16p11.2 Deletion Syndrome Guidebook

SIMONS VIP CONNECT

VARIATION IN INDIVIDUALS PROJECT

16p11.2 Deletion Syndrome Guidebook

This guidebook was developed by the Simons VIP Connect Study Team to help you learn important information about living with the 16p11.2 deletion syndrome.

Inside, you will find that we review everything from basic genetics and features of 16p11.2 deletion syndrome, to a description of clinical care and management considerations.

- Simons VIP Connect

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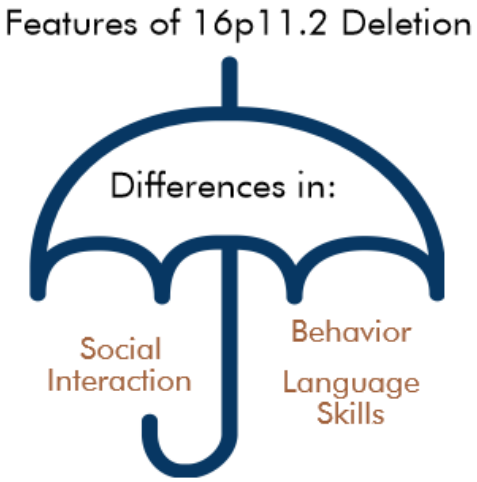
How Did We Collect All of this Information?

What is Simons VIP Connect?

Simons VIP Connect is a research project aimed at characterizing specific genetic diagnoses that have been associated with autism, such as differences in speech and language development, social interaction, and behavior.



Thanks to the many 16p11.2 deletion families who have participated in the Simons Variation in Individuals Project (Simons VIP), we have learned a wealth of information about 16p11.2 deletion syndrome. This guidebook provides an in-depth summary of findings from the Simons VIP study. We are excited to share this information with you and other newly-diagnosed families. Simons VIP research has helped us to better understand what to expect for children and young adults with 16p11.2 deletion syndrome. The success of this project can be attributed to the close partnership between families and researchers.

What is the Simons Variation in Individuals Project (Simons VIP)?

In 2010, the Simons Foundation began working to build a collaborative relationship between families and researchers to advance our understanding of 16p11.2 deletion syndrome. Families shared their medical histories and participated in different assessments, and researchers compiled this information and published what they've learned in medical journals. When families and researchers partner together like this, we are able to address questions quickly and give back to the 16p11.2 community. Families involved in Simons VIP Connect not only receive useful feedback by participating in research surveys, but they also are helping other families now and in the future.

Simons VIP Connect has been an important resource for connecting and supporting families who once felt alone after hearing about the diagnosis of 16p11.2. Now, the online community at Simons VIP Connect extends from our website to other social networks, like Facebook, where families from all over the globe support each other by sharing their stories and advice.

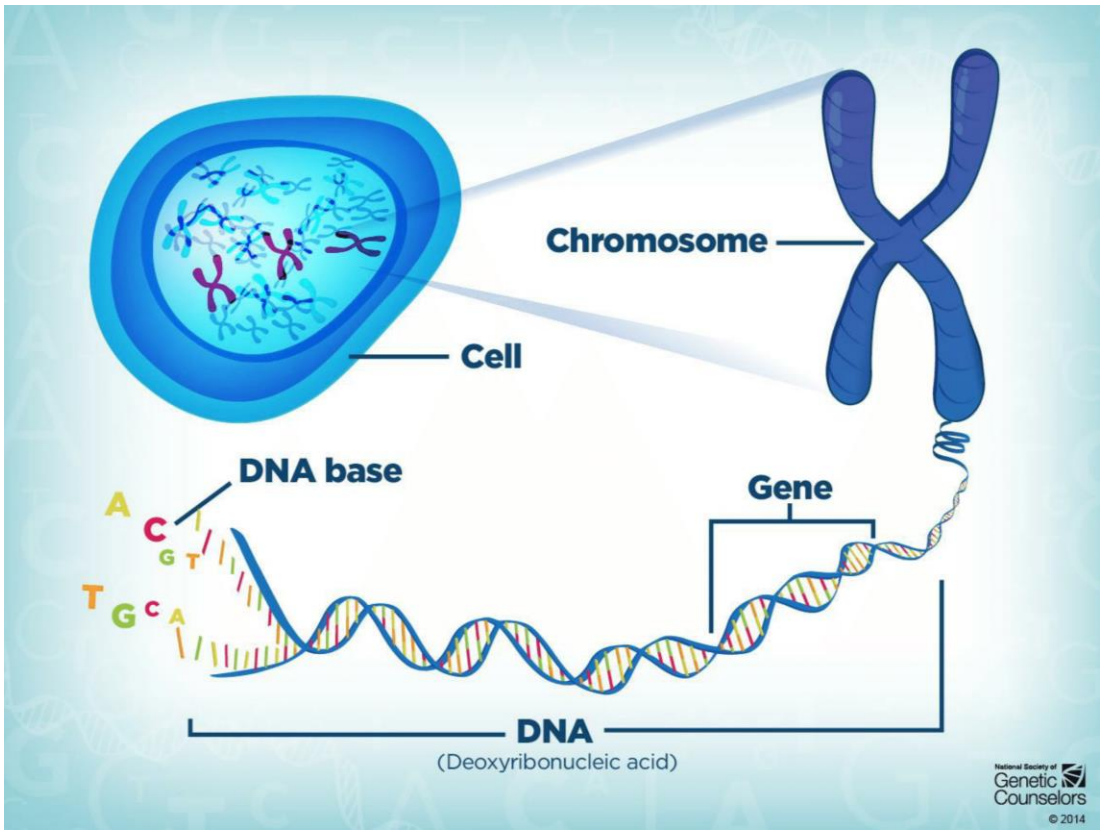
If you are not already a part of the online community, please visit our website at https://www.simonsvipconnect.org. There you can learn more about 16p11.2 deletion syndrome by participating in research, watching informational webinars, or asking an expert any questions that haven't been answered in this guidebook.

Simons VIP Connect Research

In the Simons VIP study, families partner with researchers to share information and learn about the behavioral, psychological, physical, and medical features associated with different genetic changes. In particular, Simons VIP is interested in genetic changes known to cause autism and other neurodevelopmental disorders. Sharing information with Simons VIP Connect gives researchers access to an incredible repository of data, including your child's de-identified medical information, which advances our knowledge about genetic causes of these disorders. Our model demonstrates the value of sharing information to create a resource that is accessible by researchers across multiple medical disciplines.

