PREDICTIONS OF TYPE 2 DIABETES AND COMPLICATIONS IN GREENLAND IN 2014

Nina Martinsen 1, Marit E. Jørgensen 2, Peter Bjerregaard 2, Allan Krasnik 3, Bendix Carstensen 1, Knut Borch-Johnsen 1

1 Steno Diabetes Center, Gentofte, Denmark
2 National Institute of Public Health, Copenhagen, Denmark
3 Department of Health Services Research, University of Copenhagen, Copenhagen, Denmark

Received 9 November 2005; Accepted 17 May 2006

ABSTRACT

Objectives. The objective of this study was to predict the prevalence of type 2 diabetes and the associated burden to the health care system in Greenland posed by diabetic complications by 2014. The predictions were based on changes in demographic variables and obesity.

Study design. Projection model based on two cross-sectional population surveys from 1993 and 1999.

Methods. The development in BMI was described and projected to 2014 under two assumptions: 1) distribution of BMI is constant from 1999, and 2) the trend in BMI found in the surveys will continue until 2014. The prevalence of type 2 diabetes was predicted under these assumptions and based on the observed association between BMI and type 2 diabetes. The prevalence of complications was estimated using the 2nd assumption, as was the prevalence of hypertension, dyslipidemia, Ischemic Heart Disease (IHD) and stroke in the non-diabetic population in 2014.

Results. The prevalence of type 2 diabetes was not predicted to increase by 2014 under the 1st assumption. It was predicted to increase from 11% to 23% for women, but not for men under the 2nd assumption. Approximately half of the cases of cardiovascular disease and cardiovascular risk factors predicted by 2014 were attributable to diabetes.

Conclusions. The prevalence of type 2 diabetes was predicted to increase in Greenland, and the number of complications was predicted to double from 1999 to 2014. Both prophylactic and treatment initiatives are needed to deal with the extra burden posed by type 2 diabetes to the Greenlandic health care system in 2014.

(Int J Circumpolar Health 2006:65(3):243-252.)

Keywords: type 2 diabetes, complications, prevalence, projection, Inuit
INTRODUCTION

Projections of the prevalence of type 2 diabetes and its complications are important when planning and allocating resources in the health care system. This is especially the case for countries like Greenland, where the disease is relatively new and the prevalence rapidly increasing.

Epidemiological surveys on diabetes in Greenland and other countries in the Arctic region from the 1950s - 1980s indicate that diabetes was rare among the Inuit (1-4). Studies of the Inuit in Canada, Alaska and Greenland from the late 1980s onward found increasing prevalence rates and rates similar to or higher than the prevalence of diabetes in Western countries (5-7).

Greenland is an island characterized by a small, scattered population and Arctic climate. The population is 57,000, 92% of which live in towns and small villages on the west coast. These are only accessible by sea or air. Approximately 90% of the population is ethnic Inuit with a substantial admixture of European, mainly Danish, genes (5). The remaining 10% are mainly ethnic Danes. Until the Second World War, Greenland was to a large extent unaffected by the outside world and the majority lived by hunting and fishing. A rapid westernization occurred after the war (5,8) and the disease pattern changed from predominantly communicable diseases to being dominated by lifestyle-related, non-communicable diseases. Greenland is undergoing an epidemiological transition (9-11).

Greenland was included in only one (12) of the published global diabetes projections (12-16). The projected estimates for Greenland were, however, based on estimates from Denmark, which again were based on estimates from Sweden. This is inappropriate since the cultural, geographical and genetic make-up of the Greenlandic and Danish/Swedish populations is entirely different. For a country like Greenland where the disease is relatively new, the prevalence is high and 70% of the persons with type 2 diabetes are undiagnosed (5), more accurate estimates are needed. Therefore the aim of this study was to estimate the prevalence of type 2 diabetes and associated complications in Greenland in 2014 under two distinct assumptions about the development in obesity, based on methods similar to those applied in the before-mentioned global projections.

MATERIAL AND METHODS

Data

Data on the prevalence of type 2 diabetes and the increase in obesity in Greenland were derived from the 1993 -1994 Greenland Health Survey and the 1999 - 2001 Health Survey which are both population-based cross-sectional surveys. Both surveys were based on a random sample from the west coast of Greenland and included only persons of Inuit ancestry, defined as having at least one Inuit parent (5,17).

