Specific Care Considerations for Patients with Turner Syndrome

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Specific Care Considerations for Patients with Turner Syndrome

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Learning Objectives
At the end of this lecture, participants will be able to:

1. Be aware of the most up-to-date information on Turner Syndrome care
2. Review the risks associated with reproductive health
3. Risk of developing diabetes
4. Recommendations of transitional care in girls with Turner Syndrome
5. Understanding the importance of continued adult care

Diagnosis and Genetics

- Considering a diagnosis of TS in phenotypic females with a karyotype containing:
  - –One X chromosome
  - –Complete or partial absence of the second sex chromosome
  - – Associated with one or more typical clinical manifestations of TS
- Consider testing for Turner syndrome (TS) in a female with typical signs

Type and frequency of chromosome abnormalities in Turner syndrome

Karyotype	%	Description
45,X	40–50	Monosomy X
45,X/46,XX	15–25	
45,X/47,XXX; 45,X/46,XX/47,XXX	3	Mosaicism with 'Triple X'
45,X/46,XY	10–12	Mixed gonadal dysgenesis
46,XX, del(p22.3); 46,X,r(X)/46,XX		Deletion Xp22.3
		Ring X chromosome
46,X i(Xq); 46,X,idic(Xp)	(10%)	Isochromosome Xq; isodicentric Xp
X-autosome translocation, unbalanced	Rare	Various
46,XX,del(q24)		Not TS; premature ovarian failure
46,X,idic(X)(q24)		Not TS; isodicentric Xq24

Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting, *European Journal of Endocrinology*, *177*(3), G1-G70.

Common Abnormalities associated with Turner Syndrome and Approximate Prevalence

Feature	Frequency (%)
Growth failure and reduced adult height	95–100
Failure to thrive during first year of life	50
Glucose intolerance	15–50
Type 2 diabetes	10
Type 1 diabetes	?
Thyroiditis	15–30, ann. incidence ~3%
Hypertension	50
Elevated hepatic enzymes	50–80

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Common Abnormalities associated with Turner Syndrome and Approximate Prevalence

Feature	Frequency (%)
Micrognathia (small mandibular bone)	60
High-arched palate	35
Abnormal dental development	?
Neck	
Low posterior hairline	40
Broad short-appearing neck	40
Pterygium colli (webbed neck)	25

Judith L. Ross MD, et all Turner Syndrome: Toward Early Recognition and Improved Outcomes, Medscape, 2019

Common Abnormalities associated with Turner Syndrome and Approximate Prevalence

Feature	Frequency (%)
Lymphedema of hands and feet	25
Multiple pigmented nevi	25
Nail hypoplasia/dystrophy	10
Skeleton	
Bone age delay	85
Decreased bone mineral content	50–80
Cubitus valgus	50
Short fourth metacarpal	35
Genu valgum	35

Judith L. Ross MD, et all Turner Syndrome: Toward Early Recognition and Improved Outcomes, Medscape, 2019

Common Abnormalities associated with Turner Syndrome and Approximate Prevalence

Feature	Frequency (%)
Bicuspid aortic valve	14–34
Coarctation aorta	7–14
Aortic dilation/aneurysm	3–42
Horseshoe kidney	10
Abnormal positioning or duplication of renal pelvis, ureters or vessels	15
Renal aplasia	3

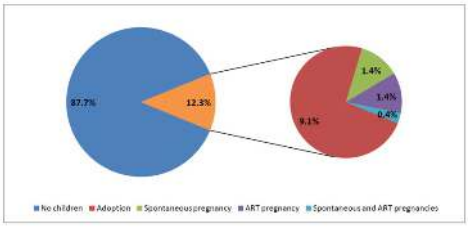
Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting, *European Journal of Endocrinology*, *177*(3), G1-G70.

