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ORTHOPAEDIC SURGERY

Normative Data of Pulmonary Function Tests and Measures of Chest Development: Is a T1-T12 Height of 22 cm Adequate?

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Introduction

- Shortening of the spine from T1-T12 has deleterious effects on PFTs
  - Karol et al, JBJS 2008
    - Mean age at surgery 3.3 yrs; 59% of T spine fused
    - FEV1 & FVC at 14.6 yr f/u: 55-58% predicted
  - Emans et al, SRS 2004
    - Inverse relationship between %-predicted PFTs at f/u and either # levels fused or earlier age at fusion.
- There has been suggestion a T1-T12 height of 22 cm at skeletal maturity is adequate for pulmonary function

Study Purpose

- To develop normative data on PFTs and radiographic measures of chest development in “normal” patients.

- To determine if T1-T12 height of 22 cm is adequate, based on normative PFT values, at skeletal maturity.

Methods

- St. Louis Children's Hospital Pulmonology database
  - All patients who underwent PFT testing
  - PFT values of greater than 90%, consist of patients with minimal to mild asthma
  - Exclusion: any chest wall or spine deformity
- Cross-referenced to Radiology database to identify all identified patients who had a chest radiograph within 2 months of PFT testing.

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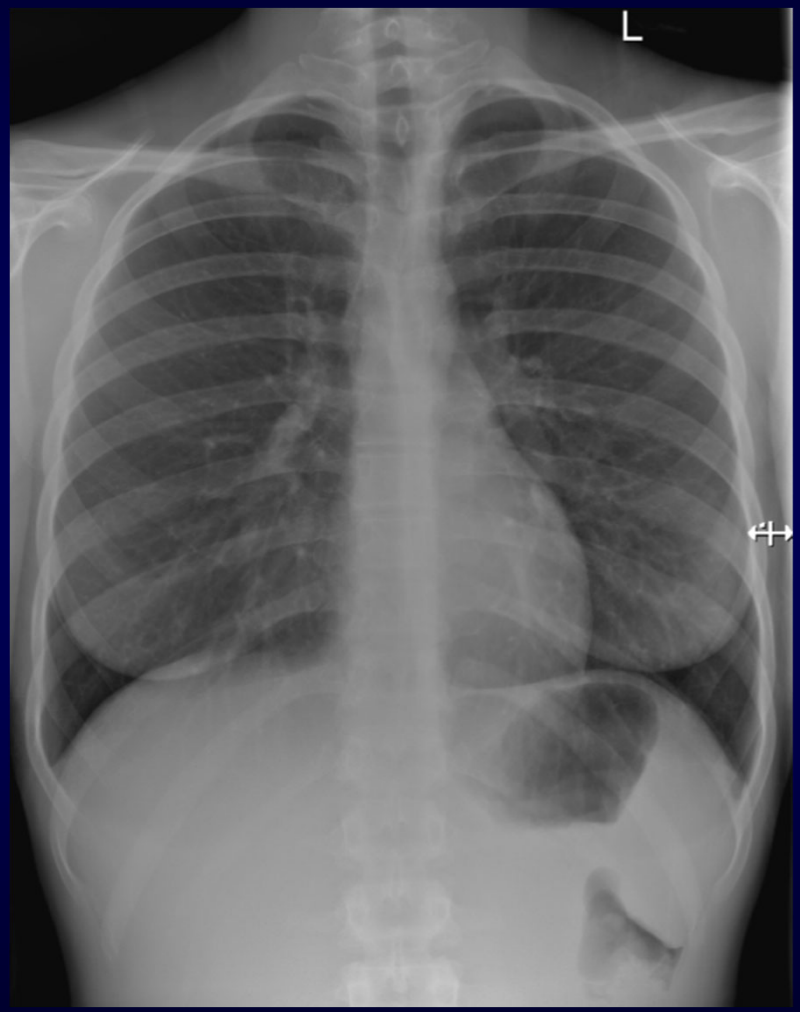

Sample Chest Radiograph:

