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Craniofacial anthropometry in a group of healthy Latvian residents

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Craniofacial anthropometrics has become an important tool used by genetic counsellors and in reconstructive surgery. In genetic counselling, it is necessary to identify dysmorphic syndromes as accurately as possible. Nevertheless, dysmorphic characters are usually reported by clinicians mainly in descriptive terms. Anthropometrical measurements can overcome these problems. The aim of this study was to show variations of craniofacial parameters in normal (without any family history of craniofacial or other genetic malformations) Latvian residents. **Materials and methods.** Craniofacial anthropometrical measurements (total 38) have been studied in healthy Latvian residents. For this study, 77 individuals were examined. All measurements were made by one observer and performed with the GPM anthropological Instruments, Siber Hegner & Co.AG. All parameters were compared between males and females and between two ethnically different groups – Latvians and non-Latvians. **Results**. Statistical analysis ($p < 0.05$) showed a strong sex-related morphology in the craniofacial complex (higher values in males were observed in the parameters used to characterize head and face). However, several parameters such as orbital depth, mandible body length, nose height, ala thickness, upper and lower vermilion height showed no significant differences between males and females. No significant differences in these parameters between Latvians and non-Latvians were obtained. **Conclusions**. Our measurements can provide the basic framework for estimating the craniofacial standards of Latvian population. Anthropometrical measurements should be continued to establish craniofacial standards for diagnostic and treatment planning needs of Latvian adults.

Key words: anthropometry, craniofacial parameters, anthropometrical standards

INTRODUCTION

This study was aimed to establish standards for craniofacial anthropometrical parameters of Latvian population. Craniofacial anthropometrics has become an important tool used by genetic counsellors and in reconstructive surgery. In genetic counselling it is necessary to identify dysmorphic syndromes as accurately as possible. The diagnosis of many dysmorphic syndromes is based not only on advanced cytogenetic and molecular techniques, but also on recognition of subtle morphological anomalies in craniofacial region. Dysmorphic characters are usually reported by clinicians in descriptive terms such as "wide-set eyes", "broad nose", and "large mouth". However, such description is subjective. Anthropometrical measurements can overcome these problems. Measurements taken from a patient can be compared with the values obtained in the normal population, and deviations from the normative values can be evaluated. For instance, anthropometrical data can help in early diagnosis of rather common syndromes. In some patients with Noonan syndrome, higher faces were observed (1). Craniofacial measurements are also an integral part of the evaluation of dysmorphic patients. Evaluation of asymmetry is of great importance in the diagnosis of craniosynostoses.

Anthropometrical approach was used to differentiate individuals with and without prenatal alcohol exposure. It was shown that children with foetal alcohol syndrome and partial foetal alcohol syndrome have a distinctive facial phenotype that can be characterized anthropometrically (2). Several authors (3) have shown that the frequency of minor anomalies is increased among infants of diabetic mothers.

For evaluation of deviations in craniofacial morphology, standards of anthropometrical measurements should be established for a particular population (4). Nevertheless, only few studies present normal values on healthy individuals in some particular population. Measurements for nose length, nasal protrusion, and philtrum length were obtained on healthy individuals of Central European origin (5). Anthropometrical variations in fronto-occipital circumference, inner and outer canthal distances, interpupillary distance were shown in Turkish subjects (6). In spite of that, craniofacial dimensions are not available in the clinics in many countries, including Latvia. For this reason it seems important to develop such standards for Latvian population. The aim of this study is to show variations of craniofacial parameters in normal (without any family history of craniofacial or other genetic anomalies) Latvian residents.

MATERIALS AND METHODS

In this cross-sectional study, the subjects were clinically healthy individuals. Craniofacial measurements were taken if an individual met the following criteria: Latvian resident, age 18–23 years, normal craniofacial configuration, no known history of craniofacial surgery, trauma, craniofacial abnormalities in the family. For this study, 77 individuals were considered, 3 individuals were excluded because of missing data. The individuals were informed about the nature of the study and were invited to participate. Informed consent was obtained.