Fertility

- The probability of females with Turner Syndrome to conceive ⊕⊕⊕⊕
  - spontaneously decreases rapidly with age
  - if at all present
  - consideration should be given to offering fertility treatment at a young age
- Spontaneous pregnancies occur in 4.8–7.6% of women with TS
- Frequency of miscarriages after spontaneous pregnancy was reported to be high: 30.8–45.1%

Bryman, Pregnancy rate and outcome in Swedish Women with turner syndrome Fertility and Sterility 2011

Pregnancies in TS Women



Fertil Steril. 2011 Jun; 95(7): 2251–2256.

Pregnancy cases: pregnancy outcome and comments on progeny

Tarani, Pregnancy in patients with Turner Syndrome: six new cases and review of the literature Gynecological Endocrinology 1998 12 83-87

Spontaneous Pregnancy Outcomes in Turner Syndrome Patients

Maternal karyotype	Patients	Pregnancies	Healthy	Miscarriages	Stillborn	Malformed	No details
Literature							
45,X	15	25	13	9	2	5	0
45,X/46,XX	23	41	18	11	2	7	3
45,X/47,XXX	12	20	16	1	6	3	2
45,X/46,XX/47,XXX	14	44	13	15	6	13	2
45,X/46,XX/47,XXX/48,XXXX	1	2	0	2	–	0	0
46,X,del(Xp)	3	5	—	–	–	3	—
Personal cases							
45,X/46,X,r(X)	1	1	0	0	0	1	0
45,X/46,XX/47,XXX	2	4	1	2	0	2	0
46,X,del(X)(p21)	1	1	1	0	—	1	—
45,X/46,XX	2	4	2	2	—	12 (20%)	—
Total	74	160	62 (38%)	47 (29%)	11 (7%)	41 (26%)	9 (6%)

Tarani, Pregnancy in patients with Turner Syndrome: six new cases and review of the literature Gynecological Endocrinology 1998 12 83-87

Maternal characteristics in women with TS karyotype giving birth in Sweden from 1973–2007

	45,X	45,X/46,XX	Others	45,X/46,XX low-grade mosaicism (<10%)	All TS women	All TS women excluding 45,X/46,XX low-grade mosaicism (<10%)	Medical Birth Register reference group[a]
n	12	28	52	12	112	100	56,000
Age at TS diagnosis (yr), median (range)	36 (10–42)	35 (13–65)	33 (8–46)	33 (8–44)	33 (8–65)	33 (8–65)	NA
TS known before first delivery [n (%)]	8 (80)	15 (39)	25 (48)	6 (50)	48 (43)	54 (54)	NA
Women's year of birth [n (%)]							
<1940	0	1 (7.0)	0	0	1 (0.9)	1 (1.0)	507 (0.9)
1940–1949	0	3 (7.0)	1 (1.9)	1 (8.3)	5 (4.5)	4 (4.0)	2,500 (4.5)
1950–1959	0	13 (34.2)	8 (15.4)	1 (8.3)	22 (19.6)	21 (21.0)	11,000 (19.6)
1960–1969	5 (50.0)	17 (44.7)	24 (46.2)	5 (41.7)	51 (45.5)	46 (46.0)	25,500 (45.5)
1970–1979	4 (40.0)	3 (7.9)	16 (30.8)	5 (41.7)	28 (25.0)	23 (23.0)	14,000 (25.0)
≥1980	1 (10.0)	1 (5.0)	3 (5.8)	0	5 (4.5)	5 (5.0)	2,500 (4.5)
Year of first delivery [n (%)]							
1973–1982	0	11 (28.9)	5 (9.6)	1 (8.3)	17 (15.2)	16 (16.0)	10,875 (19.4)
1983–1989	1 (10.0)	7 (18.4)	6 (11.5)	1 (8.3)	15 (13.4)	14 (14.0)	11,453 (20.5)
1990–1999	4 (40.0)	14 (36.8)	18 (34.6)	5 (41.7)	41 (36.6)	36 (36.0)	20,634 (36.8)
2000–2007	5 (50.0)	6 (15.8)	23 (44.2)	5 (41.7)	39 (34.8)	34 (34.0)	13,038 (23.3)
Maternal age at first delivery (yr), median (range)	28.5 (18–32)	30 (18–37)	28 (20–41)	31.5 (26.5–39)	30 (18–41)	30 (18–41)	26 (13–48)
Maternal age at second delivery (yr), median (range)	30.5 (22–37)	34 (21–43)	31.5 (22–43)	33.5 (22–38)	32 (21–43)	32 (21–43)	28 (16–47)
Parity[b] (n)							
1	8	15	24	6	53	47	17,405
2	1	14	11	4	30	36	25,509
≥3	1	9	4	2	21	19	13,086
Height (cm), median (range)	157 (140–165)	162 (150–180)	161 (140–178)	166 (158–174)	161 (140–180)	160 (140–180)	165 (120–190)
Smoking at first delivery[c] [n/N (%)]	2/10 (20.0)	2/26 (7.7)	6/45 (13.3)	4/11 (36.4)	14/92 (15.2)	10/81 (12.3)	[illegible]
BMI at first delivery (kg/m²), median (range)	22.4 (18.8–29.2)	25.4 (19.7–33.4)	24.4 (18.5–39.4)	25.2 (18.0–35.1)	24.5 (18.0–39.4)	24.5 (18.5–39.4)	23.0 (13.7–61.3)

