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Computer application for forensic determination of conception date

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Abstract: The goal of the study showcased in this paper is to present how the removal of the human factor and the added speed of calculations affect the results of forensic expertise in the case of determining the period of conception in paternity research. We do this by introducing experimental software and applying standard methods such as the methodology of forensic expertise used to design limited range of conception period for minors in paternity research, the calculation of the probability to conceive before or during the start of cohabitation and the calculation of the probability to conceive after the start of cohabitation, standards which were al developed by the National Institute of Forensic Medicine „Mina Minovici" Bucharest and are used nationwide.

The data introduced in the program were the parameters already established for intrauterine growth which were obtained by processing mathematical tables and curves of Lubchenco for rapid determination of the statistical average duration of pregnancy and its limits.

The software we are presenting in this paper was developed in .NET and has interface which is simple to use allowing the user to easily calculate the probable period of conception via a mathematical algorithm.

Key Words: forensic expertise, the probability of calculus of conception, experimental software.

The legal time of conception is defined, under Article 61 of the Family Code, as the time period of 300-180 calendar days preceding birth [19] and it falls on us to calculate the legal time of conception. Seeing as, by law, a can be born later than 300 days or until 180 from conception forensic expertise needs to calculate the probability of the date of conception by using well studied parameters. [6].

The forensic expertise used to determine the period of conception in order to determine paternity should contain the following information: Clinical data, laboratory and testimonial data necessary in the expertise regarding the date of the conception: the date of birth and the sex of the infant, major fetal anthropometric indices (waist, weight, cranial perimeter), the maturity of the infant, placental weight, clinical diagnosis of gestational age, obstetric historical data (date of last menstrual period, first fetal movements), history of any pregnant pathological information, laboratory investigations (fetal age estimation based on shaft femoral length and biparietal diameter fixed fetal ultrasound), the evolution curve of infants weight in neonatal period, date or period of sexual cohabitation as presented in the court statements.

Maternal-fetal medical data interpretation requires: statistical tables and curves on intrauterine growth of fetuses containing the main anthropometric indices (waist, weight, cranial perimeter), obtained by various authors of clinical statistical material, tables of estimated (theoretically) intrauterine growth of conception product, drawn on the basis of anthropological research, tables on the scores of infants (morpho-functional and neurological)

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maturity, pathological bias curve of intrauterine growth, curves and tables regarding the average weight gain in premature babies depending on their weight at the moment of birth and during the neonatal period, the curve of the normal evolution of the biparietal diameter (DBP) and estimating the gestational age by assessing the length of the femoral shaft of the fetus via an ultrasound, tables and formulas for the calculation of conception probability (previously used in research methodology of an extended period of conception) [2-9, 11-14].

The final goal was the development of a software which could aid in the calculation of the probable date of conception by using the classic parameters already established, such as size of the child, date of birth, sex and the presumed date of conception.

MATERIAL AND METHODS

The methods used are the standard methods of forensic expertise used to determine the probable period of conception and developed by the „Mina Minovici" National Institute of Forensic Medicine, Bucharest : the establishment of a possible period of conception, the calculation of the probability of conception at the indicated time of cohabitation, the calculation of the probability of conception before or during the start of cohabitation, the calculation of the probability of conception after the start of cohabitation

In order to input parameters and formulas into the software itself we used the aforementioned charts and tables of intrauterine growth (mathematical tables and the curves of Lubchenco for rapid determination of the statistical average duration of pregnancy and its limits).
To bring this project to completion we looked at the methodology of forensic expertise of a limited period of child conception in paternity research, practical methods of cases analysis, determination of degrees of content probability, use of statistical tables on fetal anthropometric indices and addition of formulas to calculate mathematical concept of probability.

There are three possible outcomes other all this information is introduced into the program:

1. The period of cohabitation is contained within the determined period of conception. In this case the child could be conceived during the cohabitation of the parties.
2. The period of cohabitation coincides only in part with the period of conception.
3. The two periods do not coincide at all.

Even though there were difficulties in the implementation of the software due to the adjustments that need to be made for each case we try to integrate more elements in order to make the program more accurate.

The determination of the probable period of conception is done by using statistical analysis tables created by Wichmann and Freudenberg which take into consideration two main parameters: the average (m) and the standard deviation or medium square deviation (sigma).

Standard deviation is represented by dividing the individual values to the average. The obtained values have a close probability of certitude of 99,74%. For even closer values we used three tables. [2-7].

