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The Greenland Eskimos craniometric diversity

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Introduction

This paper presents morphological analysis of Greenland Eskimos skulls. It is widely accepted that Greenland inhabitants, living in one of the most inhospitable areas people have ever populated, constitute an interesting group for research on ecologically based differentiation of Homo sapiens (e.g. Koertvelyessy 1972, Ruff 1994). Craniometric characteristics of human morphology have been for long time one of the main aims of arctic anthropology (Hrdlička 1910, Furst and Hansen 1915, Oschinsky 1962, Zegura 1978), and as Eskimo groups have a long history of being researched anthropologically, they consist one of the most commonly used reference group for analysing climatic differentiation of human species. Most researchers treat Eskimos as morphologically homogenous, distinguishing at best four main group: Asian, South Alaskan, Canadian and Greenland Eskimos. Although this distinction is well founded on the cultural and ethnological basis (Dumond 1987) some researchers give also indication for further division.

The main advantage of the population of Greenland Eskimos is a relatively simple model of settlement on the island, with habitable area occurring only on the shores and clear migration routes (Dumond 1987, see also Figure 1). This provokes some authors to state that the groups on the ends of different migration routes (i.e. NE i SE groups) can be treated as isolates (Laughlin 1966). If such opinion is well grounded by anthropological research, it can give some insight into process of adaptation to the climate of the group living in extremely harsh environment.

Table 1: List of samples with names of archaeological sites and their locations

Site code	*Location*	*Site name*	*Number of individuals*
111	NW	York Peninsula	6
112	NW	Upernivik (Upernavik)	34
113	NW	Umanak (Umânaq)	38
114	NW	Ritenbaenk & Disko	35
115	NW	Jacobshavn (Ilulissat)	15
116	NW	Christianshåb (Qasigiannguit)	15
117	NW	Egedesminde (Ausiait)	20
121	SW	Sukkertoppen (Manitsôq)	10
122	SW	Godthåb (Nûk)	16
123	SW	Frederikshåb (Pâmiut)	11
124	SW	Julianehåb (Qaqortoq)	11
211	NE	Steward Peninsula	15
212	NE	Storm Bay	4
221	SE	Kutek	11
222	SE	Angmagssalik (Ammassadik)	13
223	SE	Nualik	17

Table 2: F-matrix between researched Greenland sample and Howells' data (only samples with distance smaller then Norse sample are presented, mean calculated from all distances to Howells' samples)

Sample	*Location*	*Between groups F-matrix distance to 'x'*
Eskimo	**Greenland; America**	16.4800
Zalavar	Hungary; Central Europe	71.8680
Guam	Oceania	80.1310
Atayal	Taiwan; Asia	83.4830
Anyang (Shang dynasty)	China; Asia	90.0160
Hokkaido	North Japan; Asia	93.8750
Santa Cruz Island	California; North America	94.2470
North Kyushu	South Japan; Asia	99.9900
Ainu	North Japan; Asia	106.9520
Norse (medieval)	**Norway; North Europe**	112.9650
MEAN		136.1685