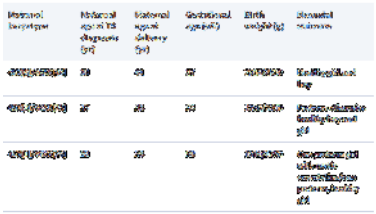
Hagman et al.The Journal of Clinical Endocrinology & Metabolism, Volume 96, Issue 11, 1 November 2011, Pages 3475–3482

Birth defects in singletons born to women with TS karyotype in Sweden from 1973–2007

Maternal karyotype	Gender, year of birth	Birth defect
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Hagman et al.The Journal of Clinical Endocrinology & Metabolism, Volume 96, Issue 11, 1 November 2011, Pages 3475–3482

Obstetric outcomes in women with TS karyotype giving birth to twins (n = 3) in Sweden from 1973–2007



Hagman et al. *The Journal of Clinical Endocrinology & Metabolism*, Volume 96, Issue 11, 1 November 2011, Pages 3475–3482

Fertility

- Considering oocyte donation for fertility, only after thorough screening and appropriate counseling ⊕⊕⊕⊕
- Management of pregnant women with TS should be undertaken by ⊕⊕⊕◯
  - multidisciplinary team
    - maternal-fetal medicine specialists
    - cardiologists with expertise in managing women with TS

Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting. *European Journal of Endocrinology*, *177*(3), G1-G70.

Clinical characteristics of the study group

Patients age at the time of enrollment (years)[a]	37 (26–47)
Patients age at the time of diagnosis (years)[a]	34.5 (18–46)
Age of menarche (years)[a]	13 (11–18)
Age at marriage (years)[a]	25 (15–40)
Patients age at first pregnancy (years)[a,b]	23 (18–32)
Time from the marriage to the first conception (months)[a,b]	12 (6–49)
Height of the patients (cm)[a]	163 (132–174)
Body mass index at the enrollment (kg/m^2)[c]	28.43 ± 1.21

Reprod Bio Endocrinol. 2015; 13: 59

Comparison of the ratios of live birth and miscarriage or terminated fetus between groups

Maternal karyotype	45,X/46,XX (*n* = 17)	45,X/46,XX/47,XXX (*n* = 5)	All cases (*n* = 22)	p
No of pregnancies (n)	35	17	52	.678
Live birth (n (%))	10 (28.6)	7 (41.2)	17 (32.7)	.611
Miscarriage (n (%))	25 (71.4)	10 (58.8)	35 (67.3)	.712

Reprod Bio Endocrinol. 2015; 13: 59.

