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**The Value of Information of Duration of Pregnancy
in Establishment of Paternity***

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Summary. In order to get an idea of the value of the information on the duration of pregnancy in establishment of paternity, 511 records from 17 lower courts in Sweden were studied.

It was found that when a blood group investigation has been performed, only a small number of cases remain where the paternity claim should be rejected by a court of law for the reason that the period of pregnancy has been extremely long or short.

It was shown that only very extreme probability values (percentages) should give reason for rejection of paternity claims if a larger risk of error is to be avoided. The risk is somewhat smaller with long pregnancies than with short ones.

The results of this study emphasize the difficulties involved in probability assessment in paternity suits.

Zusammenfassung. Zur Schätzung der Information, die bei der Feststellung der Vaterschaft aus der Länge der Schwangerschaft zu gewinnen ist, wurden 511 Urteile von 17 Untergerichten Schwedens studiert.

Nach Durchführung der Blutgruppenuntersuchungen bleibt nur eine kleine Anzahl von Fällen übrig, bei der wegen extrem langer oder kurzer Schwangerschaftsdauer vom Gericht die Vaterschaftsvermutung widerlegt werden soll. Nur extreme Wahrscheinlichkeiten (Prozentzahlen) sind zur Vermeidung von Fehlern geeignet. Die Gefahr der Fehlbeurteilung ist bei längerer Schwangerschaftsdauer geringer als bei kürzerer.

Key words: Blood group investigation — Establishment of paternity — Length of pregnancy — Probability assessment — Probability values.

The paternity of children born out of wedlock is established in Sweden either by acknowledgment (about 80%) or by the decision of a court of law. Since as yet it is not possible to produce direct proof of the paternity of a particular man, the rule now prevailing in Swedish law concerning the establishment of paternity by a court judgement is based upon the following legal presumption: "The court shall declare a man to be the father of a child born out of wedlock if it is established that he has had sexual intercourse with the child's mother during the time when the child could have been conceived, and that with due consideration of all circumstances it is probable (up to 1st January 1970 the wording ran "not improbable") that the child was conceived by him".

In settling a paternity dispute the *conception period* plays an important role. If it cannot be proved that the putative father has had intercourse with the

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mother during the conception period, the claim shall be rejected. Furthermore, the conception period can be of importance in the probability assessment that shall precede the judgement in a case where intercourse or intercourses during this period have been proved. The timing of the intercourse (intercourses) during the conception period is one of several factors which may be taken into consideration in this assessment.

No legal conception period is laid down in Swedish law, and this period therefore has to be decided by the court *in casu*. In the case of fullterm offspring the conception period is considered at present to lie between the 300th and 240th days before birth. In cases where intercourse has taken place outside these limits or where the child is premature, doubt may often arise as to whether it can be considered *probable* that the child was conceived at the intercourse in question.

For this probability assessment data from Swedish hospitals collected by Engström and Falconer (1965) concerning the birth length and birth weight of about 59000 infants with a known gestational period is used nowadays. [Certain series from other countries are also sometimes used, *e.g.* a German material comprising 19608 infants (Föllmer and Könninger, 1951) or a series from Finland comprising 27522 births (Timonen, Uotila, Kuusisto, Lokki and Vara, 1966).] From these data the limit of probability in calculation of the earliest or latest time point at which the child can have been conceived is estimated such that the birth weight and birth length, respectively, are correlated to the stated time point of conception. The probability (in per cent) is hereby obtained. Stegman and Hellwig (1961) have suggested the following predicate for different percentage values: very probable 31–69%, probable 11–30%, 70–89%; improbable 5–10%, 90–95%; very improbable 1–4%, 96–99%; highly improbable <1%, >99%, that a randomly selected child with a particular birth length and birth weight, respectively, can have been conceived earlier or later than at the stated time point. [This probability concept has a different character from that used in blood group determination (Essen-Möller, 1938; Essen-Möller and Quensel, 1939; Hummel, 1970).]

