SIF Writings on Greenland vol. 19

Inuit Health in Transition

Greenland survey 2005-2009

Population sample and survey methods

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The publication can be downloaded at: www.si-folkesundhed.dk

Electronic ISBN: 978-87-7899-138-6
ISSN: 1601-7765

Contents

The Inuit Health in Transition study is a general health study among adults in Greenland. The total population in Greenland numbered 56,969 in 2005; of these 52,289 (92%) lived in West Greenland and most of the remaining persons in Ammassalik municipality in East Greenland (Table 1). The population may be divided according to place of birth into persons born in Greenland and persons born outside Greenland. For the adult population this corresponds roughly to ethnic Greenlanders (Inuit) and Danes, respectively. Place of birth is the only ethnic variable in the central person register, but in an interview study these criteria may be supplemented with additional information. In the following, the participants were classified as Greenlanders or Danes based on the impression of the interviewers. This corresponds well with objective criteria collected as part of the interview, such as ethnicity of the grandparents, place of birth of parents, self-identification etc.

Table 1. Population in Greenland 2005. Source: Statistics Greenland (http://bank.stat.gl).

	All	All	Age 18+	Age 18+
	Total	Born in Greenland	Total	Born in Greenland
West Greenland	52.289	46.113	36.870	31.430
East Greenland	3.577	3.307	2.244	2.015
North Greenland	850	796	555	507

1. Development of methods

A number of new questions and procedures were included in the study after pilot testing. This included the food frequency questionnaire (FFQ) and long IPAQ, ultrasound of abdomen and carotids, bioimpedance, Actiheart®, and on the spot measurement of blood glucose with Hemocue. In 2003 a logistic pilot study was carried out by chartered boat in three villages in Ilulissat municipality (Saqqaq, Qeqertaq og Ilimanaq). For 99 participants, information was collected about by and large the same variables as were collected during the survey in 2005-2009. The participation rate was 49.7%.

2. Data collection

The participants were selected through a stratified random sample of adult (aged 18+) inhabitants in Greenland, who had been born in Greenland or Denmark. Faroese people or persons born in other countries were not included. Participants in our population survey in 1999-2001 were also excluded, except in one town (Qasigiannguit) where they were followed up.

Greenland was divided into 10 regions based on geography and community size (Table 2). From each region a number of towns and villages were selected for the study.

	Towns with 2000+ inhabitants Adult population 24,400	Smaller towns Adult population 8,700	Villages Adult population 6,000
South	Qaqortoq	Narsaq	Eqalugaarsuit Narsarmiit Aappilattoq
Mid	Nuuk Maniitsoq		Atammik Napasoq
North	Aasiaat	Qasigiannguit Upernavik	Kullorsuaq Innaarsuit Aappilattoq
East		Tasiilaq	Kuummiut Tiniteqilaaq

Table 2. Communities selected for the study.

The towns were selected as being representative of the region with regard to living conditions. In towns, a random sample of 11-22% was drawn from the central population register with a view to obtaining an expected number of participants around 300. This number represents the practical limit for a team during a 4-6 weeks' visit. The sample size ranged from 161 in Upernavik to 1106 in Nuuk. Villages (settlements) were chosen at random in the selected municipalities and in the selected villages all adults were invited to participate.

Information was collected during 2005-2009 in 8 towns and 10 villages in Greenland from Kullorsuaq in Upernavik municipality in the north to Narsarmiit and Aappilattoq in Nanortalik municipality in the south, and Tasiilaq in the east (Figure 1). Some towns (Aasiaat, Maniitsoq, Nuuk, Qaqortoq) were visited twice in order to reach the desired participation rate.

Figure 1. Map of Greenland with study communities.

Data was collected by a team consisting of a local person responsible for the recruitment of participants, a supervisor, one or two laboratory technicians, 2-4 interviewers, and two clinical assistants. In addition to this Greenlandic/Danish team an ultrasound technician from Québec participated in 2006-2008. The interviews were conducted in Greenlandic or Danish according to the choice of the participant. A total of 77 persons assisted with data collection or processing of data (Appendix 1).

In towns we usually rented accommodation for the investigators from private house owners, while the local hospital or health centre assisted with procuring facilities for the examinations. While the towns, except Upernavik and Tasiilaq, were visited by public transport, the villages were visited on three expeditions by a chartered boat (Figure 2). The expeditions took place in the Fall of 2006 (North Greenland), 2007 (Central and South Greenland), and 2008 (East Greenland). M/S Kisaq can sail in almost all weather conditions and has accommodation for 12 passengers and large volumes of equipment. It is an unambiguously more convenient alternative to public transport, chartered helicopter or local boat charter.

Figure 2. M/S Kisaq was used for transport to and as floating hotel in the villages on three expeditions in 2006, 2007 and 2008.

The participants were informed about the arrival of the team and about the investigation by a personal letter and they were after the arrival of the team contacted by the person responsible for recruitment. On the day of the investigation the participants were asked to show up at an appointed time, fasting (i.e. at least 8 hours without eating or drinking). They were orally and in writing informed about the investigation and signed an informed consent. Then fasting blood samples were drawn and a 2hr oral glucose tolerance test was started by ingestion of 75g glucose in a drink. During the next 2½ hours the participants were interviewed (40 min.), filled in a questionnaire, had various clinical tests performed and were issued with an Actiheart device for a 1-4 days' monitoring of heart rate and movements. After 2 hours, another blood sample was drawn. At the end of the session, participants were informed about the results of the investigation and were invited to ask questions. When the Actiheart device was returned, a compensation of DKK 200 was paid to each participant.

