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UNDERSTANDING GENES & CHROMOSOMES

SLC6A1-related neurodevelopmental disorder

rarechromo.org

This guide is designed to help families and healthcare professionals looking after people with SLC6A1-related neurodevelopmental disorder. It contains information about the cause, the ways in which it can affect people and suggestions about the help and management that can benefit people with this condition.

What is SLC6A1-related neurodevelopmental disorder?

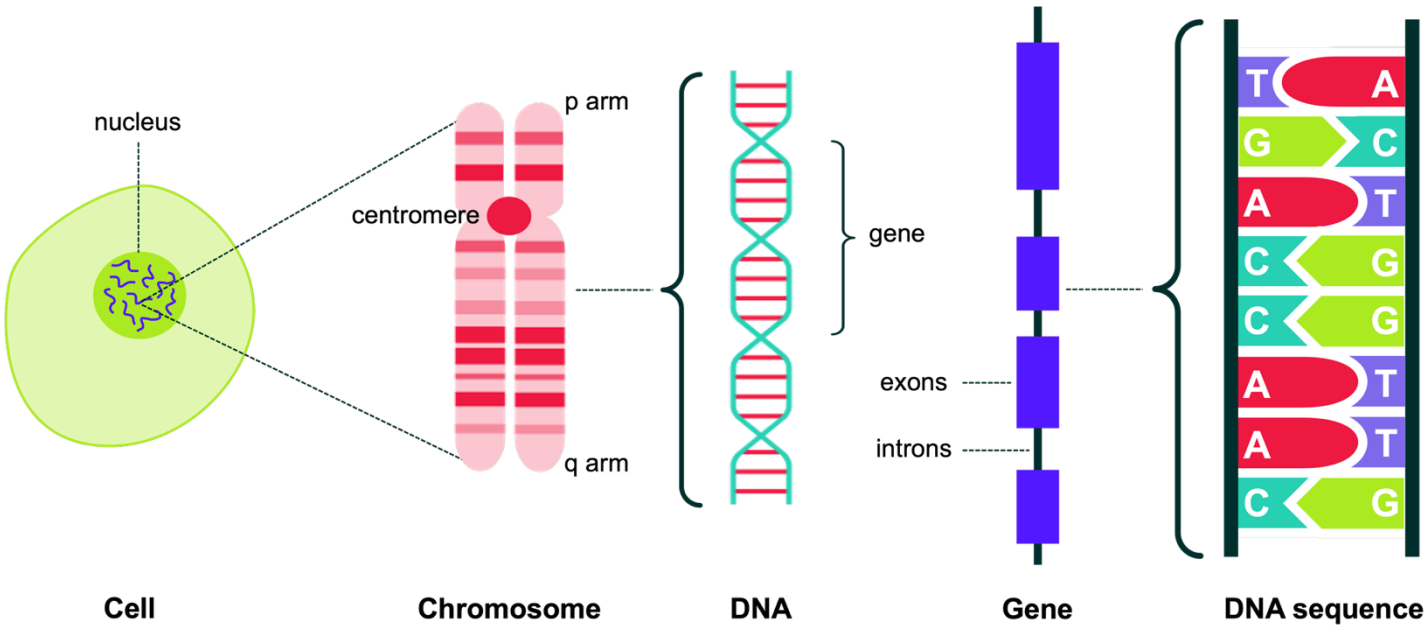
SLC6A1-related NDD, also referred to as myoclonic-atonic epilepsy or SLC6A1-NDD, is a rare genetic condition associated with seizures, developmental delay, movement disorders and neurobehavioural features. As is common with genetic conditions, each person can be affected differently - even among affected members within the same family. Every person with SLC6A1-related NDD is unique. Not everyone will have all the same features, and even when features are shared, they can affect each person differently and to different degrees.

SLC6A1-related NDD is caused by certain changes (variants) in the SLC6A1 gene or the loss (deletion) of one copy of the SLC6A1 gene. The loss of the gene may occur as part of a larger deletion that affects the chromosome on which the gene is located.

What causes SLC6A1-related NDD?

Genes are instructions that have important roles in our growth and development. They are made of DNA and are incorporated into organised structures called chromosomes. Chromosomes therefore contain our genetic information. Chromosomes are located inside our cells, the building blocks of our bodies. In people with genetic conditions, one or more of their genes don't instruct the body as we would expect, which can lead to changes in how their body works.

