

ORIGINAL RESEARCH

LOW BIRTHWEIGHT AS AN INDICATOR OF CHILD HEALTH IN GREENLAND – USE, KNOWLEDGE AND IMPLICATIONS

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ABSTRACT

Objectives. The aim of this study was to analyse if low birthweight is a valuable indicator of child health in Greenland.

Study design. A case study focusing on “low birthweight as an indicator in Greenland” with 3 units and 5 subunits of analyses.

Methods. Literature reviews, interviews with health care professionals and an analysis of the National Birth Register.

Results. Low birthweight was a well-known and yearly surveyed indicator, but not used by clinicians or by policymakers. Research was sparse, but the major risk factor observed was smoking. The rate of low birthweight in 1997–2005 was on average 5.0%. Of the low birthweight cases, 67.0% infants were born prematurely but only 44.8% of these births had a low birthweight. The known risk factors for a low birthweight in Greenland included abnormal delivery, low Apgar score at 5 minutes, female gender, multiple birth, being a single mother and less than complete prenatal care by a midwife. For preterm birth, associations were found with a not normal delivery, perinatal mortality, low Apgar score at 5 minutes, multiple birth, single mothers, mothers born in Greenland, young mothers, mothers living in a village and in nulliparae.

Conclusions. Low birthweight is as valuable an indicator of child health at the national level in Greenland as it is in other developed countries. If interventions are to be aimed at known, quantitatively important, modifiable determinants of low birthweight, the results suggest that cigarette smoking and antenatal care are the most important to address

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Keywords: low birthweight, child health, indicator, Greenland, smoking, antenatal care

INTRODUCTION

An important condition for securing the highest attainable standard of health in the child population is having updated knowledge on children's health and the factors influencing it. In Greenland, the development of a set of relevant and reliable indicators of child health has been proposed as a step in that direction (1). In connection to that research, low birthweight has been suggested as one of the core indicators.

The aim of identifying health indicators is to establish a baseline of core data that are related to health and collected in a standardised way that makes it possible to identify trends and to facilitate the planning and commissioning of services (2). Health indicators are to fulfil some basic criteria. The European Commissions report on indicators of child health (CHILD) recognized that indicators must have the fundamental attributes of being scientific (grounded in research), robust (strong in their effect and resilient to extraneous changes) and comparable (2), while OECD has suggested that criteria for indicators should include the importance of what is being measured, scientific soundness and feasibility (3).

The theoretical proposition behind the study was that an internationally used indicator might not be equally relevant in all countries. The evaluation of low birthweight as an indicator of child health in Greenland must be based on analyses of its importance and implications within Greenland. It is therefore necessary to explore its use in health surveys, in clinical use, and in policy-making; to explore and analyse risk factors and consequences of low birthweight in

Greenland; to compare the Greenlandic findings with determinants of low birthweight in other countries and in genetically and culturally identical populations.

Based on this theoretical preposition, the aim of this study was to explore the value of low birthweight as an indicator of child health in Greenland.

Low birthweight

Low birthweight is used as an indicator of child health internationally (4–6). It is defined by the World Health Organization (WHO) as a birthweight below 2,500 grams (5.5 pounds) in a live birth child (7). Low birthweight is caused by intrauterine growth restrictions, by preterm birth (before the 37th week of gestation) or by a combination of both these factors.

Low birthweight is considered a major public health problem worldwide by the World Health Organization (WHO). One of the major goals adopted by the United Nations General Assembly in 2002 was to reduce the incidence of low birthweight by at least one-third between 2000 and 2010. In 2000 the mean rate of low birthweight around the world was 15.5% (4). Across the European region it ranged from 4% to 16% (8), while the Nordic countries had very low rates of between 4% and 5% (4). As well, a wide range was found within individual countries. In Sweden, for example, the proportion of children with a low birthweight ranged from 0.5% to 7.7% between municipalities in 1999–2001 (9).

