

From body shape to functional capability: New child data for occupant protection and transportation safety

SAFER Child Occupant Protection

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Why YouthShape.US Was Needed

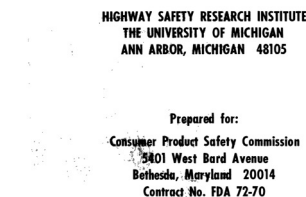
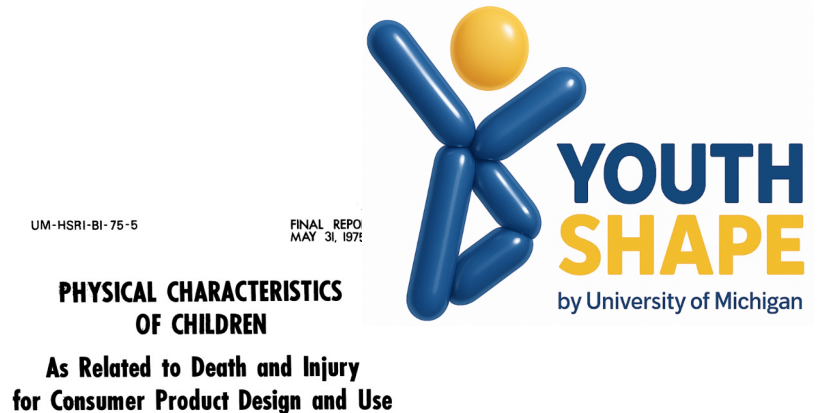
Out of Date: last comprehensive study was in 1977

1D data: standard body dimensions do not convey size and shape across postures, including head, hands, and feet

Lacking Diversity: even the 1970s data has minimal representation of non-white children

Poor Adolescent Representation: available modern 3D data are primarily from 2-11 years old

YouthShape.US was developed to provide contemporary data on the size, shape, and physical capability of U.S. children and adolescents



YouthShape.US Study Design

Phase 1 = deep lab protocol

Phase 2 = targeted diversity expansion

Phase 3 = scalable national core protocol

Measure	Phase 1: UMTRI Pilot	Phase 2: NC Black	Phase 2: TX Hispanic	Phase 1: UMTRI East Asian	Phase 3: NC, FL, OH, TX
Number of Participants (Target)	649 (600)	215 (150)	519 (300)	235 (300)	~3540 (3000)
Session Duration (mins)	120	45	90	120	30-45
Whole-body scan postures	24	2	6	12	2
Manual anthro measures	52	29	32	32	8
Head scans	6	1	1	6	1
Hand Scans	24	1	1	10	1
PassFit Scans	2	1	1	2	2
Body composition	1	1	1	1	1
Grip Strength	2 x 3	2 x 3	2 x 3	2 x 3	2 x 3
Lower extremity power	3	--	--	--	--
Foot scans	2	--	--	2	--
Foot-in-Motion	3	--	--	--	--
Actigraphy	7-10 days	--	7-10 days	7-10 days	--



Study total for most measures in common across phases is >4000

Protocols: Linking Structure, Shape, and Function

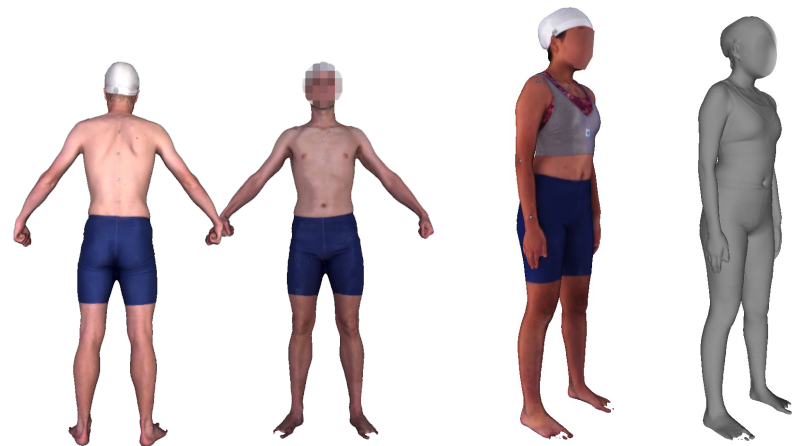
- Standardized manual methods tied to prior studies
- Repeated core measures across phases
- Rich scan protocols
- Design for synthesis and public use

Standard Manual Anthropometry

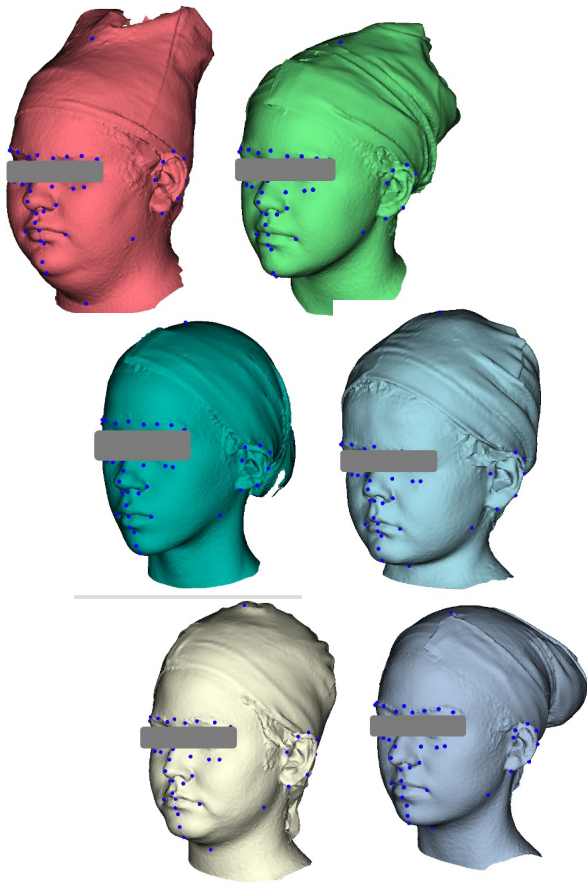
Critical to link the 3D data to existing datasets (e.g., NHANES; ANSUR II)



