respondents defined as children included in the survey are over 18 years of age.



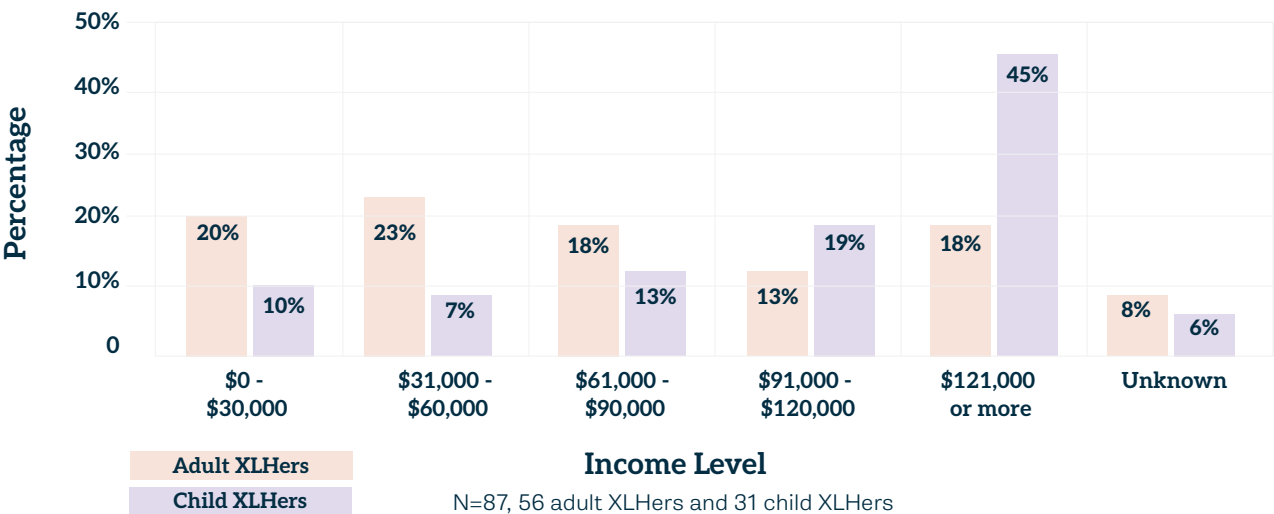
When considering the survey results, it's important to acknowledge the make-up of survey respondents.

- **Gender:** among adult respondents, 82% were females. The male XLH experience may be under-represented.
- **Age:** out of 56 adult respondents, nearly two-thirds were age 45 or over. The experiences of younger adults aged 18-44 may be under-represented.
- **Location:** all respondents lived in the U.S., most in an urban setting. The experiences of rural individuals may be under-represented.

The **majority of adult XLHer** respondent **households earned less than \$90,000 per year**. The **majority of child XLHers** in the survey **were in families earning \$91,000 or more**.