3. Questionnaires

Two questionnaires were used as survey instruments, one for the interviews and one self-administered by the participants. In both cases the questions consisted partly of questions used before in Greenland, partly of newly developed questions a number of which were constructed in close collaboration with Canadian scientists. The questionnaires covered the following topics. Some questions, marked with an *, were identical with questions used in the population survey of 1993-1994.

Interview questionnaire [Greenlandic] [Danish] [English]

- Sociocultural and demographic factors*
- Dietary Food Frequency Questionnaire (constructed with researchers from Québec)
- Physical activity (long IPAQ - International Physical Activity Questionnaire)
- Smoking*
- Social risk factors, social capital, traditional activities
- Self rated health*
- Self reported disease and symptoms*
- Self reported heart disease, diabetes, hypertension, Rose questionnaire
- Satisfaction with health care*
- Knowledge about the public health programme - Inuuneritta

Self administered questionnaire [Greenlandic] [Danish] [English]

- Suicidal thoughts* and attempts
- Alcohol*
- Marihuana*
- Violence and sexual abuse*
- Gambling

In particular the FFQ and IPAQ were new to this study. The FFQ included questions about frequency of consumption of 23 traditional and 43 imported foods, portion sizes and seasonal variation. This enables the researchers to calculate daily consumption of various foods, energy intake and distribution on macronutrients, consumption of dietary fatty acids, contaminants and micronutrients. The international "Long IPAQ" (International Physical Activity Questionnaire) was used (http://www.ipaq.ki.se/ipaq.htm) slightly modified to suit the local conditions. This questionnaire taps moderate and vigorous activity in four domains (work, transport, domestic chores, leisure time) and sedentary activities.

4. Clinical procedures and sampling of biological media

The clinical procedures included:

- Anthropometric measurements: height, weight, waist and hip circumference
- Bioimpedance
- Blood pressure
- ECG
- Ultrasound examination of subcutaneous and visceral abdominal fat and liver fat
- Ultrasound examination of carotid intima media thickness (CIMT)
- Oral glucose tolerance test (OGTT)
- Combined measurement of heart rate and body movement (Actiheart®)

Blood samples were collected and stored for future analyses.
The following analyses were performed:

- Glucose, insulin, C-peptide (fasting and 120 min. after an OGTT)
- HbA1c
- Cholesterol, total HDL, calculated LDL ,calculated VLDL and triglyceride
- Fatty acids in RBC membranes
- Mercury and selenium in full blood
- Organochlorines (PCB and pesticides)
- Urine stix for albumine, nitrit and leucocytes
- Urine albumine and creatinine

Clinical procedures

Anthropometric measurements

Height and weight were measured with the participants stripped to their underwear and socks. On the standing participant, waist circumference was measured midway between the rib cage and the iliac crest, hip circumference at its maximum. Weight was measured on a standard electronic clinical scale.

Body impedance

Bioimpedance and calculation of fat percentage was performed on a leg-to-leg Tanita TBF-300MA. Based on a single reading, fat percent was calculated by the internal algoritm of the device, which is based on height, weight, sex, impedance and age; body type was set as standard. Fat percent was recorded in the data file as well as impedance in order to allow the use of alternative algoritms.

Blood pressure

Blood pressure was measured at the right arm of the sitting participant after at least five minutes of initial rest. Using an automatic measuring device (Kivex UA-779) with an appropriate size cuff, the blood pressure was read to the nearest mm

Hg three times with at least 1 min. interval. The two last measurements were averaged for the analyses.

ECG
A 12-lead electrocardiogram was obtained with a NIHON COHDEN 9130 apparatus. All ECGs were coded according to Minnesota codes by the same experienced assistant.

Ultrasound examination of subcutaneous and visceral abdominal fat and liver fat
Intra-abdominal adipose tissue was assessed by ultrasonography, which is considered a valid and reproducible method compared with CT and MRI (Stolk et al. 2001). Measurements were performed with a portable ultrasound scanner (Pie Medical) using a 3.5 MHz transducer with the participant in supine position and at the end of a normal expiration. The distances between the posterior edge of the abdominal muscles and the lumbar spine was measured using electronic calipers. For all images the transducer was placed on a straight line drawn between the left and right midpoint between the lower rib and iliac crest. Distances were measured from three different angles: medial, 10 cm. left and 10 cm. right lateral. Subcutaneous abdominal fat thickness was measured on a transverse plane and was defined as the depth from the cutaneous boundary to the linea alba. Liver fat was measured in one ultrasound image where both liver and right kidney were visualized. One standard image was used for analysis (Edens et al. 2009).

Ultrasound examination of carotid arteries
To be added.

Combined measurement of heart rate and body movement (Actiheart®)
The Actiheart is an objective physiological measurement of physical activity and a well validated physiological measurement of physical activity in populations (Brage et al. 2007; Crouter et al. 2007). It works as a combined heart rate and movement monitor that measures acceleration in one dimension and heart rate every 15 seconds. The Actiheart is attached to two electrodes on the chest and remain for 1-4 days. Heart rate and acceleration information is used to determine the intensity of physical activity (counts per minute). Given the intensity and duration of activity is it possible to determine the total energy consumption by using a predefined model (Branched Equation model) (Brage et al. 2004). Furthermore, it is possible to count how many minutes spent at different intensities.

