

Health survey in Greenland 2014

Population sample and survey methods



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Contents

1. Overall aim of the health survey 2014	4
2. Sample	4
3. Data collection	5
4. Questionnaires and clinical examinations	7
5. Clinical procedures	9
6. Sampling of biological media	10
7. Information about results to participants and local health centres	13
8. Participation rate, non-participation and representativeness	13
9. Data entry and validation	17
10. Appendix 1.....	18

1. Overall aim of the health survey 2014

The health survey in Greenland 2014 is a population-based health study among adults in Greenland (>18 years old). The aim of the survey was to examine health and illness in the population. The study provides information on the general health status in 2014 and serves as a follow-up of participants examined in three former health surveys in Greenland (1993-94, 1999-2001, 2005-10). Demographic, regional and social variations in health and risk factors for health were examined by the use of questionnaires and a clinical examination. The survey covers topics, such as childhood conditions, smoking, alcohol, physical activity, diet, obesity, diabetes, physical health and mental health and contributes to the monitoring of the Public Health Program in Greenland (Inuuneritta II 2013-2019).

2. Sample

The health survey 2014 serves as a follow-up of the health status from three former health surveys in Greenland (1993-94, 1999-2001, 2005-2010):

Cohort 1 B93 (established 1993-1994; participation rate 57%, N=1728 interviews). Interview information on sociodemographic factors, childhood conditions, a 14 item food frequency questionnaire (FFQ), self-reported health, height and weight, drug use, smoking, alcohol, etc. This cohort is geographically representative of the whole of Greenland.

Cohort 2 B99 (established 1999-2001; participation rate 67%, N=1961 interviews and 1317 clinical examinations). Besides questionnaire information the survey included an ECG and measurements of height, weight, waist and hip circumference, blood pressure and blood analyses for lipids (cholesterol and triglyceride), a 75g oral glucose tolerance test (glucose, insulin, c-peptide), HbA1c, apoA1 and apo-B, persistent organic pollutants, as well as serum and DNA stored in the project biobank. This cohort is geographically representative of West Greenland.

Cohort 3 B2005 (established 2005-2010; participation rate 67%, N=3117 interviews and clinical examinations) added a 68-item Food Frequency Questionnaire (FFQ), long IPAQ (International Physical Activity Questionnaire) and measurements of body fat percent, ultrasound of abdomen for fat distribution, ultrasound of carotid arteries, Actiheart (combined accelerometry and heart rate) and blood analyses for fatty acids, vitamin D, mercury, etc. and stable isotopes of N and C in toe nails. DNA was collected and stored in the project biobank. Birthweight was looked up in patient hospital records. This cohort is geographically representative of the whole of Greenland.

The current health survey 2014 (B2014) includes participants from these past three surveys (overall sample group) and a new randomly drawn sample of individuals

from the central person register aged 18-25 years old (supplementary sample). Criteria for participation in the 2014 survey included continued residency in Greenland at recruitment. Moreover, only individuals with a clinical examination in one of the last two surveys were included in the overall sample. For logistic reasons settlements with an expected number of participants <25 participants and towns with an expected number of participants <60 participants were excluded from the overall sample. To increase the geographical representation, large samples in Maniitsoq and Qasigiannnguit due to oversampling were reduced by 50%. A total sample size of 3359 participants including 407 young Greenlanders aged 18-25 remained. Only people born in Greenland or Denmark were included. The total sample was reduced by 11% because of movement to other towns or villages not included in the survey, death or other reasons.

In total 63% participated in the health survey 2014. A total of 2102 persons participated of whom 1862 answered the self-administrated questionnaire. Blood was collected from a subsample (n=547).

At enrolment, participants were classified as Greenlanders or Danes based on their primary language and self-identification. This corresponds well with criteria collected as part of the interview, such as ethnicity of the grandparents, place of birth of parents, self-identification etc. Danes in Greenland are mostly short term immigrants and the current study description will focus on the Inuit population.

