

# High liveborn birth weights in the Faroes: a comparison between birth weights in the Faroes and in Denmark

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**SUMMARY** The average birth weight of 10 132 liveborn infants delivered in the Faroes during the period 1969-81 was 3610 grams, which is the highest average weight reported by 33 countries from which we were able to obtain information. Comparison of live births only between the Faroes and Denmark shows a displacement between their birth weight curves of 225 grams. A less active elective delivery in the Faroes could not explain this considerable difference. When standardisation is made with respect to discrepancies in maternal age and marital status in the two populations, the difference between their average birth weights is increased by 5% and 9% respectively. A matching for maternal parity yields a difference between the averages which is 23% below the one between the total populations. Other factors must be responsible. Both environmental and genetic factors plus the possibility of the Faroes being closer to having an optimal birth weight than other countries are discussed.

The Faroe Islands are located between Norway and Iceland, and the population of about 45 000 has its own language and culture.<sup>1</sup> Summary surveys of birth weights in the Faroes showed that these were quite high compared with Scandinavian and international standards,<sup>2-5</sup> but a more detailed analysis of this difference is not available.

The purpose of this investigation was to determine the birth weights of liveborn infants in the Faroes during the period 1969-81 and to compare these values with those from other countries. A more detailed comparison is made between the Faroes and Denmark.

## Material and methods

The material for the Faroes comprised officially recorded data of all liveborn infants born in the period 1969-81 (10 164) which were submitted by midwives. These data were then data processed and stored by the National Board of Health in Copenhagen, Denmark. Only a minor part of this material has been published.<sup>2,4</sup> The material for Denmark was obtained in part directly from the National Board of Health and in part from its official publications,<sup>6,7</sup> whereas the material for the remaining 31 countries was obtained from several

sources.<sup>4 8-12</sup> This survey includes only data on liveborn infants. This has the advantage of eliminating confusion with respect to the very great differences between countries in setting the limit between stillbirths and spontaneous abortions. The birth weights in the Faroes and Denmark are arranged according to maternal age, marital status, and number of previous pregnancies. Statistical data on parity were not available.

The birth weight distributions are available in the form of weight groups defined by 500 g intervals. Two principles are in use:

-999, 1000-1499, ... , 4500-4999, 5000- (I-999) or -1000, 1001-1500, ... , 4501-5000, 5001- (I-1000).

The average ( $\bar{x}$ ) and standard deviation (SD) of a birth weight distribution comprising N newborn infants were calculated according to the following formulas:

$$\bar{x} = \frac{\sum_i (n_i m_i)}{N} \quad \text{and} \quad \text{SD} = \sqrt{\frac{\sum_i (n_i m_i^2) - \bar{x}^2 N}{N-1}}$$

where  $n_i$  represents the number of newborn in weight-group  $i$  and  $m_i$  represents the centre of the matching interval.  $m_i$  may assume the values 750 g, 1250 g, ... , 4750 g and 5250 g, whether the distribution is arranged according to the I-999 or the I-1000 principle.

The usual practice in both Denmark and the Faroes is to round off the birth weights on birth certificates to the nearest multiple of 50 g. Consequently, using the above formulas, a weight distribution made up according to the I-999 principle results in an average very nearly 50 g higher than when the I-1000 principle is used, while the corresponding standard deviations are almost equal in the two principles. In isolated cases a correction of the averages is made by subtracting 25 g from (I-999) or adding 25 g to (I-1000) the calculated averages, but in other cases comparison is made only when birth weights are recorded according to identical principles. The rounding off practice in countries other than Denmark and the Faroes was not studied, and therefore a corresponding correction of them was not possible.

Birth weight distributions were analysed statistically by standard tests on the assumption that they have a normal distribution, which is approximately correct. The figure shows the total distribution of liveborn birth weights in the Faroes and in Denmark. The figure is plotted on probit paper where each line represents a normal distribution with a standard deviation that is proportional to the slope of the line. It can be seen that the curves below the 10 percentile and above the 95 percentile deviate from the remaining linear distributions, which represent the intervening 85% of birth weights. The level of significance is  $p = 0.05$ .

## Results

The average and standard deviation in the Faroes for the period 1969-81 representing 10 132 liveborn

infants was  $3610 \pm 603$  g (corrected average). During that period the annual birth weight average (corrected) fluctuated from 3585 g to 3643 g, but chance alone can explain these deviations (analysis of variance:  $p > 0.1$ ).

In table 1 are recorded the average birth weights and standard deviations of countries where the liveborn birth weights are the highest. Unfortunately, it was possible to obtain birth weights only according to either I-999 or I-1000 for most of the countries, making necessary the corresponding division of the table. It can be seen that the highest birth weights occurred in the Faroes, followed by Iceland and then Norway. The differences in average birth weights between the Faroes and Iceland, and between Iceland and Norway, both amount to about 50 g and are statistically significant (Student *t* test:  $p < 0.001$ ).