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Comparison of the ratios of live birth and miscarriage or terminated fetus between low and high grade mosaic cell line groups

Mosaic cell line ratio	Cases with low grade mosaic cell line (*n* = 17)	Cases with high grade mosaic cell line (*n* = 5)	All cases (*n* = 22)	p
No of Pregnancies (n)	46	6	52	.062
Miscarriage (n (%))	30 (65.2)	5 (83.3)	35 (67.3)	.468
Live Birth (n (%))	16 (34.8)	1 (16.7)	17 (32.7)	.127

Reprod Bio Endocrinol. 2015; 13: 59

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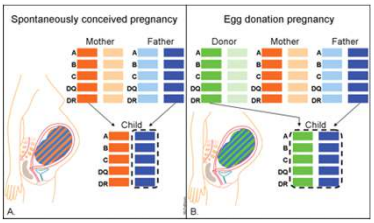
Figure 3 Schematic of the inheritance of the most immunogenic HLA-antigens in a spontaneously conceived and an ED ...



Human Reproduction Update, Volume 16, Issue 6, November-December 2010, Pages 704–712, https://doi.org/10.1093/humupd/dmq017

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OXFORD

Perinatal outcomes of the pregnancies that resulted in live birth

	Number	Percentage
Route of delivery		
Vaginal	9	52.9 %
Abdominal (C/S)	8	47.1 %
Fetal gender		
Female	12	70.6 %
Male	5	29.4 %
Adverse perinatal outcomes		
IUGR	1	5.9 %
P.previa	1	5.9 %
GDM	2	11.8 %

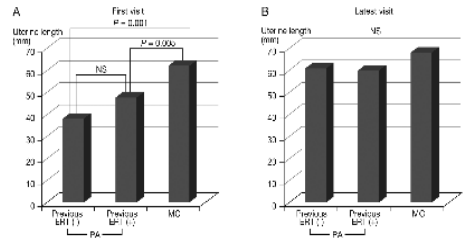
C/S, cesarean section; IUGR, intrauterine growth restriction; P.previa, placenta previa; GDM, gestational diabetes mellitus

Reprod Bio Endocrinol. 2015; 13:

	Primary amenorrhea (n = 88)		Menstrual cycle (n = 12)	P
	Previous ERT (-) (n = 16)	Previous ERT (-) (n = 72)		
Age (years)	31.8 ± 9.1 (17 – 58)	32.0 ± 7.4 (18 – 49)	28.9 ± 6.6 (18 – 40)	NS
Age at initial evaluation	23.6 ± 8.9 (15 – 50)	26.1 ± 6.6 (14 – 41)	23.2 ± 5.0 (18 – 30)	NS
Height (cm)	147.2 ± 7.9 (130.0 – 163.0)	145.6 ± 5.1 (132.0 – 158.0)	141.1 ± 6.0 (130.0 – 149.5)	0.047
BMI (kg/m^2)	22.2 ± 4.8 (15.8 – 36.0)	21.9 ± 3.6 (15.0 – 33.6)	23.0 ± 3.2 (19.0 – 29.0)	NS
Karyotype	Monosomy 6 Structural abnormality 5 Mosaic 4 Unknown 1	Monosomy 11 Structural abnormality 19 Mosaic 30 Unknown 9	Structural abnormality 4 Mosaic 8	
Medical history of GH therapy	GH (+) 3 GH (-) 9 others 4	GH (+) 27 GH (-) 23 Others 22	GH (+) 6 GH (-) 5 Others 1	
Age at initiating ERT (years)	22.3 ± 6.2 (16 – 37)	20.2 ± 6.5 (14 – 44)	13.0 ± 1.0 (12 – 14) (Age at menarche)	
Duration of ERT (years)	5.1 ± 3.3 (1 – 9)	11.2 ± 7.1 (5 – 32)		

Nakamura et al.Endocrine Journal 2015, 62 (11), 965-970

Estrogen Replacement Effect on Uterus and Bones in Patients with Turner Syndrome



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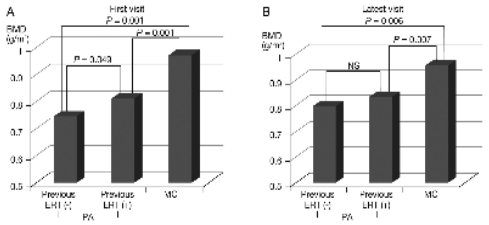