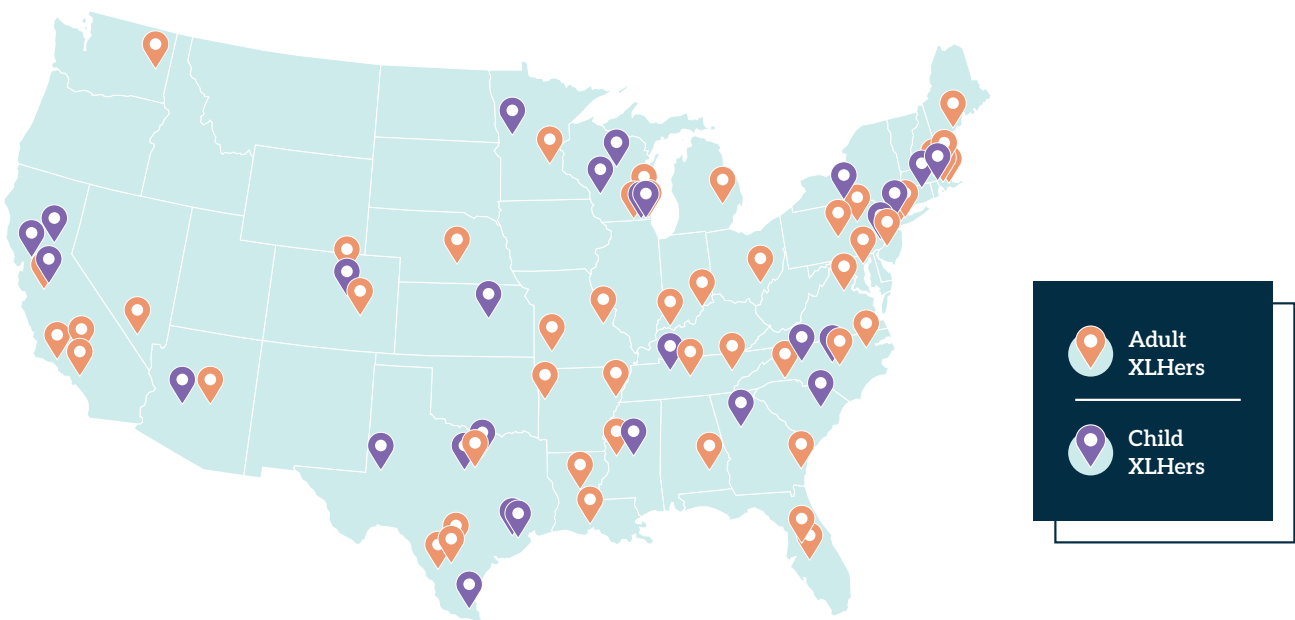
Adult and child XLHers also differed regarding insurance coverage. While nearly all respondents had some form of insurance coverage, more child XLHers had private insurance compared with adults (74% vs 57%, respectively).

► **Figure 2: Annual Household Income of Respondents**



Survey respondents lived across the U.S.—69 were living in an urban or suburban community, and 14 in a rural community.

► **Figure 3: Geographic Distribution of Survey Respondents**



Physical, Mental, and Social Impacts

“

For as long as I can remember I have dealt with pain. It stands out more when I don't have pain rather than when I do... it always concerns me, I am wondering what the pain is from, what it is, and when to go to the doctor. It can be debilitating.

- Adult XLHer

XLH can place substantial physical burdens on those living with it. These burdens may have an impact on mental health, relationships, and social activities.

Physical Burdens

“

“As a kid... it was about looking different, not hearing as well, and awkward peer stuff... but as I'm getting older, it's more challenging. The hearing is the biggest social impact... I can't join groups or meetups because it's hard to hear.

- Adult XLHer

Both adult and child XLHers noted that pain was the most burdensome physical symptom of XLH. Both groups also noted fatigue, dental health, mental health, and sleep as burdensome. However, some key differences exist.

Child XLHers ranked physical appearance as the second most burdensome symptom, whereas adults mentioned lack of flexibility and stiffness. Lastly, while hearing issues were more of a burden for adults, limited mobility was rated as a high-impact burden for children.

► Figure 4: Top 7 Most Burdensome Symptoms for Adult and Child XLHers, Ranked

Rank	Adult XLHers	Children XLHers
1	Pain	Pain
2	Lack of flexibility/stiffness	Physical appearance
3	Fatigue / Lack of energy	Fatigue / Lack of energy
4	Mental health	Dental health
5	Dental health	Mental health
6	Hearing issues	Limited mobility
7	Sleep	Sleep