Definition of 16p11.2 Deletion

In every cell there is a copy of our DNA, which contains all of our genetic information. DNA is written in a code made up of four letters – A, C, T, G – the "spelling," or order, of these letters makes up the instructions for everything our body does. Our DNA is very long so it needs to be coiled up into packages, or structures we call "chromosomes."



Slide 1: This project was made possible through the National Society of Genetic Counselors and a grant from the Audrey Heimler Special Project Award

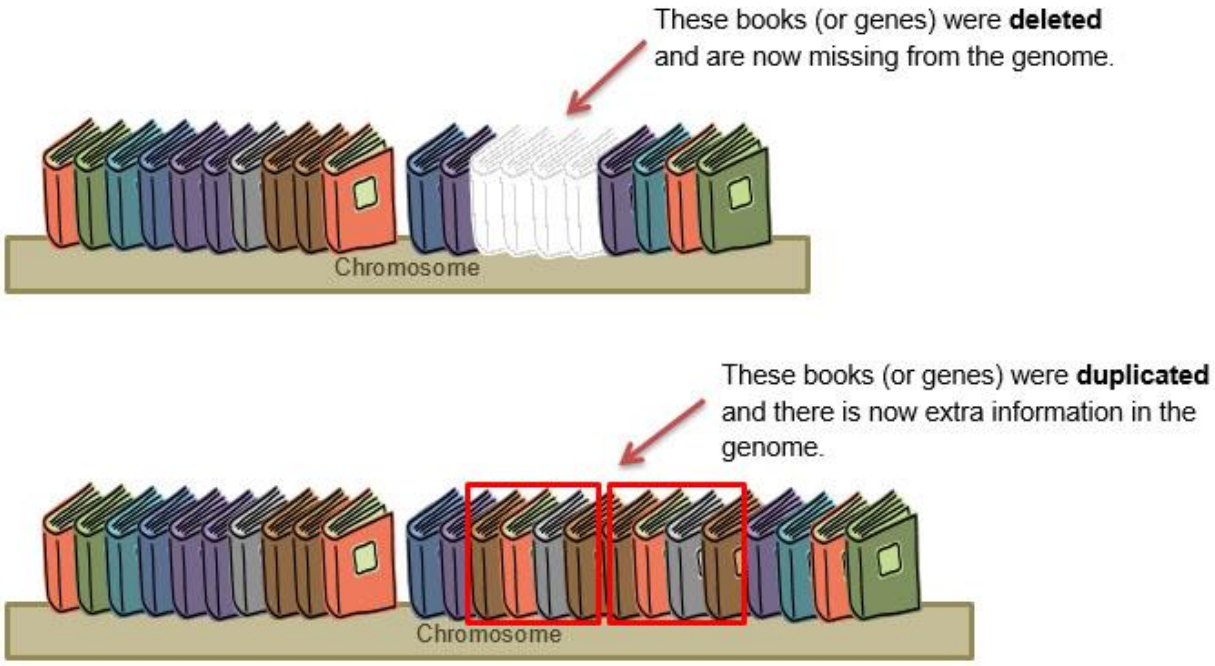
Humans have 46 chromosomes. We label the pairs of chromosomes 1 through 22, with the last pair being the sex chromosomes. These are made up of either two X chromosomes (female) or one X and one Y chromosome (male). Chromosomes are arranged into pairs because every person receives one half of the pair from Mom and the other half of the pair from Dad.

DNA is broken up into individual, readable segments called "genes." We believe that humans have about 20,000 genes, and each gene provides a set of instructions for the body to perform a specific job.

When a person has a 16p11.2 deletion, typically we find that a group of about 29 genes (~600,000 letters of DNA code) are missing, or deleted (some people may have more or less than this number). This means that one chromosome has the expected number of genes, while the other chromosome is missing information. Researchers now know that this specific section of chromosome 16 contains genes that play an important role in health, development, and brain function.

What is a Copy Number Variant (CNV)?

The 16p11.2 deletion is also often referred to as a Copy Number Variant, or CNV. A CNV is a difference in the number of copies of a particular section of genetic material. Since most people have two copies of their genetic material (as described above – one copy from mom and one copy from dad), a **deletion** *or* **duplication** of genetic material (i.e., a **missing** *or* **extra** section of a chromosome) is considered a CNV.