3. Data collection

Data was collected during 2014 (10 months) in 11 towns and 8 villages in Greenland from Kullorsuaq in the north to Narsarmiit and Aappilattoq in Nanortalik in the south, and Tasiilaq in the east (table 3.1).

Table 3.1. Towns and villages participating in the 2014 health study.

	Towns with 2000+ inhabitants	Smaller towns	Villages
South	Qaqortoq	Narsaq Nanortalik	
Mid	Nuuk Maniitsoq Sisimiut		Atammik Napasq
North	Aasiaat Ilulissat	Qasigiannnguit Upernavik	Kullorsuaq Innaarsuit Aappilattoq Ukussissat Saattut
East		Tasiilaq	Kuummiut



Figure 3.1. Map of Greenland with blue dots indicating places for examination in 2014.

The location of the examinations

The survey was carried out locally at schools, health centres or other available facilities. The local health centres, the regional administration and the health administration was informed about the survey (when and what) in advance.

Towns and villages were visited by public transport (air plane) and a chartered boat; M/S Kisaq was used to visit Upernavik and villages from Nuuk to Kullorsuaq. This expedition took place in the fall of 2014. M/S Kisaq can sail in almost all weather conditions and has accommodation for 12 passengers and space for large volumes of equipment. It is an unambiguously more convenient alternative to public transport, chartered helicopter or local boat charter.



Figure 3.2. M/S Kisaq was used for transport to the villages and as a floating hotel on four expeditions in 2006, 2007, 2008, 2010 and 2014.

Information for participants and health care system before examination

Invitations to participate in the survey were sent as a personally addressed letter. For acceptance of participation, individuals could respond by e-mail, letter or SMS. All individuals were also contacted by phone by the person in charge of recruitment. Upon examination, participants were informed orally and in writing about the survey and signed a consent form. Those who had blood tests done were asked in writing to determine whether results should be passed on to the local health centre. The health authorities including health centres, regional administration and health administration were informed in writing before the survey started. The survey was advertised on posters and through TV and radio. Furthermore, a Facebook page was established, where participants could read more about the study. Lastly it was possible to access information on the survey from the website www.folkesundhed.gl.

The study was approved by the ethical review committee for Greenland.

4. Questionnaire data and clinical examinations

Questionnaires

Data were collected by a team consisting of 2-4 trained interviewers. In most places local personnel was employed for recruitment of participants and for interviewing purposes. Two questionnaires were used as survey instruments, one for

face-to-face interviews and one self-administered with questions of a more sensitive character. In both cases the questionnaire consisted mostly of questions that had been used in one of the previous health surveys in Greenland. The interview lasted on average 35 minutes. The interview was conducted in Greenlandic or Danish according to the choice of the participant.

Clinical examinations

All participants went through a number of clinical examinations. Blood pressure was measured thrice during the interview (an average based on the two last measures was used for analyses) and measures of height, weight, fat percentage and waist and hip circumferences were obtained.

Blood samples were drawn from a sub sample of non-fasting participants (N=547) by biomedical laboratory technicians from Steno Diabetes Centre in Denmark. The excess blood is stored in a biobank at Steno Diabetes Centre in Denmark. Steno Diabetes Centre was also responsible for the handling and analyses of blood samples at the examination site before shipment to Canada (Centre de Toxicologie du Québec/INSPO) and Denmark (Steno Diabetes Centre) for analysis.

The main interview topics and clinical measurements in the health survey 2014 are presented in the following.