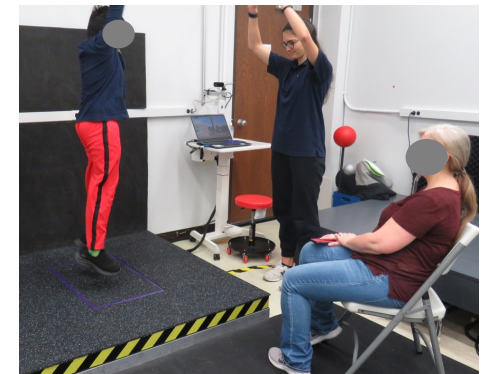
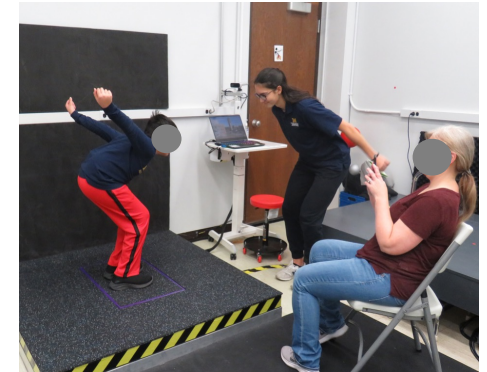
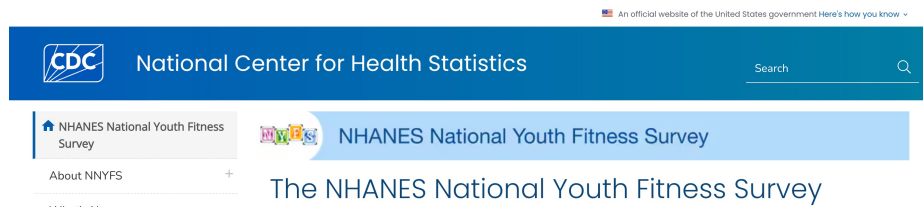
Whole-Body / Posture