UNICEF states that low birthweight is not a proxy for any one dimension of either maternal or perinatal health outcomes, and it considers low birthweight to be closely asso-

ciated with foetal or neonatal morbidity and mortality, inhibited growth, poor cognitive development and chronic disease later in life (4). The associations of birthweight with adult health are thought to be plausibly explained by the programming hypothesis (10). The best-documented associations are higher death rates from coronary heart disease and stroke, and most studies have indicated that it is growth for gestational age rather than duration of gestation itself that is associated with adult health (11).

Table I. Important factors with known causal or indirect effect on low birthweight.*

<i>Non-influential factors</i>
Genetic factors, including ethnicity, first-born infants, multiple births, female sex of the foetus, living at high altitudes.
<i>Potentially influential factors (in long and short term)</i>
Deprived socio-economic conditions, young mothers, old mothers, maternal nutrition before and during pregnancy, the mother's own foetal growth, mother's body composition, mother of short stature, the mother's nutrition and diet during pregnancy, alcohol intake, smoking, drug abuse, maternal morbidity, pregnancy complications, physically demanding work, birth interval, prior spontaneous abortion, parity, prior low birthweight, maternal education, environmental contaminants, antenatal care, stress, paternal height and weight.*

* See references 4, 8, 12–17.

Even if the contribution of genetic factors to low birthweight are regarded as substantial (12), many other influencing factors exist and many, both causal factors and factors with a more indirect effect on birthweight, have been found to be highly associated (13). The factors regarded as the most important contributors to low birthweight are summarized in Table I (4, 8, 12–17).

MATERIAL AND METHODS

Based on the aim of the study, an embedded single case study with multiple sources of evidence and data converging in a triangulating fashion was selected as the most favourable design. The case was defined as “low birthweight as a child health indicator in Greenland” with 3 units and 5 subunits of analyses (Table II). The study was performed according to Yin (18).

Low birthweight as an indicator in Greenland – use in surveillance, policy and clinical work: A literature search on the use of low birthweight data in health surveillance and policymaking was made using national reports, reports using national data (19–22) and the

Table II. Units and subunits of analyses in the case study.

Unit and subunits of analyses	Data sources	Addressing
<i>Low birthweight as an indicator in Greenland</i> – use in surveillance – use in clinical work – use in policymaking	National reports, interviews	Feasibility, scientific soundness, and importance
<i>Exploring factors found associated with low birthweight in Greenland</i> – in research – in the National Birth Register	Literature review, analyses of data from the national birth register	Scientific soundness, and comparability
<i>Factors associated with low birthweight in comparable indigenous Arctic populations</i>	Literature review	Scientific soundness, robustness and comparability

yearly reports from the Office of the Chief Medical Officer in Greenland. Three interviews were conducted on the use of low birthweight in policymaking and in clinical work. One focus group interview was held with the heads of the perinatal care division at Queen Ingrid's Hospital in Nuuk. This division is responsible for perinatal care in Greenland. A second focus group interview was held with major policymakers from the Office of Prevention and the Ministry of Health. A third interview was held with the Chief Medical Officer in Greenland. The interviews were carried out in Danish using the same interview guide, which included questions about the informants' views on indicators in general, low birthweight as an indicator, factors associated with low birthweight and whether they considered low birthweight to be a health problem in Greenland. All interviews were taped and the author transcribed the recordings. Analyses were performed with primary weight on categorizing and the concentration of meaning (23).

Exploring factors found associated with low birthweight in research and in the National Birth Register in Greenland: A second literature search to identify research on low birthweight in Greenland was performed through PubMed on 5 March 2007, using "birthweight" and "Greenland" as keywords. It resulted in identifying 7 publications. The abstracts were read and 3 articles, including research on birthweight, were analysed (24–26).

Data in the National Birth Register from 1999 to 2005 were analysed. This register records all births in Greenland. From the register, items identifying low birthweight and preterm births (listed in Table I) were selected. The items identify the mother's name; her birth date; her personal identification code; her place of birth;

the municipality where she lives; the day of last menstruation; complications during pregnancy; antenatal care; complications during delivery; week of gestation at delivery; the gender of child, its birthweight (grams) and length at birth (cm); Apgar score at 1, 5 and 10 minutes; if a multiple birth; deaths before, during and until 1 week after delivery; earlier live births, stillbirths and abortions. To determine the week of gestation, an ultrasound examination was done early in the pregnancy in about 95% of all pregnancies.