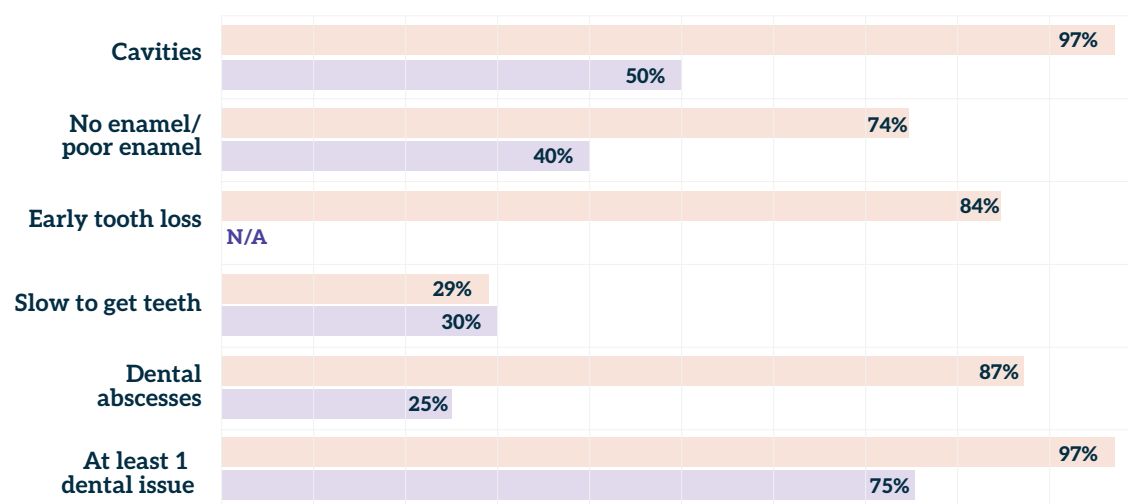
n=56, 36 adult XLHers, 20 child XLHers

Dental Issues

Phosphorus is needed for strong and healthy teeth.⁷ Since phosphorus levels are lower in people with XLH, teeth and dental issues often arise.¹

As with general physical burdens, dental issues were reported by both adult and child XLHers. Individually, these issues became more prevalent among respondents as they aged.

► Figure 5: Dental Issues Experienced by Respondents*



Adult XLHers

Child XLHers

n=56, 36 adult XLHers, 20 child XLHers

* The average age of adult XLHers was 49.4 years and ranged from age 19 to 69. The average age of child XLHers was 9 years and ranged from age 2 to 20.

Mental Health and Personal Relationships

“

There are days I wish I was normal and could get up and do what I want without XLH. It is depressing when you step out of bed and have pain. Like last Thursday, I couldn't walk or bear weight and had to call off work and I had plans that got completely shredded. I was very upset all day that day.

– Adult XLHer

Mental health concerns were common across both adult and child XLHers. Of all respondents, **83% of adults** and **90% of children** reported **at least 1 mental health issue**. Even though mental health concerns were common for all, just 13% of adults and 3% of children were reported to be seeing a mental health professional.

The most common mental health issues across both age groups were **anxiety** (84% for adults, 50% for children) and **fear** (~60% for both). The most frequently mentioned sources of anxiety and fear for all XLHers included healthcare procedures, social anxiety, and disease progression.

While adult XLHers noted high rates of **depression** (71%) and **social isolation** (61%), 15% to 20% of child XLHers experienced these mental health impacts.

The survey revealed that respondents who ranked pain and/or sleep issues as high-impact burdens (6 or greater on a scale of 1 to 10) noted that XLH also had a greater impact on other aspects of their lives. Compared to the group of XLHers who rated pain and sleep issues lower, those who rated pain and sleep issues higher also reported being more likely to rely on disability services and having more challenges with:

- Mental health
- Work and/or school (absenteeism, productivity, advancement)
- Medical trauma
- Personal relationships

Access to Expert, Quality Medical Care

XLHers face unique challenges across their care journey, from getting a diagnosis to receiving care, and during the transition from pediatric to adult care.

Getting a Diagnosis

Getting to a diagnosis of XLH can take time and effort, which may include seeing several doctors of different medical specialties.

Respondents saw

2.3 doctors

on average
before receiving an
accurate diagnosis

Adult XLHers were

**5.1 years older
when diagnosed**

on average with XLH than children
(mean age at diagnosis: 7.2 vs. 2.1
respectively)

