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Intake of traditional Inuit diet vary in parallel with inflammation as estimated from YKL-40 and hsCRP in Inuit and non-Inuit in Greenland

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ABSTRACT

Background: Chronic low-grade inflammation is involved in the initiation and progression of atherosclerosis and ischemic heart disease. This was rare in pre-western Inuit who lived on a diet that consisted mainly of marine mammals rich in n-3 fatty acids.
Objectives: To assess the association between biomarkers of inflammation and the intake of traditional Inuit diet in addition to Inuit ethnicity.
Methods: YKL-40 and hsCRP were measured in serum from 535 Inuit and non-Inuit living in the capital city Nuuk in West Greenland or in the main town or a settlement in rural East Greenland. Dietary habits were assessed by an interview-based food frequency questionnaire.
Results: The participation rate was 95%. YKL-40 was higher in Inuit than in non-Inuit ($p < 0.001$), in Inuit with a higher intake of traditional Inuit diet ($p < 0.001$), and in Inuit from rural compared to urban areas ($p < 0.001$). It also rose with age ($p < 0.001$), alcohol intake (0.019) and smoking ($p < 0.001$). Inuit had higher hsCRP compared to non-Inuit ($p = 0.003$) and hsCRP increased in parallel with intake of traditional Inuit foods ($p < 0.001$). Alcohol associated with a decrease in hsCRP in Inuit ($p = 0.004$). YKL-40 and hsCRP increased with higher intakes of traditional Inuit diet after adjusting for ethnicity, gender, age, smoking, alcohol intake and BMI.
Conclusions: Biomarkers of inflammation vary in parallel with the intake of traditional Inuit diet. A diet based on marine mammals from the Arctic does not reduce inflammatory activity and it may be speculated that markers of inflammation reflect the disease rather than the cause of the disease.

1. Introduction

Chronic low-grade inflammation is involved in the initiation and progression of atherosclerosis [1] and the severity of atherosclerosis associates with markers of inflammation [2]. Atherosclerosis and inflammation have been linked to n-3 fatty acid consumption [3]. High intakes of n-3 fatty acids associate with lower inflammatory activity via suppression of proinflammatory cytokines [4]. A lower risk of inflammatory diseases such as rheumatoid arthritis has been found in subjects with a high intake of n-3 fatty acids [5]. Consequently, decreasing inflammation may be speculated to reduce atherosclerosis and hence the risk of ischemic heart disease [6].

Low occurrence of ischemic heart disease in pre-western Inuit was confirmed recently [7] and high physical activity influenced their cardiovascular risk profile [8]. Also, pre-western Inuit had a high intake of traditional Inuit foods that consist mainly of marine mammals [9–11] rich in n-3 fatty acids. These were linked to the low occurrence of ischemic heart disease [11]. It may thus be speculated that the traditional Inuit diet rich in n-3 fatty acids influences inflammation and biomarkers of inflammation.

YKL-40 and hsCRP are markers of inflammation [12]. YKL-40 participates in inflammatory processes, angiogenesis and apoptosis that are important for the risk of ischemic heart diseases [12]. YKL-40 is independently associated with the presence of cardiovascular disease [12] and may be an indicator of presence and progression of coronary artery disease [13]. Also, YKL-40

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concentrations are associated with cardiovascular and all-cause mortality [14]. This supports a role of YKL-40 in cardiovascular disease similar to hsCRP [15,16].

The aim of the present study was to investigate the association between biomarkers of inflammation and the intake of traditional Inuit diet in addition to ethnicity in non-Inuit and in Inuit living in urban and rural areas of Greenland with markedly different dietary habits.

2. Subjects and methods

2.1. Area of investigation

Fig. 1 shows the areas included in the study. Nuuk (64.15N 51.35W) in West Greenland is the capital of Greenland with 16,000 inhabitants of whom 75% were Inuit (Eskimo) and 25% non-Inuit (Caucasians). Nuuk is a modern city with access to a wide variety of imported foods supplementary to traditional Greenlandic food items.

Ammassalik district (65.35N 38.00W) in East Greenland is difficult to access by sea due to pack ice from the northern icecap. It is sparsely populated with 2943 inhabitants (93% Inuit) in 243,000 km^2. The main town Tasiilaq has one store with a limited selection and five minor shops. Each of the settlements has one store with a limited selection depending on access by sea and air. City, town and settlements are situated on fjords with access to the sea.