Interview

Demographic factors	Age and gender
Social determinants	Education, occupation, residence, household conditions, household assets
Diet	Revised version of the Food Frequency Questionnaire used in the Health Survey 2005-10, one question on food security
Physical activity	Physical activity at work, home, leisure time, transport and sedentary activities (long IPAQ)
Smoking	Smoking, age of onset, limitations for smoking, snuff
Illness and symptoms	Self-perceived heart disease, diabetes and blood pressure, family disposition and longstanding illness. Symptoms of physical and mental health
Health	Self-perceived health, own effort to obtain a good health
Medicine	Self-reported use of medicine
Health care	Use of health care and satisfaction with health care
Hearing and ear status	Ear illness and hearing status
Dental health	Chewing ability

Self-administrated questionnaire

Gambling	Gambling
Mental health	"Goldbergs General Health Questionnaire" (12 questions), life satisfaction
Alcohol and hash	Problem drinking (Cage-C-questionnaire), binge drinking, weekly use, alcohol problems in childhood, hash

Violence and sexual abuse	Self-perceived problems with violence in childhood home and sexual abuse (child, adolescent, adult)
Suicide attempts and thoughts	Earlier in life/latest year

Clinical examinations

Measurements	Height, weight, waist circumference, hip circumference, body fat percentage, bio impedance, blood pressure (measured thrice)
Biochemical measures	HbA1c, total cholesterol, HDL- cholesterol, calculated LDL- cholesterol, triglyceride, mercury and persistent organic pollutants (POPs), RNA, DNA, blood samples for biobank

Interviewer-administrated questionnaire [\[Greenlandic\]](#) [\[Danish\]](#)

Self-administered questionnaire [\[Greenlandic\]](#) [\[Danish\]](#)

5. Clinical procedures

The clinical procedures included:

- Anthropometric measurements: height, weight, waist and hip circumference
- Bio impedance, body fat percentage
- Blood pressure

Anthropometric measurements

Measurements were taken with the participant standing up and dressed down to undergarments and socks. Waist circumference was measured midway between the rib cage and the iliac crest and hip circumference at its maximum. Weight was measured on a standard electronic clinical scale.

Bio impedance

Bio impedance and calculation of fat percentage was performed on a leg-to-leg Tanita (Tanita SC 330 S). Based on a single reading, fat percent was calculated by the internal algorithm of the device, which is based on height, weight, sex, impedance and age; body type was set as standard. Fat percentage was recorded in the data file as well as impedance in order to allow the use of alternative algorithms.

Blood pressure

Blood pressure was measured on the right arm of a sitting participant after at least five minutes of rest. Using an automatic measuring device (Secma Model AND UA 787) with an appropriate size cuff, the blood pressure was read to the nearest mm Hg three times during the interview with at least 1 min. interval. The two last measurements were averaged for the analyses.

6. Sampling of biological media

Blood samples were collected and stored at -80° C for future analyses.

The following analyses were performed:

- HbA1c
- Cholesterol, total HDL, calculated LDL ,calculated VLDL and triglyceride
- Mercury in full blood
- Persistent Organic Pollutants (POPs) (see appendix 1)

Blood samples were collected after information about the study and signing of the informed consent. Blood samples were drawn by venipuncture at normal venous pressure. Blood was collected in BD-Vacutainer Systems™, Belliver Industrial Estate, Plymouth PL6 7BP, UK. Whole blood was allowed to clot and serum and plasma were separated by centrifugation for 10 minutes at 3000 rpm at 20°C. Samples were stored at -20°C until analysis or transfer to bio bank.

For bio bank: 6 x 1 ml of EDTA-plasma, 6 x 1 ml of serum, and 3 x 1.8 ml of urine. 3 tubes stored at -20°C and 3 tubes stored at -80°C . Buffy coats were stored at -80°C until extraction of DNA. The bio bank is located at the Steno Diabetes Centre.

HbA_{1c}

HbA_{1c} was measured in whole blood with a monoclonal antibody agglutination reaction (DCA Vantage). HbA_{1c} was measured at site, time to test results: 6 minutes.

Reference: <http://www.healthcare.siemens.com/point-of-care/diabetes/dca-vantage-analyzer/technical-specifications>

Laboratory: Steno Diabetes Centre, Gentofte, Denmark.