16 y/o Female presenting with shortness of breath with exercise

Methods

- Initial query of Pulmonology database:
  1797 PFT studies
- After cross-referencing with Radiology database:
  - 149 patients with 149 data points
  - Mean age 12.4 years (7.1 to 18.4 years)

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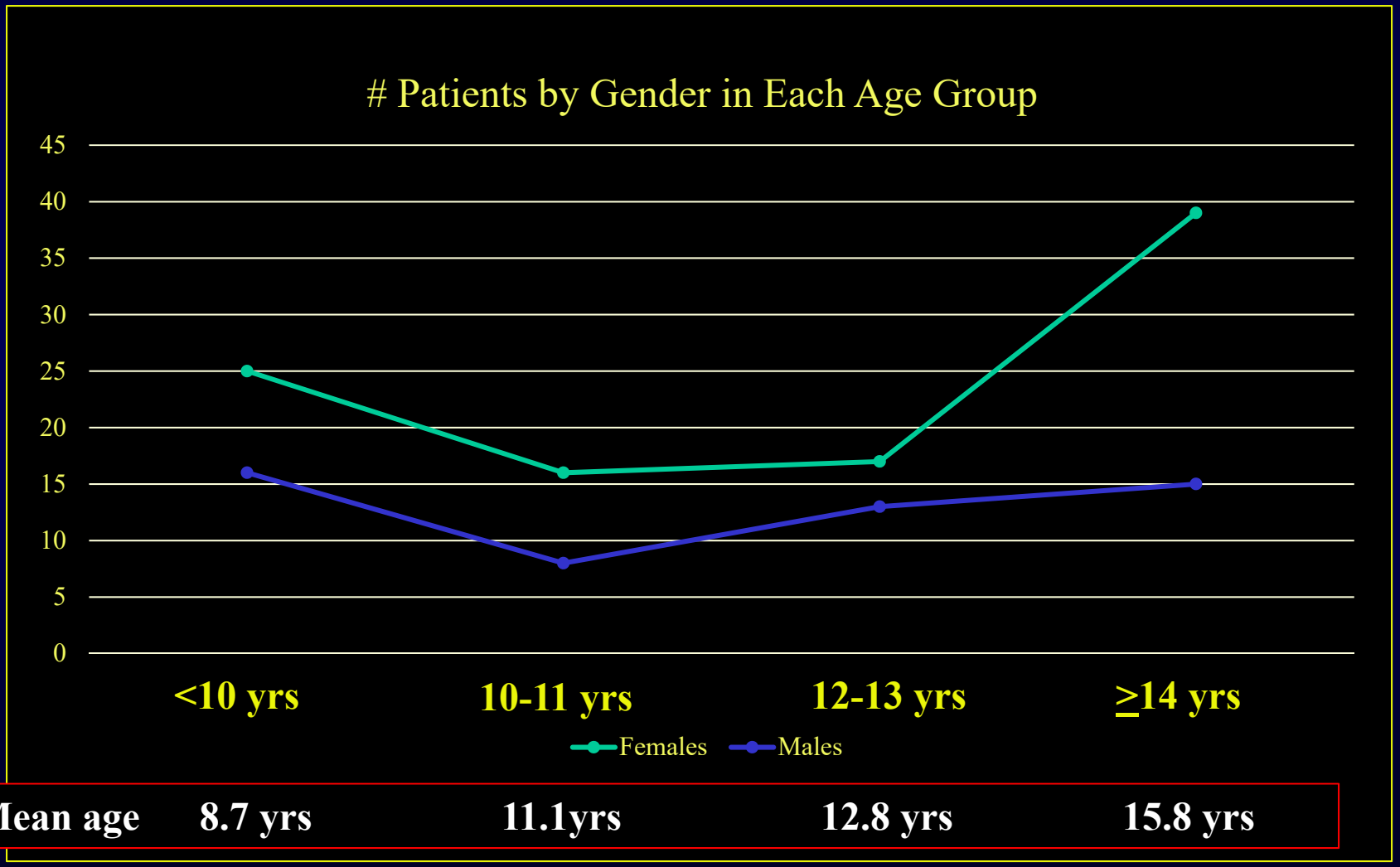
Methods