XLHers traveled an average of

274 miles roundtrip

to the doctor who made the diagnosis

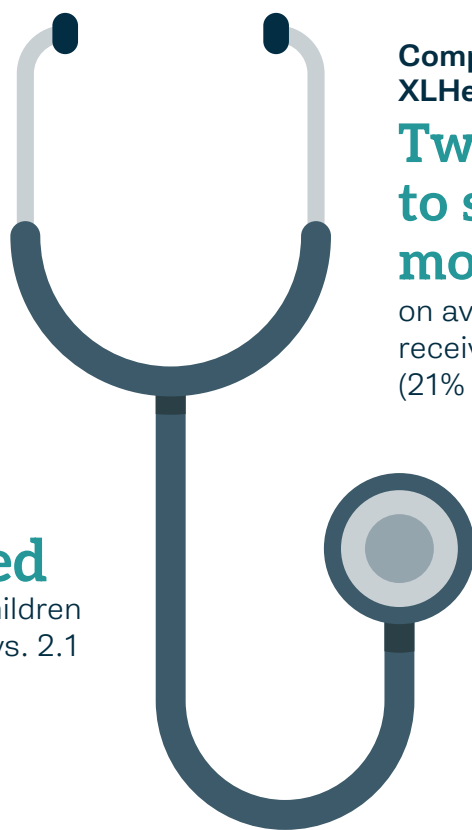
Compared with child
XLHers, adults were

**Twice as likely
to see 5 or
more doctors**

on average before
receiving a diagnosis
(21% of adults vs. 10% for children)

Endocrinologists

were the most common
specialists to make the diagnosis
(36% for adults, 45% for children)



Age at diagnosis is younger for child XLHers than it was several decades ago for respondents who are now adults. Yet barriers to timely diagnosis still remain. The two challenges cited were the impression held by the doctor that the child would grow out of the symptoms and a delay in genetic testing to confirm a diagnosis.

Endocrinologists were the most common specialist to make the XLH diagnosis. Other diagnosing providers included orthopedists and orthopedic surgeons, geneticists, primary care providers, pediatricians, and nephrologists.

Adult XLHers know that medical knowledge at the time of their diagnosis was not as robust as it is now. This encouraging trend suggests that, for many healthcare providers, knowledge of XLH has improved over the years.

Then

“

At the time, they didn't know how to diagnose or treat XLH. I had my first surgery in 1974, but beyond that the doctors didn't know much about how to treat it properly.

- Adult XLHer

Now

“

At 3 she was still 'waddling' and we took her to our pediatrician. We were then referred to a physical therapist, then an orthopedic surgeon who thought... it was some form of rickets. They referred us to endocrinology and confirmed XLH through genetic testing.

- Caregiver of Child XLHer

XLH Care Experience

“

My entire life I was bounced from one doctor to another who didn't know what they were talking about. Even with specialists, they say 'adults don't need [treatment],' which is frustrating.

- Adult XLHer

“

Having to find the care on my own is challenging and you have to come armed with information for whoever you do see.

- Caregiver of Child XLHer



When it comes to ongoing care for XLH, **endocrinologists** were the most commonly mentioned specialist.