In the 1993 - 1994 Greenland Health Survey, 3,025 participants ≥ 18 years of age were randomly drawn from the Central Population Register (18). A total of 1,728 participated in the survey (57%). A subsample of 264 persons ≥ 18 years of age was selected randomly for clinical examination. Of these, 162 persons ≥ 35 years of age were included in the analysis. Further details on the survey are published elsewhere (17,18).
The 1999 - 2001 Health Survey included a random sample of 1,345 Inuit from the west coast of Greenland ≥ 35 years of age. Ninehundred-and-seventeen participated (68%) and underwent a clinical examination including a 2-h standard 75-g OGTT (19). Further details on the survey are published elsewhere (20).

A population projection for Greenland for 2014 including all ≥ 35 years of age was obtained from Statistics Greenland (21).

**Measurements**

BMI was available from both surveys. Normal weight was defined as BMI < 25 kg/m², overweight as 25 - 29 kg/m² and obesity as ≥ 30 kg/m², according to the World Health Organization (WHO) (22).

The following measurements were available from the 1999 - 2001 Health Survey. Type 2 diabetes was classified according to the WHO criteria (fasting plasma glucose ≥ 7.0 mmol/l and/or 2-h plasma glucose ≥ 11.1 mmol/l) (19) or known diabetes. Sitting, resting (5 min.) blood pressure was measured three times using a standard mercury sphygmomanometer with appropriate cuff size. The last of the measurements was used in the analysis. Hypertension was defined as BP ≥ 130/80 mmHg for persons with type 2 diabetes and as ≥ 140/90 mmHg for persons without type 2 diabetes (23). Dyslipidemia was defined as LDL ≥ 2.5 mmol/l for persons with type 2 diabetes and as LDL ≥ 3.0 mmol/l for persons without type 2 diabetes in accordance with the most recent treatment guidelines (23). IHD was defined based on ECG (restricted to MI diagnosed on the basis of Q-wave), self-reported history of myocardial infarction (MI) and Rose Questionnaire. Self-reported stroke was included in the questionnaire. Microalbuminuria and macroalbuminuria (only persons with type 2 diabetes) was determined on the basis of a spot urine sample. Microalbuminuria was defined as urine albumin:creatinin-ratio between 30 mg/g and 300 mg/g and macroalbuminuria was defined as urine albumin:creatinin ratio ≥ 300 mg/g.

**Statistical analyses**

All analyses were performed using the Genmod procedure in SAS version 8. The extrapolation of type 2 diabetes was based on the extrapolation of the prevalence of overweight and obesity as determined by BMI and stratified by sex. Two scenarios were conducted separately.

- First scenario: It was assumed that the BMI distribution was constant from 1999 onward in the Greenlandic population.
- Second scenario: It was assumed that the development in BMI described by the surveys would continue linearly until 2014.

A stepwise analysis was performed. The first step was to describe the association between BMI, age and time using the linear regression of log (BMI) on age and time. Under the first scenario, described by $\text{BMI}_{\text{FIX}}$, the distribution of BMI was held constant from the 1999 - 2001 Health Survey onward. Under the second scenario, described by $\text{BMI}_{\text{PROJECTED}}$, the development in the distribution of BMI continues until 2014 as estimated by the two surveys. The associations for each scenario were described by the following linear functions where all variables were continuous:

**First Scenario:**

$$\log (\text{BMI}_{\text{FIX}}) = \alpha + \beta (\text{age}) + \epsilon$$

**Second Scenario:**

$$\log (\text{BMI}_{\text{PROJECTED}}) = \alpha + \beta (\text{age}) + \gamma (\text{year}) + \epsilon;$$

Log (BMI) was chosen because with log (BMI) the residuals in the analysis were closer to a normal distribution.
The second step was to determine the association between the prevalence of type 2 diabetes, age and BMI for both sexes using logistic regression. The response variable, type 2 diabetes, was coded as a binary variable, based on the WHO criteria (19). Only data from the 1999 - 2001 Health Survey were applied in this step, as the OGTT was performed only in this survey. Age and BMI were coded as continuous variables. The logistic regression model was as follows:

\[
\text{Logit}(P(\text{Diabetes})) = \alpha + \beta \text{ (age)} + \gamma \text{ (BMI)}.
\]

This model described the probability of having type 2 diabetes as a function of age and BMI for an individual in the 1999 - 2001 Health Survey.

The results from the first and second steps were applied in the third step to predict the prevalence of type 2 diabetes in 2014. A data set mimicking the Greenlandic population in 2014 was generated, based on the population prognosis from Statistics Greenland. The dataset has 27,842 observations and contains the variables age and sex. Using the estimates from the linear regression analysis in step 1, the values of overweight and obesity in the Greenlandic population were simulated under both scenarios. This simulated distribution was then used in the model that was generated in step 2.