Region-Specific Design Applications

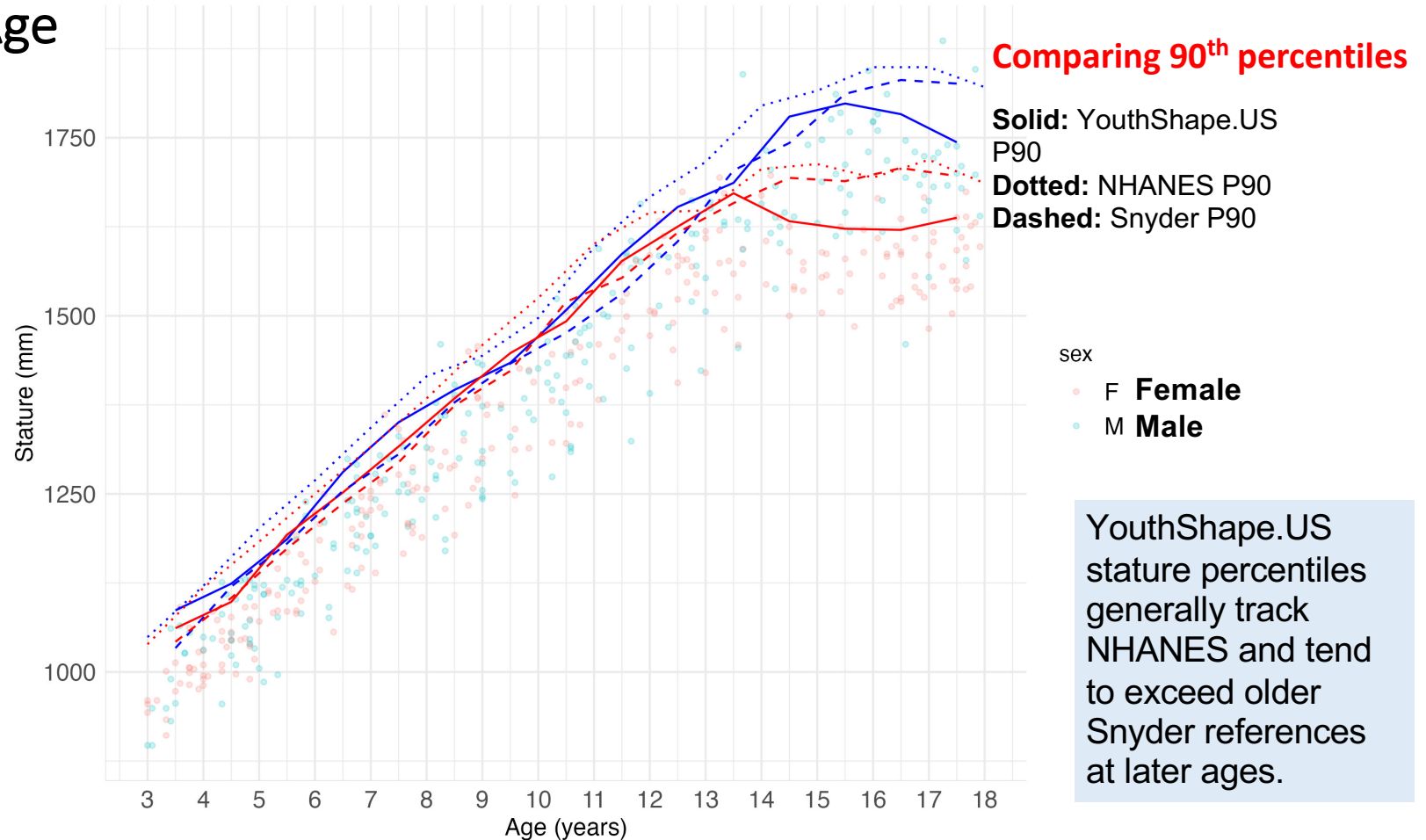


Physical Capability & Activity Measures

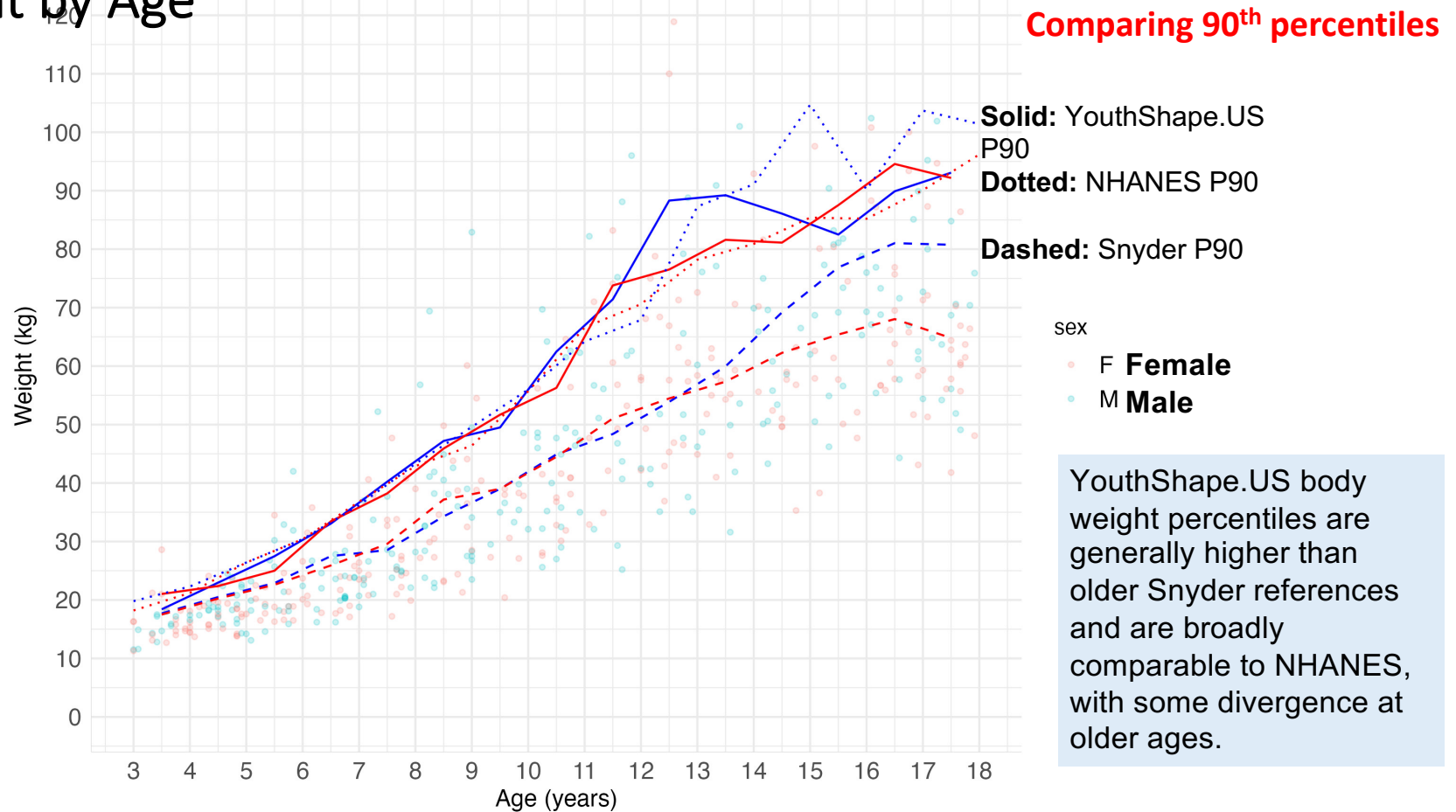


Jones, M. L., Ebert, S. M., Miller, C. S., Park, B. K. D., Jung, H., Wood, A, Robinson, L. & Reed, M. P. (2024). *Laboratory Methods for a Pilot Study of the US YouthShape Survey of Child and Youth Anthropometry and Physical Capability*. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 68(1), 193–198.

Results [Phase 1]: YouthShape.US vs. NHANES and Snyder Stature by Age



Results [Phase 1]: YouthShape.US vs. NHANES and Snyder Body Weight by Age

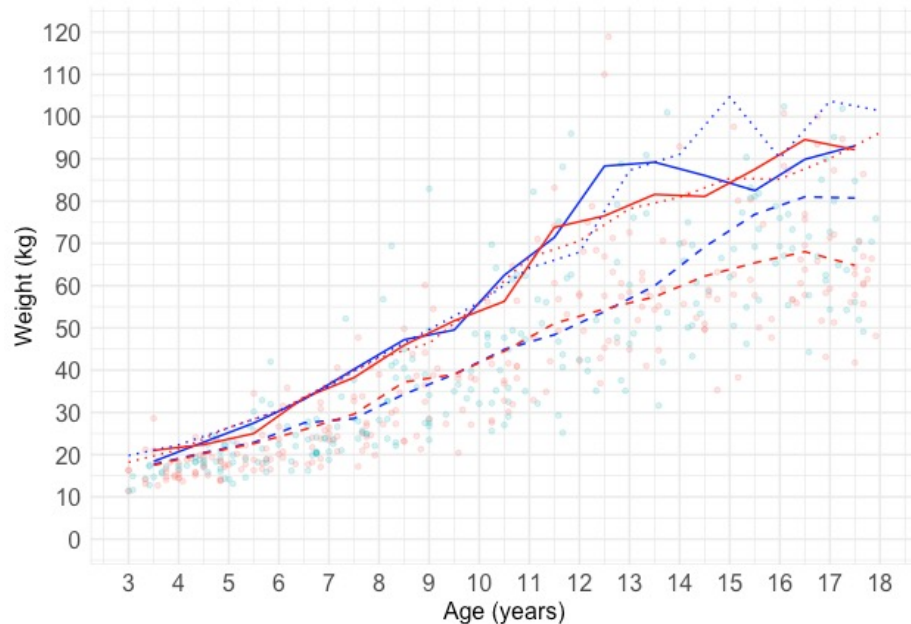


Results [Phase 2]: Hispanic Sample vs. Snyder Body weight and waist-related dimensions