All measurements were made by one observer and performed with the GPM Anthropological Instruments, Siber Hegner & Co.AG. The measurements were taken with a spreading calliper, sliding calliper, and measuring tape. A subject was asked to sit upright in resting position for measurements. A total of 19 landmarks were included and 38 measurements taken from the head, face, orbital and nasoorbital region. Anthropometrics using specialized instruments has several advantages: it is a simple, non-invasive, inexpensive technique, and is based on direct measurements. Anthropometrical landmarks and measurements commonly used to characterize the craniofacial region are shown in Fig. 1 and Table 1. Descrip-

Table 1. **Craniofacial landmarks and measurements**

Landmark	Measurement	Landmark	Measurement
eu – *euryon*	eu-eu – maximum head breadth	cph – *crista philtri*	cph-cph – philtrum width
ft – *frontotemporale*	ft-ft – minimal frontal breadth	n – *nasion*	n-gn – morphological face height
t – *tragion*	t-t – cranial base width	en – *endocanthion*	en-en – intercanthal width
g – *glabella* op – *opistocranion*	g-op – maximum head length	ex – *exocanthion*	ex-ex – biocular width
g – *glabella*	g-op – head circumference		Interpupillary distance
zy – *zygion*	zy-zy – maximum facial breadth		en-ex – bilateral eye fissure length
go – *gonion*	go-go – mandible breadth	tr – *trihion*	tr-gn – physiognomial face height
t – *tragion*	g-t – bilateral supraorbital depth	n – *nasion*	n-gn – morphological face height
t – *tragion* n – *nasion*	n-t – bilateral upper face depth	en – *endocanthion*	en-en – intercanthal width
sn – *subnasale*	sn-t – bilateral maxillary depth	ex – *exocanthion*	ex-ex – biocular width
gn – *gnation*	gn-t – bilateral mandibular depth	en – *endocanthion* ex – *exocanthion*	en-ex – bilateral eye fissure length
ex – *exocanthion*	ex-t – bilateral orbital depth	n – *nasion* sn – *subnasale*	n-sn – nose height
al – *alare*	al-al – nose width	ch – *cheilion*	ch-ch – labial fissure width
	columella width	ch – *cheilion* sto – *stomion*	ch-sto – bilateral labial fissure half width
	ala thickness	ls – *labiale superius* sto – *stomion*	ls-sto – upper vermilion height
sn – *subnasale* ls – *labiale superius*	sn-ls – philtrum length	sto – *stomion* li – *labiale inferius*	sto-li – lower vermilion height

tive and inferential statistics have been used for interpretation of the results. All the measurements were processed by SPSS (10.0). Mean, standard deviation, and independent sample *t* test were used for evaluating the difference between males and females as well as between Latvians and non-Latvians.

RESULTS

Measurements of 77 individuals (39 males and 38 females) were obtained. Craniofacial measurements (total 38) were compared between males and females, and between Latvians and non-Latvians. All measurements are given in centimetres. Mean values, standard deviation, two-tailed significance, and mean differences of the measurements are shown in Tables 2, 3, 4.

Analysis of parameters in Table 2, as expected, showed statistically significant differences between males and females in main anthropometrical measurements used to characterize the craniofacial region, although in 9 measurements statistically significant

Table 2. **Comparison of craniofacial measurements (cm) between males and females**

