

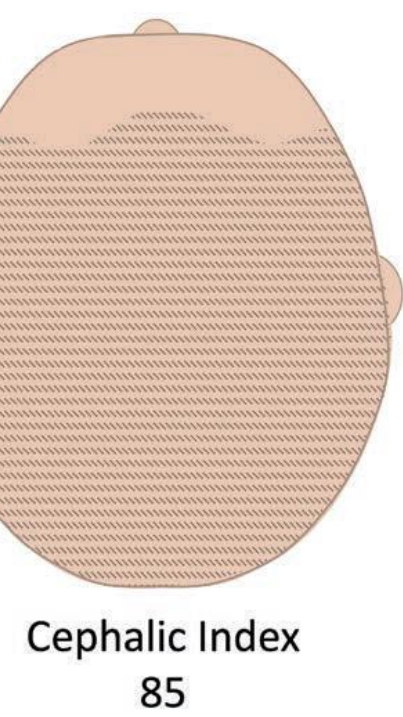
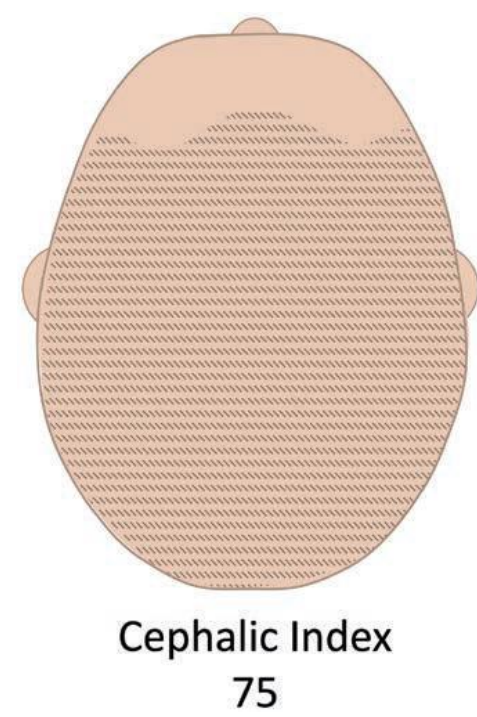