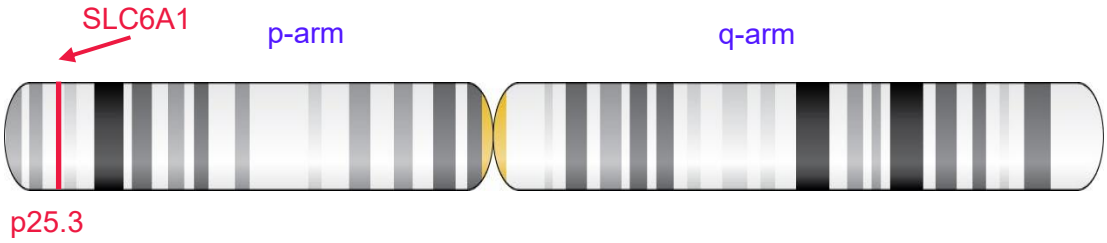
DNA is made up of building blocks called 'bases' or 'nucleotides'. There are four DNA bases which can be abbreviated to the letters A, C, G, and T. These DNA bases are paired up in the DNA structure into 'base-pairs'. The full sequence of our DNA is over three billion base-pairs long. There are changes in the DNA sequence (variants) present in everyone's genes. It is variants in our genes that make each one of us unique individuals.



SLC6A1-related NDD is caused by specific changes (known as pathogenic variants) to the DNA sequence of a gene called SLC6A1, which is an abbreviation of the gene's full name, solute carrier family 6 member 1.

SLC6A1-related NDD can also be caused by the loss of SLC6A1 due to a chromosome deletion.
The SLC6A1 gene is located in the short 'p' arm of chromosome 3 in a region called 3p25.3, as shown in the image below.

Chromosome 3



We have two copies of chromosome 3 in our cells, so we also have two copies of the SLC6A1 gene. SLC6A1-related NDD occurs when only one copy of the SLC6A1 gene is affected; the second copy is fully functional. This is known as autosomal dominant since all numbered chromosomes are called autosomes and genetic conditions that occur when only one copy of an autosomal gene is affected are known as dominant.

Unique publishes a separate guide to single gene disorders – autosomal dominant inheritance

Unique publishes a separate guide to deletions and microdeletions

The SLC6A1 gene is used to make a protein called the GABA transporter. This protein plays a key role in the brain by helping to move a chemical messenger called GABA. GABA helps calm the brain by telling nerve cells to slow down or stop sending signals. The GABA transporter helps keep the brain in balance by removing extra GABA from the spaces between brain cells.

Genetic Tests

A diagnosis of SLC6A1-related NDD is made when a person displays certain symptoms, and a genetic test finds an impactful change (pathogenic variant) in one copy of the SLC6A1 gene. These variants can be identified by a type of genetic test called sequencing (e.g. gene panels, whole exome sequencing (WES) or whole genome sequencing (WGS)). Gene deletions can also be identified by a sequencing test, but are more commonly identified using a different type of genetic test, called a chromosome microarray (CMA, e.g. arrayCGH or SNParray).

Unique publishes separate guides to DNA sequencing

Genetic Test Results

The results of genetic (genomic) testing are likely to be given to you by your geneticist, a genetic counsellor or the clinician who ordered the test. Depending on the test that was carried out, someone with SLC6A1-related NDD might have results that look like the following example result of a DNA sequencing test (e.g. whole exome sequencing (WES) or whole genome sequencing (WGS)), that can identify gene variants, is shown on the next page for the SLC6A1 gene:

p.Ala357Val (A357V) (GCG>GTG): c.1070C>T in exon 10 of the *SLC6A1* gene (NM_003042.4)

p.Ala357Val (A357V)	signifies the change to the protein: the amino acid alanine (A) has been replaced by the amino acid valine (V) at position 357 in the sequence of amino acids that make up the protein
GCG>GTG	signifies the gene sequence change; the C nucleotide has been replaced by a T nucleotide
c.1070	signifies the base pair position of the change within the gene sequence (the position where the A nucleotide has been replaced by the G nucleotide)
exon 10	signifies which part of the gene has been altered, in this case exon 10
SLC6A1	signifies the gene that is affected
NM_003042.4	denotes the reference sequence used