Measurements	Males (n = 39)		Females (n = 38)		Mean difference	p
	Mean	Std. deviation	Mean	Std. deviation		
eu-eu	15.42	1.01	14.58	0.59	0.83	0.01
ft-ft	11.49	1.10	10.66	0.74	0.84	0.01
t-t	14.42	0.59	13.55	0.50	0.87	0.01
g-op	19.31	0.68	18.33	0.66	0.98	0.01
g-op 1	57.37	1.49	55.22	1.87	2.16	0.01
zy-zy	13.31	0.98	12.24	0.80	1.07	0.01
go-go	10.54	0.63	9.69	0.75	0.85	0.01
g-t; *r*	12.83	0.55	12.14	0.48	0.69	0.01
g-t; *l*	12.80	0.48	12.10	0.47	0.71	0.01
n-t; *r*	12.45	0.49	11.76	0.43	0.69	0.01
n-t; *l*	12.48	0.46	11.77	0.42	0.71	0.01
sn-t; *r*	13.05	0.49	12.13	0.40	0.92	0.01
sn-t; *l*	12.99	0.46	12.07	0.35	0.92	0.01
gn-t; *r*	14.77	1.03	13.42	0.57	1.35	0.01
gn-t; *l*	14.74	1.00	13.45	0.51	1.30	0.01
ex-t; *r*	7.65	0.45	7.44	1.74	0.21	0.48[1]
ex-t; *l*	7.60	0.38	7.37	1.68	0.23	0.42[1]
gn-go; *r*	9.21	0.60	8.94	1.43	0.27	0.28[1]
gn-go; *l*	9.18	0.62	8.92	1.44	0.26	0.30[1]
tr-gn	18.73	0.73	17.70	0.79	1.03	0.01
n-gn	12.41	0.60	11.76	0.62	0.65	0.01
en-en	2.91	0.30	2.66	0.24	0.25	0.01
ex-ex	10.63	0.58	10.06	0.60	0.58	0.01
pupils	6.39	0.41	6.04	0.42	0.35	0.01
en-en; *r*	3.67	0.29	3.48	0.27	0.19	0.01
en-en; *l*	3.79	0.30	3.58	0.28	0.21	0.01
n-sn	5.87	0.54	5.67	0.57	0.21	0.11[1]
al-al	3.53	0.32	3.28	0.27	0.25	0.01
columella	1.04	0.18	0.88	0.13	0.16	0.01
ala; *r*	0.99	0.16	1.41	1.71	-0.42	0.13[1]
ala; *l*	1.00	0.23	1.48	1.78	-0.47	0.10[1]
sn-ls	1.27	0.23	1.14	0.19	0.13	0.01
cph-cph	1.08	0.21	0.91	0.18	0.17	0.01
ch-ch	5.08	0.37	4.65	0.34	0.43	0.01
ch-sto; *r*	2.84	0.24	2.63	0.25	0.22	0.01
ch-sto; *l*	2.85	0.24	2.68	0.24	0.17	0.01
ls-sto	0.81	0.23	0.78	0.14	0.03	0.47[1]
sto-li	1.07	0.26	1.03	0.14	0.04	0.40[1]

[1] Mean differences are not statistically significant.
r – right side, *l* – left side.

differences were not obtained. Higher values in males were observed in the parameters used to characterize the head: maximum head breadth, maximum head length, and head circumference; males had also a greater cranial base width. Measurements of face showed that males in comparison with females had wider and higher faces (both physiognomial and morphological), bigger minimal frontal breadth and upper face depth. Measurements taken from the jaw region (mandible breadth, maxillary depth) mandibular depth, showed that this region in males is more expressive than in females. However, mandibular body length did not show statistically significant differences between males and females. Comparing measurements from the orbital region we found that supraorbital depth, orbital depth, intercanthal width, biocular width, eye fissure length, and interpupillary distance were larger in males, but orbital depth was similar in males and females. Four parameters were studied for the nose region. Wider noses with a wi-

Table 3. **Comparison of craniofacial measurements (cm) between Latvian and non-Latvian males**