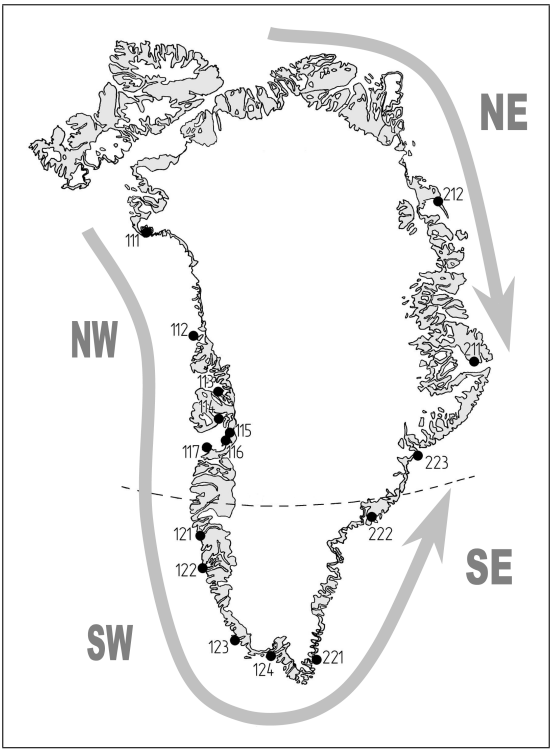

Figure 1: Location of sites and migration routes

Materials and methods

Data used for present analysis comes from two comprehensive anthropological studies: Aleš Hrdlička's "Catalog of human crania in United States National Museum Collections: Eskimo in general" (1942) and Furst and Hansen's "Crania Groenlandica" (1915). There were overall 416 skulls originating from Greenland and 271 (123 females and 148 males) presenting individuals derived from specified locations were chosen for present analysis. The list of the sites is presented in Table 1 and their location on the Figure 1.

The individuals from both sources can be described as representing indigenous inhabitants of Greenland, but actual chronology of the samples remains unknown, though it can be safely assumed that majority of them represent Thule culture period (1000–1600 AD), as the remains of earlier inhabitants are scarcer (Oschinsky 1962). The data was checked for its uniformity, as unknown chronology of the researched samples can indicate some Caucasian influence. As a reference the Howells' data were used (Howells 1989). F-matrix between groups from all over the world and researched Greenland sample were measured (df_1=9 df_2=2787). Calculated values are proportional to distance measures and are computed from Mahalanobis D^2 statistics. The smallest difference (distance 16.48 with mean distance of 136.1685, see also Table 2) occurred between researched sample ('x') and reference Eskimo group which consists of Green-

Table 3: Jackknifed classification matrix for researched Greenland Eskimos ('x') and Howells' Eskimos samples

	'x'	*Eskimo*	*'x' + Eskimo*
'x'	184	24	208
	67.90%	22.22%	54.88%
Eskimo	59	58	117
	21.77%	53.70%	30.87%
Santa Cruz Island	6	6	12
	2.21%	5.56%	3.17%
North Kyushu	3	4	7
	1.11%	3.70%	1.85%
Tolai	3	4	7
	1.11%	3.70%	1.85%
Lake Alexandrina Tribes	2	2	4
	0.74%	1.85%	1.06%
Moriori	1	3	4
	0.37%	2.78%	1.06%
Ainu	1	2	3
	0.37%	1.85%	0.79%
Egypt	3		3
	1.11%		0.79%
Norse (medieval)	2	1	3
	0.74%	0.93%	0.79%
Yauyos	2	1	3
	0.74%	0.93%	0.79%
Zalavar	2	1	3
	0.74%	0.93%	0.79%
Arikara (early)	1		1
	0.37%		0.26%
Berg	1		1
	0.37%		0.26%
Easter Island		1	1
		0.93%	0.26%
Guam		1	1
		0.93%	0.26%
Zulu	1		1
	0.37%		0.26%
Total number	271	108	379

land Eskimo without Caucasian admixture. Also discriminant analysis shows that only 2 of total number of 271 researched Eskimo skulls group together with Norse sample (also one of the original Howells' Eskimo are grouped together with Norse sample) – see jackknifed classification matrix for 'x' and Howells' Eskimo samples in Table 3.

Only most common cranial measurements that simultaneously well describe skull morphology were chosen. Analysed features were maximal cranial length (*gonion-opisthocranion*; M1 acc. to R. Martin 1957-66), (*eurion-eurion*; M8), cranial height (*basion-bregma*; M17), upper facial height (*nasion-prosthion*; M48), bizygomatic facial breadth (*zygion-zygion*; M45), nasal height (*nasion-nasospinale*; M55), nasal breadth (*aperthion-aperthion*; M54), orbital height (*subconchion-supraconchion*; M52) and orbital breadth (*dacryon-ectoconchion*; M51a) (see also Table 4). Only skulls with full data, together with precise information on their origins were taken into analysis. Table 5 presents mean values of all variables for each sample.