Table 1 contains the medium pregnancy period post conception corresponding to fetal length between 45-55 cm, a correction coefficient for sex and the maximum deviation from average. The correction coefficient for sex is 2 days for length of 45-48 cm and of 1 day for 49–55 cm. This coefficient will be deduced from the medium period of pregnancy for masculine sex and will be added for those of feminine sex [7].

Table 2 contains the medium period of pregnancy post conception in rounded numbers, the correction coefficient for sex and the standard deviation for fetal length between 45–55 cm. Table 3 contains in the first column the coefficients obtained by dividing the standard deviation (sigma) coefficients of several deviations in the maximum deviation (delta). In the second column we have the percentage frequency versus the maximum frequency of pregnancy. In the 3rd and 4th columns we have the percentage probability for deviations in less or more to the average [7].

Table 1.

Length at birth (cm)	The average duration of pregnancy (days)	Correction factor for gender	Maximum Deviation
45	248	2	60
46	252	2	56
47	257	2	51
48	261	2	45
49	264	1	42
50	266	1	40
51	268	1	38
52	270	1	37
53	271	1	37
54	273	1	37
55	274	1	37

The software is designed to use all three tables along with a matrix equation that substitutes variables according to their value, automatically modifying

Table 2.

Length at birth (cm)	The average duration of pregnancy (days)	Correction factor for gender	Sigma Standard deviation
45	247,8	2	19,3
46	252,1	2	17,9
47	256,8	2	16,2
48	260,9	2	14,5
49	263,9	1	13,5
50	266,1	1	12,8
51	268,1	1	12,2
52	269,8	1	11,9
53	271,5	1	11,8
54	272,8	1	11,8
55	273,8	1	11,9

the correction coefficient, tables with anthropometric information and the Gauss curve.

The top four standard methods used in this software are:

1. Setting possible period of conception in which the average duration of development in length, at birth, is known. These are listed in Table 1. The period of conception is written in columns 2 and 3 and is corrected with minus for male fetuses and plus for female. Finally we add and minimum and the maximum deviations in column 4, resulting the possible limits of pregnancy. After that, we retroactively calculate the calendar from the date of birth.

2. The calculation of the probability on a specified date: using Table 2 and 3. The calculated interval between cohabitation and birth date is deducted from the number obtained by the medium average duration of pregnancy in column 2, corrected by the factor in column 3 of Table 2. The difference is divided by the corresponding standard deviation of column 4, the coefficient obtained is compared with the first column of Table 3. Within table 3 we pay close attention to column 2, the frequency of births for the sought after duration of pregnancy. If the uncorrected coefficient exceeds 3,1 the indicated date cannot be the date of conception.

3. The Calculation of the probability of conception before or during the start of cohabitation: the interval between the start of cohabitation and child birth date is calculated. We reduce the medium average length of corrected pregnancy. Deviation obtained is divided by the standard error and the coefficient obtained is compared with column 1 of Table 3. If the deviation is in addition we will read the percentage of probability in column 4, if less then we will read the percentage in column 3. If the deviation is in addition to the average and coefficient obtained by using Table 2 is greater, that the period of cohabitation is higher than the minimum period for the development of pregnancy. In conclusion the task took place during cohabitation.

4. The calculation of conception probability before or during the start of cohabitation: the interval between the start of cohabitation and child birth date is calculated. We reduced the medium average length of corrected pregnancy. The deviation obtained is divided by the standard error and the coefficient obtained is compared with column 1 of Table 3. If the deviation is in addition we will read the percentage of probability of column 4, if less then we will read the percentage in column If the deviation is higher than the average and coefficient obtained by using Table B is greater, that the period of cohabitation is higher than the minimum period for the development of pregnancy. In conclusion the conception took place during cohabitation.

The information used in the tables above is provided by Belis V., Tratat de Medicina Legala (sub red.), vol. II, Ed. Medicala, Bucuresti, 1995.

Table 3.