Sampling of biological media

Blood samples were collected as the first procedure after information about the study and signing of the informed consent. Participants had been fasting overnight. 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.

Capillary blood glucose was also measured on the spot at 0 and 120 min. with HemoCue® Monitor, in order for the participants to be given information about their diabetic status immediately.

A spot urine sample was collected from each participant and samples were stored at 4 °C or at room temperature until shipment. Urine samples were analysed for microalbumine and creatinine.

Nail samples were collected for analysis of stable isotopes of carbon (^{13}C), nitrogen (^{15}N) and sulphur (^{34}S) and stored at room temperature.

Oral Glucose Tolerance Test
After a minimum of 8 hours fasting all participants without medical treatment for previously diagnosed diabetes had an oral glucose tolerance test. Plasma glucose was measured fasting. The participant received 246.5 ml glucosemonohydrate (333.3 mg/ml) (in 2005 82.5 g) equivalent to 75 g of glucose. Plasma glucose was measured again after 120 min. Blood was drawn from the cubital vein. The samples were spun at 20 °C, 3000 rpm for 10 minutes. Plasma was separated, frozen at –20°C and transported to one central laboratory for measurement of plasma glucose. Glucose tolerance was classified according to WHO criteria (WHO 1999).

Glucose
Test tube: Terumo Sodium Fluoride/Citrate (FC Mixture) venosafe-5/3 ml No. VF-053SFC32, separated into Nunc Cryo Tube 4.5 ml No.363452.
Blood component: a minimum of 1 ml plasma.
Preparation: Centrifuged at 20°C, 3000 rpm for 10 minutes the same day. Stored frozen at -20ºC.
Method: Hexokinase/G6P-DH-Determination on Hitachi 912 System.
Laboratory: Steno Diabetes Centre, Gentofte, Denmark.
NB. In 2005, the test tubes used were BD-Vacutainer FH 20mg 143 I.U. No. 367764; samples were immediately put on ice and centrifuged at 4°C.

Insulin
Test tube: BD-Vacutainer dry No. 367819. Separated into a Nunc Cryo Tube 4.5 ml No. 363452 Blood component: a minimum of 1 ml of serum.
Preparation: Allowed to stand for >30 minutes and <1.5 hour before centrifugation. Centrifuged at 20 °C, 3000 rpm for 10 minutes. Stored frozen at -20ºC.

Method of analysis: Two-site fluoroimmunometric assay for quantification of intact insulin in human serum (Wallac Auto Delfia).
References: Auto DELFIA™Insulin kit B080-101, Wallac Oy, Finland.
Laboratory: Steno Diabetes Centre, Gentofte, Denmark.
Normal range: (fasting) 5-69 pmol/l.

C-peptide
Test tube: BD-Vacutainer dry No. 367819. Separated into a Nunc Cryo Tube 4.5 ml No. 363452.
Blood component: a minimum of 1 ml of serum.
Preparation: Allowed to stand for >30 minutes and <1.5 hour before centrifugation. Centrifuged at 20 °C, 3000 rpm for 10 minutes. Stored frozen at -20ºC.
Method of analysis: Wallac Auto Delfia.
Reference: Auto DELFIA™ Cpeptid kit B081-101, Wallac Oy, Finland.
Laboratory: Steno Diabetes Centre, Gentofte, Denmark.
Normal range: (fasting) 200-700 pmol/l.

HbA_{1c}
Test tube: BioRAD Sample Preparation kit. (Na-heparinised (5μl) capillary in Eppendorf tube with 1 ml EDTA and potassium cyanide solution (0.25mmol/l)).
Preparation: The capillary was filled with blood stabilized with EDTA, and transferred into the sample preparation vial and shaked to rinse the blood from the capillary. Stored at 4 °C or at room temperature until shipment.
Method: Ion exchange HPLC; measured by Tosoh G7.
Reference: Tosoh method sheet for Hemoglobin A1c
Laboratory: Steno Diabetes Centre, Gentofte, Denmark.
Normal range: 4.1 – 6.4%.

Lipids
Test tube: BD-Vacutainer dry No. 367819. Separated into Nunc Cryo Tube 1.8 ml No. 368632.
Blood component: a minimum of 1.5 ml serum.
Preparation: Allowed to rest for at least 30 minutes before centrifugation. Centrifuged at 20°C, 3000 rpm for 10 minutes. Stored frozen at -20ºC.
Methods: Enzymatic colorimetric tests using Hitachi 917.
Total cholesterol: CHOD-PAP, Roche 11489437216
HDL: HDL-Cholesterol plus, Roche 04713184190.
Triacylglycol (triglyceride): Triglycerides GPO-PAP, Roche 11488872216.
LDL and VLDL values were calculated from these.
Laboratory: Steno Diabetes Centre, Gentofte, Denmark.

Fatty acids in RBC membranes
Test tube: BD-Vacutainer EDTA Hemogard plus 9/10 ml K2E no. 367525
Blood component: Full blood
Preparation: A minimum of 2 ml full blood in a Nunc Cryo tube 4,5 ml no. 363452. Stored frozen at -20°C and then -80°C at Steno diabetes Center.