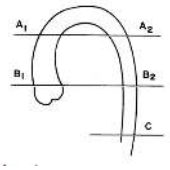
Nakamura et al.Endocrine Journal 2015, 62 (11), 965-970

Cardiovascular risks During Pregnancy

- All women with TS should be counseled about the increased cardiovascular risk of pregnancy
- Imaging of the thoracic aorta and heart with a transthoracic echocardiography (TTE) and CT/ cardiac magnetic resonance scan (CMR) within 2 years before planned pregnancy or Assisted Reproductive therapy (ART) in all women with TS
- ART or spontaneous conception should be avoided in case of an ascending ascending aortic size index ASI of >2.5 cm/m^2 or an ascending (ASI) 2.0-2.5 cm/m^2 with associated risk factors for aortic dissection AoD, which include
  - bicuspid aortic valve
  - elongation of the transverse aorta
  - coarctation of the aorta
  - hypertension
- Women with a history (AoD) should be advised against pregnancy
  - If already pregnant, these women should be followed very closely at a specialist center and deliver by cesarean section
- Preform transthoracic echocardiography (TTE) in women with TS without aortic dilatation or other risk factors (hypertension, bicuspid aortic valve, coarctation, previous aortic surgery) at least once during pregnancy
  - approximately 20 weeks of gestation

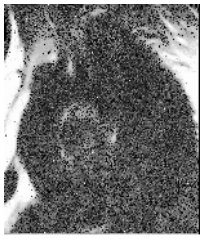
Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting, *European Journal of Endocrinology*, *177*(3), G1-G70.

Aortic dilatation in Turner syndrome:the role of MRI in early recognition



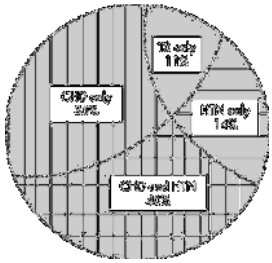
Pediatr Radiol (2005) 35: 323–326

Aortic dilatation in Turner syndrome:the role of MRI in early recognition



Pediatr Radiol (2005) 35: 323–326

Venn diagram of 65 people with TS who had aortic dissection with signs of congenital heart disease (CHD) or systemic hypertension (HTN)

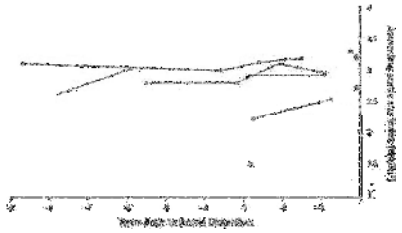


J Med Genet. 2007 Dec; 44(12): 745–749

Cardiovascular risks During Pregnancy

- Women with TS with an ascending ASI >2.0 cm/m² or any risk factor (hypertension, bicuspid aortic valve, coarctation, previous AoD or surgery) should be monitored frequently:
  - Transthoracic echocardiography at 4- to 8-week intervals during pregnancy
  - During the first 6 months postpartum
- Cardiac magnetic resonance scan (without gadolinium) should be performed during pregnancy when there is suspicion of disease of the distal ascending aorta, aortic arch or descending aorta
- Blood pressure control is strict (135/85 mmHg) in all pregnant women with TS
- During pregnancy prophylactic surgery is reasonable in case of a dilated aorta with rapid increase in diameter

Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting, *European Journal of Endocrinology*, *177*(3), G1-G70.



Moderate Aortic Enlargement and Bicuspid Aortic Valve Are Associated With Aortic Dissection in Turner Syndrome, Volume: 126, Issue: 18, Pages: 2220-2226, DOI: (10.1161/CIRCULATIONAHA.111.068833)

Cardiovascular risks During Pregnancy

- Exercise testing before pregnancy can be useful to reveal exercise induced hypertension, especially in women with coarctation
- Women with aortic dilatation, bicuspid aortic valve, elongation of the transverse aorta, coarctation of the aorta and/or hypertension should be advised that pregnancy would carry a high risk of aortic dissection
- Vaginal delivery is reasonable in women with TS with an ascending ASI below 2.0 cm/m^2
- In women with TS with a history of AoD, a cesarean section should be performed

32

Gravholt et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting, *European Journal of Endocrinology*, *177*(3), G1-G70.