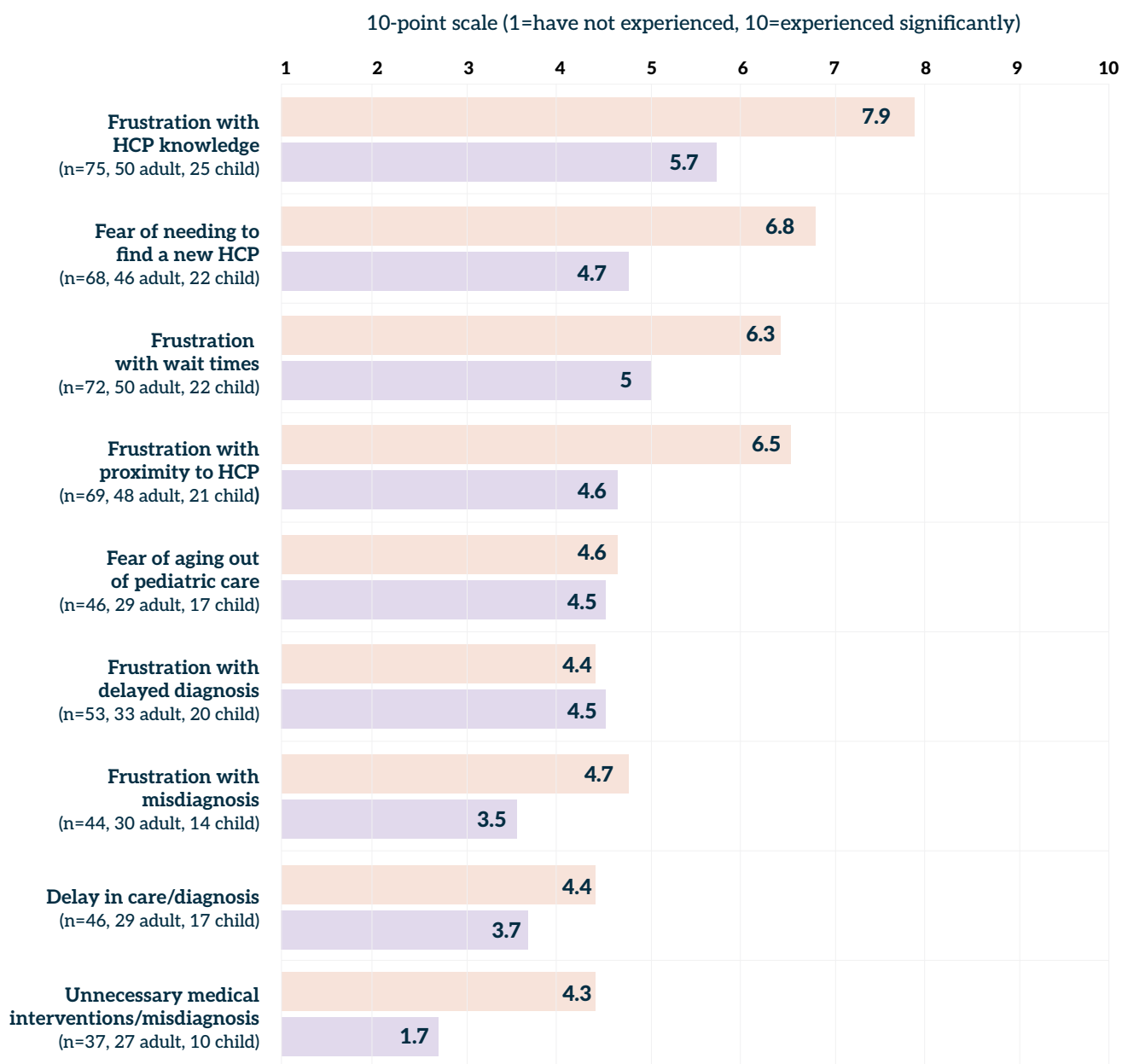
93% for adults **84%** for children

Other providers involved in caring for XLHers included:

- Audiologists (hearing)
- Dentists
- Geneticists
- Nephrologists (kidney)
- Neurologists (brain)
- Occupational therapists
- Ophthalmologists (eye)
- Orthopedists
- Pain specialists
- Pediatricians
- Physical therapists
- Podiatrists (foot)
- Primary care
- Psychologists / psychiatrists
- Rheumatologists
- Surgeons

Most respondents rated their main XLH healthcare provider (HCP) as fairly knowledgeable. On a 10-point scale, with 10 being excellent, average ratings were 7.9 for adults and 8.7 for children. Respondents cited HCP involvement in XLH research and caring for other XLHers as reasons why these HCPs provide good care.

► **Figure 6: Top Care Challenges by Age Group, among those that Reported Challenges***



Adult XLHers

Child XLHers

Challenges were rated on a scale of 1 to 10, but in determining these results, rankings of “1” were eliminated because respondents were told to choose 1 if they hadn’t experienced the issue.

* The average age of adult XLHers was 49.4 years and ranged from age 19 to 69. The average age of child XLHers was 9 years and ranged from age 2 to 20.

Other barriers to quality care had more to do with the logistics of accessing care. Specifically, XLHers cited frustration with extensive delays for scheduling medical appointments, long travel distances to doctors' offices, and hours of waiting while at the offices.

“

Having to wait 6 months from a nephrologist to endocrinologist for XLH related stuff, that was the longest.

- Adult XLHer

“

Getting there and having to wait... a couple hours for the doctor's appointments and the blood work, if they want to do x-rays or ultrasounds it takes a lot longer, every time we go... we are there all day.