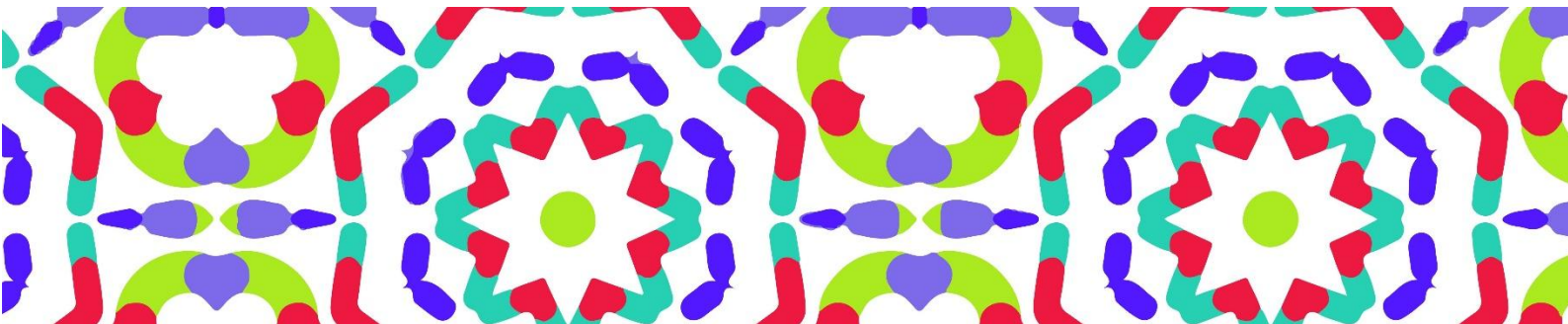
The result of a chromosome microarray (CMA) test (e.g. arrayCGH or a SNParray), that can identify deletions and duplications, is shown here for a microdeletion within band 3p25.3:

arr[GRCh38] 3p25.3(10,980,979_11,038,483)x1dn

arr	The analysis was by array (arr)
GRCh38	Human Genome build 38. This is the reference DNA sequence that the base pair numbers refer to. As more information about the human genome is found, new 'builds' of the genome are made, and the base pair numbers may be adjusted. This means base pair positions change depending on the assembly used
3p25.3	the chromosome involved is chromosome 3 and the position of the deletion is in band p25.3
10,980,979_11,038,483	the base pairs between 10,980,979 and 11,038,483 have been shown to be deleted. Take the first long number from the second and you get 57,505 (57.505 kb). This is the number of base pairs that are deleted
x1	means there is one copy of these base pairs, not two – one on each chromosome 2 – as you would normally expect, so this a deletion
dn	means *de novo*. The biological parents' chromosomes have been checked and no deletion or other chromosome change has been found at the same position. The deletion is very unlikely to be inherited and has almost certainly occurred for the first time in this family with this child

mat here would mean that the deletion has been inherited from the mother
pat here would mean that it has been inherited from the father

Unique publishes a separate guide to Interpreting Genetic Test Results



What features and symptoms do people with SLC6A1-related NDD have?

As is common with many genetic conditions, children and adults with SLC6A1-related NDD can have a range of features and symptoms. As more people are diagnosed, and information is shared, the range of features, and the likelihood of a child or adult having these features, will become clearer.

Common features

Most children with SLC6A1-related NDD have:

- Mild to severe developmental delay (speech and language delay)
- Mild to severe intellectual disability (ID) or learning difficulties (LD), including dyslexia or dysgraphia
- Seizures
- Low muscle tone (hypotonia)
- Movement disorders such as tremors, repetitive movement or sounds (stereotypies), or difficulty with balance and walking (ataxia)
- Behavioural differences including aggression, attention-deficit/hyperactivity disorder (ADHD), anxiety or features of autism spectrum disorder (ASD)

Other possible features include:

- Sleep issues (difficulty in falling/staying asleep)
- Gastrointestinal issues, such as diarrhoea and constipation

Pregnancy and birth

Pregnancies are typically unremarkable and proceed without major complications.

Appearance

Some children with SLC6A1-related NDD may have a head circumference outside of the 'normal' range, a high palate, wide nasal bridge or squint (strabismus), however this varies considerably between children. No consistent facial features have been seen in children with SLC6A1-related NDD.

Development

Intellectual development and learning

Many children with SLC6A1-related NDD have intellectual disability (ID) or learning difficulties. ID ranges from mild to severe but is usually in the moderate range and many children have needed additional support with their learning. Early intervention can prove particularly beneficial and formal testing to assess specific, individual needs is recommended.