Measurements	Latvian (n = 26)		non-Latvian (n = 13)		Mean difference	p
	Mean	Std. deviation	Mean	Std. deviation		
eu-eu	15.32	1.06	15.61	0.90	-0.29	0.41
ft-ft	11.27	1.16	11.95	0.85	-0.68	0.07
t-t	14.34	0.57	14.58	0.62	-0.23	0.25
g-op	19.43	0.63	19.07	0.72	0.36	0.12
g-op 1	57.43	1.13	57.25	2.08	0.19	0.72
zy-zy	13.25	1.00	13.43	0.97	-0.18	0.59
go-go	10.66	0.66	10.31	0.52	0.35	0.10
g-t; *r*	12.86	0.57	12.78	0.52	0.08	0.66
g-t; *l*	12.81	0.45	12.78	0.55	0.03	0.87
n-t; *r*	12.43	0.49	12.51	0.51	-0.08	0.64
n-t; *l*	12.46	0.43	12.54	0.52	-0.08	0.61
sn-t; *r*	13.07	0.52	13.02	0.46	0.05	0.75
sn-t; *l*	12.99	0.45	12.98	0.50	0.02	0.92
gn-t; *r*	14.83	1.16	14.65	0.76	0.18	0.61
gn-t; *l*	14.86	1.14	14.52	0.62	0.34	0.32
ex-t; *r*	7.68	0.45	7.59	0.48	0.09	0.57
ex-t; *l*	7.61	0.37	7.57	0.40	0.04	0.75
gn-go; *r*	9.23	0.66	9.15	0.48	0.08	0.70
gn-go; *l*	9.25	0.65	9.05	0.55	0.20	0.35
tr-gn	18.68	0.74	18.85	0.71	-0.17	0.50
n-gn	12.48	0.55	12.28	0.69	0.19	0.35
en-en	2.87	0.28	2.99	0.32	-0.12	0.23
ex-ex	10.54	0.58	10.82	0.57	-0.28	0.15
pupils	6.35	0.29	6.46	0.58	-0.11	0.44
en-en; *r*	3.67	0.34	3.65	0.17	0.02	0.85
en-en; *l*	3.77	0.36	3.84	0.15	-0.07	0.53
n-sn	5.85	0.61	5.93	0.38	-0.08	0.65
al-al	3.57	0.28	3.45	0.38	0.12	0.26
columella	1.06	0.20	0.99	0.15	0.07	0.30
ala; *r*	1.00	0.14	0.98	0.20	0.02	0.73
ala; *l*	0.99	0.24	1.03	0.22	-0.04	0.59
sn-ls	1.33	0.19	1.15	0.25	0.18	0.01[2]
cph-cph	1.11	0.17	1.03	0.27	0.08	0.26
ch-ch	5.12	0.35	5.01	0.41	0.11	0.40
ch-sto; *r*	2.87	0.24	2.78	0.24	0.08	0.31
ch-sto; *l*	2.88	0.23	2.78	0.27	0.10	0.23
ls-sto	0.82	0.26	0.80	0.14	0.02	0.84
sto-li	1.09	0.28	1.04	0.20	0.05	0.54

[2] Mean differences are statistically significant.
r – right side, *l* – left side

der columella were observed in males, but there was no significant difference between nose height and alar thickness in males and females. In the mouth region, philtrum length, philtrum width, as well as labial fissure width and labial fissure half-width were greater in males, but there was no difference in vermillion height – both upper and lower.

Craniofacial measurements were compared between Latvian and non-Latvian males and females (Tables 3 and 4). Analysis of the results given in Table 3 showed no statistically significant differences between Latvian and non-Latvian males in this study group, except of philtrum length (Latvian males had a greater distance between subnasale and labiale superius). Table 4 shows that there is no statistically significant differences in almost all craniofacial measurements if compared between Latvian and non-Latvian females. Only in two parameters – mandible breadth and nose height – we observed higher, statistically significant values for Latvian females.

Table 4. **Comparison of craniofacial measurements (cm) between Latvian and non-Latvian females**