Mean age	**8.7 yrs**	**11.1yrs**	**12.8 yrs**	**15.8 yrs**

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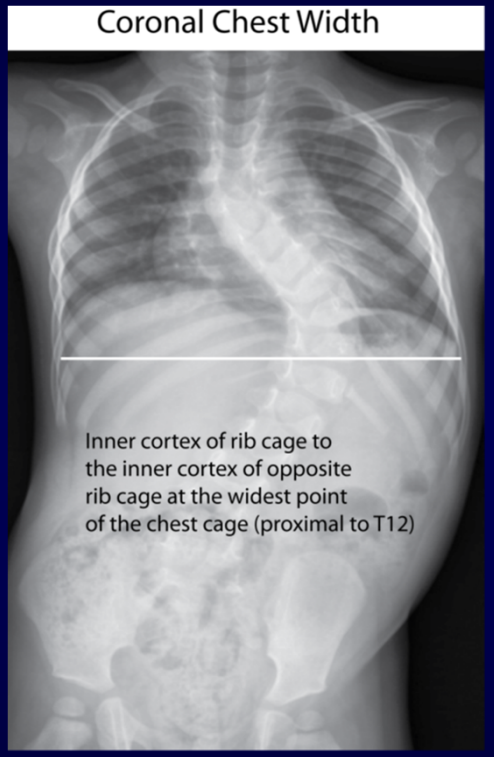
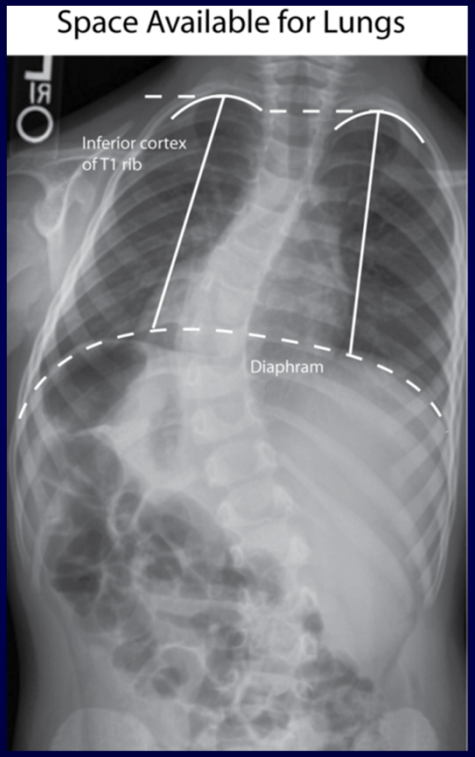
Methods

- PFT data
  - Absolute FVC
  - %-predicted FVC
  - Absolute FEV1
  - %-predicted FEV1
- Chest Radiographs
  - T1-T12 length
  - Coronal Chest Width (CCW)
  - Space Available for the Lung (SAL)





*Taken from the GSSG Measurement Guide

Results: Entire Cohort

- Radiographic Measures (means)
  - T1-T12: 25.6 cm
  - CCW: 25.5 cm
  - SAL: 19.0 cm bilateral
- PFTs (means)
  - Absolute FEV1: 2.69 l
  - %-predicted FEV1: **106.9%**
  - Absolute FVC: 2.97 l
  - Mean %-predicted FVC: **103.9%**