Lipids

Lipids were measured in serum by enzymatic colorimetric tests using Hitachi 917 (Roche Diagnostics, Mannheim, Germany).

LDL and VLDL values were calculated from total cholesterol and HDL cholesterol.

Laboratory: Steno Diabetes Centre, Gentofte, Denmark.

Mercury

Mercury was measured in full blood by inductively coupled mass spectrometry (ICP-MS). Detection limit: Mercury 0.5 nmol/l;.

Normal range: n/a

Laboratory: Laboratoire de Toxicologie/INSPQ, Sainte-Foy, Québec, Canada

Organochlorines (PCB, pesticides, PFOS, PFOA, PBDE) (see appendix 1)

Organochlorines were measured in EDTA-Plasma.

Method of analysis: A 1:1:3 mixture of ammonium sulfate:ethanol:hexane was first added to the plasma to extract organochlorines. The extracts were then concentrated and purified on two Florisil columns (60100 mesh; Fisher Scientific, Nepean, Ontario, Canada). Fifteen PCB congeners (IUPAC nos. 28, 52, 99, 101, 105, 118, 128, 138, 153, 156, 163, 170, 180, 183 and 187) and 11 chlorinated pesticides or their metabolites (aldrin, alpha-chlordane, gamma-chlordane, p,p'-dichlorodiphenyltrichloroethane (DDT), p,p'-dichlorodiphenyldichloroethene (DDE), hexachlorobenzene (HCB), β-hexachlorocyclohexane (β-HCH), cisnonachlor, trans-nonachlor, oxychlordane and Mirex) were measured in the purified extracts with an HP 5890 high-resolution gas chromatograph equipped with dual-capillary columns (HP Ultra I and Ultra II) and dual Ni-63 electron capture detectors (Hewlett-Packard, Palo Alto, CA, USA). Percent recovery ranged from 89% to 100%, and the detection limit was approximately 0.02 µg/L for all compounds. Coefficients of variation (n = 20, different days) ranged from 2.1% to 9.1%. Biases, i.e. the difference between the concentration of the reference material and the concentration found using the analytic method, ranged from 10.9% to 3.8%. The POPs were reported on a standardized lipid adjusted basis when relying on blood specimens for quantifying concentrations of lipophilic environmental contaminants. Estimates of total serum lipids were calculated by summation of the individual lipid components by the formula: Total plasma lipid = 1.677 (total cholesterol - free cholesterol) + free cholesterol + triglycerides + phospholipids.

Normal range: n/a

Laboratory: Laboratoire de Toxicologie/INSPQ, Sainte-Foy, Québec, Canada. For details of all analyses, see <https://www.inspq.qc.ca/ctq/repertoire-des-analyses>.

Nunavik Health Study - Qanuippitaa? – How are we?

The comparability of the four health surveys in Greenland and the Canadian Nunavik Health Study conducted in 2004 among Inuit in Nunavik is presented in table 6.1

THE HEALTH SURVEY IN GREENLAND 2014

Table 6.1. Overview of selected variables in four Health Surveys in Greenland and the Nunavik survey in 2004. ● means that the variables are comparable across examinations.