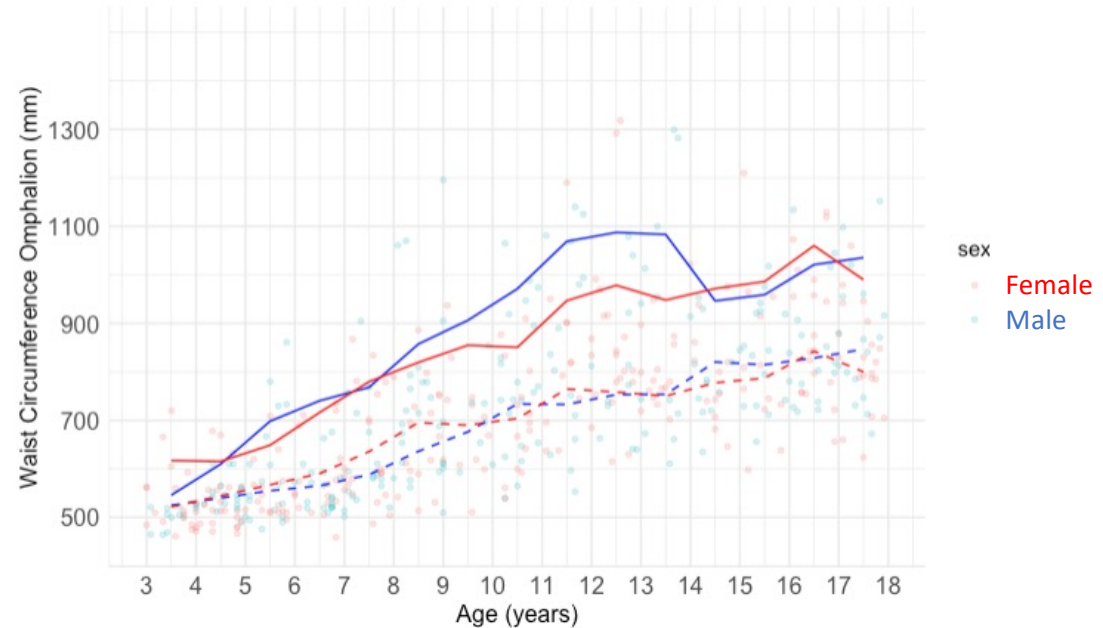
Comparing 90th percentiles

— current sample
.... NHANES
--- Snyder 77

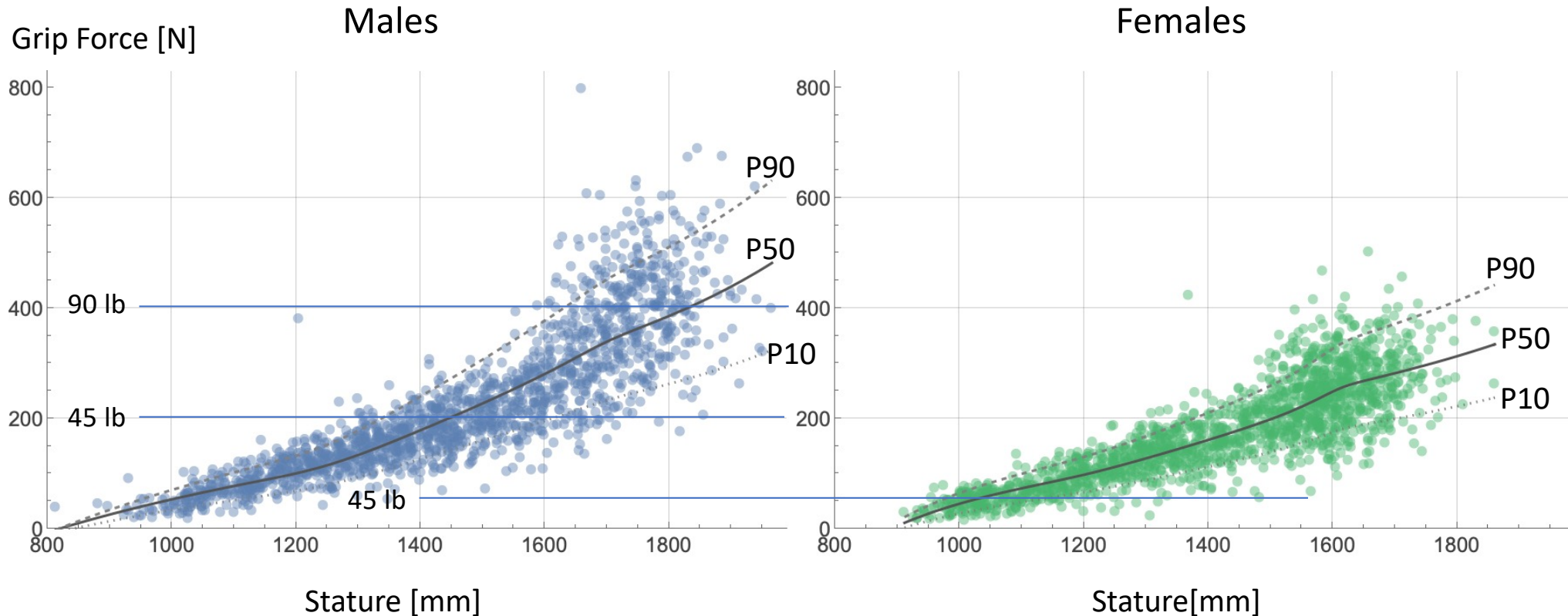
Body Weight (kg)

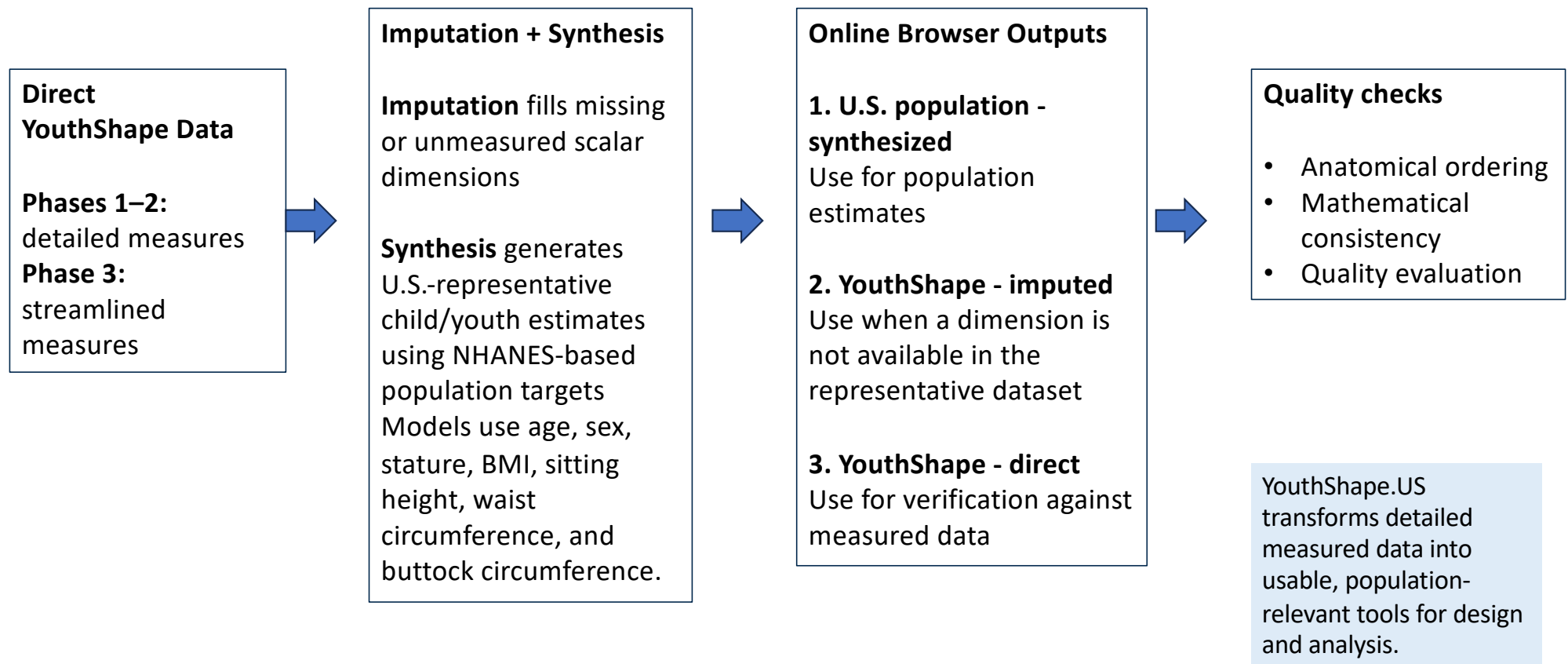


Waist Circumference - Omphalion (mm)