The items with known association to low birthweight and preterm birth were gender; multiple birth; parity; birth reported by midwife to be normal or not; mortality in the first week of life; Apgar score below 7 at 5 minutes; age, ethnicity and civil status of the mother; prenatal care; if mother was living in a town or a village; and the municipality's wealth.

Ethnicity was defined in the study as mothers born in Greenland or outside Greenland, which is the only measure on ethnicity offered by Statistics Greenland. *Young mothers* were defined as mothers below 20 years of age at delivery. *Older mothers* were defined as mothers 35 years or older at delivery. *Living in a poor municipality* was used as a proxy for wealth since no individual socio-economic data are reported in the register. From Statistic Greenland, the mean income in the households in the municipalities where the mothers had permanent addresses was registered; the less affluent group of municipalities (a mean annual household income <140.000 DKK) was compared with the more affluent. *Single mothers* were mothers not married or cohabiting with the father, and they were compared with married or cohabitating mothers. *Insufficient prenatal care:* The recommended number

of visits during pregnancy was 2 with the doctor and 6 or more with the midwife before 37 weeks of pregnancy. For mothers delivering at term, mothers receiving recommended prenatal care were compared with mothers with less than recommended care. *Living in a village* was a proxy for mothers with lower socio-economic status and who had difficulty accessing health care. *Parity*: Mothers with 0 earlier deliveries and with 5 or more deliveries were analysed. *Growth restricted children* were defined as mature children with a birthweight below 2,500 grams – as small for gestational age has not been assessed in Greenlandic children.

All data analyses were made in SPSS 13.0 using chi-square test and chi-square test for trends. Data given are proportions and 95% confidence intervals.

Factors associated with low birthweight in comparable indigenous Arctic populations: A literature search in PubMed was made, dated 6 March 2007, using “birthweight” and “Inuit,” with the limit “publication date after 1 January 1980.” The search resulted in 25 hits; after reading the abstracts, 12 articles were included (27–38).

RESULTS

Low birthweight as an indicator in Greenland – use in surveillance, policy and clinical work: Low birthweight is surveyed yearly by the Office of the Chief Medical Officer in

Greenland (Table III). Low birthweight was not mentioned in the public health report or in any of the reports on child mortality; it was mentioned but not used in the evaluation of perinatal care (19–22). The analysis of child mortality in 1987–1991 (19) found perinatal mortality especially frequent in children between 1,500 and 2,499 grams compared with Denmark, but it was the only consequence of low birthweight analysed. No data on the distribution of low birthweight within subnational levels (regional or municipality) were found.

All professionals interviewed considered health indicators to be important tools and bearing points. Building indicators of child health was also viewed positively by all informants, whose comments included that such “indicators might be used to put focus on aspects of child health.” Low birthweight was viewed as an important indicator because it was found “important to have a goal” and because it is a traditionally used indicator with data going a long way back. But it was also put forward that low birthweight is difficult to interpret together with uncertainty about the contributing factors, and some doubt was expressed at to the information low birthweight data might offer. Concern about the relevance of the cut-off values in Greenlandic children was also expressed. None of the interviewees regarded low birthweight as a major public health problem in Greenland, but the lack of concrete knowledge about the consequences of low birthweight was addressed. Neither clinicians nor administra-

Table III. Incidence of low birthweight and preterm birth in Greenland.*

Year	1954	1990	2000**	2001	2002	2003	2004	2005
Mean birthweight (g)	3,251	3,376	3,482	3,457	3,458	3,474	3,460	3,490
Low birthweight (%)			3.5	7.0	6.1	6.5	6.7	3.7
Preterm births (%)			5.8	8.5	8.2	8.6	9.5	7.7

*Data from the Office of the Chief Medical Officer in Greenland.