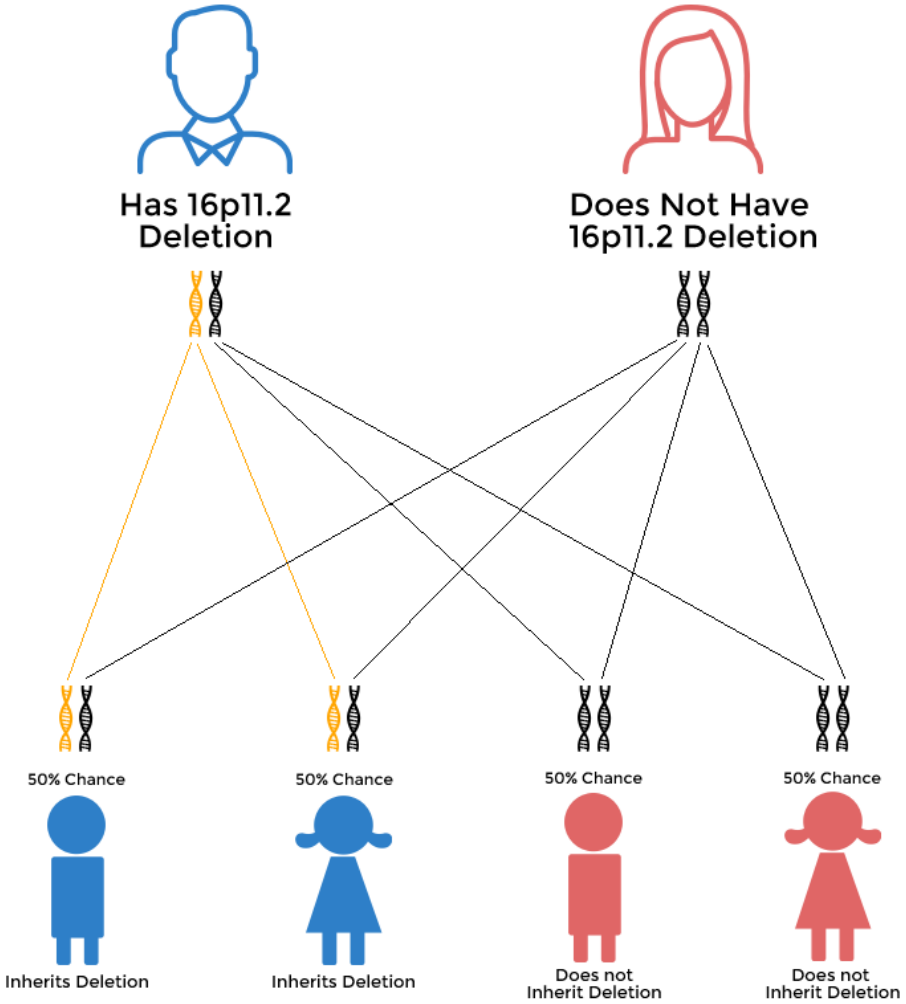


Inheritance

This deletion can happen in a couple of different ways. It can be *de novo,* meaning that the deletion is brand new in the family. Most often, 16p11.2 deletions are *de novo*; various studies have found that close to 75% of children (3 out of 4) with a 16p11.2 deletion did not inherit it from mom or dad. However, in some families, the deletion is inherited; meaning that either mom or dad also has the 16p11.2 deletion and passed it on to their child.

If a parent of a child with a 16p11.2 deletion is found to have the deletion as well, there is a 50% that any of his or her other children will have the same deletion.

Since a 16p11.2 deletion can be passed down from a parent to their children, it is possible to test other family members to see if they have this same deletion. There are also tests that can be done during pregnancy to find out if the next child will have the same 16p11.2 deletion a parent carries. Talk to your genetic counselor about these testing options.



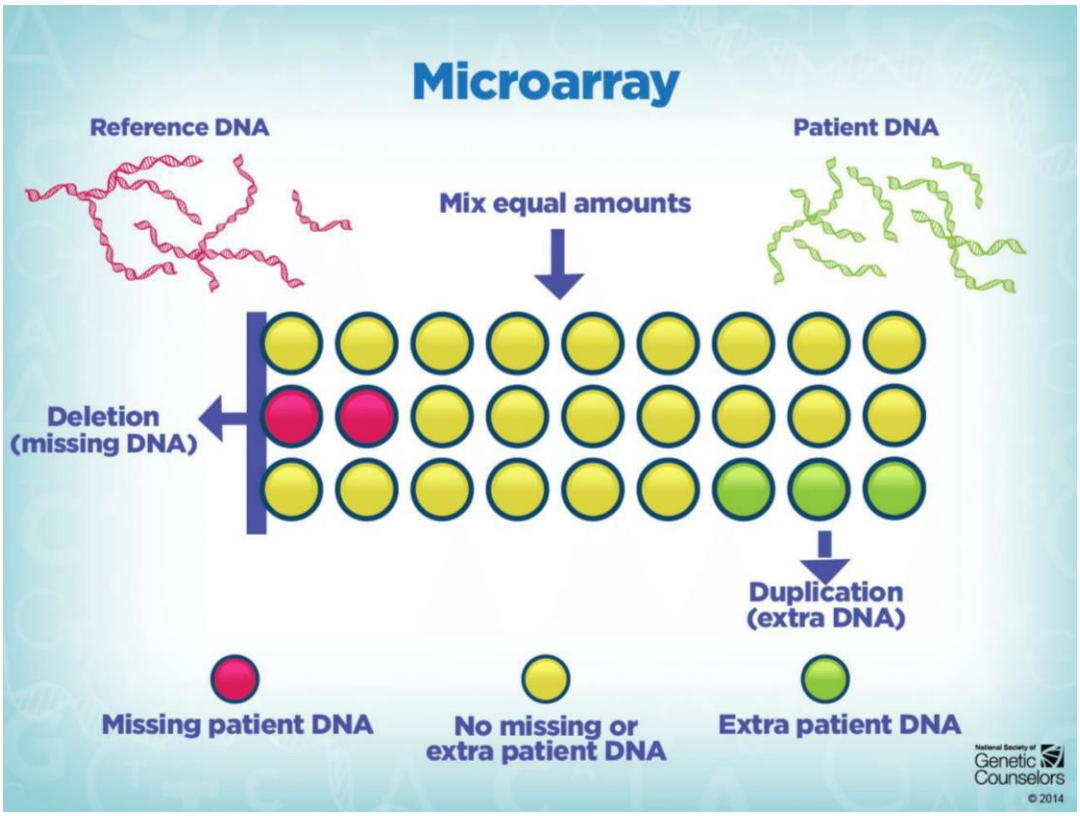
How is a 16p11.2 Deletion Found?

Children diagnosed with 16p11.2 deletion syndrome have had *genetic* testing, as this is a *genetic* diagnosis. There are different types of genetic tests, and the ones we talk about here are able to detect a typical 16p11.2 deletion.

Genetic testing has improved over the past 10-15 years, and we are now able to identify many different types of genetic changes in people. We have genetic tests including the microarray test that look for many different genetic changes at the same time. Microarray testing is often the first test ordered when a health care provider suspects that there may be a genetic reason for a child's delays.

Another test, called Fluorescence In Situ Hybridization (FISH*)*, can also detect the 16p11.2 deletion. Unlike the microarray test that covers many different chromosome conditions, the FISH test is targeted to only a single condition.

Nowadays, the FISH test is primarily used to determine if other relatives *also* carry the specific genetic change that was identified in the family.



Slide 2: This project was made possible through the National Society of Genetic Counselors and a grant from the Audrey Heimler Special Project Award

How Common are 16p11.2 CNVs?

A loss or gain of material (called a "copy number variant" or "CNV") from 16p11.2 is increasingly recognized as one of the most common chromosome disorders. 1 in 100 people with autism has a 16p11.2 deletion or duplication, which makes the 16p11.2 CNV one of the most common genetic causes of autism.

Based on several research studies, we believe the prevalence of 16p11.2 CNVs are:

- 1/2300 people has a 16p11.2 deletion
- 1/1900 people has a 16p11.2 duplication

The picture below demonstrates how common 16p11.2 **CNVs** are in 100 children with autism. Out of 100 children with a formal diagnosis of autism, one will have a 16p11.2 deletion **or** duplication.