The figure shows a parallel displacement between the Faroese and Danish birth weight curves of 225 g. Moreover, relatively heavier infants were born in the Faroes than in Denmark, since the curves deviate from each other above the 75 percentiles. In the same time period the frequency of newborn infants who were lighter than 2501 g was about 1.7 times greater in Denmark than in the Faroes (5.9% v 3.5%), while the frequency of newborn infants heavier than 4500 g was three times greater in the Faroes than in Denmark (4.8% v 1.6%).

Table 2 shows that liveborn birth weights are related to maternal age (analysis of variance:  $p < 0.001$ ) with a tendency to increase directly with age in both the Faroes and Denmark. The age distributions differ from each other in the two populations ( $\chi^2$  test:  $p < 0.001$ ). The age variation is greater in the Faroes, as a higher proportion of

Table 1 Countries with the highest average liveborn birth weights (The table includes the Faroes' neighbouring countries Iceland, Norway, and Great Britain)

Grouping principle	Country	Year or period	Number of livebirths	Birth weight (g) (Average $\pm$ SD)	Source
I-999	Faroes	1969-76	6366	3631 $\pm$ 609	—
	Iceland	1980-81	9073	3580 $\pm$ 570	*
	Norway	1979	51338	3525 $\pm$ 574	8
	Sweden	1979	95466	3502 $\pm$ 577	8
	Denmark	1980	57018	3411 $\pm$ 585	†
I-1000	Faroes	1977-81	3766	3591 $\pm$ 593	—
	Iceland	1972-74	13615	3553 $\pm$ 593	9
	New Zealand	1974-80	278746	3393 $\pm$ 576	4
	Denmark	1972-80	595668	3358 $\pm$ 580	4
	San Marino	1972-78	1740	3358 $\pm$ 564	4
	Great Britain	1970	16815	3341 $\pm$ 628‡,**	10
	England and Wales	1980-82	1773575	3314 $\pm$ 634‡	11

\*Personal communication from the Director General of Public Health, Iceland.

†Personal communication from the Medico-statistical Department, National Board of Health, Copenhagen, Denmark.

‡There was a slight deviation from other countries in the grouping method as the group of infants with birth weights higher than 4000 g was not subdivided according to the intervals 4001-4500, 4501-5000, and 5001-g. The "centre" of the interval used for calculation of that group was 4750 g.

\*\*Singletons only.

Table 2 Birth weight and distribution of births according to maternal age in the Faroes and Denmark: difference between the two populations' average birth weights according to maternal age

Maternal age (yr)	Faroes 1977-80 (1-1000)			Denmark 1977 (1-1000)			
	A	B	C	A	B	C	D
≤19	3454 ± 561	415	138	3240 ± 577	3960	64	214 ± 29.0
20-24	3538 ± 567	930	309	3305 ± 559	20970	339	233 ± 19.0
25-29	3645 ± 570	899	298	3386 ± 572	22634	366	259 ± 19.4
30-34	3680 ± 629	478	159	3416 ± 589	11257	182	264 ± 29.3
≥35	3644 ± 695	291	97	3425 ± 623	3011	49	219 ± 42.3
Total	3590 ± 593	3013	1001	3357 ± 576	61832	1000	234 ± 11.1

A = birth weight:  $\bar{x} \pm SD$ .

B = number of births: n.

C = rate per 1000 births.

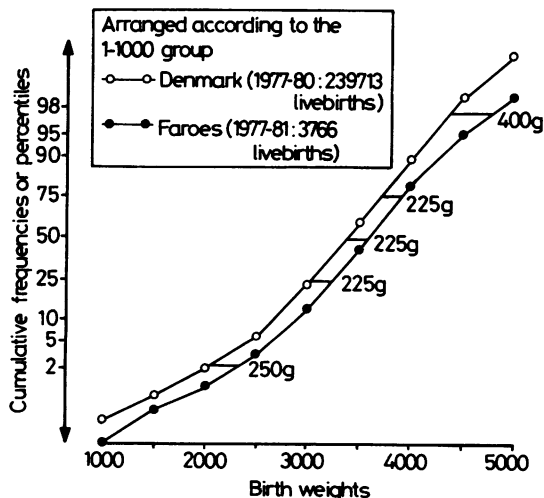
D = difference between average birth weights of the Faroes and Denmark ± standard error of the difference:

$$\bar{x}_F - \bar{x}_{DK} \pm \sqrt{\frac{SD_F^2}{n_F} + \frac{SD_{DK}^2}{n_{DK}}}$$

women who have babies before 20 and after 34 is seen there. When standardisation for this discrepancy is made by transferring the Danish age distribution to the Faroes, an increase in the Faroese birth weight to 3602 g occurs, corresponding to an increase in the difference between the two countries' average birth weights by 5% (246 g v 234 g). The difference fluctuated from 214 g to 264 g in the various age groups, but chance alone can explain this variation (analysis of variance:  $p > 0.1$ ).