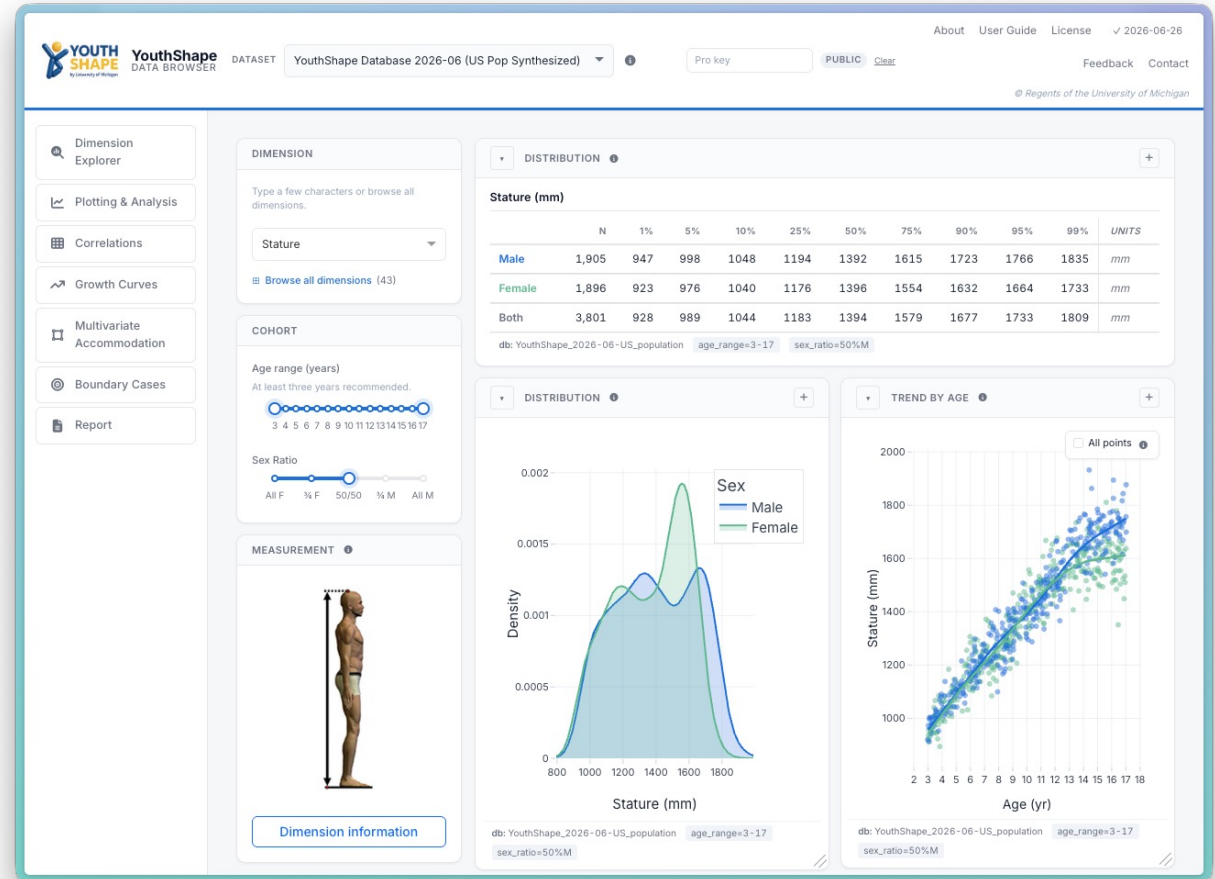
Results [Phase 1]: Grip Force by Stature and Sex





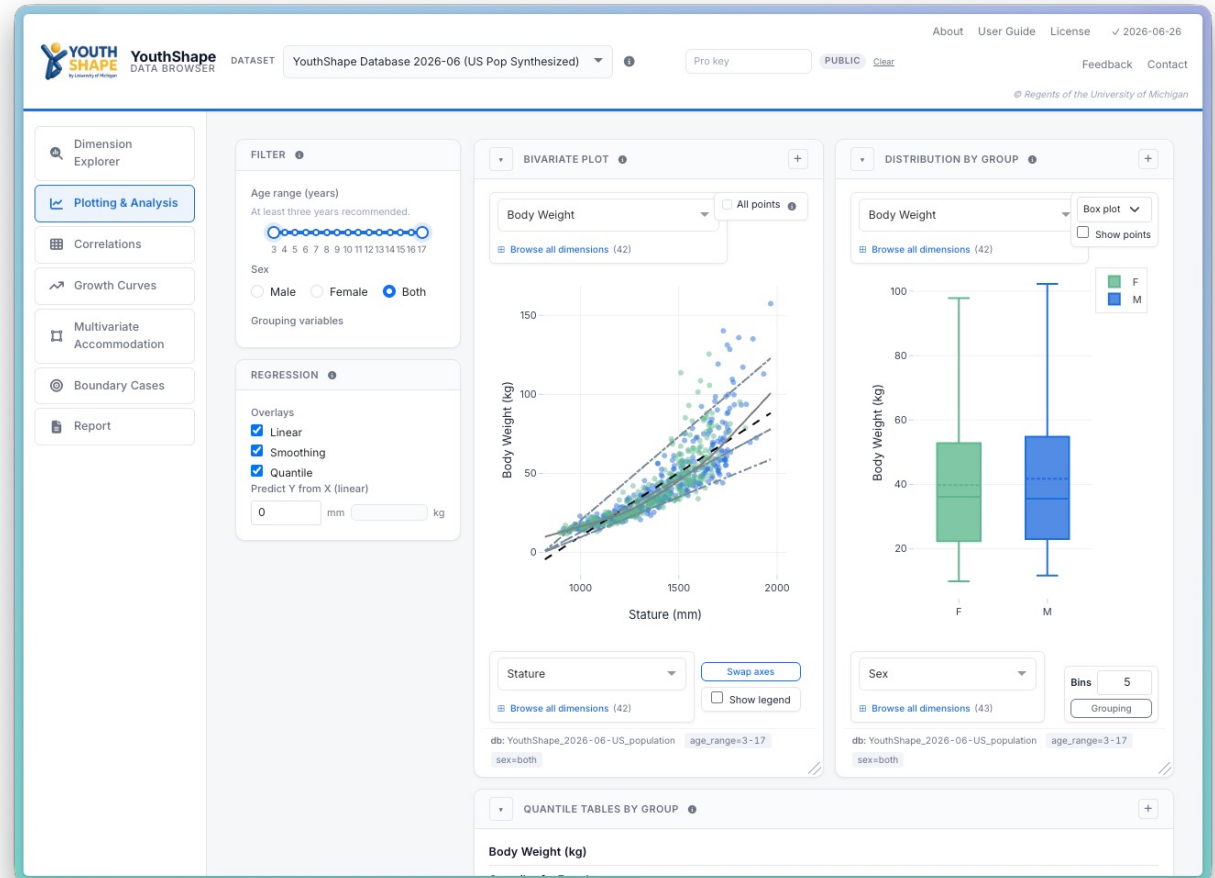
YouthShape.US: Dimension Explorer

Dimension explorer provides univariate statistics, percentile<->value conversion, plotting vs age



