Table 2. Residual enzyme activity of β-mannosidase and clinical phenotype associated by MANBA mutations.

Mutation			Activity in patients' cells (patient vs. normal) *	Activity in transfected COS-7 cells	Symptoms	Ref. for molecular analysis	Ref. for clinical analysis
Position	**DNA**	**Protein**					
Exon 2	c.248G>T	p.Glu83X	Leukocytes : 1 vs. 245-467 Fibroblasts : 4 vs. 58-389	ND	Age of onset : 5 years. Hearing loss, mental retardation. No other neurological signs. Angiokeratomas. No facial dysmorphism, no skeletal deformation.	[23]	[19]
Exon 10	c.1276C>T	p.Gln426X					
Exon 3	c.375A>G	p. Tyr126AlafsX11	Leukocytes: 0.5 vs. 104-432 Fibroblasts: 0 vs. 60-208	ND	Infantile onset. Speech impairment, mental retardation, hyperactive behavior, facial dysmorphism and respiratory infections. No skeletal deformations.	[24]	[9]
Exon 12	c.1513T>C	p.Ser505Pro		0			
Exon 4	c.544C>T	p.Arg182Trp	Fibroblasts : 1.5% Serum and leukocytes : not detectable	0	Age of onset : 24 years. Angiokeratoma, slight deafnesss, abdominal pain. No neurological involvement.	[17, 24]	[17]
Exon 11	c.1398G>A	p.Trp466X		ND			
Exon 5	c. 563_572dup10	p.Trp192X	Leukocytes: 18 vs. 469 U/L Serum: 24 vs. 407 U/L	ND	Age of onset : 18 months. Delay in speech acquisition. Motor and vocal tics, attention-deficit/hyperactivity disorder, aggressiveness compatible with Gilles de la Tourette syndrome. Recurrent upper airway infections,	[16]	[16]
Intron 13	c.1705-1G>A	not applicable		ND			

					hearing loss. No other neurological problems. No dysmorphism.		
Exon 6	c.693G>A	p.Trp231X	Leukocytes, fibroblasts and serum :<1%	ND	Mental retardation since childhood, aggressive behavior, deafness, recurrent erysipelas, mild renal failure. Multiple angiokeratomas.	[18]	[18]
Exon 9	c.1175G>A	p.Gly392Glu	Leukocytes : 3 vs. 73-186 Fibroblasts : 1.9 and 5 vs. 98-428	0	Age of onset : 12 years. Angiokeratoma, scantly communicative. No mental retardation, no hearing loss, no behavior problems, no neurological skeletal deformation, no respiratory signs, no facial dysmorphism, no infections.	[17, 24]	[11]
Exon 13	c.1848delA	p.Asp617IlefsX8		ND			
Exon 11	c.1454-1455delAT	p. Tyr485CysfsX27	Leukocytes : 4.7 vs. 160-300 Fibroblasts : 0 vs. 115-455	ND	Age of onset : 15 months. Speech development problems. Recurrent respiratory tract infections, hearing loss. Motor and mental retardation (at age 5), hyperactive and aggressive behavior (at age 18), facial dysmorphism and skeletal deformation.	[23]	[8]
Intron 7	c.960+1G>A	p.Val321IlefsX5	Plasma: 5.4 vs.193-331 Fibroblasts: 10%	ND	Age of onset : 2 years. Hearing loss, mental retardation and developmental disorders. Hypertension and chronic renal failure. Numerous angiokeratomas.	[13]	[13]

Intron 15	c.2015-2A>G	p.Val720LeufsX6 p.Val720AlafsX75	Fibroblasts : 0 vs. 51-195	ND	Age of onset : 14 months. Severe psychomotor retardation, bone deformities and facial dysmorphism, macroglossia, gingivial hyperplasia, umbilical hernia. Recurrent skin and respiratory infections. Hypotonia, aggressive behavior.	[25]	[6]
			Leukocytes :0 Fibroblasts : 0 Plasma : 0		Affected brother: milder facial dysmorphism, mental retardation, hearing impairment and recurrent infections.		[6]
ND	ND	ND	Leukocytes: 0 vs. 119 Fibroblasts: 0 vs. 103	ND	Age of onset : 1 year. Facial dysmorphism and skeletal deformations, mental retardation, hyperactive behavior, mild hearing loss. (+ sulfamidase deficiency)		[2]
ND	ND	ND	Leukocytes: 0 vs. 45-150	ND	Age of onset : 3 weeks. Mental retardation, hearing loss, hypotonia, speech retardation, feeding difficulties, respiratory infections. No facial dysmorphism, no skeletal deformation.		[5]
ND	ND	ND	Leukocytes: 7 vs. 245-467 Fibroblasts: 8.7 vs. 58-389	ND	Age of onset : 9 months. Seizures, moderate developmental delay. Brachecephaly. No skeletal deformation. Death at 15 months.		[7]

ND	ND	ND	Leukocytes: 3 vs. 80-170	ND	Age of onset : 6 years. Disinterest, apathy, clumsiness, demyelinating peripheral neuropathy. No facial dysmorphism, no skeletal deformation, no hearing loss.	[10]
ND	ND	ND	Serum : 22 vs. 180-600 Leukocytes: 0 vs. 100-450	ND	Age of onset : 7 months. Hypotonia, feeding difficulties, recurring respiratory infections, delayed motor development.	[12]

* Unless otherwise indicated, enzyme activity is expressed as nmol/h.mg protein for leukocytes or fibroblasts, or nmol/h.ml for serum. ND, not determined.