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Speech and language

Children with SLC6A1-related NDD typically experience some degree of speech and language delay, and many may find it difficult to coordinate movement of their lips, jaw, and tongue to make the right sounds (apraxia of speech). Children with SLC6A1-NDD may babble around age 14 months (reported range from 6-36 months), say their first word by age 25 months (10-52 months), and use phrased speech by age 34 months (23-54 months) (Goodspeed, 2023). The eventual range of achievement is broad, but some may remain non-verbal. Those who do develop speech may achieve single words, short phrases or basic sentences and some go on to develop conversational skills and a broad vocabulary. Many parents believe that their child can understand much more than they can express.

An assessment by a speech therapist should be able to identify your child's specific difficulties, allowing regular therapy sessions tailored to your child's specific areas of need. Where individuals have no speech or very few words, Augmentative and Alternative Communication (AAC) methods, including pointing, pictograms, gestures, facial expression and simplified sign language and high-tech communication systems (aided communication) have enabled some to communicate their thoughts and needs well.

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Behaviour

Children with SLC6A1-related NDD typically tend to have behaviour in keeping with their overall degree of developmental delay, and most have a happy disposition. Many children have an autism spectrum disorder (ASD) diagnosis or traits. Other reported behaviours include ADHD, anxiety, aggressive, risky behaviours and irritability. Families report that these challenging behaviours can be the most impactful feature of SLC6A1-related NDD. Some children also have difficulty falling or staying asleep.

Management strategies should focus on keeping children safe from environmental risks and hazards, and addressing the root causes of challenging behaviours - such as providing sensory supports, using strategies to manage anxiety, and creating structured environments to help with attention - while nurturing the child's inherently friendly and sociable personality. Efforts to take into account and introduce strategies to tackle communication and other difficulties can also be beneficial.

> ***"For those with moderate to severe intellectual disability whilst physically able, risky behaviours can be common due to a lack of danger awareness."***

Gross and fine motor skills

Developmental delay has been reported in most children with SLC6A1-related NDD so far [2025]. The degree of delay ranges from mild to severe. Developmental "milestones", including rolling, sitting, walking, playing with toys, using cutlery, using zips and buttons, and toilet training, are often delayed, although there is a wide range of eventual ability, with some children acquiring mobility and other skills around the same age as "typical" children and others showing more obvious delay. Some children experience hand or arm tremors when performing fine motor tasks, and leg tremors when standing or walking. Other motor symptoms may include repetitive hand movements (motor stereotypies) lasting from seconds to minutes that are often associated with excitement or stress, such as clenching their fists and stiffening their arms. Low muscle tone (hypotonia) is common and may affect mobility. Some children may have an unusual gait when walking because of stiffness, or balance issues (known as ataxia). For some, independent walking may not be achieved. A loss of skills (developmental regression), which may be temporary or permanent, has been reported in some children, and is an area of active research.

Many benefit from early intervention with treatments or therapies such as orthotics e.g. insoles, braces, splints and callipers; occupational therapy (OT); and physiotherapy (PT).

"Most children require PT and OT input throughout their young lives and into adulthood. Many children have high sensory needs with sensory seeking behaviours that require significant OT support."

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Feeding

Feeding difficulties are common in the newborn period. Low muscle tone can affect swallowing, and some infants may have a weak suck, requiring high-calorie formula to support healthy weight gain. Some babies also suffer from gastro-oesophageal reflux (GERD/GORD) (in which feeds return readily up the food passage), which may require treatment, including careful positioning for feeds, medication, nutritional supplements or, in some cases, insertion of a nasogastric tube (NGT) or percutaneous endoscopic gastrostomy tube (PEG/G-tube). Other issues that have been reported include aspiration (where fluid, food or saliva enters the airway or lungs). Some children have benefited from attending a feeding clinic where an assessment can be made, and advice to help treat any eating and drinking difficulties provided.

Unique publishes a separate guide to Feeding

Growth and stature

Some children with SLC6A1-related NDD described in the medical literature so far [2025] are noted as having short stature. A few of these children also present with smaller than expected head size (microcephaly). Beyond infancy, height and weight are variable but may remain below average.

Puberty

There is limited information available about puberty in children with SLC6A1-related NDD. We do know that some boys and girls appeared to go through puberty as expected. Some families of children with chromosome disorders and behavioural or learning difficulties can be particularly concerned at their daughter's ability to cope with menstruation, and for some, discussing menstrual regulation options with a paediatrician may be beneficial.

"Becoming young adults for those with more awareness of their challenges often triggers increased anxiety and may lead to mental health issues... early psychological assessment and support is recommended."