**Mean of 1996–2000.

Table IV. Prevalence of low birthweight and preterm births from the National Birth Register in Greenland 1999–2005.

	Prevalence in all births (n=6.322)	Prevalence in low birthweight cases (n=318)	Prevalence in premature births (n= 527)	Prevalence in intrauterine growth restricted births born at term (n=109)
	% (95% CI)	% (95% CI)*	% (95% CI)**	% (95% CI)***
Prematurity	8.2 (5.9–10.5)	67.0 (61.8–72.2)	-	-
Low birthweight	5.0 (4.8–5.5)	-	48.4 (44.1–52.7)	-
Outcome measures				
Normal delivery	74.8 (73.7–75.9)	39.3 (33.9–44.7) (p<0.001)	45.1 (40.9–49.4) (p<0.001)	52.3 (47.8–56.9) (p<0.001)
Perinatal death	0.6 (0.4–0.8)	–	6.3 (4.2–8.4) (p<0.001)	1.0 (0.9–2.9) (p=0.07)
Apgar score <7 at 5 minutes	0.8 (0.6–1.0)	5.8 (3.2–8.4) (p<0.001)	9.3 (6.8–11.8) (p<0.001)	1.9 (0.7–4.5) (p<0.001)
Risk factors				
Female gender	49.1 (47.9–50.3)	56.9 (51.5–62.3) (p=0.004)	47.3 (43.0–51.6) (p=0.4)	59.6 (50.4–68.8) (p=0.33)
Single births	98.1 (97.8–98.4)	83.6 (79.5–87.7) (p<0.001)	88.3 (88.6–91.4) (p<0.001)	88.1 (82.0–94.2) (p<0.001)
Single mothers	23.3 (22.3–24.4)	29.3 (24.3–34.3) (p=0.009)	27.7 (23.9–31.5) (p=0.01)	34.3 (25.4–43.2) (p=0.006)
Mother born in Greenland	92.2 (91.5–92.9)	94.0 (91.4–96.6) (p=0.23)	95.7 (93.8–97.4) (p=0.002)	92.3 (87.3–97.3) (p=0.23)
Young mothers (<20 years)	17.0 (15.8–20.6)	20.1 (15.7–24.5) (p=0.43)	21.5 (17.9–25.0) (p=0.06)	18.9 (11.6–26.3) (p=0.98)
Older mothers (>=35 years)	15.5 (14.5–16.5)	18.9 (14.6–23.2) (p=0.11)	17.7 (14.1–21.3) (p=0.18)	15.4 (8.6–22.2) (p=0.34)
Living in a poor municipality	26.2 (25.1–27.3)	28.6 (23.6–33.6) (p=0.30)	26.7 (22.9–30.5) (p=0.78)	
Living in a village	18.5 (17.6–19.5)	17.5 (13.3–21.7) (p=0.62)	22.1 (18.5–25.6) (p=0.03)	16.5 (9.5–23.5) (p=0.73)
Paritet				
0 para****	34.4 (33.2–35.6)	38.1 (32.7–43.5) (p=0.17)	37.6 (33.4–41.7) (p=0.07)	38.9 (29.7–48.1) (p=0.55)
5 or more para****	4.2 (3.7–4.7)	3.5 (1.5–5.5) (p=0.71)	4.7 (2.9–6.5) (p=0.39)	4.6 (0.7–8.6) (p=0.69)
Had recommended prenatal care				
>=2 doctor exam	54.0 (52.7–55.3)	46.1 (40.6–51.6) (p=0.99)	–	54.7 (45.2–64.2) (p=0.88)
>=6 midwife exam	56.4 (55.1–57.7)	68.6 (63.5–73.7) (p=0.01)		69.8 (61.1–78.5) (p=0.005)

* Compared with all not-low birthweight children.

** Compared with not-preterm children.

*** Compared with not-intrauterine growth-restricted children.

**** Compared with 1–4 para.

tors used low birthweight in evaluating health care or in policy development. Administrators in the National Office of Prevention found that the low birthweight issues were covered in the national strategy on securing a healthy pregnancy.