Table 3 shows that birth weights in both populations are lower in infants born to unwed mothers, widows, and divorced women than in infants born to married or separated women (Student *t* test:  $p < 0.001$ ). The births are distributed differently according to these two groups in the Faroes and in Denmark ( $\chi^2$  test:  $p < 0.001$ ). A higher proportion of women who have babies outside marriage is seen in the Faroes. When standardisation for this discrepancy is made by transferring the distribution of Danish births according to maternal marital status to the Faroes, the difference between the birth weights in the two countries is increased by 9% (247 g v 226 g). The difference between the populations' average birth weights is larger in married and separated women than in the remainder (256 g v 190 g) (Student *t* test:  $p < 0.005$ ).

Table 4 shows that birth weights of liveborn infants in both populations are related to the number of previous pregnancies (analysis of variance:  $p < 0.001$ ), with a tendency to rise directly with the number in the Faroes but not in Denmark. The populations' composition with respect to this factor differs in the two countries ( $\chi^2$  test:  $p < 0.001$ ). Standardisation for this discrepancy by transferring the Danish maternal distribution to the Faroes reduces the difference between the two populations' average birth weights by about 9% (215 g v 235 g). The difference between the birth weights is related to the number of maternal previous pregnancies (analysis of variance:  $p < 0.001$ ) with a tendency to increase directly with the number. The difference is 23% lower in the group "zero previous pregnancies" than in the total population (182 g v 235 g).



Cumulated frequencies of liveborn birth weights in the Faroes and in Denmark. The values are plotted on probit paper, see Material and methods. The differences between the curves at the 2, 25, 50, 75, and 98 percentiles are shown.

### Discussion

Birth weights of liveborn infants in the Faroes are the highest in 33 countries from which we were able to

Table 3 *Birth weight and distribution of births according to maternal marital status in the Faroes and Denmark: difference between the two populations' average birth weights according to maternal marital status*

Maternal marital status	Faroes 1971-76 (1-999)			Denmark 1972 (1-999)			
	A	B	C	A	B	C	D
Unmarried, widowed, or divorced	3483 ± 614	1168	249	3293 ± 601	10877	144	190 ± 18.8
Married or separated	3688 ± 595	3541	752	3432 ± 577	64619	856	256 ± 10.3
Total	3637 ± 606	4709	1001	3411 ± 583	75496	1000	226 ± 9.08

A = birth weight:  $\bar{x} \pm SD$ .

B = number of births: n.

C = rate per 1000 births.

D = difference between average birth weights of the Faroes and Denmark ± standard error of the difference:

$$\bar{x}_F - \bar{x}_{DK} \pm \sqrt{\frac{SD_F^2}{n_F} + \frac{SD_{DK}^2}{n_{DK}}}$$

obtain information, and they have remained at a constant level during the 13-year period. In order to determine the reason for these high birth weights, a comparison was made of the Faroes and Denmark. These two countries are well suited for comparison because (1) the maternal experts in the Faroes (midwives and doctors) are nearly all trained in Denmark, and therefore the procedures and terminology are very similar; (2) the same legal obligations concerning reporting child birth data are present in both countries, and these data are computed in the same place (National Board of Health, Copenhagen); (3) the two countries' health and social standards are highly comparable.

For the most part the observed difference in average birth weights in the two countries of about 230 g reflects a displacement of about 225 g in all the weight groups. The percentage of medically induced deliveries during 1977-81 in the Faroes was 19%,<sup>13</sup> while in Denmark it was 10% in 1979.<sup>14</sup> This,

together with the finding of a displacement of all weight groups, makes the possibility of a less active elective delivery in the Faroes as a cause for the discrepancy between the two birth weight averages very improbable.

Birth weight is known to increase with increasing maternal age and parity when examined separately, and it tends to be higher in children born of mothers who are married than in others.<sup>10-15</sup> Statistics on parity were not obtainable but the number of previous pregnancies may reflect the same major trends, and therefore this factor was investigated (at the time of the study, legislation concerning induction of abortion was identical and conservative in both countries).