The BMIs estimated in BMI\textsubscript{FIX} in step 1 were applied to describe the first scenario. The BMIs estimated in BMI\textsubscript{PROJECTED} in step 1 were applied to describe the second scenario. The type 2 diabetes prevalence simulation models for men and women were as follows:

\text{First Scenario: } \text{Logit}(P(\text{Diabetes})) = \alpha + \beta \text{ (age)} + \gamma \text{ (BMI\textsubscript{FIX})}

\text{Second Scenario: } \text{Logit}(P(\text{Diabetes})) = \alpha + \beta \text{ (age)} + \gamma \text{ (BMI\textsubscript{PROJECTED})}

\[\alpha, \beta \text{ and } \gamma \text{ are the parameter estimates retrieved from the 1999 - 2001 Health Survey in step 2. These models generated a simulated probability for each person in 2014 of having type 2 diabetes, based on the projection model. These probabilities were added up to age-specific prevalence estimates and the expected number was calculated using the population projection.}

The confidence intervals for the prevalence estimates generated in step 3 were calculated using the following formula:

\[p \pm 1.96 \sqrt{\frac{p(1-p)}{n}}, \text{ where } p = \frac{x}{n}, \text{ } n = \text{number of cases, } x = \text{number of persons}\]

The confidence intervals describe the interval within which the prevalence will lie, with a probability of 95%, assuming that the development in overweight and obesity proceeds as assumed and disregarding the estimation errors. Thus they are likely to be underestimations.

The prevalence of complications was predicted using a similar stepwise method, based on the prevalence of complications in the 1999 - 2001 Health Survey and on the predicted prevalence of type 2 diabetes reported here. Each complication was entered in the analysis as a binary variable. Step one was to estimate the association between the respective complications, age and type 2 diabetes, using logistic regression. Step two was to apply this association to the population of Greenland of 2014. By use of logistic regression, the probability of having type 2 diabetes and of a given complication was calculated for each person in 2014. These probabilities were summarized and multiplied by the number of persons in each age and sex stratum. The results describe the prevalence of complications in 2014. The prevalence
of cardiovascular disease and cardiovascular risk factors among non-diabetics was predicted by calculating the probability of having cardiovascular disease or cardiovascular risk factors minus the probability of having type 2 diabetes for each individual, following the same procedure. These calculations were performed under a strong assumption of independence between complications and diabetes.

RESULTS

Obesity development
The prevalence of obesity increased among women from 12% to 26% between the two surveys in 1993 and 1999. The prevalence of overweight increased from 27% to 35%. There was a decrease in the prevalence of obesity for men from 20% to 19%, while the prevalence of overweight remained constant.

Diabetes
The prevalence of type 2 diabetes in 1999 was 10% for women and 11% for men, increasing with age (Fig. 1). Fig. 2 shows the age-specific prevalence estimates for men and women in 2014, based on the two assumptions. The prevalence increased with age for both men and women under both assumptions. Under the 1st assumption the prevalence of type 2 diabetes was predicted to be significantly lower for women than for men only in the +65 age group. The prevalence of type 2 diabetes was significantly higher for women in all age groups compared to men under the 2nd assumption.

Figure 1. Prevalence of type 2 diabetes in the 1999 - 2001 Health Survey.

Figure 2. Estimated prevalence of type 2 diabetes in 2014 under the 2nd assumption.
For men, there was no significant difference between the estimates based on the two assumptions, as shown in Fig. 2. This is due to the fact that no significant increase in obesity and overweight was observed during the period, causing the two scenarios to be essentially identical.

For women, a higher prevalence of type 2 diabetes was predicted under the 2nd assumption compared with the 1st. The difference between the estimates increased with increasing age. In all age groups, more women than men were predicted to have type 2 diabetes in 2014.

Table I shows the estimated prevalence of type 2 diabetes in 1999 and in 2014 under the two assumptions. The type 2 diabetes prevalence estimates, based on the 1st assumption, were similar to the observed prevalence estimates from the 1999 - 2001 Health Survey. Under the 2nd assumption compared with the 1st, the prevalence for women increased by approximately 115%, from 10% to 23%, while the prevalence for men decreased by approximately 9%, from 12% to 11%. The number of people with type 2 diabetes was predicted to be 3,100 or 4,600 in 2014, depending on the assumption.