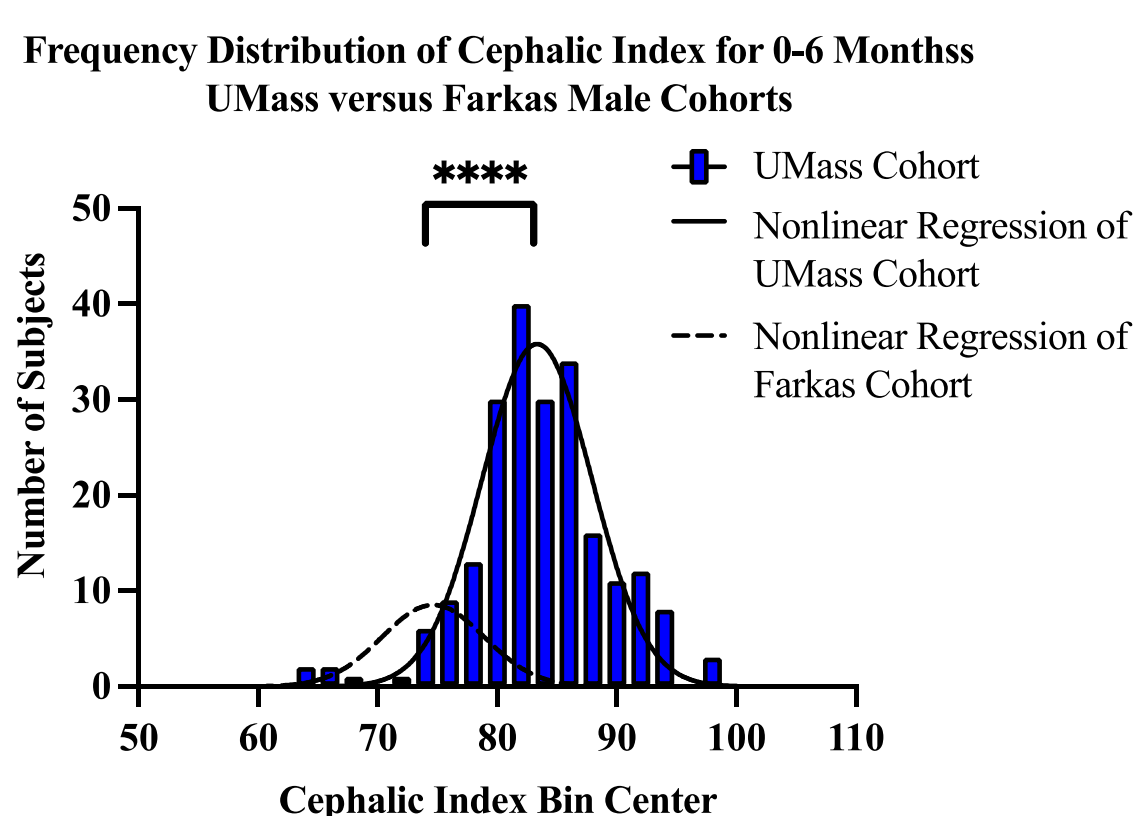
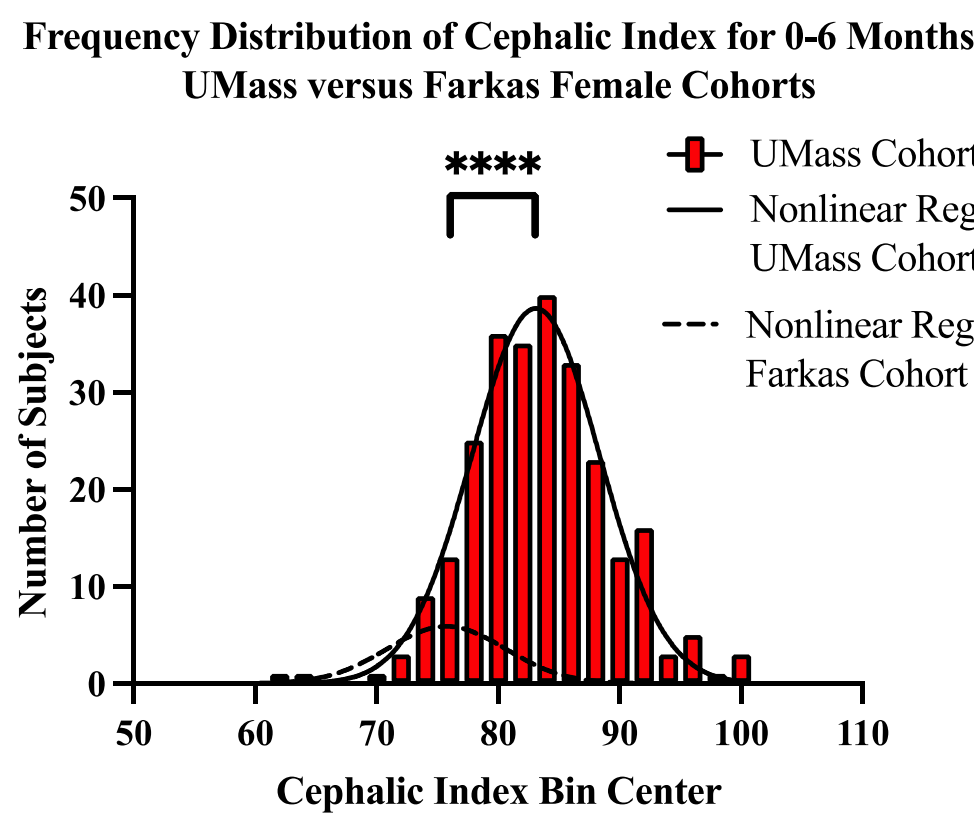