There is a relationship between the greater variation in maternal age in the Faroes and a higher total fertility rate (total number of liveborn children per 1000 women): during 1976-80 it was 2635 in the Faroes and 1645 in Denmark.<sup>20</sup> These phenomena

Table 4 *Birth weight and distribution of births according to number of previous maternal pregnancies in the Faroes and Denmark: difference between the two populations' average birth weights according to number of previous maternal pregnancies*

No of previous maternal pregnancies	Faroes 1970-76 (1-999)			Denmark 1972 (1-999)			
	A	B	C	A	B	C	D
0	3509 ± 589	1713	310	3327 ± 566	26144	369	182 ± 14.6
1	3634 ± 591	1486	269	3437 ± 592	24100	340	197 ± 15.8
2	3715 ± 585	1114	202	3452 ± 595	12114	171	263 ± 16.6
3	3724 ± 574	635	115	3440 ± 627	4920	70	284 ± 24.5
4	3867 ± 644	278	50	3408 ± 658	2019	29	459 ± 41.3
5 or more	3755 ± 651	292	53	3394 ± 714	1494	22	361 ± 42.3
Total	3635 ± 609	5518	999	3399 ± 588	70791	999	235 ± 8.5

A = birth weight:  $\bar{x} \pm SD$ .

B = number of births: n.

C = rate per 1000 births.

D = difference between average birth weights of the Faroes and Denmark ± standard error of the difference:

$$\bar{x}_F - \bar{x}_{DK} \pm \sqrt{\frac{SD_F^2}{n_F} + \frac{SD_{DK}^2}{n_{DK}}}$$

and the occurrence of a higher proportion of women who have babies outside marriage in the Faroes may be explained by differences in the two populations with respect to the following conditions: (1) general attitudes towards (a) the age at which women should have babies; (b) the size of the family; and (c) having an abortion; (2) availability of contraceptives; (3) legislation concerning induction of abortion. As mentioned above, the indications in the laws were identical in both countries until April 1970, when a liberalisation was made in Denmark; in October 1973 free abortion was legalised in Denmark, whereas in the Faroes no change has been made since 1959; thus legislation has been more liberal in Denmark during both periods in question (see tables 2 and 3).

When standardisation of the two populations is made with respect to maternal age, marital status, and number of previous pregnancies, the difference between the populations' average birth weights is increased by 5% and 9% in the first two parameters and decreased by 9% in the last. In the group of "zero previous pregnancies" the mothers match each other directly with respect to parity. The difference between the populations' average birth weights of the infants of those mothers who had had no abortions or previous childbirths is 23% lower than the difference between the values of the total populations.

Neither differences between the practice of inducing deliveries nor differing maternal distributions according to age, marital status, and parity can thus satisfactorily explain the considerable difference in the average liveborn birth weights in the two populations.

The prevalence of insulin-requiring diabetes mellitus in the Faroes is about half that in Denmark.<sup>16</sup>

Environmental determinants of birth weight may occur differently in the Faroes, where fishing and the fishing industry are predominant occupations, and in more industrialised and urbanised Denmark. Maternal smoking of more than 15 cigarettes a day has been found to reduce the average birth weight by 158 g,<sup>17</sup> but it seems to us very unlikely that there should be such a large difference between the smoking habits of pregnant women in the two populations. The difference between the two populations' average birth weights was larger for infants born to married and separated women than to others. Possible differences in the occurrence of environmental determinants may therefore manifest themselves more strongly in that group. The difference between the birth weights was found to be unrelated to maternal age. Its relationship to earlier maternal pregnancies is difficult to interpret, as indicated above.

Anthropological studies have shown a large number of common characteristics between the Faroese and the Icelandic people.<sup>18, 19</sup> The extremely high birth weights here compared to those in the rest of the world can possibly be related to a common ethnic background. However, these countries presumably also have a large number of common environmental and social characteristics (fishing industry, habits of life, nourishment, etc).

The late fetal death rate per 1000 livebirths in 1976–80 in the Faroes was 11.0, whereas it was 5.6 in Denmark.<sup>20</sup> The difference between these two values is anyway too small to account for the observed discrepancy between the birth weights of liveborn infants through a stronger selection of heavy infants in the Faroes.

Generally there is an inverse relationship between the proportion of heavy infants in a country and its infant mortality rate.<sup>5</sup> The higher frequency of stillbirths in the Faroes than in Denmark is thus probably caused by factors unrelated to birth weight. Indeed, if the high birth weight in the Faroes is environmentally determined, it may be that this population is closer to the optimal birth weight than others.

Additional epidemiological studies are necessary to explain these conditions. Causes of perinatal mortality plus the degree and type of employment, smoking, and eating habits during pregnancy must be investigated. In their isolated location the Faroes offer a relatively well defined population and therefore present a highly suitable location for epidemiological studies.

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