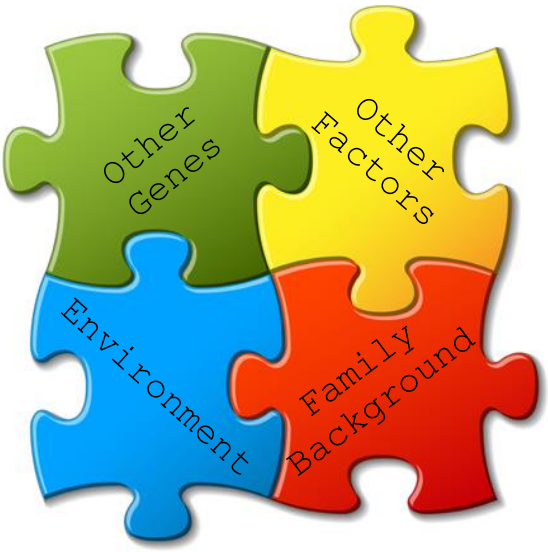
Most Common Features of 16p11.2 Deletion Syndrome

What Makes Something a "Syndrome?"

A syndrome is a recognizable pattern of features, signs and symptoms (such as medical, developmental, and behavioral concerns or characteristic physical findings) that occur together due to the same underlying cause. The characteristics of 16p11.2 deletion syndrome include a wide range of different developmental and behavioral concerns, as well as some specific medical conditions. Importantly, the syndrome can be very variable from one person to the next, and not everyone with the deletion will have the same abilities or challenges.

There are some people with the 16p11.2 deletion who have few reported problems, apart from a mild learning disability in school, for example. Other people with the deletion may have more significant learning and behavioral issues, and / or medical problems. The reason for such a great degree of variation among individuals who have the same (or a similar) deletion is still being studied. At this point, we do know that family background, environmental factors, and other genetic differences all contribute to how a person is affected by a 16p11.2 deletion.

While it is possible for someone with a 16p11.2 deletion to have no noticeable health or behavioral problems, this is not typical. *The majority of people with 16p11.2 deletion syndrome have a combination of the features described below.*



For young children, it is helpful to know the range of medical, learning, and behavior issues that can occur in 16p11.2 deletion syndrome, so that you can help your child receive the right support and care. The most common features fall into categories of developmental delay, behavior, growth patterns, and other medical issues. Specific aspects of 16p11.2 deletion syndrome are further explained here and in articles on our website.

Differences in Development

Thinking and Learning Skills (Cognition)

Most children and adults with 16p11.2 deletion syndrome have trouble with learning and understanding. Intelligence Quotient (IQ) is one measure used to assess a person's intelligence. Children with 16p11.2 deletion syndrome often have lower IQs than their siblings and parents. Of course, there is still a wide range in IQ within the 16p11.2 deletion population. The average IQ in the general population is 100. Among people with the deletion, we believe the average IQ is about 20-30 points lower than their parents *without* the deletion. We have worked with families whose children with 16p11.2 deletion syndrome have IQs as high as 130 and as low as 40, and everything in between. It is important to remember that an IQ score is just one measure of intelligence. Many people with the 16p11.2 deletion function independently, have meaningful relationships, and hold jobs.

Speech and Language

Speech and language problems are the most common features seen in 16p11.2 deletion syndrome. 71% of individuals with the syndrome have a diagnosed speech or language-related disorder. Language delay may be one of the first signs of 16p11.2 deletion that parents notice in their child. Typically, children with 16p11.2 deletion syndrome have more trouble with expressive language (speaking) than receptive language (listening and understanding). This means that they can understand and process what other people are saying, but they have a harder time initiating conversations or choosing the right words. Families have told us that using sign language and communication devices can help with early communication skills.

The most common types of language disorders reported are expressive/mixed receptive-expressive language deficits and phonological processing disorders. A mixed receptive-expressive language deficit means that a child is having trouble both with getting his/her message across to others and understanding the messages coming from others. As stated above, most children mainly have trouble being able to express themselves. A phonological processing disorder is a type of speech problem also known as an articulation disorder. Children with a phonological disorder do not use some or all of the speech sounds expected for their age group. A child may have problems saying certain types of words, such as words that begin with two consonants. The word "spoon" may be pronounced as "soon," making the child difficult to understand.

Motor Skills

Some, but not all, children with 16p11.2 deletion have trouble with motor skills development. 53% of individuals with the deletion have developmental coordination disorder. This disorder is characterized by problems with movement due to lack of coordination. Neurological differences in people with 16p11.2 deletion syndrome are thought to cause problems with coordination. Parents often describe their children as clumsy. Interestingly, about half of people with 16p11.2 deletion syndrome are either left-handed or have the ability to use both right and left hands equally. Scientists believe that this is probably due to differences in the way their brains developed. **Low muscle tone** (hypotonia) is also frequently seen in infancy.

Behavior

Autism Spectrum Disorder (ASD)

Most people with 16p11.2 deletion syndrome will never be diagnosed with autism. About 24% of individuals with the 16p11.2 deletion have a clinical diagnosis of Autism Spectrum Disorder (ASD).

16p11.2 deletions are often found in people diagnosed with autism; but not everyone with 16p11.2 deletion syndrome will be diagnosed with autism. In fact, even though autism is probably one of the best known features of 16p11.2 deletion syndrome, it is not the most common. About 24% of individuals with the 16p11.2 deletion are diagnosed with ASD.

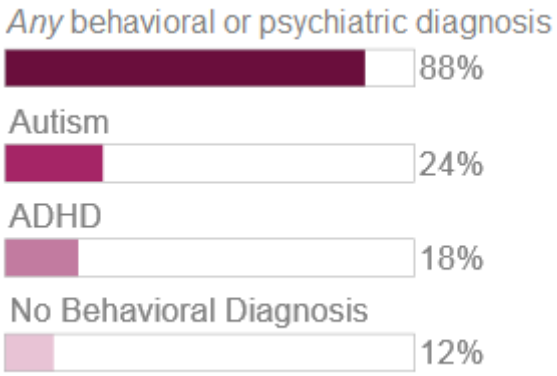
Frequently a child with 16p11.2 deletion syndrome will not meet strict diagnostic criteria for ASD but will have characteristics of autism. One example of an “autistic-like” behavior is repetitive/restrictive behaviors (RRBs), meaning the child may like lining up items. Not surprisingly, the language-related disorders that are features of autism, such as phonological processing (articulation) disorder, are most commonly seen among children with a 16p11.2 deletion. The majority of people with 16p11.2 deletion syndrome (88%) show more than one feature of autism, including difficulties with social interactions, communication skills, and restricted, repetitive behavior. Typically, males are more likely to have ASD that is more severe and ASD will show up less frequently in females.

Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is almost as common in individuals with the 16p11.2 deletion as autism; 18% of those with the 16p11.2 deletion are found to have ADHD. Some children with 16p11.2 deletion may use medications to help increase attention span and reduce hyperactivity.