2.2. Subjects

Participants were 50–69 years of age, men and women, Greenlanders (all Inuit) and not Greenlanders (Caucasians). We included individuals registered, selected, and living on the address. The places selected for investigation were Nuuk, Tasiilaq, and the settlements Tiniteqilaaq, Sermiligaaq, Kulusuk and Kuummiut in Ammassalik district (Fig. 1). For practical reasons, settlements with less than 15 inhabitants in the selected age group were not included. In Nuuk, names and addresses were obtained from the hospital registration system. A random sample of 480 (25% of the total population aged 50 to 69 y) was selected. The hospital registration system had not been regularly updated and for the subsequent investigation in Ammassalik district names and addresses were obtained from the National Civil Registration System in which every person living in Denmark, the Faeroe Islands and Greenland is recorded.

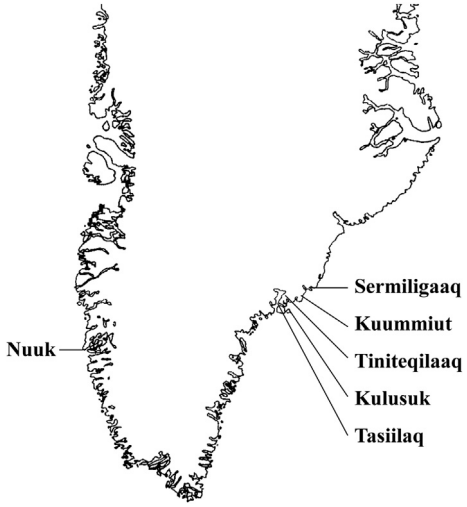

Fig. 1. Map of Greenland that indicates sites included in the survey. Nuuk is the capital of Greenland and is situated on the more heavily populated west coast of Greenland while Tasiilaq is the major town in the sparsely populated East Greenland. Tiniteqilaaq, Sermiligaaq, Kuummiut and Kulusuk are settlements with a population of less than 500.

The local hospital porter or the nursing station attendant delivered a letter of invitation. Non-responders were invited three times.

A Greenlander (Inuit) was defined as an individual born in Greenland with both parents born in Greenland.

Ethical approval by the Commission for Scientific Research in Greenland was obtained (j. number 505-31). All subjects gave informed written consent in Danish or Greenlandic by participant choice.

2.3. Investigational procedures

The investigation took place at the local hospital or nursing station or at request as home visits. One of the investigational doctors performed a physical examination that included height without shoes, weight in indoor clothing and recording of major disabilities. Participants were interviewed by a Greenlandic interpreter or by one of the investigational doctors completing a questionnaire in either Danish or Greenlandic as appropriate for the participant. Information regarding age and gender was obtained from the National Civil Registration System. Information on lifestyle patterns and dietary habits was obtained by interview-based questionnaires. An alcohol unit was defined as 12 g of alcohol. The same interpreter was used in Nuuk, Tasiilaq and all settlements.

A venous blood sample was drawn at the visit during normal working hours using minimal tourniquet, separated and stored at minus 20° Celsius until analysis. Serum was lacking in five participants.

2.4. Dietary habits

Recording of dietary habits has been described in details previously [9,10]. In brief, an interview based food frequency questionnaire (FFQ) was used to assess the dietary habits based on seven traditional Inuit and seven imported food items. For each food item, six different frequency categories were given from never to daily intake. The food item was given a frequency score calculated as the average number of days per month it was ingested. Frequency scores were summed and each participant was categorised into: Diet group 1: >80% Inuit food item scores; 2: 60–80%; 3: 40–60%; 4: 20–40%; 5: <20% Inuit food item scores on a scale where 100% was Inuit foods only and 0% was imported foods only. These evaluations were validated by crosscheck questions [9,10].

2.5. Assays

Analyses of the following inflammations markers were done: 1) Plasma YKL-40 was measured using an ELISA method (Quidel, USA). Measuring range of the assay was 20–300 ng/ml, with intra- and interassay coefficients of variation of 5.8% and 6.0%, respectively; 2) hsCRP was measured with a highly sensitive, latex-particle-enhanced immunoturbidimetric assay (DAKO, Glostrup, Denmark) with a measuring range of 0.2–80 mg/L and with a lower detection limit of 0.03 mg/L. All assays were performed with serum from participants mixed in random order with participant characteristics blinded to the laboratory.

2.6. Statistics

Results are given as median and interquartile range (IQR). Groups were compared using Mann–Whitney *U* test for