Examination	B93	B99	B2005	B2014	Nunavik
Synonym	Health profile Greenland	B99	Inuit Health in Transition	B2014	Qanuippitaa
Year	1993-1994	1999-2001	2005-2010	2014	2004
Number of participants (interview)	1.728	1.961	3.253	2.102	1.006
Number of participants (Clinical examination and blood samples)	228	1.317	3.115	547	925
Response rate	57%	62%	68%	63%	50%
Unwilling to participate	7%	-	17%	22%	-
Variable					
Education	●	●	●	●	-
Occupation	●	●	●	●	-
Income	-	-	●	-	-
Wealth	●	●	●	●	-
Social capital	-	-	●	-	●
Alcohol (amount and frequency)	●	●	●	●	●
Alcohol: CAGE	-	●	●	●	●
Smoking	●	●	●	●	●
Diet (14 items)	●	●	-	-	-
Diet (52/69 items)	-	-	●	●	(●)
Physical activity (long IPAQ)	-	-	●	●	-
Self-rated health	●	●	●	●	●
Gambling addiction	-	-	●	(●)	●
Suicide thoughts	●	●	●	●	●
General Health Questionnaire	●	●	-	●	-
Height, weight, waist and hip circumference	●	●	●	●	●
Body fat percent	-	-	●	●	●
Ultrasound of carotid artery	-	-	●	-	●
Diabetes (2-hour glucose tolerance test)	-	●	●	-	●
Diabetes (HbA1c)	-	●	●	●	-
Blood pressure (automatically)	●	-	●	●	-
ECG	-	●	●	-	-
Cholesterol and triglyceride	●	●	●	●	●
Fatty acids	(●)	-	●	●	●
DNA	-	●	●	●	●
Mercury	●	-	●	●	●
PCB and pesticides	●	●	●	●	●

7. Information about results to participants and local health centres

At the end of the examination participants were informed about some of the results, i.e. blood pressure, body mass index, percentage of body fat and they were given the possibility to ask questions. Later the results of the blood tests were sent by letter to the participants and the local health centre, provided the participant had given consent. This included information about lipids and HbA1c (table 7.1). The follow-up of diagnosed disease was the responsibility of the local health centre.

High blood pressure (hypertension) was defined as:

- Blood pressure $\geq 140/90$ – $160/100$ – possible high blood pressure - the participant was recommended to have his or hers blood pressure measured during the next visit to a doctor;
- Blood pressure $\geq 160/100$ – possible high blood pressure. The participant was recommended to see a doctor as soon as possible.

Table 7.1. Overview of diagnostic criteria for prediabetes and diabetes.

	HbA1c (IFCC standard)	HbA1c (DCCT standard)	Recommendation
Normal	Under 42 mmol/l	Under 6 %	
Prediabetes	42-47 mmol/l	6-6.4 %	Check-up at doctor after one year
Diabetes	48 mmol/l or over	6.5 % or over	Check-up at doctor in less than 2-3 weeks

Dyslipidemia was categorized according to Danish guidelines for primary prevention and the participant was recommended a new lipid measure at the next visit to the health care center in case of:

- Total cholesterol ≥ 7 mmol/l *or*
- LDL cholesterol ≥ 5 mmol/l *or*
- Triglyceride ≥ 5 mmol/l

Remaining blood tests, e.g. Mercury, were not considered clinically relevant at the individual level and were only communicated if the participant specifically requested it.

8. Participant rate, non-participation and representativeness

The sample estimation was revised locally with information about who were not actually living in the community at the time of the examination. Neighbours and the municipality office were good sources of information. For a significant proportion of the sample we were not able to obtain information about their whereabouts.

In total 2102 persons participated in the study corresponding to a participation rate at 63%. The participant rate in the health survey 2014 varied according to age and sex. Especially for young participants a low participation rate was found, namely 42% among the 18-25 years old with a higher participation among women than men.

Participants originated from 11 towns and 8 villages ranging from Nanortalik in the South to Kullorsuaq in the North as well as East Greenland. Two selected villages in the South were not visited, because of a substantial amount of ice during the first attempt to visit and storm on the second attempt. There was a considerable variation in participant rates according to geography from 48% in Saattut to 82% in Upernavik (table 8.1).