Method of analysis: The composition of phospholipids of erythrocyte membranes was measured after total lipid extraction with chloroform/methanyl mixture, phospholipid separation by thin layer chromatography and methylation of fatty acids, followed by capillary GLC using a DB-23 column in a HP-Packard GC chromatograph. The n-3 fatty acids comprised C18:3, C18:4, C20:3, C20:4, C20:5, C22:3, C22:5 and C22:6. The ratio of n-3 and n-6 fatty acids was measured as well.
Laboratory: Centre de recherche sur les maladies lipidiques (CRML), Centre hospitalier universitaire de Québec (CHUQ).

Mercury and selenium
Test tube: BD-Vacutainer EDTA Hemogard plus 3/5 ml No. 368856
Blood component: Full blood.
Preparation: none. Stored frozen at -20°C.
Method of analysis: Inductively coupled mass spectrometry (ICP-MS).
Detection limit: Mercury 0.5 nmol/l; Selenium 0.1 µmol/l.
Normal range: n/a
Laboratory: Laboratoire de Toxicologie/INSPQ, Sainte-Foy, Québec, Canada

Organochlorines (PCB and pesticides)
Test tube:BD-Vacutainer dry No. 367819.
Blood component: 2 ml EDTA-Plasma
Preparation: Allowed to rest for at least 30 minutes before centrifugation. Centrifuged at 20°C, 3000 rpm for 10 minutes. Separated into 7 ml clear vial no. 27148 from Sigma.
Stored frozen at -20ºC
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, transnonachlor, 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. Lipids were measured using standard enzymatic procedures.
Normal range: n/a
Laboratory: Laboratoire de Toxicologie/INSPQ, Sainte-Foy, Québec, Canada

Urine stix
Preparation: Spot urine less than 4 hours.
Method: Multistix7® Siemens.

Urine creatinine
Material: Spot urine
Preparation: A minimum of 2 ml urine in Nunc Cryo Tube 4,5 ml no. 363452.
Stored at 4 °C or at room temperature until shipment.
Method: Creatinin Plus/ Enzymatic colorimetric analysis on Hitachi 912 system.
Reference interval: 8000-20000 µmol/l.

Urine albumin and albumin/creatinine ratio
Material: Spot urine
Preparation: A minimum of 2 ml urine in Nunc Cryo Tube 4,5 ml no. 363452.
Stored at 4 °C or at room temperature until shipment.
Method: Quantitative immunologic analysis by turbidimetry. Hitachi 912 system
Reference interval for urine albumin/creatinine ratio: <30 mg/g.

Stable isotopes in toenails
Nail samples were physically cleaned and rinsed twice in a methanol–dichloromethane mixture (2:1 v/v) and finally air dried before online combustion and isotope analysis in a continuous flow isotope-ratio mass spectrometer (Eurovector Elemental Analyser connected to a GV-Instruments Iso-Prime dual inlet mass spectrometer). For the combined C and N isotope analyses we used 1 mg nail material and for S isotope analysis 1 to 2 mg of nail material. Isotope ratios were determined relative to the international reference materials USGS-24 (^{13}C), IAEAN-1 (^{15}N) and IAEA-S-1 (^{34}S), and calibrated against the international standards V-PDB, AIR and V-CDT respectively. Results are reported as δ-values, e.g. $\delta^{13}C=[(R_{sample}-R_{standard})/R_{standard}]*1000‰$, where R is the ratio between ^{13}C and ^{12}C in sample and standard material respectively. Reproducibility measured as ±standard deviations for ten identical samples were 0.1‰ for C, 0.3‰ for N and 0.4‰ for S (Buchardt et al. 2007).

5. 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, percent body fat, diabetes, and they were given the possibility to discuss their results with a health professional. Later the results of the blood tests and reading of the ECG were sent as a letter to the participants and the local health centre, provided the participant had given his or her permission. This included information about cholesterol, diabetic status according to the OGTT, and results of the ECG reading. The follow-up of diagnosed disease was the responsibility of the local health centre.

If, during the examination, we discovered hypertension (blood pressure $\geq$ 140/90) or diabetes, the participant was recommended to see a doctor. In a few cases the investigators contacted the health care centre directly, e.g. upon unexpected findings during ultrasound examinations (thyroid tumour, renal anomaly).

Remaining blood tests, e.g. mercury, HbA1c and fatty acid profile, were considered as not being clinically significant at the individual level and were only communicated if the participant specifically requested this.

6. Participation rate, non-participation and representativity

Population lists from the central population register were used to initially specify the sample. From these lists a random sample was drawn. Individuals in the sample were contacted in writing with an invitation to participate. Information about the study and examination procedures was given, and the recipients were asked to inform the investigators by letter or phone whether or not they wanted to participate. The samples were revised locally with information about who were not actually living in the community at the time of the examination. Neighbours and the municipality office (in the villages) were good sources of information. The raw samples were on average reduced by 19%, predominantly because people had moved from the community (Table 3). Especially in the villages the samples were supplemented with newcomers but this was not done systematically.

Table 3. Reasons for reduction of initial sample.