Unique publishes a separate guide to Puberty

Adulthood

Experiences of adulthood are likely to vary considerably and will depend on many factors. These include the level of any language or intellectual delays, possible ongoing medical concerns and improvements in early intervention and therapies/treatments.

Adults with SLC6A1-related NDD have varying levels of independence. Many continue to live with their parents or in supported settings such as a group/residential care home, with caregivers who can provide support. Levels of employment and the nature of employment may vary; SLC6A1-related neurodevelopmental disorder remains a relatively newly defined condition with limited long-term data available. However, some reported familial cases show that SLC6A1 variants can be inherited from parents in an autosomal dominant manner. This suggests that adults with SLC6A1 variants are able to live relatively typical lives, pursue careers, and have families if they wish. In most cases, the parent also carrying the variant had mild learning difficulties (Goodspeed, 2020).

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Medical concerns

The following medical concerns have been found in children with SLC6A1-related NDD. They are not found in all children so not all children with SLC6A1-related NDD will be affected.

Seizures

Frequently, children with SLC6A1-related NDD experience some form of seizure (a sudden and unexpected change in the electrical activity in the brain). Depending on the part(s) of the brain affected, symptoms vary, but include temporary confusion, uncontrollable jerking movements and loss of consciousness or awareness. Age of onset can vary considerably, while seizures may be isolated to a single incident or occur more regularly. More than one type of seizure may be present in the same individual. Electroencephalograph (EEG) and video telemetry (video EEG) are medical tests that can be used to measure and record the electrical activity of the brain and are tools that, when used alongside other tests, can help diagnose the type(s) of seizure experienced.

Seizures can cause a lot of worry for families and can be frightening to observe, but in some cases they self-resolve or resolve with medical treatment. Anti-seizure medications, such as clobazam, valproic acid, lamotrigine and benzodiazepines, may help manage symptoms. It is important to note that responses to medications can vary from one child to another. If your child has a seizure for the first time, it is important to remove nearby hazards so they can't hurt themselves and contact a medical professional.

Seizure types reported in individuals with SLC6A1-related NDD include:

Epilepsy with eyelid myoclonia (EEM) Children with EEM are sensitive to bright lights and have seizures that cause their eyelids to jerk repeatedly leading to frequent or continual blinking.

Absence seizure A change in behaviour as if the child 'switches off', sometimes with staring, eyelid flickering or lip smacking. Absences are very brief often lasting less than half a minute.

Atypical absence seizure The child may appear confused and unresponsive for minutes (very different from a typical absence seizure).

Myotonic A seizure involving stiffening of the muscles.

Myoclonic-atonic A seizure involving jerky or shock-like contraction of muscles, followed by a loss of tone so someone standing up falls to the ground.

Myoclonic generalised seizure Involving jerky or shock-like contraction of different muscles anywhere in the body but usually the arms or legs. Each myoclonic seizure lasts for a fraction of a second or a second at most.

Febrile seizure Episodes only occur when the child has a high temperature.

Early-onset/childhood absence seizure A change in behaviour as if the child 'switches off', sometimes with staring, eyelid flickering or lip smacking. Absences are very brief, often lasting less than half a minute.

Atonic (drop) seizure A type of seizure characterised by a sudden loss of muscle tone, causing a person to fall or slump

Generalised tonic-clonic At the onset of a seizure, the abnormal electrical activity involves both sides of the brain. The seizure involves a phase of stiffening followed by jerking.

Brain

A few children have structural brain anomalies, which can be detected by MRI (magnetic resonance imaging) or a CT (computerised tomography) scan of their brain. The changes seen vary but include nonspecific white matter changes (regions that connect different parts of the brain), and other incidental findings including fluid-filled sacs in the lining of the brain (arachnoid cysts).

Constipation

Constipation is sometimes observed among children with SLC6A1-related NDD and can be related to low muscle tone, little exercise, a low-bulk diet and small fluid intake, among other reasons that are not fully understood. It is important that possible causes are discussed with a health visitor or doctor, who may recommend adapting diet or giving stool softeners or laxatives. Some children have benefitted from enemas when symptoms were particularly severe.

Eyes and sight

Problems with eyes and vision are present in some children with SLC6A1-related NDD. A wide range of conditions have been reported, and an individual may have more than one vision or eye-related concern. Known concerns include uncontrolled eye movements (nystagmus), shortsightedness (myopia), and squint (strabismus).