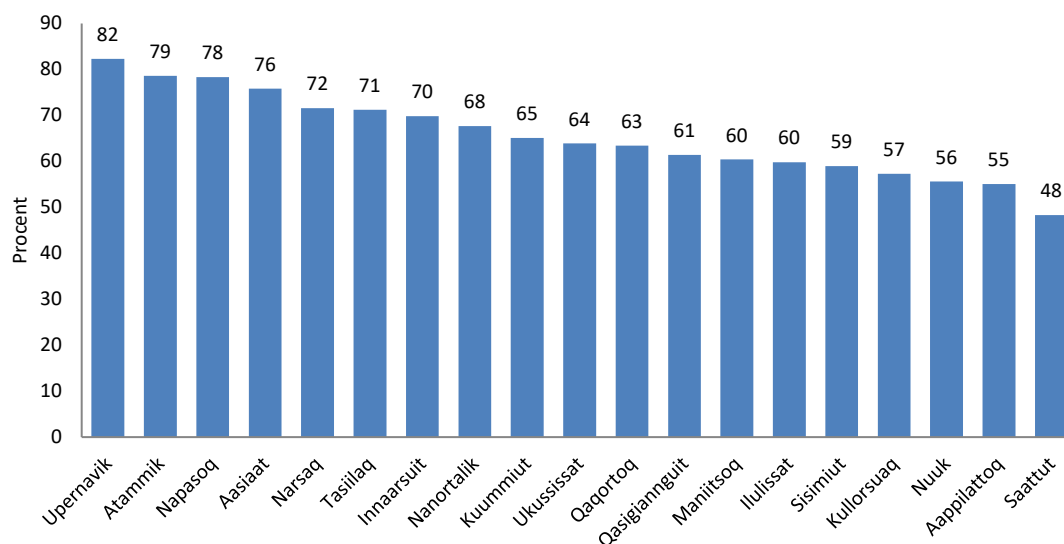


Figure 8.1. Participation rate for towns and villages in the Health survey 2014.

Table 8.1 shows how participation in the health survey 2014 varied regarding age and sex and how the participation differed from the general population in Greenland in 2014.

Table 8.1 Distribution of participants in the health survey 2014 and in the general population by sex and age.

	Participants		General population*	
	Number	%	Number	%
Males				
18-24 years	67	8.6	3.098	16.6
25-34 years	66	8.4	3.574	19.2
35-59 years	439	56.1	9.074	48.6
60+	210	26.9	2.906	15.6
I alt	782	38.4	18.652	51.2
Females				

THE HEALTH SURVEY IN GREENLAND 2014

18-24 years	114	9.1	3.010	16.9
25-34 years	144	11.5	3.493	19.6
35-59 years	729	58.2	8.372	47.1
60+	266	21.2	2.915	16.4
I alt	1.253	61.6	17.790	48.8

* Population born in Greenland

Table 8.2 describes the general reasons for not participating in 2014. The category "not contacted" means that it was not possible to contact the participant per mail, telephone or through families or neighbours. The category "no information" includes technical and human errors: problems with software or mistakes in lists for registration

Table 8.2. General reasons for not participating in the 2014 Health survey.

	B2014 %
Initial sample	N=3.359
Did not want/Did not show up	57.0
Disease	5.3
Fishing, hunting	1.8
Not contacted	25.0
Other reasons	1.2
No information	9.6
Total	100

Table 8.3 gives an overview of number of participants from former surveys which are included in the health survey 2014.

Table 8.3. Participants from former health surveys participating in the B2014 health survey.

Sample	Participants
Re-examined:	
B93	412
B99	519
B2005	1.291
Added sample in 2014 (18-25 years)	220
Total number of participants in 2014*	2.102

* The number of participants from the previous surveys does not add up to the total number of participants because some participants have been part of 2 or more of the surveys.

The non-random distribution of non-participants has implications for the precision of countrywide estimates. We know that people with serious illness or disability are over represented among the non-participants as well as those who tend to move often. We suspect that socially vulnerable people including alcoholics and people with little connection to the labour market are underrepresented in the survey.

Participants from the previous survey in 2005 were included in the overall sample size group in the 2014 health survey. This allowed us to examine whether participants and non-participants in the current study are different regarding social parameters, health behaviour and disease and helps us to decide if the participants in the study are representative of the whole population.