Diabetes

- Recommend lifelong annual measurement of HbA1c with or without fasting plasma glucose starting at age of 10 years ⊕⊕◯◯
- Risk of both type 1 diabetes mellitus is about 10-fold in patients with TS across all ages
  - Confirmation of diabetes should prompt assessment of antibodies related to type 1 diabetes, as well as evaluation by a diabetes specialist.
- Risk of type 2 diabetes mellitus is about 4-fold increased in patients with TS across all ages
- Patients with TS are at increased risk for hyperinsulinemia
  - insulin resistance
  - decreased insulin secretion
  - Impaired Glucose Tolerance Test
  - Diminished first-phase insulin release
  - Decreased β-cell responsiveness

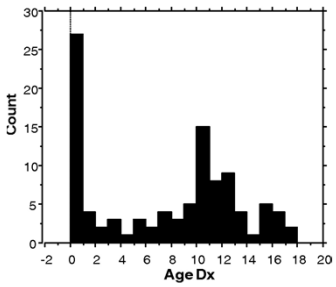
33

SuMASteneroson et al. The role of X-linked FOXP3 in the autoimmune susceptibility of Turner syndrome patients. Clinical Immunology 2009 131 139–144. (doi:10.1016/j.clim.2008.11.007)

Diabetes

- No additional increase in the incidence of insulin-requiring diabetes has been noted during GH therapy
- one study suggests treatment with GH may lead to lower adiposity and less IGT.

Fig. 1. Distribution of ages of TS diagnosis (Dx) for 102 girls participating in the NIH study from 2001–2007. The ...



The Journal of Clinical Endocrinology & Metabolism, Volume 93, Issue 6, 01 June 2008, Pages 2109–2114, https://doi.org/10.1210/jc.2007-2266

GH use, body composition, and glucose tolerance in TS

	GH (76)	No GH (26)	*P*
Age (yr)	13.9 ± 3.6	13.6 ± 3.7	NS
BMI (kg/m^2)	22.2 ± 4.7	25.1 ± 7.2	0.002[a]
Height sd	-1.93 ± 0.8	−2.51 ± 1.3	0.009[a]
BF (%)	28.2 ± 8.3	35 ± 7.7	*P* < 0.0001[b]
SAT (ml)[c]	99.5 ± 81.8	183.2 ± 37.5	0.001[b]
VAT (ml)[c]	33 ± 13.7	49.8 ± 7.8	0.0009[b]
IGT	7%	28%	0.006

The Journal of Clinical Endocrinology & Metabolism, Volume 93, Issue 6, 01 June 2008, Pages 2109–2114, https://doi.org/10.1210/jc.2007-2266

Prepubertal GH treatment, body composition, and glucose tolerance

	GH (36)	No GH (18)	*P*
Age (yr)	10.7 ± 03.4 (7–16)	12.5 ± 2.8 (7–16)	0.02
BMI (kg/m^2)	20.3 ± 3.7	23.2 ± 4.1	0.01[a]
BF (%)	24.6 ± 3.2	34.4 ± 4.5	<0.0001[b]
SAT (ml)[c]	70.3 ± 12.3	112.0 ± 21.8	0.0003[b]
VAT (ml)[c]	29.9 ± 7.0	35.9 ± 6.6	0.19[b]
IGT	0	5/17	0.001

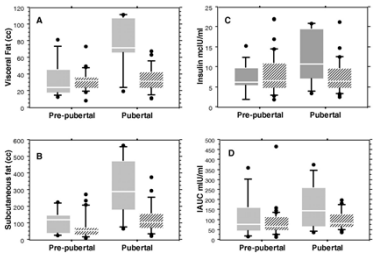
The Journal of Clinical Endocrinology & Metabolism, Volume 93, Issue 6, 01 June 2008, Pages 2109–2114, https://doi.org/10.1210/jc.2007-2266