Measurements	Latvian (n = 21)		non-Latvian (n = 17)		Mean difference	p
	Mean	Std. deviation	Mean	Std. deviation		
eu-eu	14.60	0.58	14.56	0.62	0.04	0.83
ft-ft	10.66	0.94	10.65	0.40	0.01	0.97
t-t	13.63	0.41	13.45	0.59	0.18	0.27
g-op	18.44	0.60	18.19	0.73	0.25	0.25
g-op 1	55.20	1.52	55.24	2.27	-0.05	0.94
zy-zy	12.31	0.74	12.15	0.88	0.16	0.54
go-go	9.91	0.87	9.41	0.48	0.50	0.04[2]
g-t; *r*	12.27	0.39	11.99	0.55	0.28	0.07
g-t; *l*	12.24	0.37	11.92	0.54	0.31	0.04
n-t; *r*	11.90	0.41	11.59	0.41	0.30	0.03
n-t; *l*	11.91	0.38	11.59	0.40	0.32	0.02
sn-t; *r*	12.17	0.40	12.08	0.40	0.08	0.52
sn-t; *l*	12.10	0.39	12.04	0.31	0.06	0.61
gn-t; *r*	13.45	0.58	13.38	0.58	0.07	0.71
gn-t; *l*	13.51	0.52	13.37	0.50	0.14	0.41
ex-t; *r*	7.78	2.29	7.03	0.35	0.75	0.19
ex-t; *l*	7.67	2.22	7.00	0.33	0.67	0.23
gn-go; *r*	9.26	1.81	8.54	0.56	0.73	0.12
gn-go; *l*	9.30	1.83	8.44	0.42	0.86	0.07
tr-gn	17.82	0.82	17.56	0.75	0.26	0.32
n-gn	11.88	0.65	11.62	0.58	0.26	0.21
en-en	2.71	0.25	2.61	0.22	0.10	0.19
ex-ex	10.13	0.67	9.96	0.51	0.16	0.41
pupils	6.08	0.50	5.99	0.32	0.09	0.53
en-en; *r*	3.50	0.27	3.45	0.28	0.05	0.60
en-en; *l*	3.61	0.29	3.54	0.27	0.07	0.43
n-sn	5.83	0.50	5.46	0.61	0.37	0.05[2]
al-al	3.28	0.23	3.28	0.32	0.00	1.00
columella	0.85	0.16	0.91	0.08	-0.05	0.23
ala; *r*	1.78	2.25	0.95	0.17	0.82	0.14
ala; *l*	1.89	2.33	0.97	0.19	0.92	0.12
sn-ls	1.13	0.20	1.15	0.20	-0.02	0.76
cph-cph	0.94	0.20	0.88	0.14	0.07	0.26
ch-ch	4.67	0.29	4.62	0.40	0.05	0.67
ch-sto; *r*	2.66	0.25	2.59	0.25	0.07	0.40
ch-sto; *l*	2.69	0.25	2.68	0.24	0.01	0.91
ls-sto	0.78	0.16	0.78	0.12	-0.01	0.89
sto-li	1.03	0.15	1.04	0.14	-0.01	0.79

[2] Mean differences are statistically significant.
r – right side, *l* – left side.