Table 4: List of taken measurements

Measurement	*Points*	*acc. to Martin*	*acc. to Howells*
maximal cranial length	g-op	M1	GOL
maximal cranial breadth	eu-eu	M8	XCB
cranial height	ba-b	M17	BBH
upper facial height	n-pr	M48	NPH
bizygomatic facial breadth	zy-zy	M45	ZYB
nasal height	n-ns	M55	NLH
nasal breadth	apt-apt	M54	NLB
orbital height	sbk-spa	M52	OBH
orbital breadth	d-ek	M51a	OBB

Results

The data, as expected, can describe sexual dimorphism in skull size for the Greenland Eskimo, as t-test shows significant differences in all measurements. To exclude its influence on the results of the present analysis all data was standardised for each sex separately.

Analysis of single measurements shows some significant differences in variance between samples: in maximal cranial length, maximal cranial breadth and orbital breadth (see Table 6).

The data shows that all the skulls belong to one population without much morphological differences. When analysing matrix of the Mahalanobis D^2 distances between the samples, it can be easily seen that major distances occur between sample 111 from York Peninsula (Thule settlement[1]), with maximal distance of 4.185 (underlined in Table 7) and highest mean distance from other samples equal to 2.4. This can be explained by ethnic difference of the Eskimos from that area: ethnographers classify inhabitants of Thule settlement and their closest neighbours as belonging to Polar Eskimo group, consisting of Eskimos of High Arctic Canadian Islands. So even the morphological differences are not strong enough to show significant results in variance analysis some morphological difference between this sample and rest of the Greenland population can be found. Closer analysis show that the differences in cranial length and orbital breadth between this sample and other is responsible for results: exclusion of 111 sample from ANOVA analyses shows insignificant difference in variance in cranial length ($f=1.725$, $p>0.05$) and orbital breadth ($f=1.621$, $p>0.073$).

Analysing the Mahalanobis distances between samples from East Greenland (bolded in Table 8) it can be easily seen that none of the distances between them occurs bigger than average distance between sample 111 and the rest of the Greenland inhabitants (mean distance = 2.4003). In fact mean distance between East Greenland samples (mean = 1.0525) are smaller than mean distances between all samples (mean = 1.498).

Checking the distance between the samples shows that similar morphological characteristics appear on the both shores of Greenland and there is no latitudinal

[1]Thule settlement was an eponymous site for Thule culture.

Table 5: Mean values and Standard Deviation of all variables for every sample researched