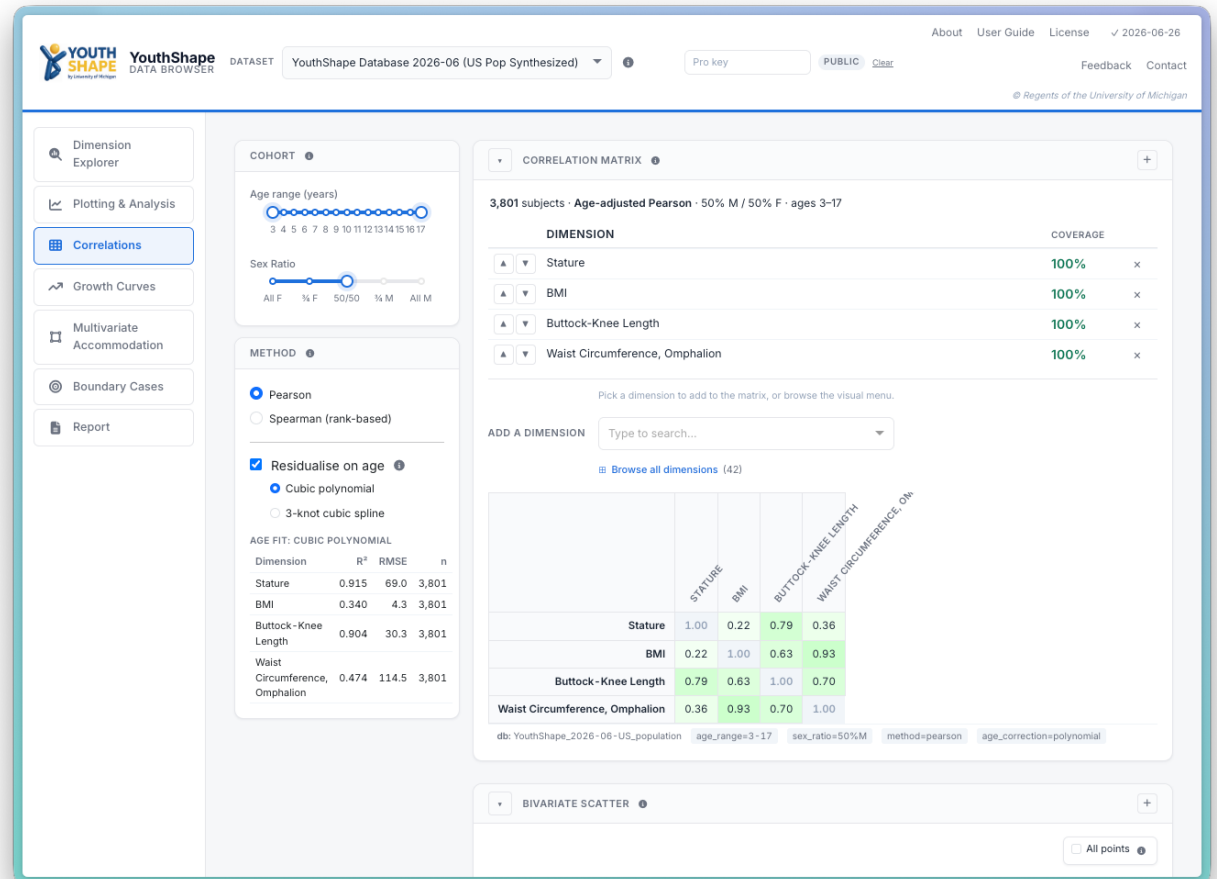
YouthShape.US: Plotting & Analysis

Plotting and analysis includes scatter & box plots, linear and quantile regressions