Adult-Onset Psychiatric Conditions

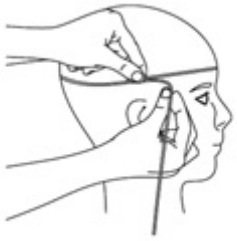
Schizophrenia is a psychiatric condition that affects a person's ability to think clearly, manage emotions, make decisions, and relate to others. Onset typically occurs in early adulthood. Schizophrenia has been reported in individuals with 16p11.2 deletion syndrome, but more research needs to be done on the risk of developing this psychiatric illness. So far, studies haven't shown a strong association, but it is important to be aware that some people with 16p11.2 deletion syndrome have developed schizophrenia. Besides schizophrenia, other conditions such as obsessive-compulsive disorder (OCD) or mood disorders such as bipolar or panic disorders have also been seen in individuals with the 16p11.2 deletion.



Growth Patterns

Increased Head Size (macrocephaly)

A larger head size is common in people who have the 16p11.2 deletion. In many cases, a larger-than-average head size does not directly cause neurological problems, but researchers are trying to understand how having a larger head size may affect brain structure and function. The 16p11.2 deletion affects brain size in a "dose-dependent" fashion, meaning that someone who has a 16p11.2 deletion will have a larger head size than someone without the deletion. People with a 16p11.2 duplication (3 copies of this region) tend to have a smaller-than-average head size.



Feeding Difficulties

Trouble with feeding has been reported by some parents for their child's first few weeks or months. While some children feed without any issues, others have trouble latching, sucking, and swallowing. These feeding difficulties can lead infants to have trouble gaining weight early in life. To help with this issue some babies have used a modified teat that is designed to help smaller babies get more milk. In more extreme cases, feeding tubes are used to make sure an infant is getting necessary nutrition.

BMI (Body Mass Index)

Being overweight can be an issue for some individuals with the deletion as they get older. **BMI** is a measure of the weight for a person's height and tends to be above average for people with the 16p11.2 deletion as children get older. As they become teenagers, obesity may become a problem. It is important to be proactive in controlling the weight of your child and to set up a healthy lifestyle (healthy diet and exercise) so that they continue to make and follow healthy habits. A consultation with a nutritionist may be helpful to learn more about how to support your child.

Neurological Issues

Brain Structure and Function

As part of the Simons VIP Phase I in-person visits, many families with 16p11.2 deletions had MRIs to study brain structure and function. In addition to the size of the brain being larger, differences in brain structure were also noted for individuals with the 16p11.2 deletion when compared to their family members and to people who did not have the 16p11.2 deletion.

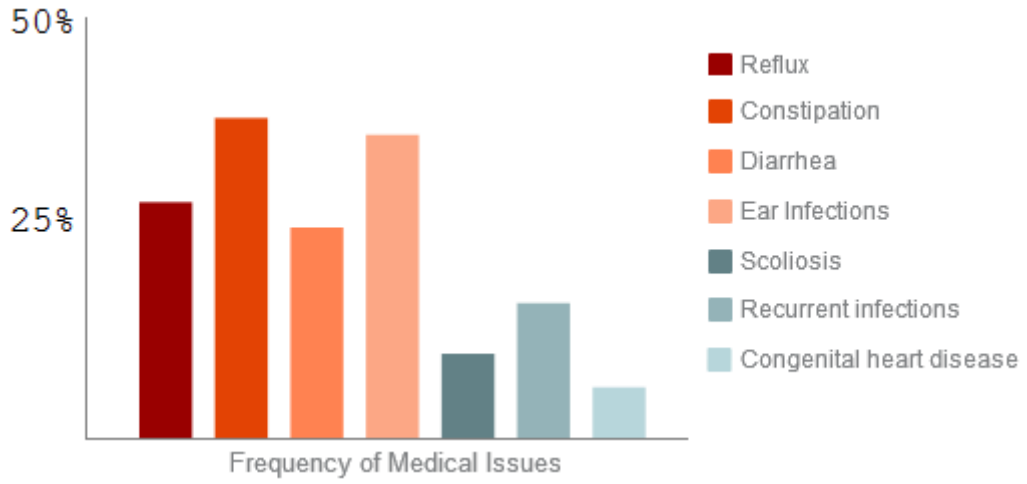
Seizures

Seizures are present in 24% of individuals with the 16p11.2 deletion. Seizures can be subtle and not easily recognized. For some children, an absence seizure may look like the child is "zoning-out" or day dreaming. If seizures are suspected, an evaluation by a neurologist should be considered. Some families find it useful to take pictures or videos of their child when he/she is having suspected seizure-like activity. Recordings of these episodes may help the neurologist to better understand and diagnose what your child is experiencing.

Other Medical Problems

Epilepsy is a relatively common neurological disorder observed in some people with the 16p11.2 deletion, and a referral should be made to a neurologist if seizures are suspected. A smaller and possibly underestimated fraction of individuals with the deletion have paroxysmal dyskinesia syndrome (repeated, brief involuntary movements triggered by sudden voluntary movements).

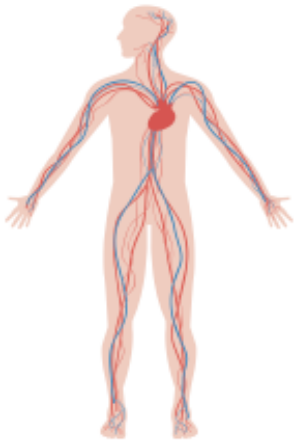
OTHER MEDICAL PROBLEMS	HOW COMMON IS IT IN A PERSON WITH 16P11.2 DELETION?	DESCRIPTION OF THESE HEALTH PROBLEMS
GASTROINTESTINAL (GI) PROBLEMS	Reflux - 28% Constipation - 38% Diarrhea - 25%	GI problems include constipation, gastro-esophageal reflux disease (GERD), and diarrhea during childhood.
OTITIS MEDIA	Seen in 36%	Ear infections in childhood
SCOLIOSIS	Seen in 10%	Abnormal curvature of the spine that develops over time
RECURRENT INFECTIONS	Seen in 16%	More infections are noticed and children may take a little more time to get over them
CONGENITAL HEART DISEASE	Seen in 6%	Heart problems present at birth are relatively common among *all* babies so it is not surprising that heart problems have been noticed in babies who also have 16p11.2 deletion. However, the chance is slightly higher than in the general population.