Reason	N	%
Moved	697	70.1
Deceased	52	5.2
Long term fishing	62	6.2
Pregnant	50	5.0
Unknown at address	40	4.0
Other reasons	94	9.4
Total	995	100.0

The final sample consisted of 4511 persons and the participation rate for the total study was 65.9%. Danes were recruited for an interview only and their participation rate was significantly lower than that of the Greenlanders. A total of 2834 Greenlanders participated in the study with a participation rate of 67.9% and 137 Danes with a participation rate of only 40.4% (Table 4).

Table 4. Participation according to place.

				Participants		Participation rate		
Community	Register population born in Greenland, aged 18+	Register sample incl. Danes	Revised sample	Green-landers	Danes	Green-landers (interview)	Green-Landers (clinical)	Danes (interview)
	N	N	N	N	N	%	%	%
Qaqortoq	2236	589	509	301	22	66.9	64.9	37.3
Narsaq	1191	254	222	145	1	69.7	69.7	7.1
Nuuk	10640	1104	931	453	75	61.1	59.8	39.5
Maniitsoq	1975	826	741	469	16	66.3	66.3	47.1
Aasiaat	2260	404	340	204	20	65.6	65.6	69.0
Qasigiannguit	902	611	403	295	0	73.6	73.6	-
Upernavik	768	161	121	84	0	69.4	69.4	-
Aappilattoq (Nan)	100	93	78	65	0	84.4	84.4	-
Narsarmiit	79	82	63	52	0	83.9	83.9	-
Eqalugaarsuit	90	88	67	55	0	82.1	82.1	-
Atammik	141	143	119	77	0	64.7	64.7	-
Napasoq	75	82	62	37	0	59.7	59.7	-
Aappilattoq (Upv)	119	119	98	65	0	67.0	67.0	-
Innaarsuit	112	111	75	65	0	86.7	86.7	-
Kullorsuaq	232	232	210	114	1	55.3	55.3	25.0
Tasiilaq	284	284	224	173	0	77.2	77.2	-
Tiniteqilaaq	98	98	71	54	0	76.1	76.1	-
Kuummiut	225	225	177	126	2	72.8	72.8	50.0
Total	21527	5506	4511	2834	137	67.9	67.5	40.4

The following concerns Greenlanders only. Participation ranged from 86.7% in the village of Innaarsuit to 55.3% in the village of Kullorsuaq (Figure 3). According to community size participation was 61.1% in Nuuk, 67.8% in other large towns, 73.0% in small towns and 70.2% in the villages. Participation rates also varied by age and sex (Figure 4). Women more often participated than men and particularly young men were under-represented. The reasons for non-participation are seen from table 5. Half of the non-participants (19% of the total sample) stated that they did not want to participate or gave a variety of excuses which were interpreted as such. This was respected without further questioning or pressure. For 431 persons no information was obtained. There were certain differences between the communities; in particular in the capital, Nuuk, many persons indicated lack of time as the reason for not wanting to participate (17% of the non-participants compared with 2% in the rest of the communities).

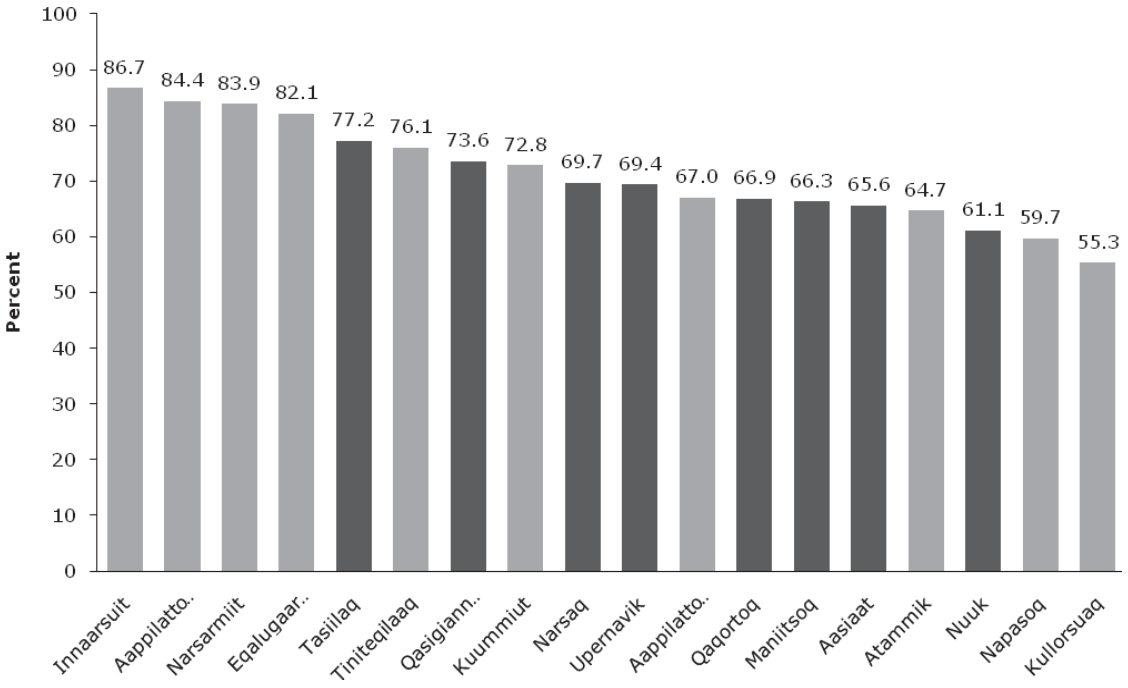

Figure 3. Participation rate by community. Black bars are towns, light grey bars are villages.