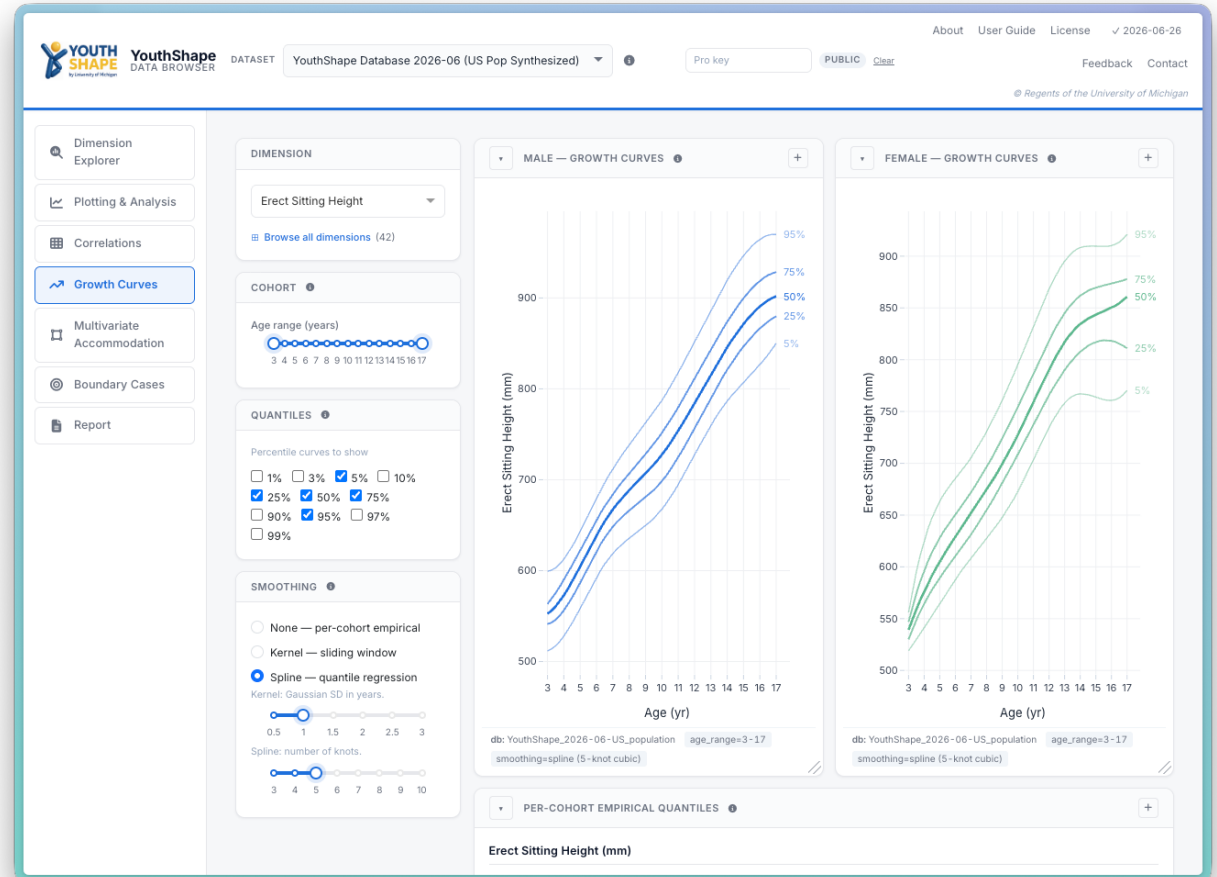
YouthShape.US: Correlations

Correlations tab includes age adjustment, scatter plots



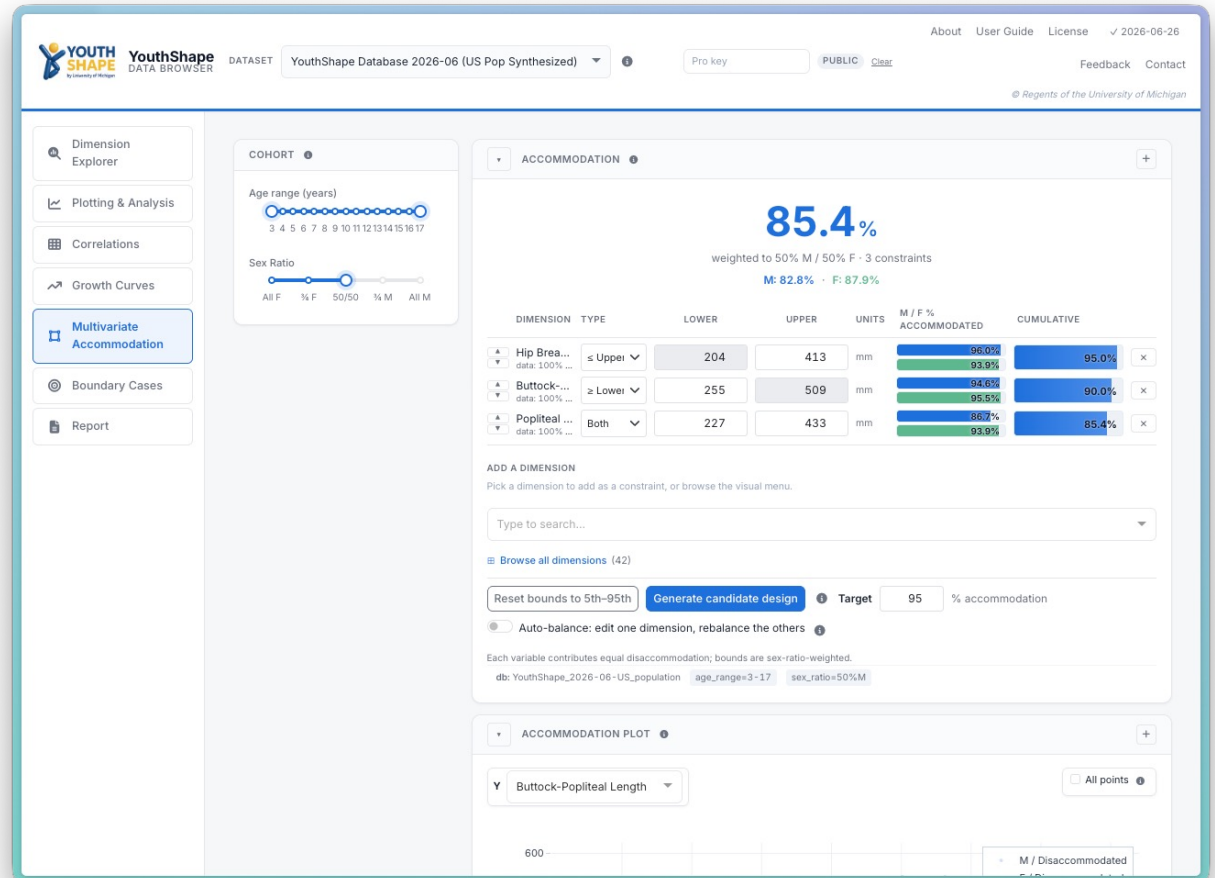
YouthShape.US: Growth Curves

Quantile growth curves available for any dimension



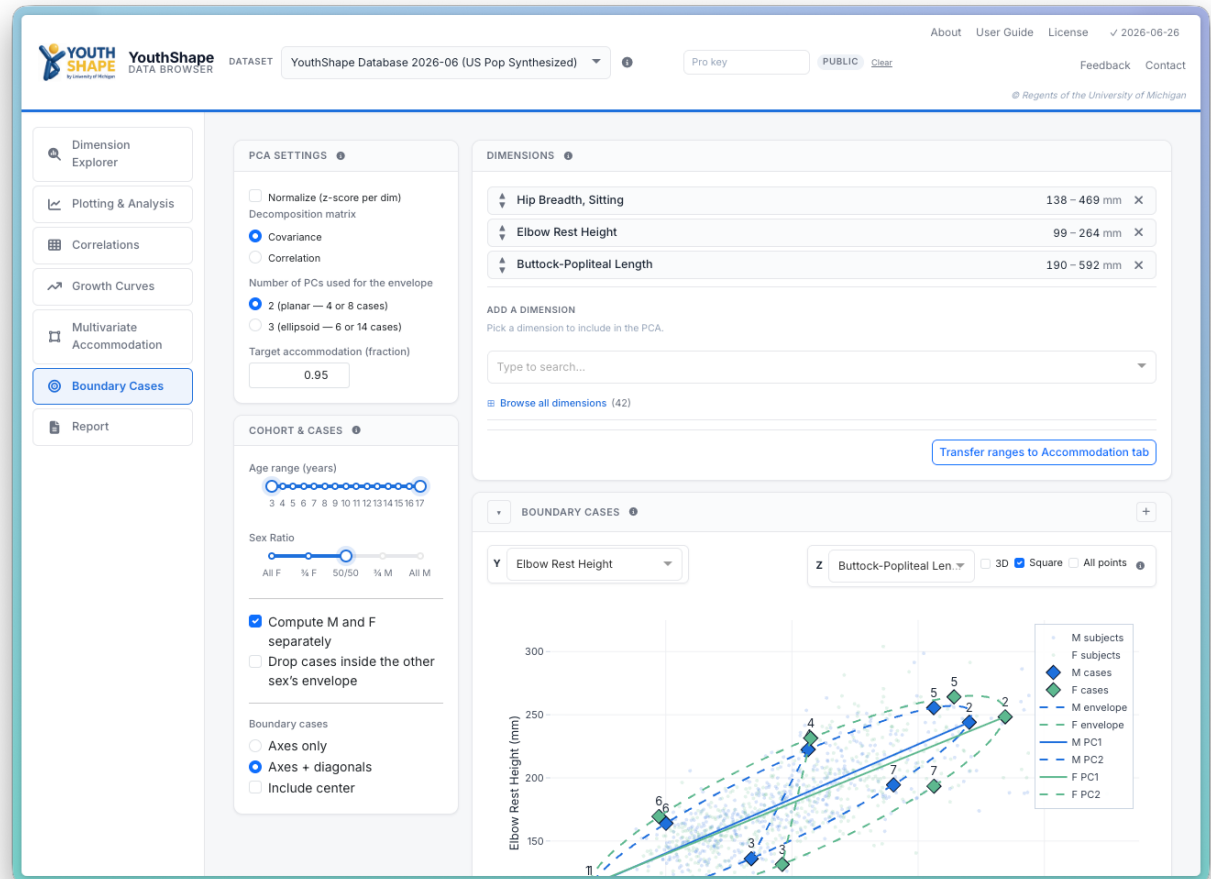
YouthShape.US: Multivariate Accommodation