Such a calculation is useful only on condition that the court material is distributed in a different way from the material of Engström and Falconer, in that it includes a considerably larger number of cases in the outer limits. Supporting the belief of such a difference is, firstly, the likelihood that a man may contest a paternity claim for just that reason that the length of pregnancy has been usually long or short, and secondly, that a woman (intentionally or unintentionally) may name a man with whom she has had intercourse at a different time from that of the true occasion of fertilization. We considered, however, that as long as no detailed knowledge of the court material was available, only very limited conclusions could be drawn concerning the validity of estimation of the probability of paternity in the individual case on the basis of a given percentage value.

Aim of the Investigation

The aim of the present investigation was to obtain, by studying a number of records and judgements from lawsuits concerning settlement of paternity disputes in different lower courts, an idea of the value of probability assessment

as described above, in cases where blood group investigation had not excluded the defendant, and if possible to arrive at a limit (percentage) applicable for practical use in such assessments.

Material and Results

An attempt was made to collect the records pertaining to all paternity lawsuits taking place during the period 1960–1964 in 17 lower courts (7 magistrates' courts and 10 district courts). Very few records were not available. The material comprised 511 cases. In 295 cases the defendant contested paternity suit.

Blood group investigation had been performed in a total of 373 "one man" cases. In 28 of these cases the blood tests resulted in exclusion of the defendant from paternity, and these cases are obviously of no interest in a study concerning exclusion from paternity on the basis of investigation of length of pregnancy. The average chance of exclusion from paternity by blood group investigation was calculated to be about 64%. (In most cases AB0, MN, Rh, Kell, P, Fy^a and Hp had been used, which gives a theoretical exclusion possibility of 66.3%. In some cases Gc, Hp and Fy^a had not been used, whereby the exclusion possibility was reduced to 56.2%.) Thus the number of cases where the paternity claim should have been rejected among the 373 "one man" cases where blood group investigation had been performed, can be calculated approximately by forming the quotient $28/0.64$, i.e. 44 cases, which means that further 16 cases should have been excluded. These 16 cases comprise only about 5% of the remaining 345, which is a remarkably low figure and means that of the remaining cases subjected to blood group investigation the paternity claim should have been allowed in 95% if the true was known. It follows, thus, that investigation based on the duration of pregnancy should only exclude paternity in a very small number of cases!

From the data on birth length and birth weight noted for the offspring, a "probability"—hereinafter called "percentage"—that the duration of pregnancy was as stated, or shorter, was calculated with the aid of the Engström and Falconer tables concerning the correlation between duration of pregnancy and birth length and weight. On these bases the range of percentages within which the observed lengths of pregnancy lay, was established. Cases with short periods of pregnancy lay within the range 0–10% and those with long periods within 90–100%; those with extremely short periods of pregnancy within the range 0–0.5%, and those with extremely long periods within the range 99.5–100%.

Table 1 gives the results of the *blood group investigations* in those cases where the date of conception was known. The percentage is calculated here on the basis of

Table 1. *Number of defendants excluded from paternity by blood group investigation in per cent of the number subjected to blood group investigation, in cases where the date of conception was known*

Percentage range	Number of defendants who were excluded by blood group investigation	Number of defendants subjected to blood group investigation	% excluded
10–90	7	124	6
0–10	5	19	26
90–100	7	31	23

birth weight, and the table includes both cases where the putative father contested the paternity suit and those where he acknowledged paternity during the trial. It is evident from the table that the frequency of cases where paternity had been excluded by blood group investigation was larger at extreme lengths of pregnancy than at less extreme lengths. This means that those cases where the paternity claim should have been rejected should be found mainly among cases with extreme lengths of pregnancy.

In 126 of the 295 cases where the plaintiff's claim had been contested, both the date of conception and information on the birth weight and birth length were available, while in 7 cases information on the body length was lacking.

For all 126 cases a percentage based on birth length and birth weight, respectively, was calculated from the tables of Engström and Falconer. If the cases had been representative of the material analysed by Engström and Falconer, they would have been evenly distributed (i.e. rectangularly distributed between 0 and 100). If, on the other hand, the offspring had not been conceived at the intercourse stated, there would be an accumulation at the extreme ends of the distribution, especially if the true time point of conception deviated greatly from the time point of the intercourse in question.