There was no difference in age between participants and non-participants in 2014 and 2005, but fewer males than females participated (39% and 26% respectively, $p < 0,001$) (table 8.1). Participants were more likely to have an education than non-participants and they had higher income. Non-participants smoked more often than participants, but the levels of alcohol consumption and good self-rated health as well as longstanding disease were the same (table 8.5). As expected, it seems that participants have a higher social position than non-participants, but on other parameters the differences are small. Unfortunately, we did not have information about non-participants in the 2005 or 2014 survey.

Table 8.5. Differences in social factors and health in 2005 between participants and non-participants in the health survey 2014. Adjusted for age and sex.

	Participants in B2014 N=1.291	Non-participants in B2014 N=594	p
Some education (%)	45.1	37.3	0.002
Wealth index	4.49	4.19	<0.001
Smokers (%)	64.8	69.9	0.03
Bingedrinking latest week (%)	37.9	40.5	0.33
Cage positive	28.2	32.8	0.11
Good self-rated health (%)	66,5	63,2	0.17
Longstanding disease (%)	34,8	38,8	0.09

Comparison of results between the health survey 2014 and former health surveys

In order to compare results from previous health surveys with the health study in 2014 in a meaningful way, it is a precondition that the distribution of participants in the surveys is comparable with regards to age, sex and geography. The geographical distribution in the previous surveys does not cover Greenland in the same way as in 2014. Compared with the health survey in 2014 South Greenland, Avanersuaq and villages were overrepresented in 2005, and in 1993 South Greenland, North-west Greenland and the villages were overrepresented. The age and sex distribution shows a clear tendency, i.e. increasingly fewer men participate in the health surveys and the participants are getting older (table 8.6).

Table 8.6. Age and sex distribution in the four health surveys.

Survey	Median age	Percent women
B93	36	53

B99	42	56
B2005	43	56
B2014	50	62

The non-random non-participation can be partly adjusted for by weighting for age, sex and geographical region. This means that a particular participant contributes more or less to the national prevalence depending on how many persons he or she represents.

9. Data entry and validation

Data from interview and the clinical examination were entered directly on tablet computers (Samsung Galaxy Tablet 2) using the software SNAPsurveys, version 12 (<http://www.snapsurveys.com/>). The Software program Snap has the advantage that it does not require internet connection during the interview. Admission to the telephone network by the SIM-card in the tablets was used to upload the interview afterwards and therefore the information from the interview was available shortly after the interview was finished. The same person with substantial experience in interviewing in both Danish and Greenlandic language entered self-administered questionnaire information into Snap throughout the study. The files were subsequently imported into the SPSS package and merged with results from biochemical analyses. The validity of data was checked against permitted values and logical errors. Education, job status, illness and residence now and at birth was recoded manually into categories and used for analyses. Analyses were performed with STATA v.12, SPSS version 22.0 and SAS.

10. Appendix 1

PCB IUPAC congener #	Other industrial chemicals	Pesticides
C_28	PBB_153	Aldrin
C_52		Alpha_chlordane
C_74	PBDE_28	Cis_Nonachlor
C_99	PBDE_47	Gamma_chlordane
C_101	PBDE_99	Hexachlorobenzene
C_105	PBDE_100	Mirex
C_118	PBDE_153	Oxychlordane
C_128	PBDE_154	p,p'-DDE
C_138	PBDE_183	p,p'-DDT
C_153	PBDE_209	Transnonachlor
C_156		Dieldrin
C_170	Perfluorohexanesulfonate (PFHxS)	Endrin
C_180	Perfluorooctanesulfonate (PFOS)	Alpha_HCH
C_183	Perfluorooctanoicacid (PFOA)	Beta_HCH
C_187		Gamma_HCH
C_189		Alpha_endosulfan
C_194		Beta_endosulfan
C_203		Heptachlor
C_209		Toxaphene_P26
		Toxaphene_P50