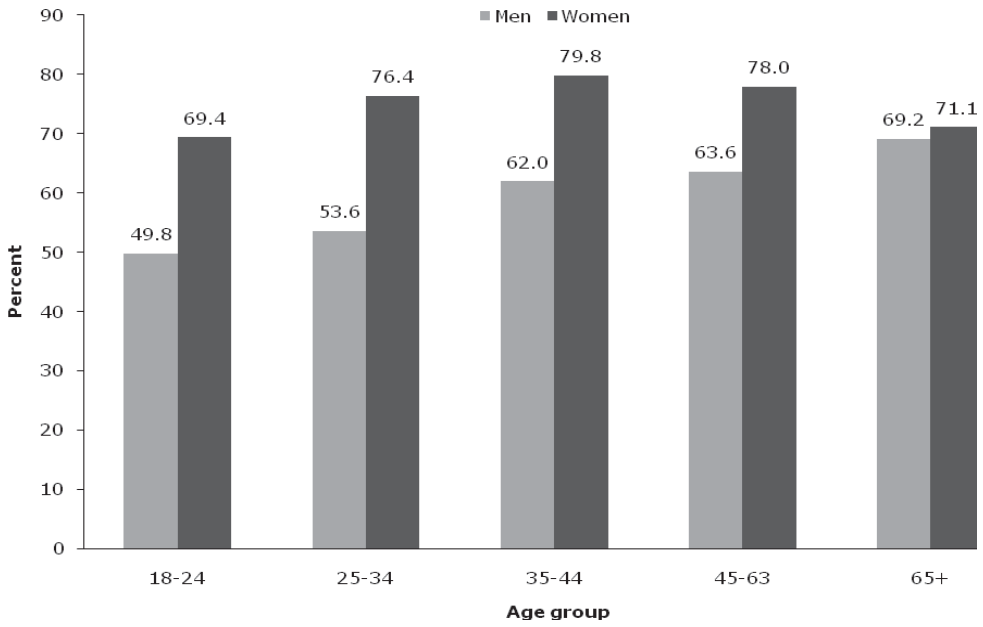

Figure 4. Participation rate by age and sex.

Table 5. Reasons for non-participation.

Reason	N	%
Doesn't want to participate	772	50.1
No contact	188	12.2
Serious illness or disability	107	6.9
Out of town	28	1.8
Other reasons	14	0.9
Unknown	431	28.0
Total	1540	100.0

The non-random distribution of non-participants has implications for the precision of countrywide estimates. We know that persons with serious illness or disability are over represented among the non-participants as well as those who tend to move often, and we suspect that socially exposed persons, alcohol abusers and persons who frequently go in and out of jobs and the unemployed likewise are over represented among the non-participants. It was the impression of the interviewers that there was a distinct downwards social trend from the beginning to the end of data collection in a town. In some towns it could be demonstrated that during the first week of the study 10% of those who had made an appointment did not show up, while during the last week of the study as many as 26% did not show up ($p<0.001$).

A social bias in the participation was only partly confirmed by information about income obtained from Statistics Greenland. The Inuit participants in the study had an average personal income of DKK 159,000 while those who did not participate had an income of DKK 144,000 and those who were excluded from the sample DKK 146,000 (p=0.001). The average household income per person, however, was similar in the three groups: DKK 92,000; 90,000 and 91,000, respectively (p=0.53).

7. Data entry and validation

Data was double entered by different persons and validated in the computer programme EpiData (http://www.epidata.dk/). The data files were subsequently imported into the SAS package and combined with results of blood analyses and clinical procedures. The validity of data was checked against permitted values and logical errors. Analyses were performed with SAS v. 9.1 or higher and with SPSS v. 15.0 or higher.

Weighting

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 total depending on how many persons he or she represents. For instance, the 9 males aged 18-24 from Aasiaat represent a total of 393 18-24 year old men in large towns in Northwest Greenland, while the 11 women aged 65+ from Eqalugaarsuit, Narsarmiit and Aappilattoq only represent 54 women of the same age in villages in South Greenland. Table 6 shows some examples of how weighting affects the results. Non-weighted analyses give a good estimate of self rated health, while obesity, smoking and consumption of traditional food are over estimated by 0.8-1.9 percent points. There is accordingly a rather small error introduced by not weighting the analyses and it was chosen not to weight. The same conclusion was reached for the analyses of the population survey in 1993-1994.

Table 6. Weighting of data for age, sex and region results in different estimates at country level.