Table 2 gives the observed and expected numbers of cases where the defendant had contested the paternity claim and where the date of conception was known. Using the tables of Engström and Falconer, from the information on birth length and birth weight the range of percentages within which the observed lengths of pregnancy lay, was established. For example, in the column for birth weight it is seen that in 94 cases the length of pregnancy lay between 10 and 90%, while in 6 cases it lay between 99.5 and 100%, i.e. an extremely long pregnancy. It can be seen in the table that 15 out of 126 observed cases lay in the range 0-10% (short pregnancies). This is a larger number than might be expected from the rectangular distribution. According to this distribution 1/10 of the material, i.e. 12.6 cases, should be found within this range.

Table 2. *Expected and observed number of cases and quotient of expected/observed number of cases where the defendant had contested paternity claim and where the date of conception was known*

Percentage range	Body length (total 119 cases)			Body weight (total 126 cases)		
	Exp.	Obs.	Exp./Obs.	Exp.	Obs.	Exp./Obs.
10-90	95.2	82	1.16	100.8	94	1.07
0-10	11.9	17	0.70	12.6	15	0.84
90-100	11.9	20	0.60	12.6	17	0.74
0-5	5.95	13	0.46	6.3	10	0.63
95-100	5.95	14	0.43	6.3	15	0.42
0-2.5	2.98	2	(1.49)	3.15	5	0.63
97.5-100	2.98	10	0.30	3.15	11	0.29
0-1	1.19	1	(1.19)	1.26	0	(∞)
99-100	1.19	8	0.15	1.26	8	0.16
0 0.5	0.60	0	(∞)	0.63	0	(∞)
99.5 100	0.60	6	0.10	0.63	6	0.11

If the rule were followed that the paternity claim should always be rejected in those cases where the percentage for the child in question lies within the range 0–10%, the claim would have been rejected in 15 of the 126 cases, i.e. about 12%. If the same rule were applied in a normal material comprising children born in wedlock (with the paternity not even questioned), 10% would be found within the 0–10% range. It may thus be stated that among those cases where the paternity was contested, there were not so many more in this percentage range than in the normal material, the difference only being about 2%. This means that if the above rule were followed and the paternity claim were rejected in all 15 cases, comparison between observed and expected percentages shows that a correct decision would be made in only 16%¹ ($15 - 12.6/15$) and consequently an incorrect decision may be feared in (maximally) 84%¹ of the cases ($12.6/15$). With this line of reasoning it is assumed that other circumstantial evidence than information on time of conception and birth weight is either lacking or may be disregarded. We are also disregarding the possibility that the extreme length of pregnancy may have been the reason that the claim is contested (which seems to be rare).

A considerably more favourable relation between expected and observed cases is obtained if the rule is followed of rejecting the paternity claim in the range 99.5–100% (the percentage range corresponding to the longest pregnancies of all, when the birth weights have been taken into account). Here the quotient between expected and observed number of cases will be 0.11 ($0.63/6$), and with this rule an incorrect decision may be expected in (maximally) 11%¹ of those cases where the paternity claim is rejected according to this rule.

Similar conditions appear to be valid for percentage calculations based on birth length and weight. Further, the risk appears to be smaller throughout with longer pregnancies (e.g. 90–100%) than with shorter (e.g. 0–10%).

Table 3 shows the probability of unjust rejection of the paternity claim in different percentage ranges. This probability can be estimated in two ways:

1. By calculating the quotient between the expected and observed number of cases (columns A and B). (This estimate gives a value which is somewhat too high, however.)

2. By calculating the quotient between the number of cases where blood group investigation has excluded the defendant from paternity, divided by 0.64, and the total number of cases subjected to blood group investigation. The difference between this quotient and 1 gives, if the decision of the court is based on percentage intervals only, an estimate of the relative number of cases where the court would erroneously reject the paternity claim, if in all cases in the respective percentage ranges the paternity claim were rejected (columns C and D).

