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Prospective and retrospective examination of an easily applicable score to predict the probability of premature birth defined by weight

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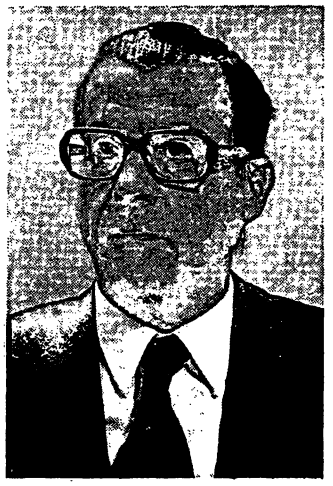
In the past it has been recognized that a great number of circumstances and events before and during pregnancy are significantly correlated with prematurity (defined by weight). These circumstances and events can therefore be designated as etiological factors. Since the frequency, i.e. the risk of prematurity increases with the number of etiological factors operating during pregnancy [1] elimination of some factors by preventive measures should decrease the risk even in the presence of others that cannot be prevented. To do so it is necessary to identify high risk pregnancies in time. For this purpose two scores have been developed grouping detectable etiological factors according to their estimated importance [2, 3]. If a certain total risk is exceeded in a pregnancy special care will be required.

Later, it was shown [4] on the basis of a study of a large enough series of consecutive newborns with birth weights below 2501 g and unselected newborns with birth weights above 3000 g as control that one can calculate for any etiological factor:

1. The significance of the factor as the percentage of prematures in pregnancies complicated by the factor, i.e. the probability of an underweight birth in those pregnancies.
2. The expense of prevention defined by the average frequency of such complicated pregnancies.
3. The practical importance of the factor as part of the total prematurity rate theoretically preventable by elimination (or compensation) of the factor.

Curriculum vitae



OTTO THALHAMMER *was born 1922 in Carynthia, Austria, studied in Vienna and obtained his MD there 1947. Working at University Childrens' Hospital Vienna he became docent 1957 and Assistant Professor 1963. Now he is head of the Dept. f. Neonatology at Univ. Childrens' Hospital Vienna. His main scientific interest is in prenatal diseases and congenital disorders (books on toxoplasmosis and prenatal diseases in man; 200 papers). Since 1966 he is also directing the Austrian Screening program for inborn errors.*

By evaluating these three important parameters for each of 41 etiological factors and factor combinations a simple, easily applicable score was created to predict the risk of prematurity early enough during pregnancy for preventive measures to be taken. In this score the accumulated probability of underweight birth due to different factors represents the total risk (Possibly because this is not a probability in the mathematical sense one should speak about risk points). Preliminary results of a retrospective examination applying the score at the time of delivery have demonstrated a good separation of pregnacies resulting in newborns below 2501 g and above 3000 g assuming that an

accumulated probability i.e. a total risk of prematurity of more than 50 points defined high risk [5]. In this study the results of prospective application of the score in 431 pregnancies will be shown and compared with the results of retrospective application in 334 of these and 940 other pregnancies.

1 Material and method

The questionaire (Tab. I) was completed by neonatologists during the 6th month of pregnancy for 481 women attending the prenatal care units of the 1st and 2nd University Obstetrical Clinics Vienna. The questionaires were evaluated before the time of the delivery and the obstetricians were not aware of the results. Since 50 of these women delivered elsewhere only 431 could be used for the prospective examination of the score.

In 334 of the 431 women the questionaire was applied a second time within the first week after delivery. This was done by pediatricians and nurses of the Dept. of Neonatology who were not acquainted with the results of the first 6-month-questionaire. 91 of these pregnancies resulted in newborns with birth weights between 2501 g and 3000 g.

In addition to this, data for the score were obtained during the first week after delivery i.e., retrospectively from 940 mothers, whose newborns were either admitted to the nurseries of the obstetrical clinics or to the premature unit of the Neonatology Department. To achieve clear-cut results only pregnancies resulting in newborns below 2501 g and above 3000 g were included in the retrospective evaluation of the score. This adds up to 1183 retrospectively examined pregnancies. Prenatal care quality as determined after delivery is defined by the number of consultations: Bad care 0–4, medium care 5–7, good care 8 or more.

Tab. I. Score for predicting risk of underweight birth.