Evaluations Following Initial Diagnosis[1]

To evaluate for medical problems in an individual diagnosed with 16p11.2 deletion, the following are recommended:

- Measure height and weight at every visit with the pediatrician
- Broad medical review
- Routine check up
- Developmental assessment with cognitive and behavioral testing
- Consider consultation with a neurologist and EEG testing if the history suggests the possibility of seizures
- In patients with spinal curvature, x-ray of the spine to evaluate for vertebral anomalies
- Consider evaluation and echocardiogram by a cardiologist if there is a heart murmur
- Screening for hypertension and diabetes in patients who are overweight or obese



[1] Miller DT, Nasir R, Sobeih MM, et al. 16p11.2 Microdeletion. 2009 Sep 22 [Updated 2011 Oct 27]. In: Pagon RA, Adam MP, Ardinger HH, et al., editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2015. Available from: http://www.ncbi.nlm.nih.gov/books/NBK11167/

Ongoing Follow Up and Management[2]

1. Early diagnosis and provision of therapies facilitates the best outcome. Referral to other appropriate medical specialists is recommended based on specific symptoms or signs. Specialists may include a developmental/behavioral pediatrician, pediatric neurologist, and/or medical geneticist.
2. Due to the high incidence of neurodevelopmental disability, immediate referral to a clinical psychologist for full neuropsychological and/or developmental assessment for diagnostic differential and treatment recommendations is strongly suggested. Interventions may include speech and language therapy, occupational therapy, and physical therapy. Because of the high incidence of expressive language delays, speech therapy and augmentative and assistive means of communication should be considered early. *For families in the UK, these assessments would usually be carried out by a child's neurodisability team.*
3. Behavioral, social, and educational interventions for individuals with neurodevelopmental disabilities, including autism, are also appropriate. Guidelines for management of individuals with autism are available from the American Academy of Pediatrics.
4. Weight management and nutrition counseling are an important part of clinical care for patients with 16p11.2 deletion and healthy food choices and an active lifestyle are important to prevent problems with excessive weight gain.
5. Brain and spine MRI should be considered especially if there are symptoms suggestive of a Chiari I malformation and/or spinal cord dysfunction.
6. Screen for scoliosis (curvature of the spine) at the annual physical with the pediatrician. If there is scoliosis, perform an x-ray of the spine to check for vertebral anomalies.
7. If there are problems with repeated ear infections (3 or more in one year), ear tubes should be considered.
8. Persons with 16p11.2 deletion have more frequent infections. Rarely the 16p11.2 deletion has been associated with severe combined immunodeficiency (SCID). If a child has more than 6 infections in a year, talk with your pediatrician about an evaluation by an immunologist.

[2] Miller DT, Nasir R, Sobeih MM, et al. 16p11.2 Microdeletion. 2009 Sep 22 [Updated 2011 Oct 27]. In: Pagon RA, Adam MP, Ardinger HH, et al., editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2015. Available from: http://www.ncbi.nlm.nih.gov/books/NBK11167/

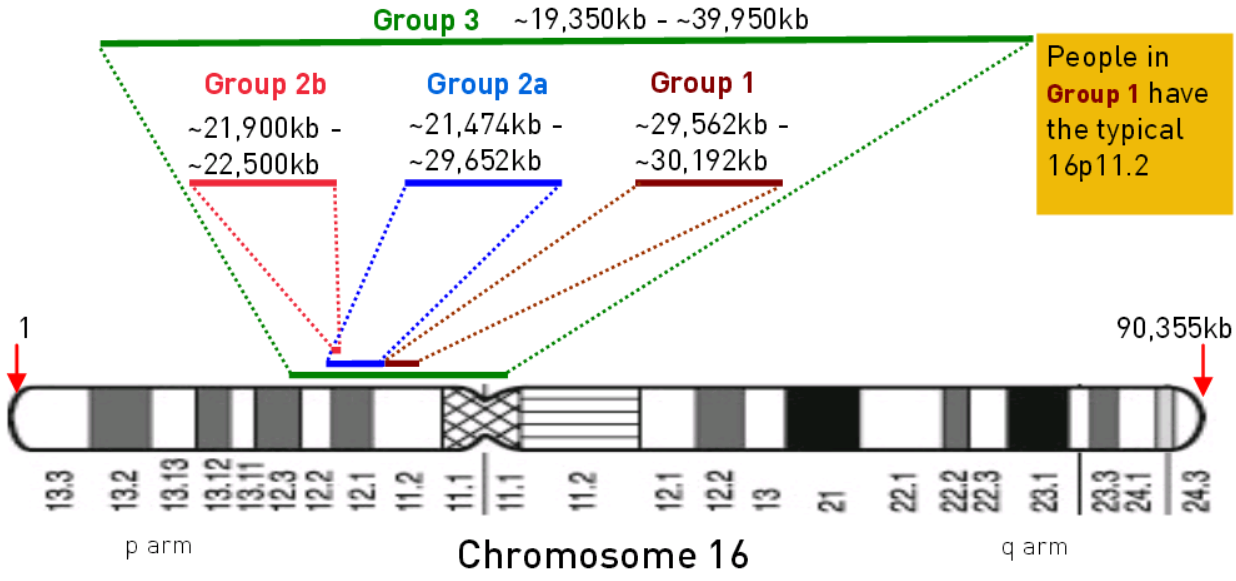
Different Deletions, Different Groups

Not every 16p11.2 deletion includes the exact same number of genes. There are different categories, or designations, used to describe 16p11.2 deletions based on the location and amount of genetic material deleted. As expected, different genes missing leads to different features.

Group 1 has the "typical," or most common, 16p11.2 deletion. This guidebook is tailored to individuals with a group 1 deletion.

Group 2 has deletions that do not overlap with Group 1 and are closer to the end of Chromosome 16; this is called the "distal" 16p11.2 region.

Group 3 has larger deletions that encomapse all of the genetic material missing in group 1 and group 2.



Living With 16p11.2 Deletion Syndrome

Growing up

As children grow up, it may feel like the gap between your child and other children is growing or that your child isn't able to keep up with peers. The gap in academic skills between a child and his/her typical peers tends to widen over time. Children with the deletion are often still learning and achieving goals at school, but it may be at their own pace. It's important to talk with your child's teacher about developing an Individualized Education Program (IEP) that meets your child's learning style and needs, but also challenges him or her.

Services

Typically there are several different kinds of professionals and services involved with the care of a child with 16p11.2 deletion syndrome. The services needed depend on the features that your child is showing. You are going to play an important role in directing, organizing, and advocating for your child's care. One or more of the following professionals may be involved in taking care of your child:

Genetic Counselors **and** ***Geneticists*** work with families with many different types of genetic diagnoses. A geneticist may help with the initial diagnosis, medical assessment, and coordination of appropriate referrals based on what we know about a child's medical concerns related to the diagnosis.