An Update of Cephalic Index Norms in a Large and Diverse Population of Well Children

Alannah Phelan, MD. Jing Xu, BS. Jacob Wood, BS. Garrick Gu, BA. Dalton Mourao, BS.
Joyce K. McIntyre, MD. Janice F. Lalikos, MD

Background

- Incidence of brachycephaly has been increasing in the U.S. secondary to diversification of U.S. population and implementation of Back to Sleep campaign
- Our 2020 study¹ demonstrated that the mean cephalic index (CI) of children has increased significantly in comparison to prior norms
- Over 50% of the children may inappropriately meet CI criteria for plagiocephaly for helmet orthosis



Methods and Materials

- Children ages 0-3 months, 3-6 months, 9-12 months, 2-3 years and 12-14 years were enrolled at well-child appointments
- Cephalic index is obtained by measuring the biparietal and anteroposterior dimensions using a manual caliper
- Birth history, self-identified race/ethnicity, frequency of back sleeping and tummy time were obtained from parents, and analyzed to identify predictors of elevated cephalic index

Table 1. Subject Demographics								
	Total	0-1 mo	2-3 mo	4-6 mo	7-8 mo	9-12 mo	2-3 yr	12-14 yr
Gender								
Male	575	108	30	81	14	100	111	131
Female	612	104	30	128	4	90	140	116
Race/Ethnicity								
Caucasian	444	70	14	68	5	67	102	118
Hispanic	315	55	23	69	4	58	56	50
African American	209	41	11	30	3	38	44	42
Asian	111	20	6	22	1	14	31	17
Mixed	89	21	4	18	5	11	16	14
Other	8	3	0	2	0	0	1	2
Parity								
First Born	539	93	28	93	6	92	115	112
Later Born	643	119	32	116	12	97	135	132
Number of Birth								
Singleton	1139	206	60	201	17	185	239	231
Multiple Birth	41	5	0	6	1	5	11	13
Gestation								
Full Term	1016	193	51	181	15	167	213	196
Post Term	140	18	9	24	1	21	33	34
Delivery								
Vaginal	858	155	39	158	13	137	180	176
Cesarean	320	57	21	51	5	53	70	64