Multivariate accommodation tab has features for design optimization



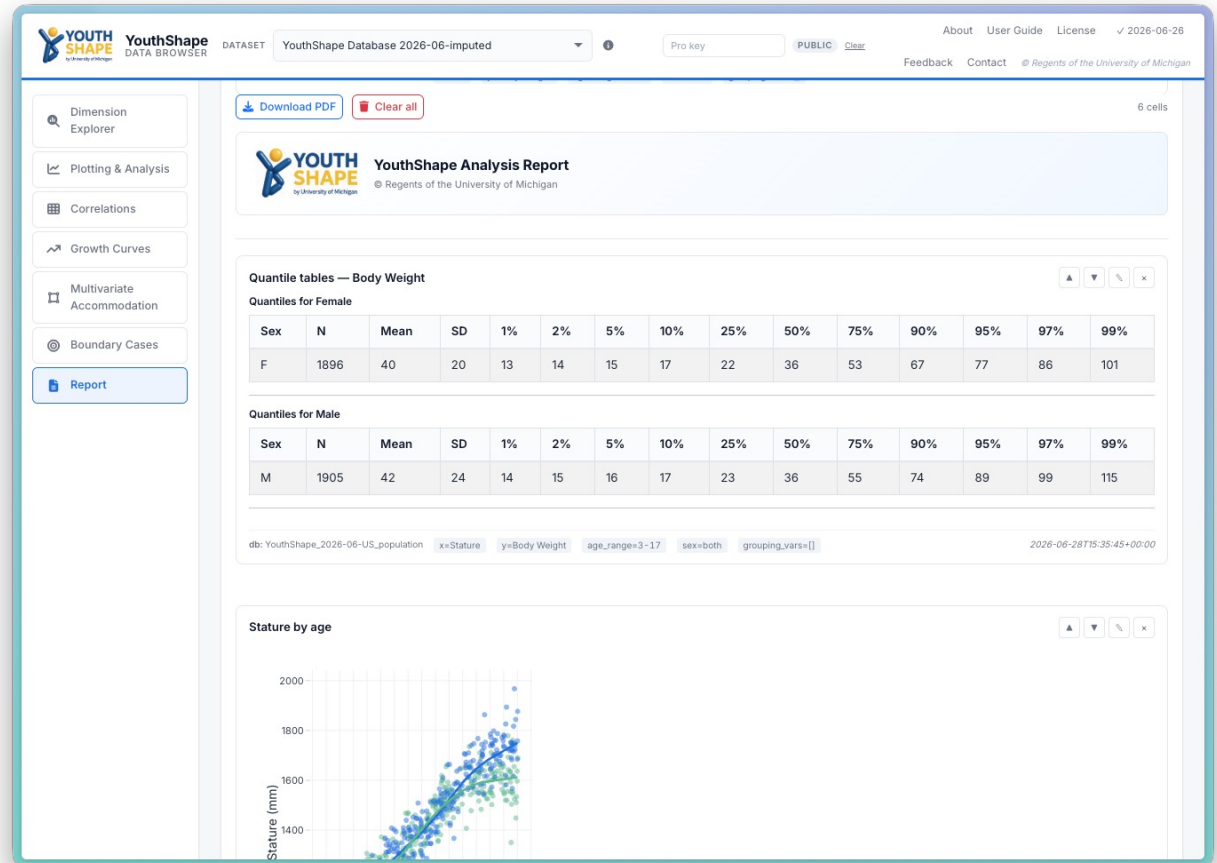
YouthShape.US: Boundary Cases

Boundary case generation using PCA
based on either correlation or covariance

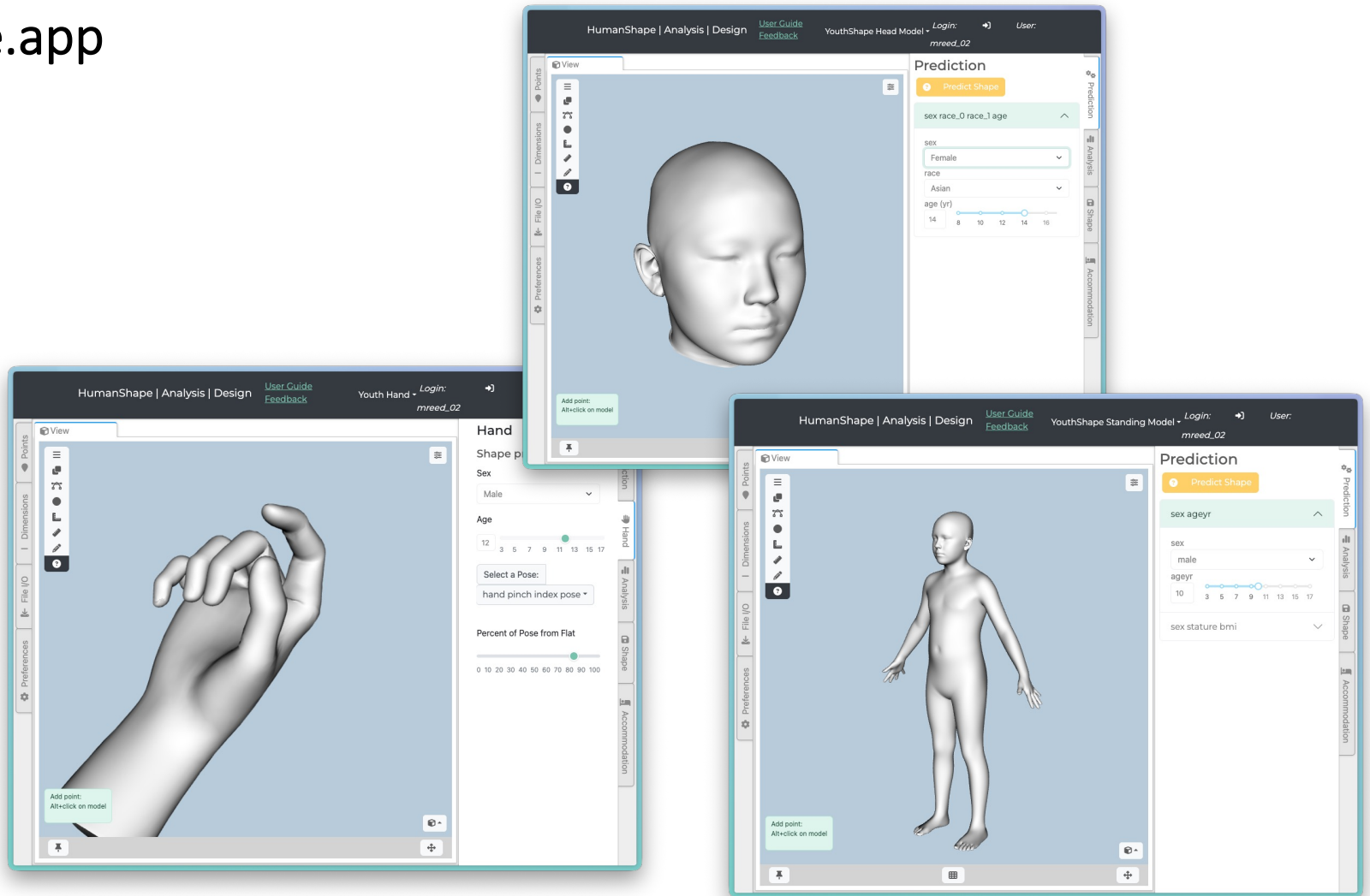


YouthShape.US: Report

Downloadable PDF report generation
including plots, tables, and notes



HumanShape.app





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