Table II shows the prevalence of complications and cardiovascular risk factors among type 2 diabetics in 2014. For all complications, the prevalence increased with age.

Table III shows the number affected by cardiovascular disease and cardiovascular risk factors among diabetics in 1999 and 2014.

### Table I. Prevalence of type 2 diabetes.

|            | Male (%) | Female (%) | Total (n) |
|------------|----------|------------|-----------|
| 1999       | 11       | 10         | 2300      |
| 2014 – 1st assumption | 12 | 11 | 3100 |
| 2014 – 2nd assumption | 11 | 23 | 4600 |

### Table II. Prevalence of complications and cardiovascular risk factors among type 2 diabetics in 2014.

|                  | Male (%) | Female (%) |
|------------------|----------|------------|
| Hypertension     | 56       | 50         |
| Dyslipidemia     | 97       | 90         |
| Ischemic Heart Disease | 10 | 9          |
| Stroke           | 5        | 7          |
| Microalbuminuria | 14       | 9          |
| Macroalbuminuria | 6        | 9          |

### Table III. Number with cardiovascular disease and cardiovascular risk factors among diabetics in 1999 and 2014 and non-diabetics in 2014.

|                    | Diabetes 1999 (n) | Diabetes 2014 (n) | Non-diabetes 2014 (n) |
|--------------------|-------------------|-------------------|-----------------------|
| Hypertension       | 1200              | 2400              | 2000                  |
| Dyslipidemia       | 2200              | 4400              | 3000                  |
| Ischemic Heart Disease | 300  | 400          | 300                   |
| Stroke             | 100               | 300               | 300                   |
| Microalbuminuria   | 300               | 500               | -                     |
| Macroalbuminuria   | 100               | 400               | -                     |
and non-diabetics in 2014. It shows that the number of persons with type 2 diabetes affected by complications was estimated to approximately double between 1999 and 2014.

Type 2 diabetes was estimated to account for approximately half of the expected cases of IHD, stroke and hypertension in 2014 and for approximately 2/3 of the expected cases of treatment-demanding dyslipidemia.

DISCUSSION

This study is, to our knowledge, the first prediction model for type 2 diabetes including temporal changes in obesity in the modeling. Other projection models have taken only demographic changes (12-16) and urbanization into account (12,14,15). Urbanization is associated with a 2 to 4 times increased prevalence of type 2 diabetes in most developing countries, primarily because of its association with obesity and physical inactivity. Studies from Greenland have shown that urbanization does not affect the prevalence of type 2 diabetes even though Greenland has undergone a rapid westernization and modernization. Hence urbanization was not used in the prediction model.

The utility of estimating the future burden posed by type 2 diabetes on the health care system is extended by including a projection of the prevalence of complications of type 2 diabetes. Amos and colleagues (16) discussed the importance of the prevalence of complications, but did not include these in the prediction.

The prevalence of type 2 diabetes for men estimated in this study was within the range of prevalence estimated for European countries at present and in the future, based on the Diabetes Atlas 2003 (12). The predicted prevalence estimates for women under the second assumption were markedly higher and in the range of the highest estimated prevalences worldwide e.g. in Nauru and the Pima Indians in Arizona (12,24). Studies of diabetes in other Inuit populations indicate a rising trend from approximately 5% for people 40+ years of age in 1987 to 11% for people 44+ years of age in 1994, based on OGTT and classified according to the WHO 1985 criteria for classification of glucose tolerance (6,7). If the trend continues and if the Inuit follow the trend of the Pima Indians in Arizona, our estimated prevalence rate of type 2 diabetes for women seems credible.

Previous studies show an ambiguous relationship between sex and the prevalence of type 2 diabetes in Inuit populations. The prevalence of diagnosed diabetes tends to be higher among women, while the prevalence of screen-detected type 2 diabetes (by OGTT) tends to be higher among men (6,7). This is also seen in western countries (25).

In Greenland in the 1999 – 2001 Health Survey, the prevalence of type 2 diabetes was estimated to be similar for men and women, as was the case for the projected prevalence based on the 1st assumption. The significant difference in the estimated prevalence of type 2 diabetes under the 2nd assumption is attributed to the different development in obesity for men and women described above.