Obstetrical		Coincidental		Social	
EPH-Gestosis	10	*Abn.weight gain during pregnancy	10	Prof.work (single)	10
		Feverish inf.I.trim.	10	below 160 cm	10
Hyperemesis	12	smoking	12	above 30y	11
		only previous preg=Ab	13	below 21y (single)	11
		2 unfortunate prev. pregn.only	18	Soc.Class IV (single)	12
		bleeding II.Trim.	18	5% + preconceptional underweight	14
		only previous pregn.= premature	19		
*Delaied conception	20	Feverish inf. II.Trim.	20	prof.work, social class IV	20
*Cervical canal fingerwide Portio 1 cm	25	Syphilis	21		
		Only previous pregn.=stillbirth	30	5% + preconc. underweight soc.cl.IV	29
Uterine deformity	30				
		Bleeding I.orIII.Trim.	30	Below 21y soc.cl.IV	31
Hypoplasia of ut.	32				
		> 50%unfort. prev.in 3+ pregnancies	40		
*Hydramnion	33			*no weight-, abdominal increase 2. half of pregnancy	40
Multiple pregn.	62	Poisonings with clin. symptoms	55		
Placenta praevia	100				

Total risk: 20–30 detectable risk, 31–50 definite risk, > 50 high risk

* Estimated from literature

2 Results

In the prospective evaluation (Tab. II) it was found that 18.7% of pregnancies resulting in newborns above 3000 g and 71.4% resulting in newborns below 2501 g exceeded the 50 prematurity risk points limit. It is remarkable that the percentage of pregnancies exceeding the 50 point limit increases with decreasing birth weight of the newborns. On the other hand, the percentage of pregnancies with no or very low risk defined by a score of less than 20 points clearly increases with increasing birth weight. This seems to indicate that lower birth weights between 3000 g and 2501 g are also correlated with factors causative for prematurity. Since 18.7%

Tab. II. Prospective examination (all cases). Birth weights in relation to number of prematurity risk points as determined by scoring during 6 th month of pregnancy.

birth weight g		probability of underweight birth (risk points) < 20	20–30	31–50	> 50	31–60	> 60	total
> 3000	No	89	66	81	54	103	32	290
	%	30.7	22.7	28.0	18.7	35.6	11.1	100.0
3000–2751	No	9	27	21	18	31	8	75
	%	12.0	36.0	28.0	24.0	41.3	10.7	100.0
2750 2501	No	3	14	11	17	18	10	45
	%	6.7	31.1	24.4	37.8	40.0	22.2	100.0
< 2501	No	0	3	3	15	6	12	21
	%	0.0	14.3	14.3	71.4	28.6	57.1	100.0
total	No	101	110	116	104	158	62	431
	%	23.5	25.5	26.9	24.2	36.7	14.4	100.0

false positive results (i.e. pregnancies resulting in normal babies but defined by the score as at risk) could be interpreted as too high a proportion. The table also shows what the relation would be if 60 risk points were taken as the limit i.e. indication for special care.

If prediction of prematurity for the purpose of prevention should be effective, preventive measures must be able to change the outcome of pregnancies with a certain risk. Such a change will mask the selective power of the score. To eliminate this, all pregnancies with detectable risk (20 points or more) and good prenatal care (defined by at least 8 consultations) were excluded. In 334 pregnancies the score was applied in the 6th month of pregnancy and at delivery. The degree of risk was assessed from the prospective and the quality of prenatal care from the retrospective scoring. 131 pregnancies had to be excluded for 8 or more consultations and 20 risk points or more. It can be seen (Tab. III) that by eliminating the masking effect of prenatal care the selective power of the score is increased. Now only 12% of normal newborns but 78% of newborns below 2501 g are the outcome of pregnancies exceeding the 50 points risk limit. If one accepts 60 points as limit indicative of special care, the percentages are 8 and 67. On the other hand 48% of normal newborns are delivered from no or low risk pregnancies as opposed to 0.0% of prematures. Once more the frequencies of birth weights between 3000 g and 2501 g are in the biologically expected correlation with the degree of risk. Accepting the 50 points limit 19% of all pregnancies should receive special care; with 60 points limit it would be 13%.