Ears and Hearing

Some children have a hearing impairment, but hearing is unaffected in most children and hearing tests at birth often give a clear response. Hearing loss may be conductive, where sound is unable to travel effectively to the inner ear; sensorineural, where there are problems with the inner ear, sometimes with the nerves that send sound signals to the brain (cochlea or auditory nerve); or a combination of both conductive and sensorineural hearing loss.

Many types of hearing loss can be managed by using hearing aids. As children are at risk of speech delay, parental concerns should be acted on early and home or school-based therapy provided.

Unique publishes a separate guide to Hearing

Breathing

Children with SLC6A1-related NDD may experience temporary irregular breathing as a result of seizures. The severity and duration of these breathing changes can vary depending on the type of seizure and the individual experiencing them.

How common is SLC6A1-related NDD?

SLC6A1-related NDD is extremely rare. As of 2025, fewer than 500 with an SLC6A1 gene variant had been reported in the medical literature, but more are known to have been diagnosed. It is expected that more people will be diagnosed with this condition as awareness increases and genetic testing becomes more routine.

Why did this happen?

When children are conceived, their parents' genetic material (DNA) is copied in the egg and sperm that make a new child. The biological copying method is not perfect, and random changes occur in the genetic code of all children that are not seen in the DNA of their parents. This happens naturally and is not due to the parents' diet, environment or lifestyle. Most of these DNA changes have no obvious effect. But in rare instances, these random DNA changes can lead to health issues or affect development. When such a random change disrupts the function of the SLC6A1 gene then a child will have SLC6A1-related NDD. In most people identified so far (2025) with SLC6A1-related NDD, the genetic change was a random (or '*de novo*') change, meaning the change occurred for the first time in that family in the affected individual. Rarely, one parent may have a chromosomal rearrangement that led to SLC6A1-related NDD in their child, or one parent may have the same change (or variant) in some of their egg or sperm cells and pass it on to their child (this is known as germline mosaicism). However, it is important to recognize that no one should be blamed for variants in their DNA and no parent is at fault when a new DNA change occurs in their child.

Can it happen again?

The possibility of having another child affected by a rare gene disorder depends on whether one of the parents carries the variant or not. In most individuals reported with SLC6A1-related NDD so far (2025), the genetic alteration has been found to be de novo (dn), which means neither parent was found to have the same SLC6A1 gene change as their child, and neither parent was found to have a chromosomal rearrangement that might have resulted in a SLC6A1 deletion in their child. Therefore, the chance of having another child with SLC6A1-related NDD is usually less than 1%.

One reason why there is some residual chance of recurrence is due to the rare phenomenon called germline mosaicism that was mentioned above. This is when a parent carries a genetic change, but it is limited to some of their egg or sperm cells. The genetic change would not, therefore, be detected in the parents' blood tests. Parental genetic testing has been reported in the medical literature for 118 individuals with SLC6A1-related NDD and parental mosaicism for a SLC6A1 variant has been reported twice (2025).

Unique publishes a short general guide to Mosaicism

In families where the SLC6A1 variant has been inherited from a parent, the possibility of having another child - either a girl or a boy - with SLC6A1-related NDD rises to 50% (1 in 2) in each pregnancy. However, the effect on the child's development, health and behaviour cannot be reliably predicted. Your local genetics centre would be able to offer counselling before you have another pregnancy.

If your child with a SLC6A1 variant goes on to have children of their own, the chances of passing on the variant to their child are 50% in each pregnancy. Your child's ability to look after their own child is very likely to be closely related to their own learning ability and behaviour.

In two families with SLC6A1-related NDD, a parent was found to be a carrier of a balanced chromosomal rearrangement. This is when a piece of a chromosome gets relocated, usually

onto a different chromosome, but no genetic material is lost. When a child is conceived, structural changes in a parent's chromosomes - such as a balanced translocation - can result in deletions within one or more of the child's chromosomes. As a result, the parent has an increased likelihood, compared to the general population, of having additional children affected by SLC6A1-related NDD. It is important to note though that this scenario is extremely rare.

For individuals carrying a balanced translocation, the potential reproductive outcomes include:

- A 25% (1 in 4) chance of passing on the balanced translocation,
- A 50% (1 in 2) chance of producing embryos with unbalanced chromosomal content (monosomy or trisomy), which typically leads to miscarriage, and
- A 25% (1 in 2) chance of having an unaffected child with 'normal' chromosomes.

Unique publishes a short general guide to Balanced translocations

A clinical geneticist or genetic counsellor can provide specific advice for each family about the chance of having further children with SLC6A1-related NDD.