Previous GH treatment, body composition, and glucose tolerance in pubertal girls with TS

	GH (27)	No GH (8)	*P*
Age (yr)	17.4 ± 2.4 (13–21)	16.9 ± 3.5 (15–19)	0.5
BMI (kg/m^2)	24.4 ± 3.8	30.7 ± 5.3	0.01[a]
BF (%)	33.7 ± 1.8	39.5 ± 3.4	0.03[b]
SAT (ml)[c]	142.5 ± 22.4	313.8 ± 75.6	<0.0001[b]
VAT (ml)[c]	36.1 ± 4.1	75.3 ± 13.8	<0.0001[b]
Fasting insulin (µIU/ml)	7.3 ± 2.8	12.5 ± 4.4	0.005[b]
IAUC (IU/min·ml)	9.9.1 ± 2.9	17.3 ± 4.2	0.0001[b]

The Journal of Clinical Endocrinology & Metabolism, Volume 93, Issue 6, 01 June 2008, Pages 2109–2114, https://doi.org/10.1210/jc.2007-2266

Pre- and postpubertal effects of GH treatment on visceral (A) and sc (B) abdominal fat and insulin



The Journal of Clinical Endocrinology & Metabolism, Volume 93, Issue 6, 01 June 2008, Pages 2109–2114, https://doi.org/10.1210/jc.2007-2266

Osteopenia, Fracture risk and Vitamin D Therapy

- *All patients with TS should be counseled on healthy lifestyle measures, and on the role of estrogen replacement in bone health*
- Screening for vitamin D deficiency with a serum 25-hydroxyvitamin D measurement between 9 and 11 years of age and every 2–3 years thereafter throughout the lifespan and treating with inactive vitamin D (ergocalciferol) as necessary
- Use DXA scans to monitor bone density after adult hormone replacement therapy has been instituted
- Use DXA scans to monitor bone density in all women when considering discontinuation of estrogen therapy (simulating menopause)

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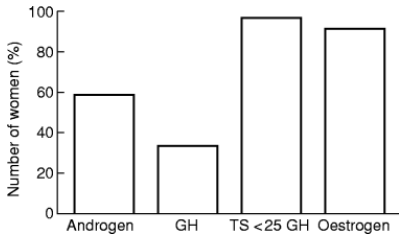
Osteoporosis and fractures in Turner syndrome–importance of growth promoting and oestrogen therapy



Clinical Endocrinology, Volume: 51, Issue: 4, Pages: 497-502, First published: 24 December 2001, DOI: (10.1046/j.1365-2265.1999.00841.x)

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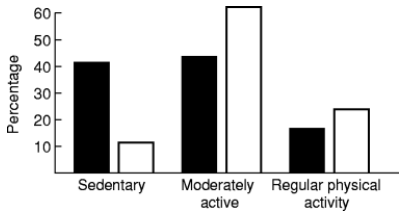

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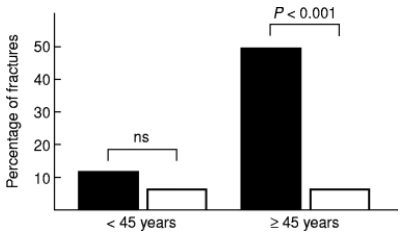

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Cancer Surveillance

- Incidence of breast cancer is reduced to at least 30% of the population average
- Risk of melanoma increased between twofold and threefold
- Risk of nervous system malignancy increased between 4.3- and 6.6-fold
- The cause of the excess risk of meningioma is unclear
- Although the risk of gonadoblastoma in individuals with a Y chromosome is not exactly quantified, gonadectomy for individuals with a fragment of Y chromosome should continue to be mandatory
- Women with TS have no increased risk of endometrial cancer

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Educational Attainment and Professional Satisfaction