For predicting the probability of prematurity with the purpose of prevention it is important to know the frequency of events increasing the risk after the 6th month of pregnancy. It is also of interest to estimate the frequency of errors made by the interviewer or the mother. This was evaluated by comparing the 334 prospective and retrospective scorings. It became apparent (Tab. IV) that the interviewers at the 6th month scoring missed some events in about 5% of cases but in 7% in the retrospective scoring. In 7% of the cases probably the mother did not mention a particular event either at the 6th or 10th month interview. A real decrease of risk (mostly due to discontinuation of professional work) occurred in 2% and a real increase of risk in 6.8%. It seems especially important that only in 1.8% of the 334 cases the total

Tab. III. Prospective examination (excluding cases with 20 or more risk points and good prenatal care.) Birth weights in relation to number of prematurity risk points as determined by scoring during 6th month of pregnancy.

		probability of underweight birth (risk points)						
birth weight		< 20	20–30	31–50	> 50	31–60	> 60	total
3000	No	71	28	30	18	36	12	147
	%	48.3	19.4	20.4	12.2	24.5	8.2	100.0
2000–2751	No	8	8	7	6	11	2	29
	%	27.6	27.6	24.1	20.7	37.9	6.9	100.0
2750–2501	No	1	6	4	7	5	6	18
	%	5.5	33.3	22.2	38.9	27.8	33.3	100.0
< 2501	No	0	1	1	7	2	6	9
	%	0.0	11.1	11.1	77.8	22.2	66.7	100.0
total	No	80	43	42	38	54	26	203
	%	39.4	21.2	20.7	18.7	26.6	12.8	100.0

Tab. IV. Changes in total risk between 6 month scoring and delivery.

reason	change after 6th m % of cases	
	minus	plus
failure interviewer prospective	4.7	1.5
failure interviewer retrospective	6.8	0.9
failure mother both	7.1	0.9
real changes	2.0	6.8
really exceeding 50 points		1.8

risk exceeded the limit of 50 points by events or complications occurring after the 6th month scoring.

The result of the retrospective examination of the score did not change essentially after the first examination [5]. One important point is (Tab. V) that after exclusion of pregnancies with detectable risk and good prenatal care only 7.6% of high risk pregnancies (above 50) resulted in newborns above 3000 g whereas 66.2% resulted in newborns

Tab. V. Retrospective examination. Birth weights above 3000 g and below 2501 g following number of prematurity risk points and prenatal care quality. Percentages in bracketts (below absolut numbers) for total material before excluding cases with 20 or more risk points and good prenatal care (8 consultations or more).

		< 20			20–30			31–50			> 50			
		0–4	5–7	8+	0–4	5–7	8+	0–4	5–7	8+	0–4	5–7	8+	total
above 3000 g	%	53.4			22.7			16.1			7.6			100.0 (of 655)
	No	64	145	141	40	109	106	28	78	119	11	39	93	973
	%		(36.3)			(26.2)			(23.1)			(14.7)		(100.0)
below 2501 g	%	6.6			6.6			27.3			59.4			100.0 (of 165)
	No	4	4	3	3	8	6	25	20	16	46	52	23	210
	%		(5.2)			(8.0)			(29.0)			(57.6)		(100.0)
% below 2501 g		5.9	2.7	2.0	7.0	6.8	5.4	47.2	20.4	11.8	80.7	57.1	19.8	1183
		3.0			6.9			29.8			66.2			100.0

below 2501 g. The influence of prenatal care quality is also clearly demonstrated. Pregnancies with more then 50 prematurity risk points resulted in newborns below 2501 g in 80.7% if badly cared for, in 57.1% if medium care was received and only in 19.8% if prenatal care was good. The influence of prenatal care is also clearly seen in pregnancies with 30–50 prematurity risk points. Below 30 prematurity risk points the quality of prenatal care is practically without influence or prenatal care is really ineffective (not preventable but rare "accidents"). As previously shown [5] pregnancies resulting in prematures that tend to escape discovery when scoring is applied are mostly those with newborns between 1751 g and 2500 g and low postnatal mortality.

3 Conclusions

The great advantage of the score proposed and examined in this study seems to be that it is based on exact risk probability calculations for each of 41 etiological factors and factor combinations. The fact that the risk probability inherent in each factor can be calculated for any population is also of great importance since certain risk probabilities will not be the same everywhere because of the dependence on social and medical, possibly also racial circumstances.

Summary

An easily applicable score to predict the risk of prematurity (**Tab. I**) (defined by weight) is examined prospectively (scoring during 6th month of pregnancy) in 431 and retrospectively (obtained after delivery) in 1183 pregnancies.

