Table 3
Selected genetic disorders associated with ADHD

Genetic Condition	Neuroanatomic alteration	Neuropsychological impairments	Gene and/or biochemistry	Ref.
Neurofibromatosis I	Aqueductal stenosis, hydrocephalus	30% learning disabilities, 10% mild mental retardation	Caused by mutations in the neurofibromin gene (NF1)	141
Varying degrees of Holoprosencephaly (HPE) associated with mild features	Microcephaly and general abnormalities involving telencephalic and diencephalic structures	Impaired executive functions, attention problems	HPE is caused most frequently by mutations in SHH, but also in SIX3, TGIF and ZIC2	142
Turner Syndrome	Unknown	Girls with Turner syndrome have significantly more problems with social relationships and school progress and were more likely to meet criteria for ADHD than control girls	Complex	143–145
Williams Syndrome	In the mice, haploinsufficiency for Cyln2 encoding CLIP-115, located in the 1.6 Mb common deletion leads to brain abnormalities, hippocampal dysfunction and particular deficits in motor coordination. Absence of CLIP-115 also leads to increased levels of CLIP-170 (a closely related cytoplasmic linker protein)	Mental retardation (average IQ 56), relative sparing of language, poor visual-motor integration (Range 41–80), hypersensitivity to sound, attention deficit disorder, cocktail party personality	Contiguous gene syndrome with haploinsufficiency, of multiple genes including Elastine (ELN), LIM kinase-1 (LIMK1), and RFC2	146, 147
Fragile X Syndrome	Cortical and sub-cortical grey matter alterations (caudate, vermis), abnormalities in dendritic arbori_ation of the cortex, alterations in volume of caudate nucleus and in the cerebellar vermix.	Wide range of variability in mental retardation, ADHD symptoms (74%), ODD, impaired executive function, viso-spatial abilities, visuomotor coordination	Unclear, possible several neurotransmitters affected.	148
Smith-Magenis Syndrome	Ventriculomegaly, dysgenesis of the cerebellar vermis overlapping with features of Joubert Syndrome	Speech delay, mental retardation (IQ 20–78), behavioral problems, self-destructive behavior, sleep disturbance, hyperactivity, peripheral neuropathy, decreased pain sensitivity	Caused by an interstitial deletion of 17p11.2	149–153
Phenylketonuria	Prefrontal cortex dysfunction	Altered executive functions	Alterations of the Dopamine metabolic pathway as consequence of PAH alteration	154–158
Fetal alcohol syndrome	D1 receptors in mesolimbic dopamine system	Difficulties in learning, speed information, attentional, working memory and self regulation processes	Several neurotransmitters are affected including dopamine, serotonine norepinephrine, glutamate, GABA, histamine	159
Deletion 22q11.2 syndrome	Abnormal left/right pattern of caudate nucleus (also seen in ADHD)	13 of 20 children tested have ADHD, mainly inattentive or combined type and/or autism spectrum problems	Suspected the involvement of COMT, contained in the deleted region	160–162
Traumatic Brain Injury (TBI)	According with severity, lesion locali_ation and time. Frontal lobe and basal ganglia lesions specially associated with ADHD phenotype	ADHD symptoms, depression, executive dysfunction, memory and behavioral alterations	Disruption of frontobasal ganglia pathways among other alterations	163–166