- Caregiver of Child XLHer



XLHers travel, on average

180 miles roundtrip, taking over 3 hours

just to get to their XLH doctor's office. XLHers spent on average \$1,000 and as much as \$15,000 on annual travel costs



Adults and caregivers cited

long wait times at doctors' offices

(ratings of 6.3 and 5.0 respectively, on a scale of 1-10 with 1=not having experienced and 10=experienced significantly)

XLHers travel long distances to find care. Challenges encountered by respondents included frustration with low knowledge of XLH among HCPs, fear of needing to find a new HCP, and fear of aging out of pediatric care. These findings underscore the need for access to more local, knowledgeable providers. And because XLH can affect a person in so many ways, there are many specialties that can be involved in providing care.

These care challenges illustrate key differences between adults and children in several aspects of the XLH experience. For example, adults reported experiencing greater challenges in the following areas: experiencing unnecessary medical interventions related to misdiagnosis, frustration with finding knowledgeable HCPs, and fear of moving to a new HCP when necessary. This likely reflects doctors' increased understanding of XLH over the years, as shown by the different eras of XLH care.



Adults rated the degree to which they experience unnecessary medical interventions

2.5 times

higher than children.

Dental Care

“

Dentists often are listening but aren't really hearing you. **You become a 'professional patient' and learn how to educate them.**

- Adult XLHer

“

The dentist didn't know about XLH when we first went, but... **she is more understanding of what is going on with my child's teeth**, the decay issues and soft teeth and she relates it back to XLH.

- Caregiver of Child XLHer

More than three-quarters of respondents said they had a regular dentist (79% of adults and 84% of children). Still, the overall perception of dental care was average. On a scale of 1 to 10 with 1 being the lowest, ratings for dental provider XLH knowledge were 4.6 for adult and 5.2 for child XLHers. However, 75% of respondents who had a dentist noted that their provider was open to learning more about XLH.



For more information about the impact of XLH on dental care, check out our fact sheet, **Dental Impact of XLH: Far-Reaching and Costly**

Transitioning to Adult Care

“

There have been a lot of conversations over the past 5-10 years bringing up these important transitions of care issues, but still not everyone gets the care and support they need.

- Dr. Thomas Carpenter, Director of the Yale Center for XLH

Transitions of care for XLHers were rare among adults. Just **6% of respondents said they formally transitioned** from pediatric to adult care. Of the 49 adults diagnosed before age 18, the most common response as to why adult care was not sought was the perception that the disease would go away over time (14 mentioned). Other reasons included:

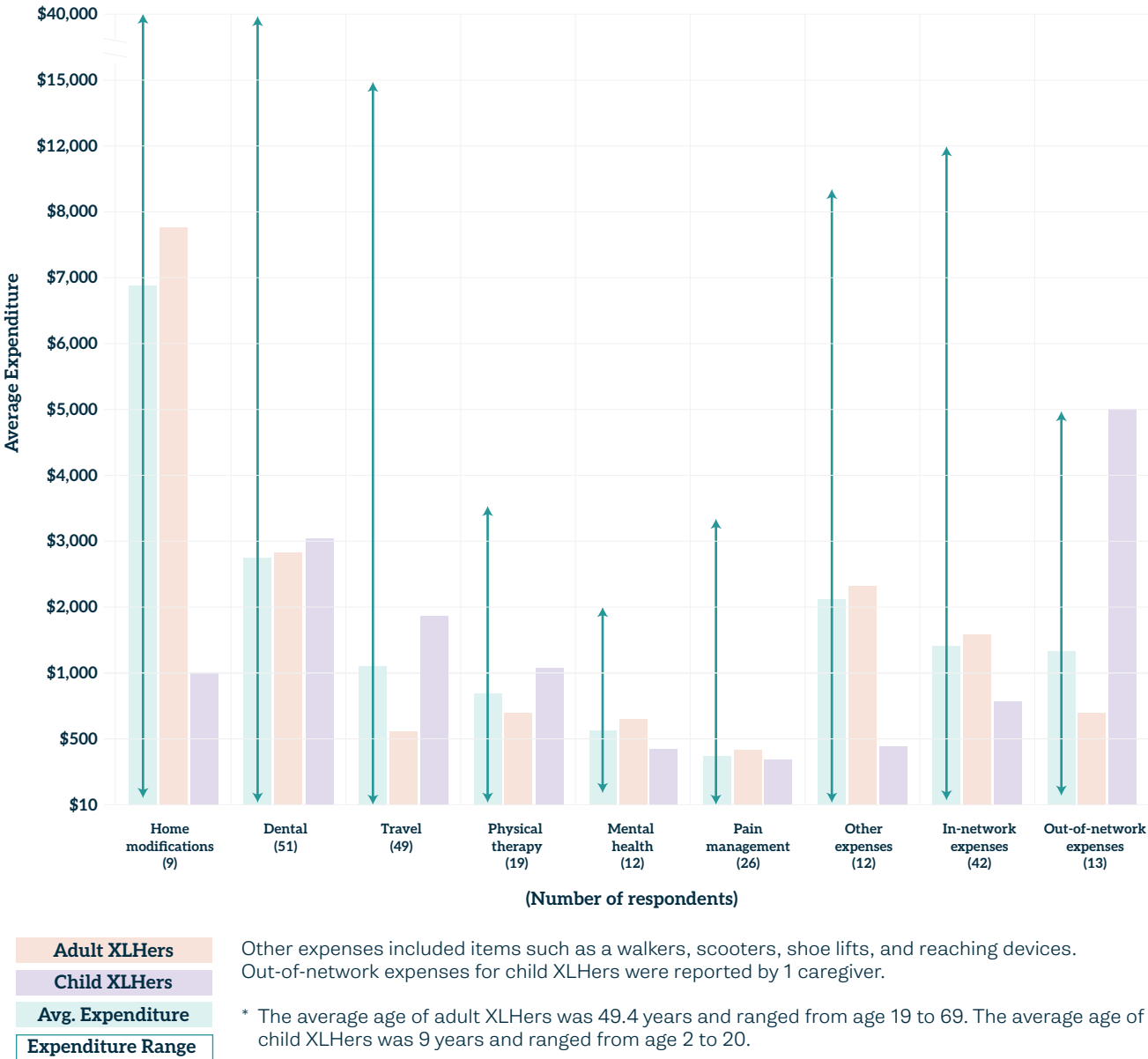
- Difficulty in finding an adult doctor
- Insurance coverage difficulties
- Lack of information

One respondent mentioned they continued care under their primary care physician, while two said the transition occurred rapidly.

Financial Burden

The survey found that **XLHers spent, on average, \$1,633 in the last year on out-of-pocket for costs related to managing or living with XLH**, ranging from \$10 to \$40,000. The percentage of annual household income used for out-of-pocket costs ranged from 0–40% for respondents with private insurance, with an average of 6%. Respondents with Medicare or Medicaid paid no more than 25% in household income for XLH care, while the average for this group was 8%.

► **Figure 7: Average XLH-related Out-of-Pocket Expenditures by Category Over 12 Months***



Since XLH has wide-ranging health implications, **XLHers visit a lot of doctors. These appointments may require traveling long distances.** In addition, many XLHers require additional services and supports for XLH-related needs. All these things make XLH a costly condition.

Respondents also mentioned **needing to take time off from work or school for care.** Some XLHers reported using vacation days for these appointments instead of family trips or leisure activities. Others also mentioned sacrificing wages.

“

A lot of my money goes to taking care of my health. Every year the out-of-pocket costs of managing the XLH really add up, including co-pays.

– Adult XLHer

As shown in Figure 7, among the out-of-pocket expenses that respondents incurred in the last year, **home modifications were the costliest.** These included installing ramps, lower toilets, and bathtub modifications. However, Figure 7 also shows that these expenses were mentioned less often than other types of costs.

Dental care costs including extractions and crowns were the most commonly mentioned out-of-pocket expense, as detailed in Figure 7. They were also among the highest costs for both child and adult XLHers. For in-network expenses including copays, office visits, and lab work, adults paid nearly twice as much on average than children.