In the prospective study (**Tab. II**) 71.4% of all pregnancies resulting in babies below 2501 g exceed the proposed 50 points risk probability limit whereas only 18.7% of pregnancies with babies of more than 3000 g do so. Excluding pregnancies with 20 or more risk points and excellent prenatal care (8 or more consultations) – which should change the outcome of risk-pregnancies – the percentages are 77.8% and 12.2% respectively (**Tab. III**). Pregnancies resulting in babies with birth weight of 2501 g –2750 g exceeded the limit in 38.9% and those with babies of 2751 g–3000 g in 20.7%. If 60 risk points are used as the limit the percentages for more than 3000 g until less than 2501 g would be 8.2%, 6.9%, 33.3% and 66.7%.

In the retrospective study (**Tab. V**) 14.7% of all pregnancies with babies above 3000 g exceeded the 50 risk points limit compared with 57.2 of those with babies below 2501 g. Excluding pregnancies with 20 or more risk points and excellent prenatal care the percentages are 7.6 and 59.4 respectively. In the retrospective study the influence of the quality of prenatal care by the number of consultations (0–4; 5–7; 8 or more) is clearly demonstrable: Pregnancies with more than 50 risk points resulted in 80.7%, 57.1% and 19.8% depending on the quality of care in babies below 2501 g. Pregnancies with 31–50 risk points did so in 47.2%, 20.4% and 11.8%.

In 334 women the score could be applied twice, in the 6th month and at delivery. Comparing both scores it was found that only 1.8% of these women exceeded the 50 risk points limit by events occurring after the 6th month scoring (**Tab. IV**).

The score, simple enough to be applied by nurses and midwives, seems to be able to select 77.8% of pregnancies resulting in babies below 2501 g already during the 6th month of pregnancy, i.e. early enough for preventive measures to be taken that decrease the frequency of underweight births by three quarters.

Keywords: Prematurity score, prevention prematurity.

Zusammenfassung

Prospektive und retrospektive Prüfung eines leicht anwendbaren Punkteschemas zur frühzeitigen Berechnung der Wahrscheinlichkeit der gewichtsdefinierten Frühgeburtlichkeit.

Bei 431 Geburten wurde ein leicht anwendbarer Score (**Tab. I**) zur frühzeitigen Feststellung des Risikos der Frühgeburtlichkeit (definiert nach dem Kindsgewicht) prospektiv getestet (Score-Festlegung während des 6. Schwangerschaftsmonats) und retrospektiv (Festlegung nach der Geburt) bei 1183 Schwangerschaften geprüft. In der prospektiven Studie (**Tab. II**) lagen 71,4% aller Schwangerschaften mit Neugeborenen unterhalb von 2501 g über der vorgeschlagenen Wahrscheinlichkeitsgrenze von 50 Risikopunkten, während dies bei Neugeborenen mit mehr als 3000 g nur in 18.7% der Fall war. Schließt man Schwangerschaften mit 20 oder mehr Risikopunkten bei gleichzeitig vorbildlicher Fürsorge (8 oder mehr Untersuchungen intra graviditate) – was den Ausgang einer Risikoschwangerschaft verbessern sollte – aus (**Tab. III**), so betragen die entsprechenden Prozentsätze 77,8 und 12,2%. Schwangerschaften mit Neugeborenen mit Geburtsgewichten von 2501 bis 2750 g lagen in 38,9% und Schwangerschaften mit Neonaten von 2751 bis 3000 g in 20.7% der Fälle über diesem Grenzwert. Setzt man 60 Risikopunkte als