- Women with TS show a similar or increased level of educational attainment compared to the general population
- Employment status of young women with TS is equal or higher
- Retirement occurs earlier
- Adult women with TS, especially older cohorts, show a lower occupational status than would be expected from their level of education and report less positive/challenging working experiences
- Women with TS often choose careers in health care, social services and teaching
- Such a finding should not be viewed as a recommendation
- Career guidance ideally includes vocational/career counseling

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Recommendations for screening in Turner syndrome at diagnosis and throughout life

	At diagnosis	After diagnosis (childhood)	After diagnosis (adults)
Weight/BMI	Yes	Every visit	Every visit
Blood pressure	Yes	Every visit	Every visit
Thyroid function (TSH and (free) T4)	Yes	Annually	Annually
Lipids			Annually if at least one cardiovascular risk factor[a] or regional recommendation
Aminotransferase, GGT and alkaline phosphatase		Annually after 10 years of age	Annually
HbA1c with or without fasting plasma glucose		Annually after 10 years of age	Annually
25-Hydroxyvitamin D		Every 2–3 years after 9–11 years of age	Every 3–5 years
Celiac screen		Starting at 2 years; thereafter every two years	With suggestive symptoms
Renal ultrasound	Yes		
Audiometric evaluation	Yes[a]	Every 3 years	Every 5 years
Ophthalmological examination	Yes[a]		
Dental evaluation	Yes, if no previous care has been established		
Clinical investigation for congenital hip dysplasia	Yes, in newborns		
Skin examination	At diagnosis	Annually	Annually
Bone mineral density			Every 5 years and when discontinuing estrogen
Skeletal assessment		5–6 years and 12–14 years (see 6.1.10.)	

When 9–12 months old; [a]when 12–18 months old; [c]cardiovascular risk factors: hypertension, overweight, tobacco, diabetes, and physical inactivity.

C&S | 46

Transition from Pediatric to Adult Care

- It is recommended that pediatric endocrinology team use available transition tools to track and document the core elements of transition
- Pediatric and adult health care teams should help establish a workflow to support a coordinated transition process
- Pediatric endocrinologists and their care teams encourage peer-to-peer (and parent-to-parent) contact with TS support and advocacy organizations to enhance knowledge and confidence, reduce stress and distress and promote the reciprocal sharing of experiences (

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C&S | 47

Three Core Transition Elements

- Transition readiness assessment: An assessment tool to be used by the pediatric care team to begin the conversation about the youth's needed skills to manage their specific condition. The tool is intended to be used for documentation and revisited over time as a teaching and training aid to ensure that each item is mastered by the time a young adult is transferred to adult care.
- Transfer summary: A summary of key medical record elements or essential information needed for communication between pediatric and adult clinicians, to be completed by pediatric clinician(s), shared with youth and family, and sent to receiving adult care clinician(s).
- Self-care assessment: An assessment tool to be used by the receiving adult care team to assess any remaining gaps in self-care knowledge, skills or additional issues that need to be addressed.

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C&S | 48

The Adult Clinic

- Clinic participation should also cover lifestyle factors such as exercise, diet and weight control, psychosocial issues including relationships both personal and work related, sexual function and plans for future fertility
- A clinic care coordinator can be helpful as the point of contact, be vigilant for psychosocial issues, ensure access to tests that may be required and follow-up on non-attendance
- Obesity is a central factor determining many long-term health outcomes including risk of hypertension, diabetes and steatohepatitis
- Weight management should be a core activity of the adult TS clinic
- Contraception and fertility options should be reviewed regularly

C&S | 49

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Role of Patient Support Organizations

- information regarding access to patient support organizations should be made available to each individual with TS on a regular basis
- Members of each medical care team should take part in combined meetings with patient groups in order to share experience and develop future care pathways
- Parents of young girls, adolescents and women with TS should be advised to contact a local TS peer-support organization
- Patient support organizations are vital in providing expertise outside of clinic attendances and for the support of careers or partners of individuals with a new diagnosis of TS
- Support organizations can also assist in developing a care network of providers on a national basis
- it is important to link patients and families to local, regional and national patient/advocacy TS groups that offer activities geared to adolescents and toward increasing their developmental autonomy.

C&S | 50

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C&S | 51

Thank You