Genetic counselors can educate families about the 16p11.2 deletion and discuss how the diagnosis affects their family. They can also coordinate genetic testing for family members and identify appropriate support resources. To locate a genetic counselor near you, visit www.nsgc.org and click "Find a Genetic Counselor."

Pediatric Neurologists will be involved if there are concerns that seizures are occurring or if other neurological issues are present. If your child is having seizures, a neurologist can monitor and manage them.

Occupational Therapists work with people to help improve their ability to perform everyday tasks. They can evaluate the impact of the 16p11.2 deletion on daily activities at home, school, or work. For example, many children have trouble with their fine motor skills. Children with 16p11.2 may struggle with handwriting, using scissors, turning pages, or using a computer. An occupational therapist can work with your child to come up with a personalized plan to improve their skills in these areas.

Physical Therapists can evaluate and provide therapy to improve motor skills and coordination. Therapy can include stretches, exercises, and body movements that increase a person's motor abilities.

Nutritionists can help children manage their weight. Having 16p11.2 deletion syndrome does not mean someone will definitely experience weight gain and obesity, but it may take more work for them to

control their weight. A nutritionist is a helpful professional to meet a family's needs for developing the right eating and weight management plan for children with 16p11.2 deletions.

Developmental Pediatricians are physicians who specialize in developmental and behavioral disorders in children, including autism, developmental delay, and intellectual disability. They can recommend appropriate medical treatments and behavioral interventions, and they can provide information about school and intervention services in your local area.

Psychiatrists are experts in the diagnosis and treatment of ADHD, obsessive compulsive disorder, schizophrenia and other mental health conditions. While there is no cure for these disorders, psychiatrists can prescribe and monitor medications to treat psychiatric symptoms.

Psychologists and Social Workers help children and adults emotionally process feelings and challenges they face in everyday life. Psychologists can diagnose and treat a wide range of emotional and behavioral problems.

Primary Care Physicians (PCP) serve as the "headquarters" for a child's overall medical care. A child with a 16p11.2 deletion will still go for wellness check-ups every year, just like with any other child. In addition, a PCP can coordinate specialty referrals and make sure that any necessary lab tests are completed.

Applied Behavior Analysis *(ABA)* is a field of psychology that focuses on understanding behavior and how it is affected by a child's environment, including interactions with other people. ABA-based techniques are used to teach a range of academic, social, communicative, motor, and adaptive skills. A few studies have shown ABA to be a helpful intervention for some children with ASD.

Speech and Language Pathologists (SLPs) Many individuals with 16p11.2 deletion syndrome work with a SLP, since speech and language disorders are among the most common disorders associated with 16p11.2 deletion syndrome.

SLPs help children and adults with a variety of communication, reading, or swallowing problems.

Speech Disorders

- Articulation - the way we say our speech sounds
- Phonology - the speech patterns we use
- Apraxia - difficulty planning and coordinating the movements needed to make speech sounds
- Fluency - stuttering
- Voice - problems with the way the voice sounds, such as hoarseness

Language Disorders

- Receptive Language - difficulty understanding language
- Expressive Language - difficulty using language

- Pragmatic Language - social communication; the way we speak to each other

Other Disorders

- Deafness/Hearing Loss - loss of hearing; therapy includes developing lip-reading, speech, and/or alternative communication systems
- Oral-Motor Disorders - weak tongue and/or lip muscles
- Swallowing/Feeding Disorders - difficulty chewing and/or swallowing

There are several ways to find an SLP if you are concerned about your child's communication skills. Your school/school district should have a certified SLP that can observe and/or test your child for speech and language difficulties. Your local children's hospital will also have certified SLPs on staff. You will find them in departments such as: Department of Hearing and Speech, Clinic for Communication Disorders, or Developmental Clinic. Your family practitioner can also recommend an SLP. The American Speech-Language-Hearing Association (ASHA) provides a search engine to help you find a local, certified SLP in your area: http://www.asha.org/findpro/

(Information from www.superduperinc.com)

If a child has been diagnosed with a delay, speech or motor, he or she may be eligible to receive early intervention services. The American Academy of Pediatrics says that "early intensive behavioral and educational intervention can make a significant positive impact on long-term outcomes." Early intervention can include many different types of therapies.

What to Tell Teachers

Children with special learning and behavioral needs often receive an Individualized Education Program (IEP) through their school to help them reach their full learning potential. As mentioned, most children with a 16p11.2 deletion do not have a diagnosis of autism. We do know, however, that children with a 16p11.2 deletion often have some degree of intellectual disability or delay in development. It's important to inform your child's teachers about your child's needs. It may be helpful to give them a copy of this guidebook so they can better understand 16p11.2 deletion syndrome.

A request for the school district to conduct a comprehensive intellectual and academic assessment and to perform testing to identify strengths/weaknesses is a good starting point. Your child's progress should be monitored and he/she should receive an IEP and/or curricular modifications, if available. Often having a tutor or aide to encourage a child and reinforce skills can be useful for students who are feeling overwhelmed.

Some children participate in a typical classroom while others may require "pull-out" services. Other children may benefit most from participation in a special education classroom. Picking the right school setting for your child should is an important decision that should involve you, your child's teachers, administrators, and therapists.

Adaptive Technologies

There are numerous technologies that can aide a child with 16p11.2 deletion syndrome with learning and language skills. The best approach to finding out what kind of adaptive technologies can best help your child is to have an Assistive Technology (AT) or Augmentative /Alternative Communication (AAC) evaluation from a skilled clinician.

When selecting a speech device, it's important to take the following points into account:

- the student's interest in and comfort level with the technology
- the student's ease in learning about and using the technology
- the degree to which the technology "taps" into the student's strengths
- the extent to which the student is able to use the technology independently and "troubleshoot" as necessary
- the effectiveness of the technology in compensating for specific difficulties as compared to alternative strategies

(Information retrieved from http://www.greatschools.org/pdfs/e_guide_at.pdf)

Tablets can now be used for adaptive technology. While the Simons VIP Connect researchers and clinicians do not endorse any specific assistive devices, it may be helpful to watch one of our webinars on selecting an iPad at https://simonsvipconnect.org/en/about-cnvs/our-webinars/500.