Grenzwert ein, so betragen die Prozentsätze für Neugeborene mit mehr als 3000 g bis weniger als 2501 g 8,2%, 6.9%, 33,3% und 66,7%.
In der retrospektiven Studie (Tab. V) lagen 14,7% aller Schwangerschaften mit Neugeborenen über 3000 g oberhalb der 50 Risikopunktgrenze im Vergleich zu 57,2% bei Schwangerschaften mit Neugeborenen unterhalb 2501 g. Schließt man wiederum Schwangerschaften mit 20 und mehr Risikopunkten sowie vorbildlicher Überwachung aus, so betragen die Prozentsätze 7,6 und 59,4%. In der retrospektiven Studie kann der Einfluß der Qualität der Schwangerschaftsüberwachung definiert durch die Anzahl der Konsultationen (0–4; 5–7; 8 oder mehr) klar nachgewiesen werden: Schwangerschaften mit mehr als 50 Risikopunkten erbrachten aufgeschlüsselt nach der Qualität der Schwangerschaftsüberwachung Neugeborene unterhalb von 2501 g in 80,7%, 57,1% und 19,8%. Bei Graviditäten mit 31–50 Risikopunkten war dies in 47,2%, 20,4% und 11,8% der Fall.
Bei 334 Frauen konnte der Score zweimal angewandt werden, und zwar im 6. Monat und bei der Geburt. Im Vergleich beider Scores fand sich, daß nur 1,8% dieser Frauen über die 50 Risikopunktgrenze hinauskamen durch Ereignisse, die nach der Festlegung des Scores im 6. Monat erfolgten (Tab. IV).
Der Score ist einfach genug, um von Krankenschwestern und Hebammen angewandt zu werden. Er scheint es zu ermöglichen, 77,8% der Schwangerschaften, die zu Neugeborenen mit einem Gewicht von unter 2501 g führen, schon während des 6. Schwangerschaftsmonats zu selektionieren. Dies scheint früh genug zu sein, um Präventivmaßnahmen zu ergreifen, die geeignet sind, die Häufigkeit der Untergewichtigkeit um drei Viertel zu senken.

Schlüsselwörter: Prämaturitäts-Score, Prämaturität (Vermeidung).

Résumé

Examen prospectif et rétrospectif d'un score facilement applicable pour évaluer la probabilité de naissance prématurée définie par le poids

Le présent article porte sur l'étude d'un score facilement applicable pour évaluer le risque de prématurité (définie par le poids (Tab. I), l'étude ayant été prospective (score établi au cours du 6ème mois de grossesse) dans 431 cas et rétrospective (score effectuée après l'accouchement) dans 1183 cas.
Dans l'étude prospective (Tab. II.) 71.4% des femmes enceintes ayant accouché des bébés au poids inférieur à 2501 g ont dépassé les 50 points proposés de limite de probabilité de risque tandis que ce ne fut le cas que pour 18.7% des grossesses ayant mix à terme des bébés d'un poids supérieur à 3000 g. Sans compter les grossesses enregistrant 20 points de risque ou plus et des soins prénataux excellents (8 consultations ou plus) – ce qui changerait le bilan des grossesses risquées – les pourcentages respectifs sont de 77.8% et de 12.2%. (Tab. III) Les grossesses résultant avec des bébés d'un poids de 2501 g–2750 g à la naissance dépassèrent la limite dans 38.9% des cas et celles avec des bébés de 2751 g–3000 g dans 20.7% des cas. Si on fixe la limite à 60 points de risque, les pourcentages pour les poids allant de plus de 3000 g à moins de 2501 g seraient alors de 8.2%, 6.9%, 33.3% et 66.7%.
Dans l'étude rétrospective (Tab. V) 14.7% de toutes les grossesses avec des bébés d'un poids supérieur à 3000 g ont dépassé la limite de 50 points de risque contre 57.2% des grossesses avec des bébés de moins de 2501 g. Excluant les grossesses avec 20 ou plus de points de risque et des soins prénataux excellents, les pourcentages sont respectivement de 7.6 et de 59.4. Dans l'étude rétrospective l'influence de la qualité des soins prénataux définie par le nombre des consultations (0–4; 5–7; 8 et plus) apparaît très clairement: Les grossesses ayant enregistré plus de 50 points de risque et des bébés d'un poids inférieur à 2501 g ont marqué une courbe dé croissante correspondant a' l'accroissement de la courbe de la qualité des soins selon des pourcentages de 80.7%, 57.1% et 19.8% – qui ont été, par contre, respectivement de 47.2%, 20.4% et 11.8% pour les grossesses avec 31–50 points de risque.
Chez 334 femmes, le score a pu être appliqué deux fois, au cours du 6ème mois et à l'accouchement. Comparant les deux scores, on a constaté que 1.8% seulement de ces femmes avaient dépassé la limite des 50 points de risque pour les résultats obtenus après le 6ème mois (Tab. IV).
Il semble que l'enregistrement, assez simple pour être effectué par des infirmières et des sages-femmes, soit assez précis et sûr pour déterminer 77.8% des grossesses résultant avec des bébés de moins de 2501 g dès le 6ème mois de la grossesse, c.à.d. suffisamment tôt pour prendre des mesures préventives afin de diminuer la fréquence de naissance prématurée aux trois quarts de la grossesse.

Mots-clés: Score de prématurité, prévention de prématurité

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