	GOL	XCB	BBH	NPH	ZYB	NLH	NLB	OBH	OBB
111	183.4 ± 6.11	134.4 ± 4.61	136.3 ± 4.39	70.7 ± 4.89	138.4 ± 7.93	53.4 ± 3.10	21.9 ± 1.68	36.0 ± 0.58	44.1 ± 2.04
112	186.2 ± 6.39	131.9 ± 4.60	137.3 ± 4.75	72.8 ± 4.88	136.3 ± 7.13	52.0 ± 3.82	23.0 ± 1.75	36.1 ± 1.59	41.9 ± 2.43
113	186.8 ± 6.55	133.2 ± 3.99	136.2 ± 4.78	73.7 ± 4.20	136.7 ± 7.00	52.5 ± 2.93	22.7 ± 1.66	35.9 ± 2.26	42.1 ± 3.01
114	187.1 ± 6.85	131.9 ± 5.30	137.6 ± 4.47	72.6 ± 4.88	136.3 ± 8.06	52.1 ± 3.33	23.3 ± 1.90	35.7 ± 2.31	42.5 ± 2.85
115	183.6 ± 5.74	134.3 ± 5.13	135.5 ± 4.59	72.1 ± 5.47	135.6 ± 5.90	52.5 ± 3.28	22.6 ± 2.34	35.4 ± 1.91	41.8 ± 3.07
116	188.0 ± 5.25	135.4 ± 3.79	136.1 ± 4.43	72.6 ± 5.12	136.8 ± 6.41	52.9 ± 4.66	22.6 ± 1.45	36.3 ± 1.69	41.7 ± 2.33
117	184.4 ± 7.54	133.8 ± 5.05	133.5 ± 5.73	73.0 ± 4.25	133.5 ± 7.69	51.9 ± 2.71	22.4 ± 1.97	35.9 ± 1.93	42.4 ± 2.22
121	182.9 ± 4.91	131.6 ± 4.46	134.5 ± 5.96	72.1 ± 3.11	133.7 ± 9.73	52.3 ± 2.65	22.4 ± 1.96	35.2 ± 1.25	42.6 ± 1.75
122	187.2 ± 7.00	132.2 ± 4.39	137.1 ± 5.23	72.6 ± 6.77	137.8 ± 7.43	52.8 ± 2.91	23.1 ± 2.27	35.8 ± 1.65	42.4 ± 2.33
123	185.6 ± 5.70	135.6 ± 3.67	138.1 ± 5.30	75.5 ± 3.45	137.5 ± 6.28	53.9 ± 1.58	22.0 ± 1.48	36.5 ± 2.91	42.9 ± 2.51
124	183.0 ± 4.67	133.8 ± 3.43	137.1 ± 4.37	73.3 ± 5.45	135.5 ± 6.19	53.2 ± 4.73	22.5 ± 1.88	34.8 ± 2.08	42.2 ± 1.60
211	183.9 ± 5.58	134.5 ± 5.50	134.3 ± 5.68	71.4 ± 4.99	134.4 ± 6.10	52.4 ± 2.99	21.9 ± 1.19	35.9 ± 2.24	41.6 ± 1.93
212	182.8 ± 4.86	135.5 ± 4.65	133.3 ± 4.92	74.0 ± 3.16	130.8 ± 4.99	52.8 ± 2.99	21.5 ± 1.73	35.0 ± 0.82	40.3 ± 1.89
221	182.9 ± 6.06	133.1 ± 5.19	135.7 ± 8.24	70.3 ± 4.41	135.8 ± 7.87	49.4 ± 3.23	22.3 ± 1.35	35.6 ± 2.16	40.0 ± 1.41
222	186.7 ± 6.10	131.0 ± 6.58	137.0 ± 4.83	74.8 ± 3.60	135.1 ± 7.34	53.4 ± 2.60	22.6 ± 1.89	35.0 ± 1.96	41.5 ± 2.15
223	183.7 ± 7.32	131.7 ± 4.75	136.5 ± 6.24	72.3 ± 5.88	132.2 ± 9.11	52.0 ± 3.85	22.9 ± 1.49	35.4 ± 2.25	40.8 ± 1.82

Table 6: The ANOVA results for researched measurements

Variable		*f*	*p*
maximal cranial length	**g-op/GOL**	**1.894**	**0.024**
maximal cranial breadth	**eu-eu/XCB**	**2.046**	**0.013**
cranial height	ba-b/BBH	1.204	0.268
upper facial height	n-pr/NPH	0.835	0.638
bizygomatic facial breadth	zy-zy/ZYB	1.576	0.080
nasal height	n-ns/NLH	1.195	0.275
nasal breadth	apt-apt/NLB	1.142	0.319
orbital height	sbk-spa/OBH	0.787	0.692
orbital breadth	**d-ek/OBB**	**1.766**	**0.039**

differences, as it is presented in the cluster tree on the Figure 2. The clustering was based on the Mahalanobis distances, and was performed using average linkage method (farthest neighbour).

Discussion

The graph shows two main clusters and series from all part of Greenland appear in both clusters. This justifies the statement that Eskimo population in Greenland is rather homogenous apart of the maximal cranial breadth, which differs between series with no clear trend occurring (see Figure 3).