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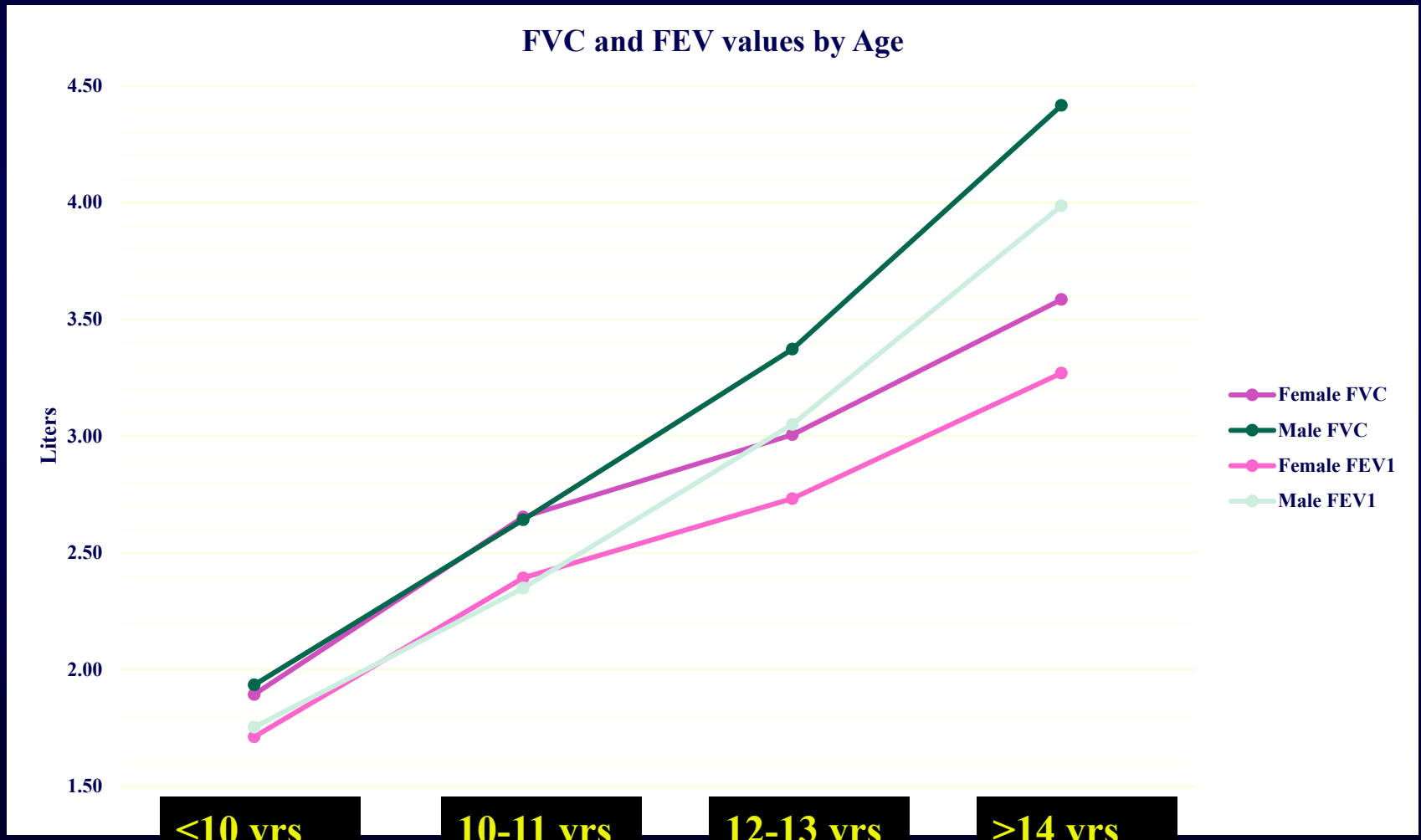
Results