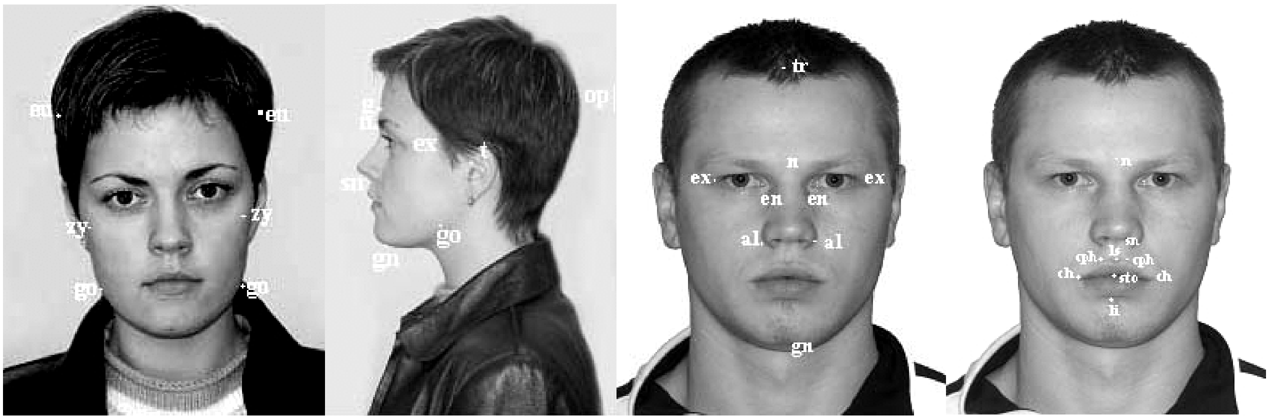

Figure. Craniofacial landmarks

DISCUSSION

This study focused on craniofacial anthropometrical measurements of healthy Latvian residents having no obvious dysmorphological features and no known family history of genetic defects. Our research was oriented to identifying the average craniofacial parameters that can assist in the diagnosis of genetic pathology and treatment planning for young adults. The obtained data were separated according to sex and nationality. As expected, sexual dimorphism was found to be statistically significant in almost all parameters that include head and face (Table 2); 29 measurements ($p < 0.05$) showed a strong sex-related morphology in the craniofacial complex. However, several parameters such as orbital depth, mandible body length, nose height, ala thickness, upper and lower vermilion height showed no significant differences between males and females. Many investigators have shown significant differences in craniofacial complex among ethnic and racial groups (7–10). Several other investigators (11) suggested also that genetic factors exert a substantial influence on the individual difference in body shape and configuration. Therefore they could be considered in developing standards for various populations (4). However, from this study we concluded that there are no differences in the main measurements between Latvian and non-Latvian individuals living in Latvia. This conclusion is supported also by measurements of interpupillary distance, intercanthal distance, philtrum length, head circumference, and head length in a group of healthy non-Latvian females (12).

CONCLUSIONS

1. Our measurements can provide the basic framework for estimating the craniofacial standards for Latvian population.

2. This study shows that sexual dimorphism is characteristic of ethnically very heterogeneous Latvian residents; only a few measurements showed no difference between males and females.

3. Despite national heterogeneity, craniofacial measurements of the head and face, with only a few exceptions, are similar in Latvians and non-Latvians, both males and females.

4. Anthropometrical measurements should be continued to establish craniofacial standards for diagnostic and treatment planning needs for Latvian adults.

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SVEIKØ LATVIJOS GYVENTOJØ GALVOS IR VEIDO ANTROPOMETRINIAI MATMENYS

S a n t r a u k a
Galvos ir veido matmenys aktualûs genetikoje ir plastinëje chirurgijoje. Pateikiant iðvadas dël genetiniø dismorfiniø sindromø, labai svarbu kuo tiksliau juos identifikuoti. Taèiau klinikoje lig ðiol dismorfiniai poþymiai apibûdinami daþniausiai apraðomojo pobûdþio terminais. Antropometriniai matavimai gali padëti objektyviau ávertinti ávairius pakitimus. Ðio darbo tikslas – nustatyti sveikø Latvijos gyventojø (praeityje neturëjusiø ir neturinèiø galvos ir veido ar kitø genetiniø sklaidos anomalijø) ávairius galvos ir veido parametrus. Iðtirti 77 individai. Ið viso gauti 38 Latvijos gyventojø galvos ir veido antropometriniai matmenys. Matavimus atliko vienas tyrëjas, panaudoti standartiniai antropometriniai instrumentai (GPM, Siber Hegner & CO.AG). Palyginti visi vyrø ir moterø, taip pat skirtingø etniniø grupiø – latviø ir ne latviø kilmës – antropometriniai galvos ir veido matmenys. Nustatytas patikimas ($p < 0,05$) galvos ir veido morfologiniø poþymiø lytinis dimorfizmas (vyrø galvos ir veido matmenys didesni nei moterø). Tuo tarpu orbitos gylis, þandikaulio kûno ilgis, nosies aukðtis, nosies sparneliø storis, virðutinës ir apatinës lûpos raudonio storis patikimai nesiskyrë. Ðis mûsø darbas – pradinis bandomasis Latvijos populiacijos galvos ir veido matmenø tyrimas. Norint sudaryti suaugusiøjø Latvijos þmoniø galvos ir veido matmenø standartus, kuriuos bûtø galima panaudoti praktikoje diagnozuojant ligas bei planuojant gydymà, bûtina tæsti antropometrinius matavimus.