	Unweighted %	Weighted for age and sex %	Weighted for age, sex and region %
Good self rated health	65.2	65.8	65.1
Obesity (BMI 30+)	23.9	22.5	22.1
Daily smokers	66.2	66.6	65.4
Pct. energy from traditional food	21.0	20.3	19.1

Socioeconomic variables

Education

The interview had questions on years in school and type of post school education. Based on this the following categories were defined:

1. Primary or high school only
2. Short vocational education (1-2 years)
3. Midlevel or long education, university

Job

The participants were asked about their own and their partner's job title. This was subsequently coded into 24 job categories. For participants below the official age of retirement (63 years) the job categories were combined into the following categories:

1. Persons with job requiring midlevel or higher education
2. Skilled workers
3. Unskilled workers
4. Hunters and fishermen
5. Students
6. Unemployed persons, retired persons, home makers

A household social group was created by first identifying the highest job category of the couple and then combining the categories into four social groups:

1. High
2. Skilled workers
3. Unskilled workers, hunters, fishermen
4. Not gainfully employed

Assets

As a proxy for wealth the participants were asked whether or not they had these items in their household: video/DVD player, computer, landline telephone, refrigerator, microwave oven, washing machine and dishwashing machine. An index of assets was calculated as the sum of items ranging from 0 to 7.

Income

Information on individual and household income was obtained from Statistics Greenland for 2005 to 2007. Household income per person in the household was calculated.

8. Seasonal variation

Although certain biological factors and health outcomes show seasonal variation, the logistics of the study permitted neither data collection throughout the year in each location nor a concentration of all data collection in one season. Furthermore, the study was carried out over a five-year-period during which time span additional secular changes may have manifested themselves. Geographical comparisons accordingly entail seasonal variation and vice versa and the two types of variation can never totally be separated.

The onset of seasons are not fixed and the proper way of defining two major seasons in an epidemiological study of diverse behavioural and health related outcomes can be discussed at length. It seems reasonable to let the season of outdoor activities ("summer") start when the temperature gets above a certain level, and to let the season of indoor activities start, when the days shorten beyond a certain length. For the present study we defined the start of "summer" as the first month when the average day temperature in the community in question was above 0^{o} C and the end of "summer" as September 30^{th} for all communities. Overall, 42% participated in the winter months and 58% in the summer months.

Table 7 shows the covariation of time and space. In particular the larger towns differ from the rest with a high proportion of examinations during winter. At this regional level, the secular variation was not important.

Table 7. Distribution of participants on season and region. Inuit 2005-2009; N=2834; P<0.001.

		Season		
		Winter %	Summer %	Median year
Region5	Nuuk	28.3	71.7	2006
	Larger towns	77.7	22.3	2006
	Smaller towns	24.7	75.3	2006
	Villages	19.0	81.0	2007
Total		42.1	57.9	

The four regions shown in table 7 are not homogeneous since, apart from the capital, each consists of several communities: 3 larger towns, 4 smaller towns, and 10 villages. While the capital and larger towns were visited twice, the smaller towns and villages were only visited once. This means that differences between communities may come out as seasonal differences.

As an example let us consider the distribution of assets as an indicator of social position. Participants were asked about possession of certain household items such as for instance a video recorder, a washing machine, a dishwashing machine etc. For a

given participant the number of assets can range from 0 to 7. Overall, participants recruited in winter had more assets than those recruited in summer (mean number of assets 4.5 and 4.1; $P<0.001$). Stratified on region there were in all cases statistically significant differences between summer and winter (Figure 5). Since assets are a general trait of the participants build up over a long time period, it is highly improbable that these observed differences between seasons are causally related to the season.

Upon scrutiny of the data, the variation could in all cases be explained by other factors. In communities that were visited twice, the same sample was used for both visits; during the first visit the participants were those eager to participate who on average had higher social position and were better educated than those who participated during the second visit. This explained the seasonal difference in assets for the capital, since the first round of data collection took place during summer and the second round during winter.

The small seasonal difference for larger towns could be explained by a combination of the specific towns visited during each season and most first round participants during winter. Regarding smaller towns, one town in East Greenland was visited during winter while three towns in the more affluent West Greenland were visited during summer. And finally, the data collection in the most remote and poor villages in the far north and South of West Greenland and in East Greenland happened during summer while the remaining villages were visited during winter.

In a statistical model with both season and region there was statistically significant variation in the mean number of assets between regions and not between seasons, which is plausible. However, considering the demonstrated spurious seasonal variation extreme care must be taken when analysing seasonal and regional variation in our data. It is not beyond our imagination that true seasonal variation could be masked by regional differences or vice versa, or that an apparent regional variation could be caused by seasonal differences.