Unique publishes separate guides to Planning your next child, Prenatal genetic testing and diagnosis, A clinical genetics appointment and Supporting siblings of children with a rare genetic condition

Can SLC6A1-related NDD be cured?

There is currently no cure for SLC6A1-related NDD. Effects of genetic changes can take place during a baby's formation and development, as well as throughout child and adulthood, so the extent to which a complete cure is possible, even in the future, is not clear. However, knowing the diagnosis means that appropriate monitoring and interventions can be put in place.

Management

No clinical practice guidelines for SLC6A1-related NDD have been published [2025]. The following suggestions have been provided by clinicians, who have personal experience of managing/treating individuals with SLC6A1-related NDD, to improve quality of life and reduce complications.

Children and adults with SLC6A1-related NDD should be under the care of a multidisciplinary team. The team should include a geneticist and paediatrician (for children) who can oversee care so that development and behaviour can be monitored, and the best help given in the form of physiotherapy, occupational therapy, speech therapy and, if needed, behavioural therapy. Individuals may have evaluations with neurology, psychiatry, ophthalmology, audiology and gastroenterology.

Immediately following diagnosis

When not carried out as part of the diagnostic process, an evaluation of the features of the SLC6A1-related NDD that are present in the child or adult who has been diagnosed with this genetic condition is recommended. This can determine which of the features of the SLC6A1-related NDD are present and how severe they are.

Supportive care

Children with SLC6A1-related NDD are likely to be under the care of a multidisciplinary team. The team should include a community or hospital paediatrician who can oversee care; monitor growth, development and behaviour; and link in with affiliated services. Involvement of a specialist neurodisability team is also recommended. Social care support and specialist school provision are also likely to be required.

How a person with a SLC6A1-related NDD is supported is therefore likely to require co-ordinated care by a number of specialists, which may include:

Paediatrician – a doctor who specialises in the physical, mental and social health of children from birth to young adulthood.

Neurologist – a doctor who specialises in conditions of the brain, spinal cord and nervous system.

Endocrinologist – a doctor who specialises in hormones and their effect on the body.

Ophthalmologist – a doctor who specialises in conditions affecting the eyes.

Audiologist – a health care professional who diagnoses, treats and helps manage a condition that involves hearing or balance.

Occupational therapist (OT) – a health care professional who uses activities to aid self-management of a condition and can provide equipment.

Physiotherapist (PT) – a health care professional who uses exercise, movement, manual therapy, education and advice to help with the body's strength and mobility.

Speech and language therapist (SALT) – a health care professional who helps with speech, language communication and sometimes feeding/swallowing difficulties.

Psychiatrist – a doctor who specialises in mental health.

Specialist nurses and/or other healthcare professionals may need to systematically and comprehensively plan a child or adult's treatment.

Treatments and therapies

Early intervention can be beneficial and formal testing to assess specific, individual needs is recommended. An education, health and care plan (EHCP) in the UK, individualized education plan (IEP) in the US, or equivalent document in other countries, may be issued after a child has undergone an assessment, to help ensure that the educational, health and social provisions deemed necessary to support the child's needs are delivered.

Treatment will depend on the specific features and symptoms experienced by the person with SLC6A1-related NDD but may include:

Physiotherapy to help manage low muscle tone and muscle spasms, which may include gait training, stretching, hydrotherapy, and balance exercises to give children more control over their movements and relax their muscles.

Occupational therapy for movement disorders and ataxia, which can include play and exercises to improve fine motor skills and coordination that support independence in daily tasks e.g dressing.

Speech therapy for language difficulties, such as delays in babbling and first words, which aims to help children communicate verbally.

Behavioural therapy can assist in managing challenging behaviours such as ADHD and ASD related irritability, such as applied behavioural analysis (ABA) to improve social skills and communication.

Medications may be prescribed depending on the symptoms exhibited by the child. Anti-seizure medications may be used to normalise brain chemistry and reduce seizure severity and frequency. Anti-psychotics such as risperidone may also be used to reduce challenging behaviours seen in ASD.

Diet can be altered to follow a ketogenic (or "keto") diet which may help manage seizures in people with SLC6A1-related conditions, especially myoclonic-atonic seizures. This special diet works by reducing the amount of carbohydrates (like pasta, rice, potatoes and sugar) and replacing them with foods high in protein and healthy fats. These changes help the brain use fat as an alternative energy source, which may help reduce seizures.