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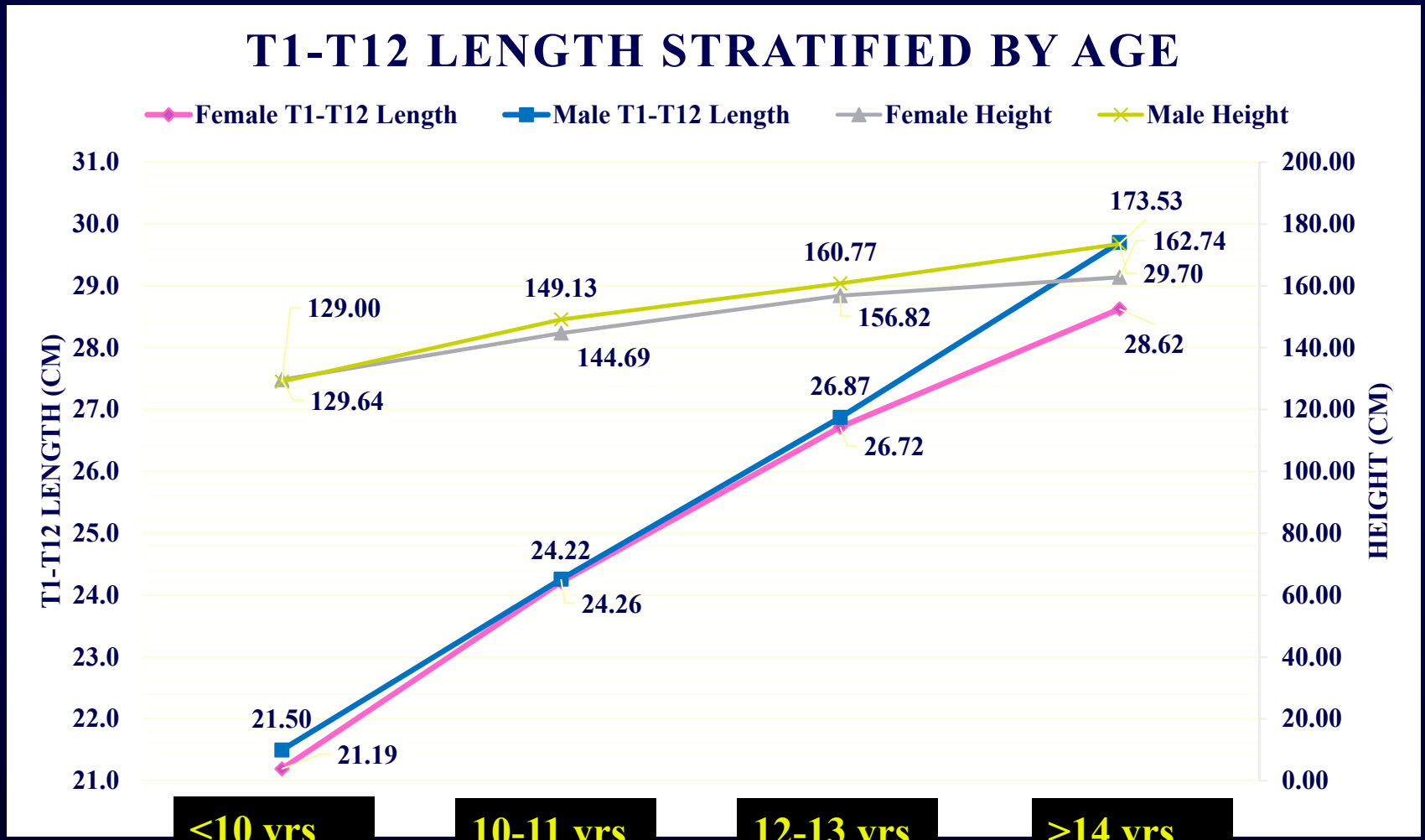