A linear development in overweight and obesity from the 1993 - 1994 Greenland Health Survey to 2014 was assumed under the 2nd assumption. As a consequence, the prevalence of obesity and overweight was
assumed to increase substantially for women during the period, while the change in prevalence for men was negligible. This might be attributed to the small study population, especially in the 1993 - 1994 Greenland Health Survey, since small populations are more vulnerable to fluctuations in data and these fluctuations are enlarged when projected into the future. The development could also be explained by westernization and urbanization affecting males and females differently. In developing countries, obesity is associated with urbanization and high socio-economic status (SES), whereas the association is reversed in developed countries. Women in Greenland tend to follow the pattern from developed countries, whereas studies show that men tend to follow the pattern from developing countries (26). Therefore, it is expected that with continued urbanization, westernization and associated relative increase in SES, the prevalence of overweight and obesity among men will increase in the future at a higher rate than can be expected among women. Hence the development in obesity in this study was probably underestimated for men but overestimated for women, and the true prevalence is likely to lie somewhere between these estimates.

The survey data used represent the Inuit population on the west coast of Greenland. The population projections include all inhabitants of Greenland, including those of Danish origin. This constitutes a risk of overestimating the prevalence of type 2 diabetes in Greenland, due to the presumably lower prevalence of type 2 diabetes among Danes, given that the Danes in Greenland keep a risk profile for type 2 diabetes similar to Danes in Denmark.

In the 1999 - 2001 Health Survey women were over-represented until 50 years of age. This might cause artificially high prevalence estimates for men, since younger men, who have a lower prevalence of type 2 diabetes than older men, are under-represented.

The prevalence estimates for hypertension and dyslipidemia are higher than earlier estimates for the prevalence of dyslipidemia and hypertension in Inuit populations (27), which is due to the utilization of the newest, low definitions of the conditions (23). Focus has been on levels of blood pressure and levels of cholesterol in need of treatment in this study because these definitions indicate the demand for health care services in a society at a given time - more than a description of a distribution does. However, this choice leaves limited possibilities for comparison across time.

In this study, the absolute risk of IHD was lower in Inuit populations compared to Western populations in other surveys, while the relative risk of IHD in combination with type 2 diabetes was higher (28-30). This indicates that the protection against IHD found in some studies of Inuit populations (27) is weakened in interaction with type 2 diabetes. The estimates for IHD and stroke might be biased. The estimates represent those surviving, e.g. severe cases causing death would be under-represented. Furthermore, IHD was determined by using three sources of information, which produced a conservative measure of IHD. Stroke was determined by self-report, probably also causing conservative estimates.

Duration of disease is an important risk factor for most complications; however, this factor is difficult to estimate since type 2 diabetes is often asymptomatic for many years and diagnosis often occurs with onset of complications (31). Since type 2 diabetes is a relatively new disease in Greenland, it
is probable that the duration of the disease will increase in the coming years and thus increase the prevalence of complications. The prevalence of complications is also likely to increase with increasing lifespan and with potentially better treatment for diabetes in the future. Therefore, the prevalence estimates predicted in this study probably underestimate the true prevalences in 2014, since the former was assumed to be equal to the prevalences in the 1999 - 2001 Health Survey.

The development in physical inactivity and in the use of western diet was not included in the projections due to lack of comparative data from the two surveys. However, the prevalence of both factors is expected to continuously increase and thus cause an increased prevalence of type 2 diabetes.

These predictions indicate a substantial increase in the number of persons with type 2 diabetes and associated complications. The treatment of type 2 diabetes is lifelong, and affects most areas of the human body and hence of the health care system as well. Specialized personal and intensified case finding is necessary to manage the disease. These are problems that all countries with a high prevalence of type 2 diabetes experience; however, the small, scattered population and the limited mobility between towns pose additional challenges to the Greenland health care system.

This study illustrates that if the development in BMI continues, the prevalence of type 2 diabetes will increase from 10% to 23% in women from 1999 to 2014. The prevalence for men was estimated to be 10% to 11%. Type 2 diabetes is predicted to be responsible for approximately half of the cases of hypertension, dyslipidemia, IHD and stroke. This pragmatic projection of the prevalence of type 2 diabetes in Greenland in 2014 suggests that unless preventive action is taken immediately and unless case finding is intensified to identify the large number of undiagnosed and hence untreated persons with type 2 diabetes, the prevalence and hence the burden on the health care system will increase substantially within the next decade.

Acknowledgements
The studies were funded by the Greenland Home Rule, Directorate of Health and Research, the Danish Medical Research Council, the Commission for Scientific Research in Greenland and Karen Elise Jensen’s Foundation.