Surveillance

It is recommended that the following evaluations are carried out/considered to monitor an individual's existing symptoms, how they respond to care and treatment and whether any new symptoms emerge over time:

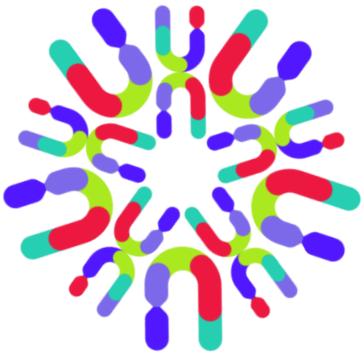
- Neurologic review and monitoring (including MRI and EEG, if indicated by seizures).
- Monitor developmental progress, including any developmental delay or regression.
- Physiotherapy reviews to assess mobility, if required.
- Monitor behaviour for any indicative signs of ASD, ADHD, aggression, or anxiety.
- Monitor changes to behaviour in response to anti-seizure medications, such as levetiracetam.
- Consider a palate review (particularly if there are feeding difficulties or speech concerns).

Research into new treatments for SLC6A1-related NDD

Research into improved treatments and management for various features of SLC6A1-related NDD, like seizures, is ongoing. One potential future approach is gene replacement therapy, which involves replacing the faulty copy of the SLC6A1 gene with a functional copy (Latzer 2024). This has successfully treated mouse models of SLC6A1 variants (Guo 2024) and the first child with SLC6A1-related NDD received a novel gene therapy in 2025, with the hope that a clinical trial will follow.

Also, although SLC6A1-related NDD is a relatively rare condition, the SLC6A1 gene itself is the subject of extensive research. For example, promising research has been carried out into novel therapeutics to help control seizures (Stone 2025), while there is hope that faulty GABA transporter proteins can be fixed with special chemicals that help them fold and function properly inside cells (Shah 2024).

Details of clinical trials related to a particular condition or gene can be found at **ClinicalTrials.gov** and **EU Clinical Trials Register**.



Families say …

"We were devastated twice by this diagnosis. Despite negative results on parental genetic tests, our second child also has SLC6A1. Their symptoms test us every day, from seizure management to challenging behaviour and the difficulties of keeping a physically able child safe, when they have severe intellectual disability. The silver linings for us are that they are both very sociable, and funny children with lots of love to give."

"We adopted our daughter with joy and gratitude, just as we had previously done with her older sister. Both of our daughters have Down syndrome, and we thought we were prepared for the challenges ahead. But we were not ready for what SLC6A1 would bring into our lives: drug-resistant epilepsy, severe developmental delay, restlessness, repeated hospitalizations, and many daily struggles we had never imagined. Yet in her, we see a great desire to live and to enjoy life. We are determined to find the right treatments to allow her to truly experience it and develop her full potential."

"Our son was diagnosed with SLC6A1 after a long journey of uncertainty and developmental delays. For a long time before the diagnosis, we felt unheard, struggling to understand what was happening to him. Receiving the genetic result was both devastating and a relief — devastating because of an unknown future, a relief because we finally had answers. Every day brings its own challenges, from developmental difficulties to navigating therapies and medical appointments. It requires a lot of attention and energy from us as parents. And yet his joy, his determination and his loving nature carry us through. He reminds us to celebrate the small victories and to find light even in the hardest moments."

Sources

The information in this booklet is drawn from the published medical literature and information from Unique members. In 2025, Unique had 18 members with SLC6A1-related NDD. The first-named author and publication date for articles in the medical literature are given to allow you to look for the abstracts or original articles on the internet in PubMed (**pubmed.ncbi.nlm.nih.gov/**).

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Note: an asterisk indicates articles which are "open access" and available to everyone at **pubmed.ncbi.nlm.nih.gov**

Inform Network Support

Rare Chromosome Disorder Support Group
The Stables, Station Road West, Oxted, Surrey, RH8, 9EE, UK
Tel: +44(0)1883 723356
help@rarechromo.org I rarechromo.org

Join Unique for family links, information and support:

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Please help us to help you!

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If you can, please make a donation:

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Facebook groups and other links:

- SLC6A1 connect UK-AQ
- SLC6A1 Europe, Research and Support Alliance (SERSA)
- SLC6A1 connect
- SLC6A1 connect Facebook group
- Simons searchlight
- SLC6A1kids

This information guide is not a substitute for personal medical advice. Families should consult a medically qualified clinician in all matters relating to genetic diagnosis, management and health. Information on genetic changes is a very fast-moving field and while the information in this guide is believed to be the best available at the time of publication, some facts may later change.

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