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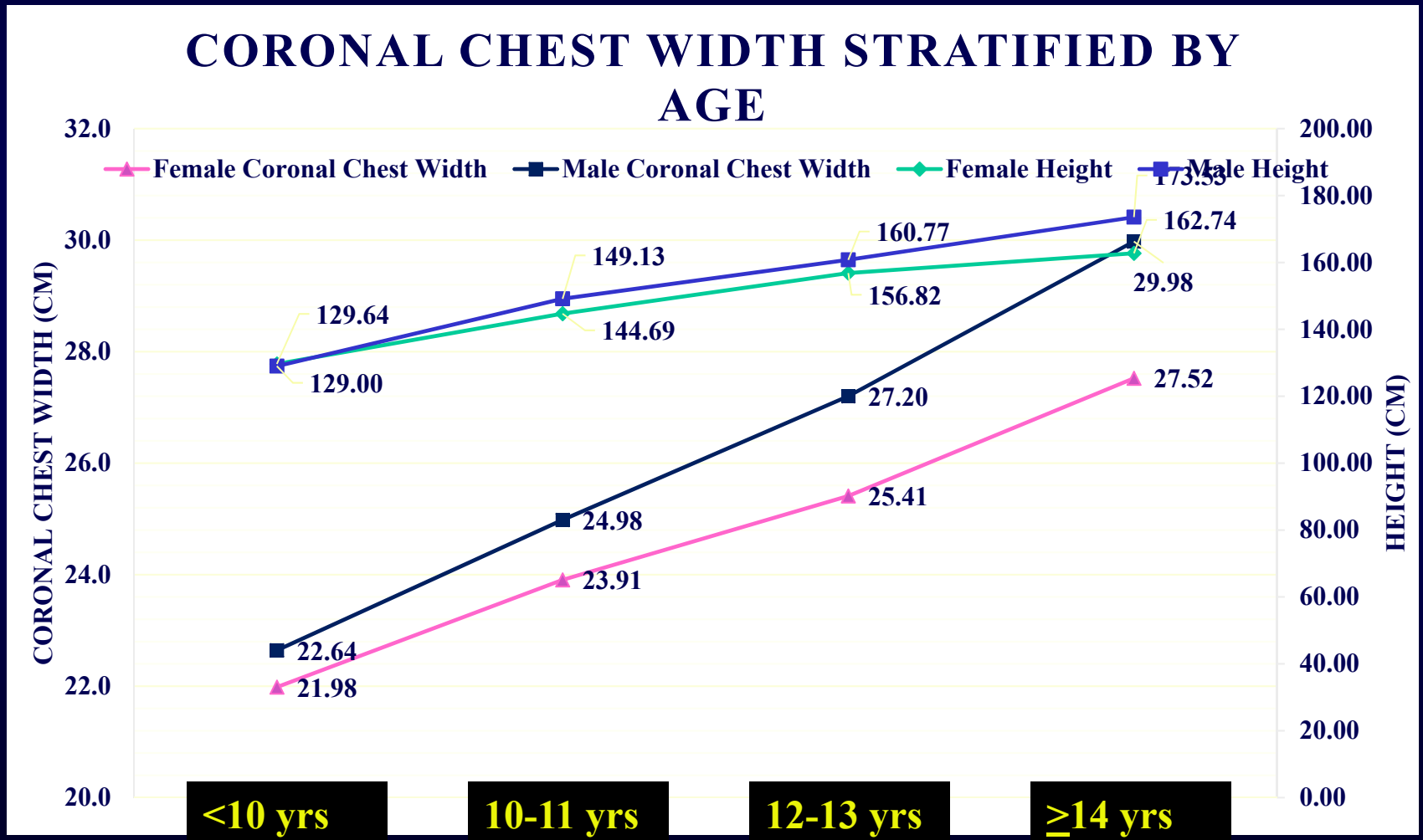