Objectives

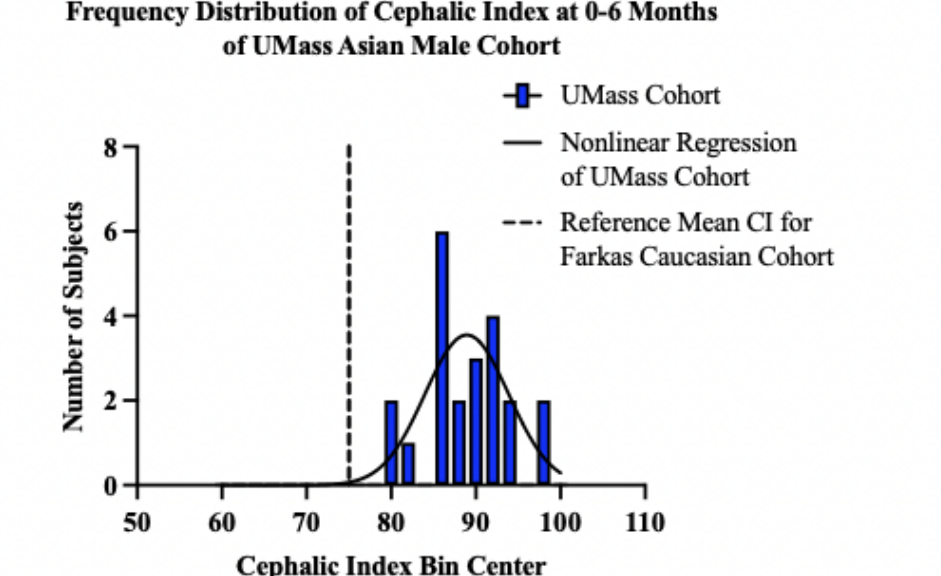
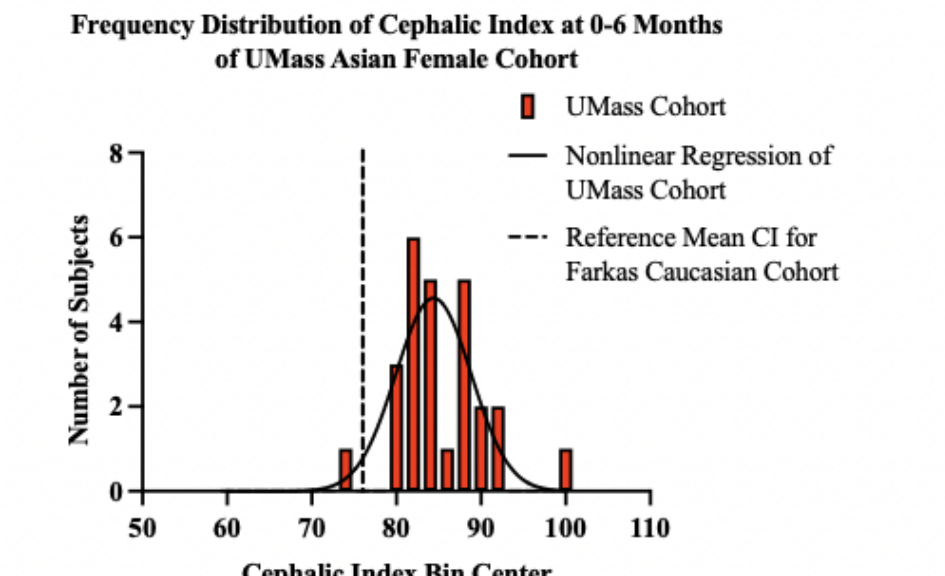
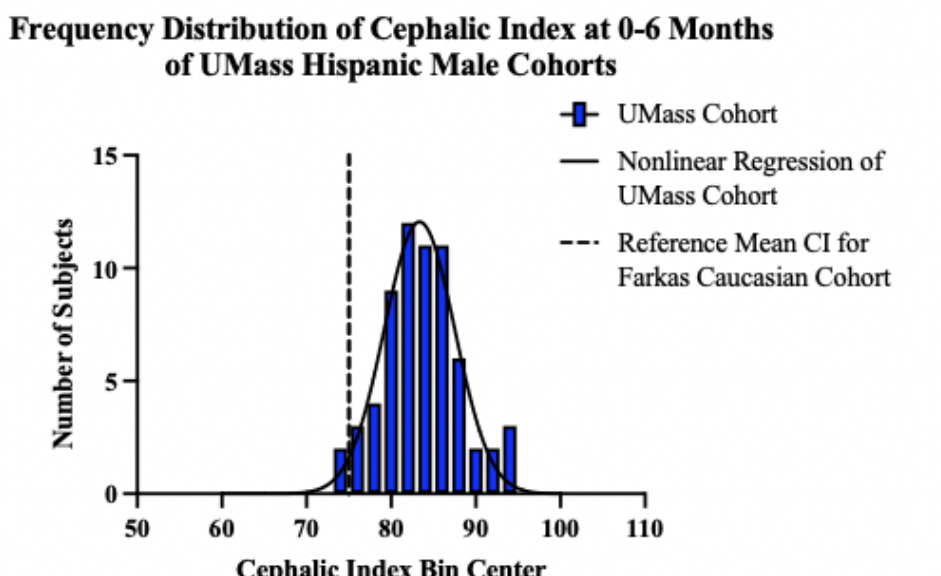
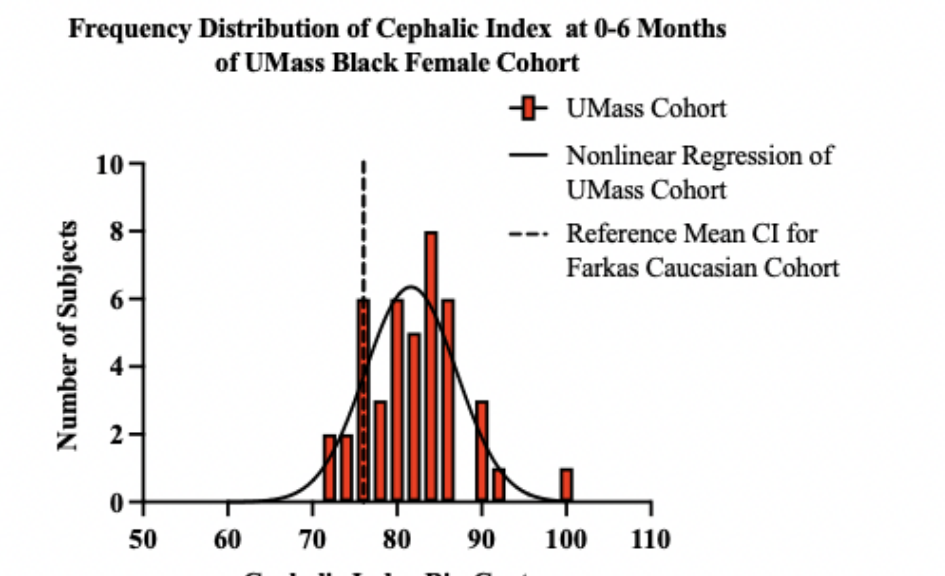