REFERENCES
1. Kromann N, Green A. Epidemiological studies in the Upernavik district, Greenland. Incidence of some chronic diseases 1950-1974. Acta Med Scand 1980; 208(5):401-406.
2. Schraer CD, Bulkow LR, Murphy NJ, Lanier AP. Diabetes prevalence, incidence, and complications among Alaska Natives, 1987. Diabetes Care 1993; 16(1):257-259.
3. Mouratoff GJ, Carroll NV, Scott EM. Diabetes mellitus in Eskimos. JAMA 1967; 199(13):107-112.
4. Mouratoff GJ, Scott EM. Diabetes mellitus in Eskimos after a decade. JAMA 1973; 226(11):1345-1346.
5. Jorgensen ME, Bjergegaard P, Borch-Johnsen K. Diabetes and impaired glucose tolerance among the inuit population of Greenland. Diabetes Care 2002; 25(10):1766-1771.
6. Ebbesson SO, Schraer CD, Risica PM, Adler AI, Ebbesson L, Mayer AM et al. Diabetes and impaired glucose tolerance in three Alaskan Eskimo populations. The Alaska-Siberia Project. Diabetes Care 1998; 21(4):563-569.
7. Murphy NJ, Schraer CD, Bulkow LR, Boyko EJ, Lanier AP. Diabetes mellitus in Alaskan Yup’ik Eskimos and Athabascan Indians after 25 yr. Diabetes Care 1992; 15(10):1390-1392.
8. Bjergegaard P. Rapid socio-cultural change and health in the Arctic. Int J Circumpolar Health 2001; 60(2):102-111.
1. Bjerrregaard P. Health and environment in Greenland and other circumpolar areas. Sci Total Environ 1995; 160-161:521-527.
2. Omran AR. Epidemiologic Transition. In: Ross JA, editor. International encyclopedia of population. London: The free Press, 1982: 172-181.
3. Bjerrregaard P. Folkesundhed i Grønland [Public Health in Greenland, in Danish]. 1. 2004. Nuuk, Directorate for Culture, Education, Research and Church. Arctic Research Journal I.
4. Diabetes Atlas. 2nd edition. International Diabetes Federation, 2003: 1-360.
5. King H, Rewers M. Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. WHO Ad Hoc Diabetes Reporting Group, Diabetes Care 1993; 16(1):157-177.
6. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care 1998; 21(9):1414-1431.
7. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care 2004; 27(5):1047-1053.
8. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabet Med 1997; 14 Suppl 5:S1-85.
9. Bjerrregaard P, Mulvad G, Pedersen HS. Cardiovascular risk factors in Inuit of Greenland. Int J Epidemiol 1997; 26(6):1182-1190.
10. Bjerrregaard P, Curtis T, Senderovitz F, Christensen U, Pars T. Levevilkår, livsstil og helbred i Grønland [Conditions of life, lifestyle and health in Greenland, in Danish]. 1995. København, Danish Institute for Clinical Epidemiology. 1995.
11. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Part I: diagnosis and classification of diabetes mellitus. Report of a WHO consultation. 1999. Geneva, WHO. WHO/NCD/NCS/99.2: 1-59.
12. Bjerrregaard P, Curtis T, Borh-Johnsen K, Mulvad G, Becker U, Andersen S et al. Inuit health in Greenland: a population survey of life style and disease in Greenland and among Inuit living in Denmark. I. Int J Circumpolar Health 2003; 62 Suppl 1:1-379.
13. Statistics Greenland (www.statgreen.gl). Population prognosis. 2004.
14. WHO Consultation on Obesity. Obesity: preventing and managing the global epidemic. 894, 3-6-2000. Geneva, WHO. WHO Technical Report Series: 1-253.
15. Tuomilehto J, Rastenyté D. Epidemiology of Macrovascular Disease and Hypertension in Diabetes Mellitus. In: Alberti kGMM, Zimmet P, DeFonzo RA, keen H, editors. International Textbook of Diabetes Mellitus. John Wiley & Sons Ltd, 1997: 1559-1583.
16. Gu K, Cowie CC, Harris MI. Diabetes and decline in heart disease mortality in US adults. JAMA 1999; 281(14):1291-1297.
17. Harris MI, Klein R, Welborn TA, Knuiman MW. Onset of NIDDM occurs at least 4-7 yr before clinical diagnosis. Diabetes Care 1992; 15(7):815-819.

Nina Martinsen
National Institute of Public Health
Øster Farimagsgade 5 A, 2nd floor
1399 Copenhagen K, Denmark
Email: nma@niph.dk