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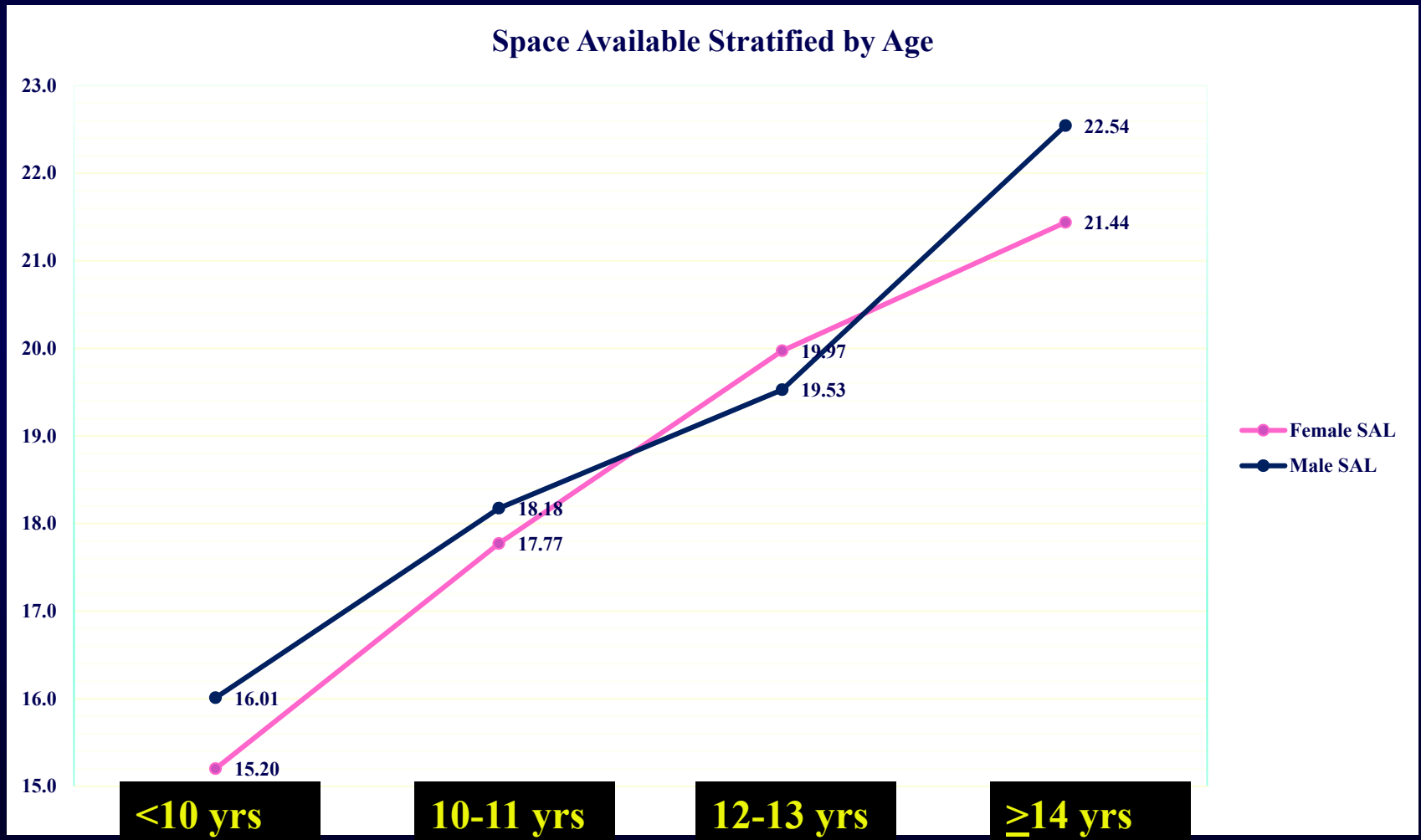

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Results

- Subcohort: Patients with T1-T12 height of 22-24 cm
  - 21 patients (11 female, 10 male)

Results

	Mean	Std. Deviation	Minimum	Maximum
FVC	2.17 l	0.33 l	1.67 l	2.88 l
FEV1	1.97 l	0.31 l	1.50 l	2.83 l
Age	9.68	1.39	7.58	11.90
Height	136.90	7.97	120.00	152.00
Weight	33.98	6.18	22.40	46.00
FVC%	103.95	12.99	90.00	139.00
FEV1%	108.24	14.98	92.00	155.00
FEV1/FVC	91.00	2.65	88.00	98.00
CCW	23.33	1.50	21.08	26.58
T1-T12 HT	22.83	0.60	22.11	23.99
SAL L	16.16	1.98	12.11	18.99
R	16.32	1.62	13.06	18.56