The only exclusion from this rule can be a York Peninsula settlement (sample 111), which differs significantly in maximal cranial length and orbital breadth.

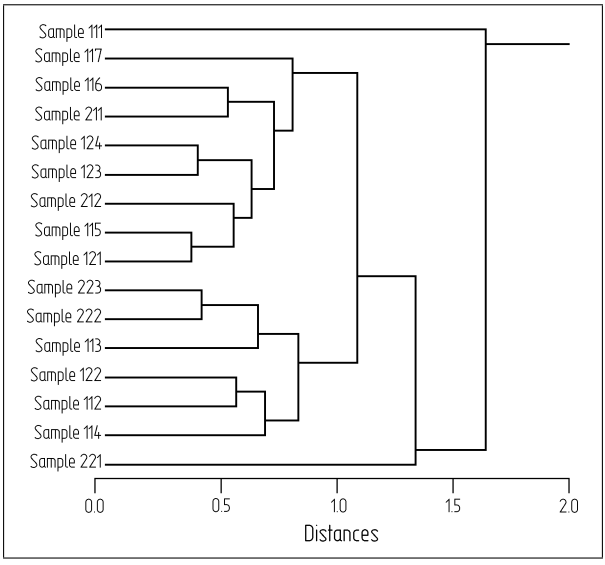

Figure 2: Cluster tree based on Mahalanobis distances using average linkage method (farthest neighbour)

Table 7: The matrix of Mahalanobis distances between samples (distances between East Greenland samples are bolded)

	111	112	113	114	115	116	117	121	122	123	124	211	212	221	222	223	mean
111	0.000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.4003
112	3.568	0.000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.5939
113	3.362	0.938	0.000	–	–	–	–	–	–	–	–	–	–	–	–	–	1.3112
114	3.384	0.691	1.660	0.000	–	–	–	–	–	–	–	–	–	–	–	–	1.9414
115	1.874	1.364	0.863	1.750	0.000	–	–	–	–	–	–	–	–	–	–	–	1.0039
116	2.697	1.461	1.004	1.890	0.873	0.000	–	–	–	–	–	–	–	–	–	–	1.4134
117	2.522	3.000	1.479	3.532	1.038	1.594	0.000	–	–	–	–	–	–	–	–	–	1.6680
121	1.032	1.330	0.773	1.336	0.496	1.100	0.597	0.000	–	–	–	–	–	–	–	–	0.9299
122	2.326	0.518	1.034	0.515	0.882	0.801	2.262	0.831	0.000	–	–	–	–	–	–	–	1.2821
123	1.698	2.205	1.393	2.752	0.832	1.713	0.801	0.575	2.115	0.000	–	–	–	–	–	–	1.3798
124	1.286	2.315	1.715	2.423	0.466	2.001	1.593	0.547	1.660	0.653	0.000	–	–	–	–	–	1.3931
211	1.777	2.154	1.183	2.724	0.604	0.382	1.259	0.632	1.251	0.955	1.143	**0.000**	–	–	–	–	1.3421
212	2.279	1.808	1.060	2.157	0.869	1.043	0.661	1.027	1.759	0.617	0.959	**0.780**	**0.000**	–	–	–	1.1821
221	4.185	1.679	1.861	3.092	1.737	2.187	2.701	2.278	2.165	2.492	2.639	**2.473**	**1.690**	**0.000**	–	–	2.1895
222	3.110	1.128	0.908	1.274	1.289	1.829	1.729	0.947	1.099	1.521	1.336	**1.862**	**1.036**	**2.132**	**0.000**	–	1.3645
223	3.304	1.344	1.746	1.882	1.126	2.039	1.920	1.378	1.296	1.755	1.553	**2.294**	**1.168**	**1.721**	**0.632**	**0.000**	1.5724