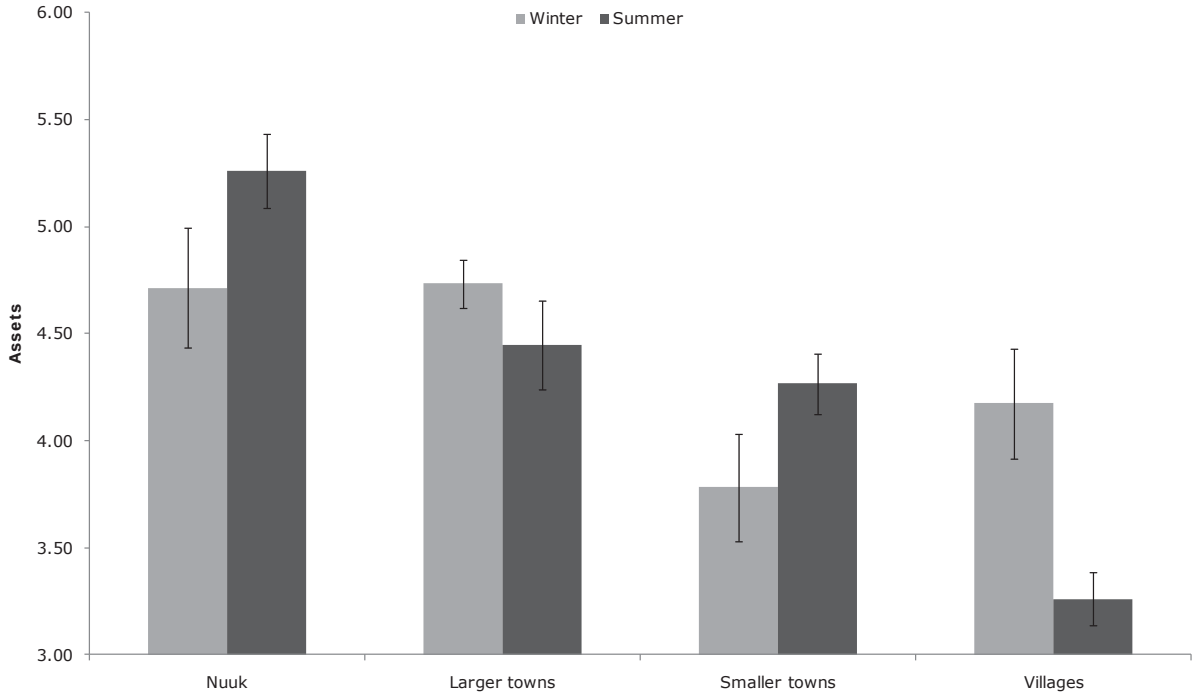

Figure 5. Mean number of assets by region and season. Inuit 2005-2009; N=2834. Nuuk P=0.001; Larger towns P=0.02; Smaller towns P=0.001; Villages P<0.001.

9. References

Brage S, Brage N, Franks PW, Ekelund U, Wareham NJ. Reliability and validity of the combined heart rate and movement sensor Actiheart. Eur J Clin Nutr 2005;59:561-570.

Brage S, Brage N, Franks PW, Ekelund U, Wong MY, Andersen LB et al. Branched equation modeling of simultaneous accelerometry and heart rate monitoring improves estimate of directly measured physical activity energy expenditure. J Appl Physiol 2004;96:343-351.

Buchardt B, Bunch V, Helin P. Fingernails and diet: Stable isotope signatures of a marine hunting community from modern Uummannaq, North Greenland. Chemical Geol 2007;244:316-329.

Crouter SE, Churilla JR, Bassett DRJ. Accuracy of the Actiheart for the assessment of energy expenditure in adults. Eur J Clin Nutr 2008;62:704-711.

Edens MA, van Ooijen PMA, Post WJ, Haagmans MJF, Kristanto W, Sijens PE, van der Jagt EJ, Stolk RP. Ultrasonography to Quantify Hepatic Fat Content: Validation by ^{1}H Magnetic Resonance Spectroscopy. Obesity 2009;17:2239–2244.

Stolk RP, Wink O, Zelissen PM, Meijer R, van Gils AP, Grobbee DE. Validity and reproducibility of ultrasonography for the measurement of intra-abdominal adipose tissue. Int J Obes Relat Metab Disord 2001;25:1346-1351.

Appendix 1

Participants in data collection and data treatment in the population study in Greenland 2005-2009.

Abelone Filemonsen	Ida Heinrich	Majken Søndergaard Nielsen
Anike Møller	Ina Sørensen	Margrethe Kleist
Anna Ballan	Inge Kjærgaard	Maria Dahl Kristensen
Anna Kleist	Inge Lyberth	Marianne Probst
Anne-Louise Schmidt Hansen	Ingeborg Heinrich	Marianne Tellier
Anni Nielsen	Ingelise Olesen	Marie Iversen
Astrid Ledgaard Holm	Inger Katrine Dahl-Petersen	Marit Eika Jørgensen
Birgitte Born	Inger Dehn	Martin Noël
Birgitte Hemmingsen	Ivalo K. Jensen	Najaaraq Kleist
Bolethe Hendriksen	Jan Petersen	Nina Krogh Larsen
Britta Drangsfeldt	Janemaria Pedersen	Ole Schnor
Camilla Budtz	Johansine Poulsen	Paarma Egede Lund
Cecilia Petrine Pedersen	Juliane Villadsen	Pauline Olesen
Charlotte Jeppesen	Karoline Klenow	Peter Bjerregaard
Charlotte Lange	Katja Løngaard	Sechmann Lama Rosbach
Christina V L Larsen	Klaus Poulsen	Silas Bjerregaard
Connie Lynge	Knut Borch-Johnsen	Sofie Steenholt
Dorthe Furstrand	Kristian Jonathansen	Susanne Brenaa Reimann
Ebba Josvassen	Kunuk Kristiansen	Susanne Månsson
Edvard Mørch	Lene Aabo	Suzie Côté
Else Jeppson	Loni Keil Brigsted	Svend Rosing Olsen
Flemming Heinrich	Louise Kleemann	Thomas Enoksen
Gert Pivat Lynge	Louise Mattaq Kristiansen	Tine Curtis
Gustav Lyberth	Louis-Frédéric Daigle	Trine Hansen
Hanne Nielsen	Maja Schick	Vive K. Egede
Helle Bekker Sørensen	Maja Lis Dybdahl Halkjær	