In this webinar, Kelly A. Johnson, PhD of the UW Autism Center describes important qualities to consider when selecting an iPad and applications (apps) to use as a communication device for your child. Before buying an iPad it's important to consider the iPad size that will best fit your child's need. For example if he/she has poor hearing, a larger device will have larger speakers. The amount of storage needed, types of accessories, such as a stylus, insurance, a protective case, built in features, and of course cost are all things to take into consideration when picking out an iPad. Once you have an iPad for your child, in order for him/her to get the full benefit you will both need expert guidance on which apps to use to attain goals. Apps can be used for a variety of functions such as communication, social interaction, education, and even distraction during medical procedures. When choosing apps to use with your child, it's important to remember that the ones that cost money are not necessarily the most useful. While there are many apps out there catering to children with special needs, mainstream apps can be helpful as well. The iPad itself has a lot of useful tools built in such as video chat and the internet. If a child is using an iPad for communication, it's important to know that it should only be used by him or her. The iPad is working as your child's voice, so nobody else in the family should be using it. Lastly, while an iPad can be an excellent adaptive technology, it is not the only useful technology out there.

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We must also thank the entire Simons VIP study team – including all of the investigators, study coordinators, project managers, and administrators, as well as our website developer, Patient Crossroads, and our data coordinating center, Prometheus Research – who have dedicated many hours to meeting with families and making sure the project runs smoothly. Their work, along with other collaborators, has led to numerous publications about 16p11.2 (listed below).

Finally, we owe a huge debt of gratitude to the many families who have participated in the Simons VIP study. Since 2010, over 200 individuals with the 16p11.2 deletion have participated in this research project, with many families still contributing updates to this day! This guidebook has been made possible thanks to the time, energy and information they have committed to sharing with us.

A special thank you is extended to our 2015 summer intern, Elly Brokamp, for developing the initial draft of this comprehensive guide. Thank you for your contribution; your work has had a tremendous impact.

Resources and References

Resources

#	VIP APPROVED WEB RESOURCES
1	The Simons VIP Connect website https://simonsvipconnect.org/
2	The Simons VIP Connect Webinars archive https://simonsvipconnect.org/en/news-and-updates/webinars
3	Simons VIP Article Summaries https://www.simonsvipconnect.org/en/about-cnvs/vip-summaries-of-research-articles
4	Unique – Understanding Chromosome Disorders http://www.rarechromo.org
4	GeneReviews – 16p11.2 Microdeletion http://www.ncbi.nlm.nih.gov/books/NBK11167/
5	Genetics Home Reference – 16p11.2 deletion syndrome http://ghr.nlm.nih.gov/condition/16p112-deletion-syndrome

References

Articles Using Simons VIP Data

YEAR PUBLISHED	TITLE	AUTHORS
2012	Simons Variation in Individuals Project (Simons VIP): A genetics-first approach to studying autism spectrum and related neurodevelopmental disorders http://www.ncbi.nlm.nih.gov/pubmed/22445335	The Simons VIP Consortium
2012	A 600 kb deletion syndrome at 16p11.2 leads to energy imbalance and neuropsychiatric disorders http://www.ncbi.nlm.nih.gov/pubmed/23054248	Zufferey, et al.
2014	Aberrant white matter microstructure in children with 16p11.2 deletions http://www.ncbi.nlm.nih.gov/pubmed/24790192	Owen, et al.
2014	Opposing Brain Differences in 16p11.2 Deletion and Duplication Carriers http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4138332/	Qureshi, et al.
2014	Eating in the absence of hunger but not loss of control behaviors are associated with 16p11.2 deletions http://www.ncbi.nlm.nih.gov/pubmed/25234362	Gill, et al.
2015	The Role of Parental Cognitive, Behavioral, and Motor Profiles in Clinical Variability in Individuals With Chromosome 16p11.2 Deletions http://www.ncbi.nlm.nih.gov/pubmed/25493922	Moreno-De-Luca, et al.
2015	Auditory Evoked M100 Response Latency Is Delayed in Children with 16p11.2 Deletion but not 16p11.2 Duplication http://www.ncbi.nlm.nih.gov/pubmed/25678630	Jenkins, et al.
2015	The cognitive and behavioral phenotype of the 16p11.2 deletion in a clinically ascertained population http://www.ncbi.nlm.nih.gov/pubmed/25064419	Hanson, et al.

Other Articles about 16p11.2 Deletion Syndrome

YEAR PUBLISHED	TITLE	AUTHORS
2008	Association between Microdeletion and Microduplication at 16p11.2 and Autism http://www.ncbi.nlm.nih.gov/pubmed/18184952	Weiss, et al.
2009	Extending the phenotype of recurrent rearrangements of 16p11.2: deletions in mentally retarded patients without autism and in normal individuals http://www.ncbi.nlm.nih.gov/pubmed/19306953	Bijlsma, et al.
2010	Evidence for a recurrent microdeletion at chromosome 16p11.2 associated with congenital anomalies of the kidney and urinary tract and hirschsprung disease http://www.ncbi.nlm.nih.gov/pubmed/20799338	Sampson, et al.
2010	Expanding the clinical spectrum of the 16p11.2 chromosomal rearrangements: three patients with syringomyelia http://www.ncbi.nlm.nih.gov/pubmed/20959866	Schaaf, et al.
2010	A new highly penetrant form of obesity due to deletions on chromosome 16p11.2 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2880448	Waters, et al.
2010	Cognitive and behavioral characterization of 16p11.2 deletion syndrome http://www.ncbi.nlm.nih.gov/pubmed/20613623	Hanson, et al.
2010	Recurrent reciprocal 16p11.2 rearrangements associated with global developmental delay, behavioral problems, dysmorphism, epilepsy, and abnormal head size http://www.ncbi.nlm.nih.gov/pubmed/19914906	Shinawi, et al.
2010	Phenotypic spectrum associated with de novo and inherited deletions and duplications at 16p11.2 in individuals ascertained for diagnosis of autism spectrum disorder http://www.ncbi.nlm.nih.gov/pubmed/19755429	Fernandez, et al.

2010	Speech delays and behavioral problems are the predominant features in individuals with developmental delays and 16p11.2 microdeletions and microduplications http://www.ncbi.nlm.nih.gov/pubmed/21731881	Rosenfeld, et al.
2011	Intra-family phenotypic heterogeneity of 16p11.2 deletion carriers in a three generation Chinese family http://www.ncbi.nlm.nih.gov/pubmed/21302351	Shen, et al.
2011	Mirror extreme BMI phenotypes associated with gene dosage at the chromosome 16p11.2 locus http://www.ncbi.nlm.nih.gov/pubmed/21881559	Jacquemont, et al.