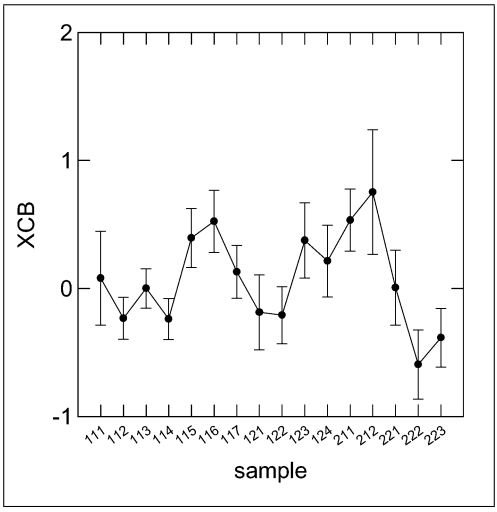

Figure 3: Results of ANOVA analysis of maximal cranial breadth in Greenland samples

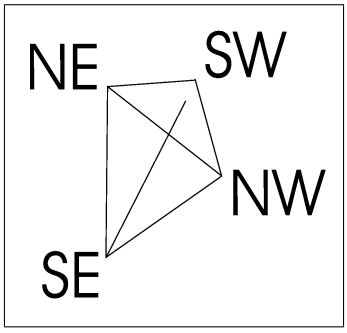

Figure 4: Graphical presentations of Mahalanobis distances between samples from main parts of Greenland

Such statement stands in discrepancy with assumption that populations of different parts of Greenland, especially from NE and SE of Greenland are thought of as isolates (e.g. Laughlin 1966: 478). The present data shows that the most distant group of Greenland inhabitants is SE part (by Mahalanobis distances), whereas distance between NE and SE groups is only second biggest (see Table 8 and Figure 4).

Table 8: The Mahalanobis distances between samples from main parts of Greenland

	NE	NW	SE	SW
NE	0.000			
NW	1.906	0.000		
SE	2.253	1.860	0.000	
SW	1.159	1.179	2.305	0.000

Table 9: T-test results for differences between groups. P<0.005 are bolded.

variable		*t-test results*			
		NE-SE	*NW-SW*	*NW-NE*	*SW-SE*
maximal cranial length	g-op/GOL	-0.413	1.062	-1.570	-0.471
maximal cranial breadth	eu-eu/XCB	1.970	-0.100	1.415	-1.353
cranial height	ba-b/BBH	-1.435	-0.533	-1.920	-0.234
upper facial height	n-pr/NPH	-0.496	-0.540	-0.824	-0.611
bizygomatic facial breadth	zy-zy/ZYB	-0.157	-0.255	-1.417	-1.447
nasal height	n-ns/NLH	0.823	-1.367	0.245	-1.849
nasal breadth	apt-apt/NLB	**-2.073**	0.782	**-2.331**	0.206
orbital height	sbk-spa/OBH	0.735	0.917	-0.286	-0.612
orbital breadth	d-ek/OBB	1.046	-0.844	-1.366	**-4.205**

Closer analysis of differences (t-test) between NE and SE groups shows significant results for nasal breadth (t=-2.073; df=59; $p<0.05$), which suggests some isolation of both groups, which does not occur on the West Coast (see Table 9). It seems nonetheless that it is not enough to treat north-east and south-east groups as isolates. Analysis of differences between groups from east coast and adequate north-west and south-west groups shows that there are also significant differences between them (NW-NE also in nasal breadth: t=-2.331, SE-SW in orbital breadth: t=-4.205; for both $p<0.05$). It can be also noticed that those significant differences in nasal breadth are in both cases caused by wider than in other Greenland groups nasal apertures in the NE sample. None-the-less it has to be stated that this difference is not significant, as analysis of variance of nasal breadth between the samples shows insignificant results (f=1.872; $p>0.1$).

As those differences are bigger (SW-SE), or similar to NE-SE difference, assumption that only populations from east Greenland can be treated as isolates seem improbable on the ground of present research. Moreover the Greenland inhabitants form quite homogenous and morphologically similar population, which can be useful as a study group for climatic influence research.

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