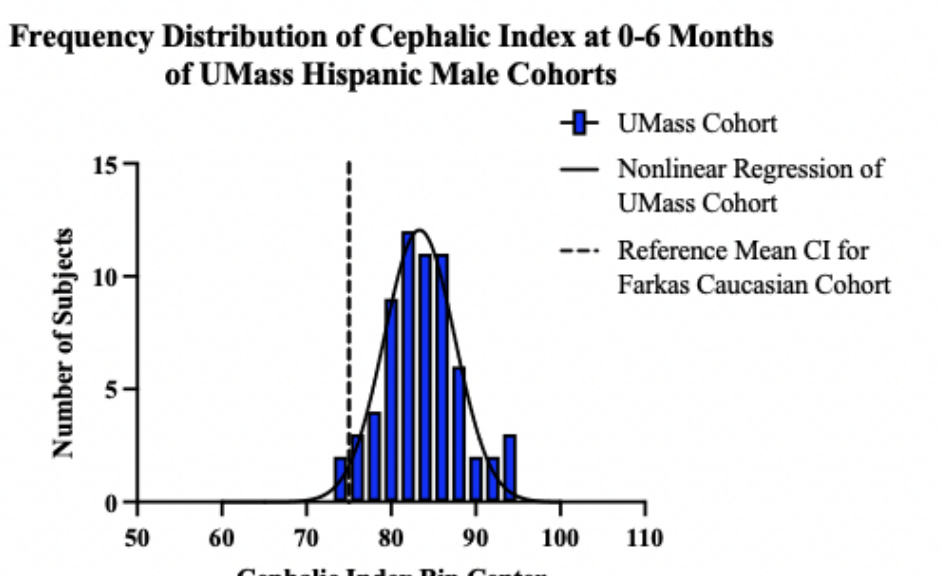
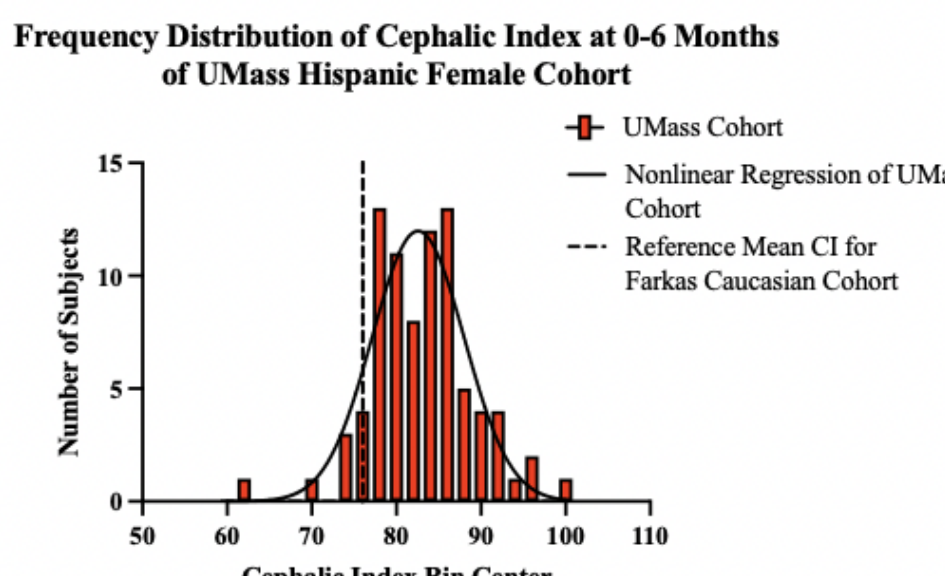
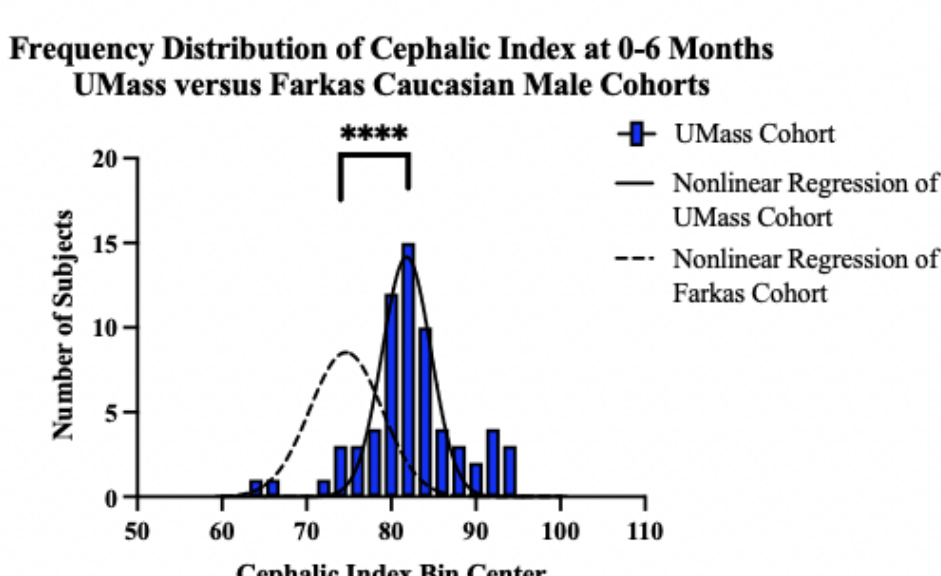
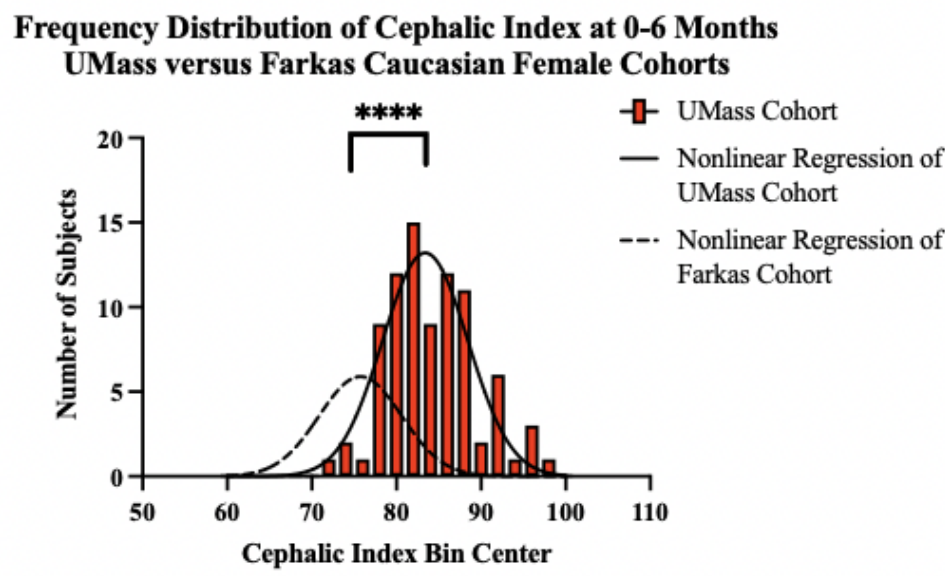
- To define cephalic index norms in a large, diverse population
- To perform cephalic index sub-group analysis on each ethnic and racial group
- To identify factors associated with higher cephalic index