Coefficient delta/ sigma	Frequency (%)	Probability Percentage	
		Deviation in less	Deviation in plus
0	100	50	50
0,1	99,5	46	54
0,2	98,0	42,1	57,9
0,3	95,6	38,2	61,8
0,4	92,3	34,5	65,5
0,5	88,2	30,8	69,1
0,6	83,5	27,4	72,6
0,7	78,3	24,2	75,8
0,8	72,6	21,2	78,8
0,9	66,7	18,4	81,6
1	60,6	15,9	84,1
1,1	54,6	13,6	86,4
1,2	48,7	11,5	88,5
1,3	43,0	9,7	90,3
1,4	37,5	8,1	91,9
1,5	32,5	6,7	93,3
1,6	27,8	5,5	94,5
1,7	23,6	4,5	95,5
1,8	19,8	3,6	96,4
1,9	16,4	2,9	97,1
2	13,5	2,3	97,7
2,1	11,0	1,8	98,2
2,2	8,9	1,4	98,6
2,3	7,1	1,1	98,9
2,4	5,6	0,8	99,1
2,5	4,4	0,6	99,4
2,6	3,4	0,5	99,5
2,7	2,6	0,4	99,6
2,8	2,0	0,3	99,7
2,9	1,5	0,2	99,8
3	1,1	0,13	99,87
3,1	0,8	0,1	99,9

In order to implement the software and to make it user friendly the developer used .NET, a platform from the Microsoft Company in order to beneficiate from some on the features that it provides:

- The multitude of languages provided by the programmers.
- The large variety of useful applications.
- The control held by an execution engine which increases the quality of the program.

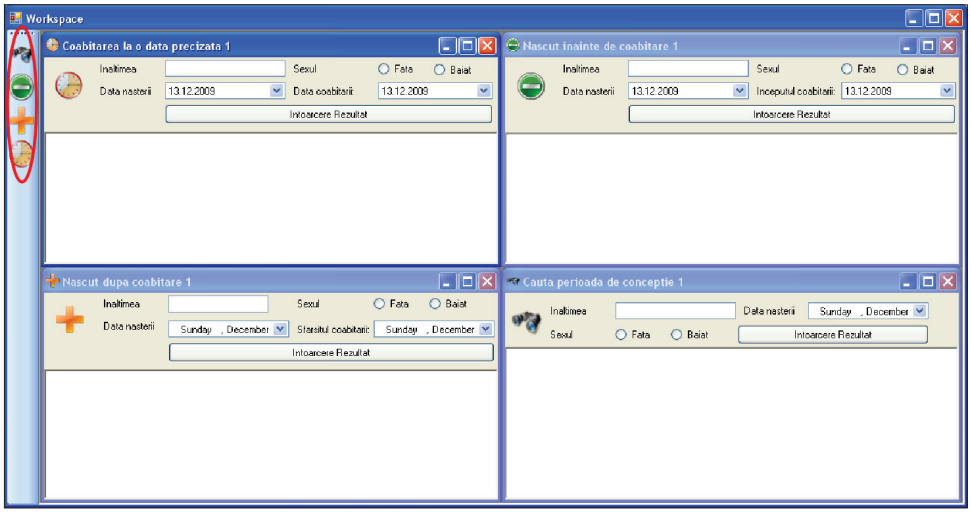
Among the languages provided by Microsoft they included C# (a language developed along with the .NET platform) and Visual Basic .NET.

The application was made using the C# language respecting the programming rule MVC. (Model-View-Controller)

According to this model our application can be divided into two parts:

- The data model that includes statistical tables and methods for solving the proposed problems.
- User interface that provides an interactive environment for communication with data model behind the application, the graphic interface of the application was built in accordance with current standards, using technology. Net Forms such as MDI (Multiple Document Interface) on the left side of the interface is a menu bar where appropriate windows from where can be launched various methods [10, 13].

Figure 1. Screenshot application



For verification we used several applications such as male child, born on 15.01., birth length 50 cm. They say that was developed on 01.04., the previous year. Pregnancy should be of 289 days. The difference from the average is 266.1-1 = 265.1 and obtain a deviation of 289-265.1 = 23.9. It is divided by the standard deviation resulting in 23.9 : 12.8 = 1.867. Last decimal place is rounded achieving 1.9.

In Table 3 we find at coefficient 1.9 a frequency of 16.4%. In the example above, if it were claimed as a date of cohabitation on the 01.03. from the previous year then 01.03. - 15.01. = 320, the deviation would be 320-265.1 = 54.9 and 54.9:12.8 = 4.28. The coefficient being greater than 3.1, excludes the conception on the affirmed date.

The program was developed so that data entry is simple. For now the program only works in view mode / computer, printing and creating other methods of calculation will be realized as a future project [10, 13].

CONCLUSIONS

The introduction of this software allows forensic expertise in the care of paternity issues to become faster and more accurate as the data bases used can be easily correlated.

Even though it does not have the precise nature of DNA testing it is the first step in he methodology of forensic expertise regarding paternity cases.

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