It is evident from column A (cf. Table 2) and column B that with the more extreme lengths of pregnancy the relative frequency of erroneous judgements decreases. This tendency is not seen in C and D, which may be due to the fact that these columns (but not A and B) include cases where paternity had been excluded from blood group investigation. These cases are distributed among

¹ No regard has been taken here of the fact that the percentages are subject to a random error.

Table 3. Comparison between probability of unjust rejection of the paternity claim, estimated from (1) the ratio of expected/observed number of cases (columns A and B) and (2) the ratio between the number of cases where blood group investigation has excluded the defendant from paternity, divided by 0.64, and the total number of cases subjected to blood group investigation (columns C and D)

A and B include only contested cases, and C and D both acknowledged and contested. A and C refer to date of conception, B and D to the first day of the last menstrual period.

The table includes only cases where the birth weight was known. The figures in brackets are based on too few cases to permit any valid conclusions.

Percentage Range	A	B	C	D
0-10	0.84	0.97	0.59	0.71
90-100	0.74	0.38	0.65	0.88
0-10, 90-100	0.70	0.55	0.62	0.83
0-5	0.63	0.61	0.44	0.73
95-100	0.42	0.29	0.69	0.91
0-5, 95-100	0.50	0.38	0.60	0.85
0-2.5	0.63	0.40	(0.13)	0.71
97.5-100	0.29	0.21	0.67	0.91
0-2.5, 97.5-100	0.39	0.27	0.50	0.84
0-1	(∞)	0.45	(0.22)	0.53
99-100	0.16	0.11	0.69	0.93
0-1, 99-100	0.32	0.18	0.55	0.80
0-0.5	(∞)	0.28	(0.22)	(0.48)
99.5-100	0.11	0.09	(0.61)	0.90
0-0.5, 99.5-100	0.21	0.13	0.53	0.78

different percentage ranges. It is evident from column C that rejection of the paternity claim would be unjust in more than half of the cases if it were rejected in all cases with extreme lengths of pregnancy.

Since columns A and B do not include cases where paternity was excluded as a result of blood group investigation, these columns contain the additional information, over and above that in columns C and D, that in certain cases there is in fact reason to reject a paternity claim on the grounds of an extreme period of pregnancy. The relative values are high, however, and *therefore the paternity should hardly be excluded unless the length of the pregnancy is so extreme as to correspond to 99.5% (extremely long pregnancies)*. With short pregnancies the relative values are higher, as seen in columns A and B, and it is doubtful here whether on the basis of the present material any percentage limit can be given at all. *Only extremely short pregnancy periods should give reason for rejection of the paternity claim.*

Discussion

This study has thus shown that when a blood group investigation has been performed, only a small number of cases remain where the paternity claim should be rejected by a court of law for the reason that the period of pregnancy has been extremely long or short.

It has been shown, further, that only very extreme percentages (probability values) should give reason for rejection of a paternity claim if a large risk of error is to be avoided.

The risk is somewhat smaller with long pregnancies than with short, which may be of practical importance since the risks of error differ so greatly. One reason for the risk difference may possibly be that the mortality in infants born after extremely short pregnancies is relatively high, and in many of these cases proceedings for the establishment of paternity are therefore never taken. Another conceivable explanation is that a woman who knows or believes that she is pregnant (with an undesired man) has an average of 30 days to entice a more desirable man to intercourse (and then claim that he is the father of the child).

Our study has shown that it is doubtful whether any percentage limit at all, or even per mille limit, can be recommended for exclusion of paternity in an individual case by reason of a short period of pregnancy, although obviously certain extremely short periods must be regarded as completely unreasonable. With long periods of pregnancy the limit of 0.5% (99.5%) gives a risk of error of only about 10%, which would seem to be acceptable.

We consider, thus, that the percentage limits should be kept very narrow, and the results of this study have emphasized the difficulties involved in *probability assessment* in paternity suits. In our opinion the best method, without comparison, is *exclusion* by means of a blood group investigation. With the use of all system discovered hitherto, it should be possible today to exclude 90% of innocent parties (Vamosi 1971), whereby a probability assessment would only be required in a few cases. In the light of our results we consider such a development important.

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