Results

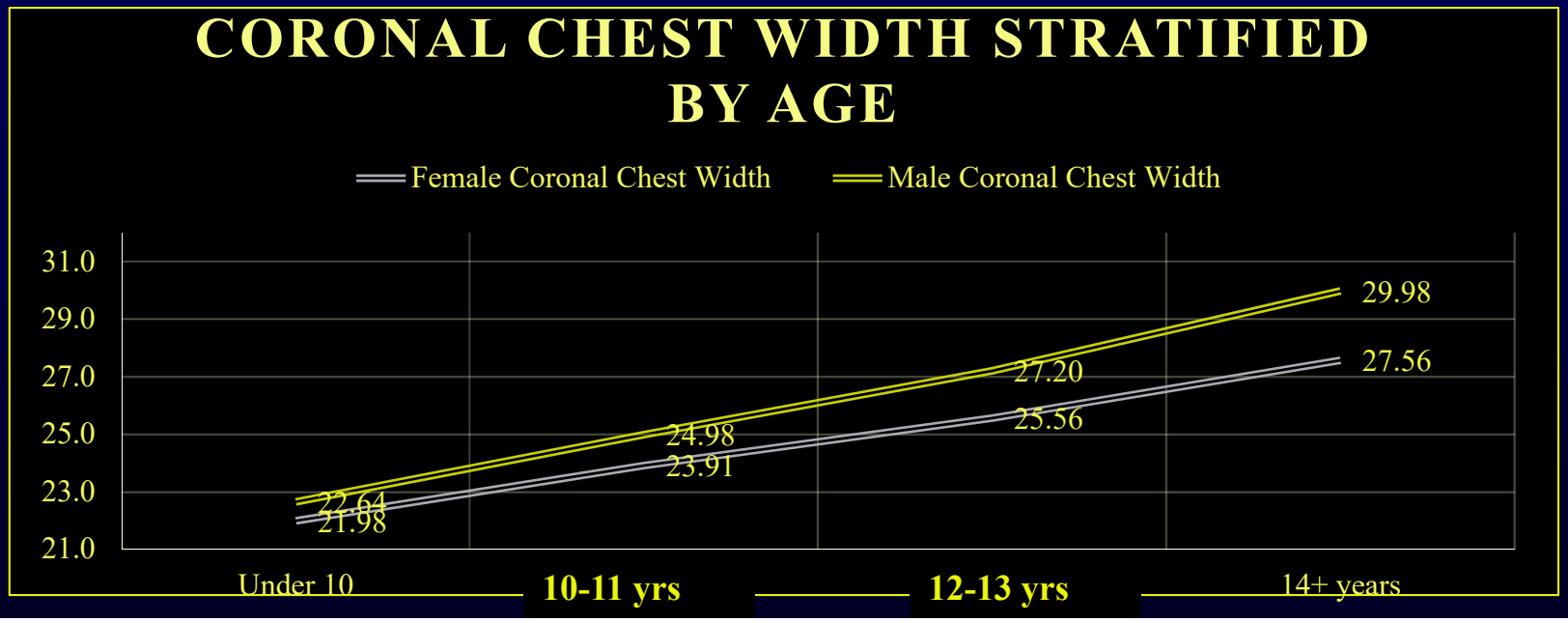
- Spirometric standards for healthy adult lifetime nonsmokers, by Gore et al, were utilized to assess the impact of T1-T12 shortening on PFT values.
- Input:
  - Mean absolute FEV1 and FVC values for the subcohort
  - Mean height of 14+ females (163.41 cm) and 14+ males (168.7 cm)

Results

- 15 year old females
  - FEV1 %-predicted: **46%**
  - FVC %-predicted: **44%**
- 15 y/o males
  - FEV1 %-predicted: **43%**
  - FVC %-predicted: **42%**

Limitations

- "Normals" had minimal to mild asthma
- Does not take into consideration radial expansion of the chest during maturity



Conclusion

- T1-T12 height at skeletal maturity of 22 cm may not be enough to guarantee patients will have an asymptomatic pulmonary status in adulthood.
- Though this analysis does not take into consideration radial expansion of the chest during maturity, the %-predicted FEV1 and FVC values are concerning, and deserve further analysis.
- Plea for collaboration to expand and deepen this data.

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Thank You