Factors contributing to and consequences of low birthweight in Greenland identified in the research: Only two risk factors have been investigated in the research: smoking and mercury exposure. Maternal smoking was found to decrease birthweight by mean 315 grams (25). Data about the association of mercury with low birthweight were contradictory (25, 39).

Analyses of data from the National Birth Register: In the 7 years from 1999 to 2005, 6,322 live births were registered, with a mean 903 live births/year. The rate of low birthweight was 5.0% (318 children) and 109 (1.7%) of live birth children were growth restricted. Of the low birthweight cases, 67.0% were born prematurely compared with 8.2% of all children ($p < 0.001$), but only 44.8% of premature births had low birthweight. The perinatal mortality rate was 11.9 and the foetal

mortality rate was 6.9. Of the known risk factors for low birthweight, those associated with low birthweight in Greenland included a not normal delivery; low Apgar score at 5 minutes; female gender; multiple births; single mothers; and less than complete prenatal care by the midwife. For preterm birth, associations were found with a not normal delivery; perinatal mortality; low Apgar score at 5 minutes; multiple birth; single mothers; mothers born in Greenland; young mothers; mothers living in a village; and in nulliparae. Intrauterine growth restriction was associated with a not normal delivery; low Apgar score at 5 minutes; multiple births; single mothers; and less than complete prenatal care by a midwife (Table IV). More mothers living in towns (45.7%) as compared with mothers living in villages (21.6%) received full prenatal care by a midwife.

Low birthweight in comparable indigenous Arctic populations: No data from indigenous Arctic populations in Russia were found in the search. *In Canadian and Alaskan Arctic populations:* In 1995–1997, the total low birthweight rate among Canadian Inuit was 5.4%. The percentage with a gestational age below 37 weeks decreased from 14.4% in 1985–1987 to 10.7% in 1995–1997. Inuit mothers had a higher risk for preterm birth and a lower risk for small, gestational age (SGA) children compared with non-Native Canadian women (36). Among Alaskan Natives the rate of low birthweight in 1989–1991 was 4.3% in rural and 5.4% in urban districts (34). Factors in the articles that are associated with birthweight in indigenous Arctic populations are summarized in Table V.

Table V. Factors found associated with low birthweight in comparable indigenous Arctic populations.*

Negative associations with birthweight

- previous history of low birthweight
- short inter-pregnancy interval
- low weight at the time of the first prenatal visit
- a small weight gain during pregnancy
- unmarried and less-educated women
- smoking
- high caffeine intake associated with earlier delivery
- alcohol use (not conclusive)
- pollution from open dumpsites

Positive associations with birthweight

- intake of n-3 highly unsaturated fatty acids
- prenatal visits

*See references 27–38.

DISCUSSION

Greenland has a population of only 57,000 people, who live in 16 cities and about 60 villages. It is a former Danish colony and both the administrative system and the health care system are modelled after the Nordic welfare systems. The disease pattern reflects the major transitions in culture and in living conditions seen in the last 50 years, and it is best compared with the pattern seen in other circumpolar indigenous populations (1, 40). Major differences in living and working conditions, housing standards and education exist between different regions, between towns and villages, between social groups and between ethnic groups. These differences are reflected in varying standards of health (1, 22).

Due to the limited resources and the small size of the population, a system for measuring children's health must be simple, coherent and include only a few core indicators that could focus on children's health and its determinants and be used in health surveys, policymaking, prevention and health promotion initiatives. Preferably, the Greenlandic indicators would be comparable at least with data from Denmark, other Nordic countries and indigenous populations in other Arctic areas.

Although connected, no simple relation between infant mortality and low birthweight seems to exist. Despite a low birthweight rate, the infant mortality is high compared with Denmark (41), even when the same frequency of very low birthweight (below 1,500 grams) is seen. In general, the early mortality rate has been unevenly distributed within Greenland with more deaths in rural

areas, many of which may have been preventable infant deaths (19, 24). The deaths were spread over the whole birthweight distribution (24) as was also found among Alaska Natives (38), although data from 1987–1991 showed perinatal mortality to be especially frequent in children weighing 1,500 to 2,499 grams (19). In later years, infant mortality decreased in Greenland (20, 41) and among other Arctic populations (38). Internationally, the decrease has been seen despite a small reduction or no reduction at all in the incidence of low birthweight (42). This also seems to be the case in Greenland, but it is too early to determine the significance of these trends because of the small number of births in the population.