References:
1. Phelan AL, Gu G, McCarthy M, Barton BA, McIntyre JK, Lalikos JF. Rethinking Farkas: Updating cephalic index norms in a large, diverse population. *Plastic & Reconstructive Surgery*. 2021;147(6):1369-1376. doi:10.1097/prs.0000000000007957.

Results

Cephalic Index of UMass Cohort is Significantly Greater than that of Farkas Cohort Across All Ethnic and Racial Subgroups

Table 2. Cephalic Index Across Various Ethnicities and Race for 0-6 Months				
	n	Mean Cephalic Index (SD)	Mean Increase Compared to Farkas Cohort (95% CI)	P value
All Subjects				
Female	262	83.3 (6.0)	7.7 (5.6-9.7)	< 0.0001
Male	219	83.3 (6.1)	7.8 (6.0-9.7)	< 0.0001
Caucasian				
Female	85	84.1 (5.3)	8.5 (6.4-10.6)	< 0.0001
Male	67	81.7 (6.9)	6.3 (4.0-8.6)	< 0.0001
Hispanic				
Female	84	82.7 (6.6)	7.0 (4.6-9.4)	< 0.0001
Male	65	83.5 (4.6)	8.1 (6.3-9.9)	< 0.0001
Black				
Female	43	82.8 (5.7)	6.1 (3.6-8.6)	< 0.0001
Male	39	83.2 (6.0)	7.7 (5.4-10.0)	< 0.0001
Asian				
Female	26	85.2 (5.2)	9.6 (6.8-12.3)	< 0.0001
Male	22	88.6 (5.0)	13.1 (10.6-16.7)	< 0.0001
Mixed				
Female	17	83.2 (7.9)	7.6 (3.8-11.3)	0.0002
Male	21	82.6 (5.8)	7.2 (4.4-9.9)	< 0.0001



Asian Race is a Predictor for Increased Cephalic Index

Table 3. Predictors for Elevated Cephalic Index for 0-6 Months			
	n	Mean Cephalic Index (SD)	P value
Gender			
Female	219	83.3 (6.1)	0.93
Male	262	83.3 (6.0)	
Ethnicity/Race			
Caucasian	152	83.1 (6.2)	0.0012**
Hispanic	147	83.0 (5.8)	
African American	82	82.4 (5.8)	
Asian	48	86.8 (5.3)	
Mixed	43	83.4 (6.5)	
Delivery			
Vaginal	352	83.3 (6.3)	0.87
C section	129	83.4 (5.3)	
Parity			
First Child	214	83.3 (6.2)	0.93
Later Child	267	83.3 (5.9)	

	n	Mean Cephalic Index (SD)	P value
Gestation			
Full Term	425	83.2 (6.1)	0.34
Post Term	51	84.1 (5.9)	
ICU-stay			
Absent	444	83.5 (6.1)	0.12
Present	36	81.8 (5.6)	
Back Sleep			
Majority	435	83.3 (6.0)	0.80
Minority	44	83.1 (6.5)	
Gaze Preference			
Absent	337	83.4 (5.8)	0.63
Present	136	83.1 (6.6)	
Tummy Time			
None	164	82.6 (5.9)	0.045*
< 15 Minutes	166	84.2 (5.6)	
> 15 Minutes	137	83.2 (6.6)	

- One-way ANOVA test demonstrates significant differences in cephalic index across ethnicities/race, individual comparisons showed that subjects of Asian race has significantly greater CI compared to all other subgroups. Unpaired t test between all other variables are did not show significance (Table 3)
- Subjects with tummy time 0-15 minutes had significantly elevated CI compared to those with no tummy time. This may be secondary to these subjects also getting more back sleep (Table 4)
- Parents of Caucasian children reported significantly more back sleep and tummy time compared to all other subgroups

Table 5. Number and Percent of Reported Back Sleep and Tummy Time Among Children of Different Race and Ethnicity					
	Back Sleep		Total	Tummy Time	
	Nightly	Not Nightly		Present	Absent
Caucasian†	314 (72%)	124 (28%)	438	347 (79%)	91 (21%)
Hispanic	191 (61%)	123 (39%)	314	220 (70%)	94 (30%)
Black	118 (58%)	86 (42%)	204	124 (61%)	80 (39%)
Asian	66 (61%)	43 (39%)	109	70 (64%)	39 (36%)
Mixed	55 (62%)	34 (38%)	89	61 (69%)	29 (33%)
Total	744	410		822	333

†Fisher's exact test between each ethnicity/race group demonstrates significantly more back sleep and tummy time in children of Caucasian race compared to all other groups

Conclusions

- Cephalic index norms in our large, diverse cohort are significantly greater than the Farkas norms, which were established in the 1980s.
- There are differences in cephalic index norms between ethnic groups
- Children of Asian decent demonstrate significantly greater cephalic index compared to other sub-groups
- The amount of back sleep and tummy time in the first six months of life also affects cephalic index values