Travel costs for fuel, parking, tolls, airfare, and lodging were significant among both groups of XLHers, but on average were over 3 times higher for children than adults.

Adults reported more “other expenses” than children, which included **assistive devices such as walkers and scooters.**

“

I tend to use paid time off or work late to make up time. **I am lucky to have paid time off** even though it is not ideal to use it for visits and not vacation. I also keep a lot of supplies: I always have lidocaine patches, ibuprofen, supplements, compression gloves, deep tissue massages... **that all adds to at least \$1000, probably closer to 2 [thousand per year].**

– Adult XLHer

Key Takeaways

As this survey makes clear, the needs of every XLHer are unique. Additionally, key differences exist between child and adult XLHers. These distinctions are critical for healthcare providers, families, policy makers, and other stakeholders to acknowledge.

- **Diagnosis:** adults are twice as likely as children to have seen 5+ different doctors before reaching a diagnosis, likely due to recent improvements in understanding of XLH
- **Symptoms:** dental and hearing issues were more commonly reported by adults than children, while impact on physical appearance was more common for children
- **Financial burden:** many financial costs are associated with XLH, including costs related to long travel distances and lost income

The survey also underscores the urgency for action to address critical needs and gaps in care, including:

- Access to knowledgeable medical and dental providers
- Resources for navigating pediatric to adult care transition
- Daily support in work and school to help reduce absenteeism and productivity losses
- Raising awareness of XLHer experiences
- Mental and emotional health resources

“

Knowing what the community is experiencing makes one feel much less alone... there's comfort in that camaraderie and knowing that others are going through the same things.

– **Bryan Stearns,**
a member of the XLH community

Advocate for Change

This is just the beginning of a long overdue conversation on the impact of XLH. Together, the XLH community and allied stakeholders can drive progress and create change.

To learn more and connect with the community:

- Visit **XLHimpact.com** for additional resources and to sign-up for survey updates
- Visit **XLHnetwork.org** and **XLHlink.com** for more information about XLH and ways to connect with community members in person and on social media

References

1. Skrinar A, et al. The lifelong impact of X-linked hypophosphatemia: results from a burden of disease survey. *J Endocr Soc*. 2019;3(7):1321-1334.
2. NIH. X-linked hypophosphatemia. <https://rarediseases.info.nih.gov/diseases/12943/x-linked-hypophosphatemia>. Accessed August 2, 2024.
3. Laurent MR, et al. X-linked hypophosphatemia. *GeneReviews*®. <https://www.ncbi.nlm.nih.gov/books/NBK83985/>. Accessed September 12, 2024.
4. Carpenter TO, et al. A clinician's guide to X-linked hypophosphatemia. *J Bone Miner Res*. 2011;26(7):1381-1388.
5. University Hospitals. Understanding bones. <https://www.uhhospitals.org/health-information/health-and-wellness-library/article/adult-diseases-and-conditions-v0/anatomy-of-the-bone>. Accessed August 14, 2024.
6. Cleveland Clinic. X-linked hypophosphatemia. <https://my.clevelandclinic.org/health/diseases/x-linked-hypophosphatemia-xlh>. Accessed August 2, 2024.
7. Mayo Clinic. Tooth abscess. <https://www.mayoclinic.org/diseases-conditions/tooth-abscess/symptoms-causes/syc-20350901>. Accessed August 2, 2024.
8. Javaid MK, et al. Musculoskeletal features in adults with X-linked hypophosphatemia: an analysis of clinical trial and survey Data. *J Clin Endocrinol Metab*. 2022;107(3):e1249-e1262.
9. Mayo Clinic. Osteoarthritis. <https://www.mayoclinic.org/diseases-conditions/osteoarthritis/symptoms-causes/syc-20351925>. Accessed August 2, 2024.
10. Mount Sinai. Phosphorus information. <https://www.mountsinai.org/health-library/supplement/phosphorus>. Accessed August 2, 2024.
11. Duplan MB, et al. Dental and periodontal features and management in XLH children and adults. *Int J Bone Fragility*. 2021 1(2):74-79.