It has become increasingly evident that the cut-off value for low birthweight of 2,500 grams may not be appropriate in all populations (4). With a mean birthweight close to 3,500 grams (Table III) and a mean weight in children born in week 36 above 2,500 grams, low birthweight must be regarded as an adverse pregnancy outcome in the Greenlandic population, even if no investigations exist on the exact cut-off value for negative health outcomes most relevant in Greenlandic children.

In later years, the rate of preterm births has increased in many developed countries and this increase is thought to be related to a rise in obstetric interventions and to an increase in the numbers of multiple births. An unexplained increase has also been seen in low-risk pregnancies in Denmark, which was thought to be related to stress (43). In Greenland premature delivery might also be on the increase (Table III), but only about half of the preterm newborns had low

birthweights (Table IV). The risk of health consequences for children born preterm with a normal birthweight is probably limited in Greenland, but the trend indicates that in Greenland the weight per gestational age has increased as well.

The incidence of low birthweight was low when compared internationally but was comparable to findings in Aboriginal populations in Northern Canada, Alaska and in the Nordic countries (4, 34, 36, 41). Low birthweights are surveyed and published yearly, thus their history goes a long way back and they are well known as an indicator by both clinicians and policymakers. But low birthweight data are not used in public health strategies or in clinics despite the data being considered important child health indicators by all informants. The clinicians instead considered both “suspected intrauterine growth restriction” and “risk for preterm birth” as conditions requiring intervention. No special reason for not using low birthweight in policymaking could be extracted from the interviewees, but one explanation given was that other issues overruled it. Other explanations might be related to the uncertainty expressed about the determinants of low birthweight in Greenland and the relevance of the cut-off point.

Research on factors associated with low birthweight among Greenlanders and other indigenous Arctic populations was found to be sparse but pointed to smoking as the most important factor. In general, the risk factors for low birthweight were the same as those found in other developed countries and in other indigenous Arctic populations (Tables I and V). Special risk factors exist in the Arctic that are uncommon in most other

developed countries, namely, mercury and organo-chloride exposure to the foetus and pollution from open dump sites (37, 44). The former are a result of high concentrations of the pollutants in the marine food chain which thereby pollute important local foods such as marine mammals. New research verifying a negative effect on birthweight due to organo-chloride exposure in Greenlanders is under publication (personal communication from Henning Sloth Pedersen, Nuuk).

In summing up the literature and the interviews, low birthweight is a well-known indicator and studied every year (Table III) but the data are not used by clinicians or policymakers. With a mean birthweight just below 3,500 grams, a low birthweight is definitely an adverse pregnancy outcome in Greenland. Research is sparse, but the risk factors found associated with low birthweight in research (Tables I and V) was much the same as in other Arctic populations and in other developed countries with smoking as the major factor, even if some risk factors especially frequent in the Arctic exist. Analysing data from the National Birth Register on known risk factors (Table I) revealed that many of the same risk factors were associated with low birthweight in Greenland (Table IV). If intervention should be aimed at known, quantitatively important, modifiable determinants of low birthweight, the results suggest that cigarette smoking and antenatal care are the most important to address. With a smoking prevalence of about 60% in adult Greenlanders, addressing the foetus's exposure to tobacco smoke is probably by far the most important issue.

In conclusion, as a low birthweight is an adverse pregnancy outcome in Greenland

and the associated risk factors are the same as in other developed countries, it can be claimed that low birthweights are a valuable indicator of children's health at the national level in Greenland as it is in other developed countries. The analyses of the low birthweight cases in the National Birth Register revealed interesting associations that are worth following, especially if data on smoking during pregnancy are included in the register.

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