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(RESEARCH ARTICLE)

Diabetes, IMC and high blood pressure during pregnancy

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Abstract

We investigated factors implicated in the development of pregnant high blood pressure risks and fetal-maternal repercussions. Were evaluated (Age, Gestity, Childbirth type, Eclampsia, Gestational diabetes, Overweight, TA/S, TA/D, Baby's weight). The logistic model retained, age of mother (OR = 1.17, 95% CI = 1.08-1.27, P < 0.001). The gestity (OR = 2.94, 95% CI = 2.16 - 04.01, P < 0.001. A systolic blood pressure greater than 90 mmHg is at risk (OR= 11.29, 95 % Cl = 1.91 -66.78, P= 0.008).A diastolic blood pressure greater than 140 mmHg (OR = 15.84, 95% CI = 2.67- 66.78, P = 0.002). Gestational diabetes (OR = 2.89, 95% CI = 1.65 - 5.06, < 0.001). The overweight (OR = 25.31, 95% CI = 18.45 - 34.71, P < 0.001). Fetal repercussions are hypotrophy and perinatal mortality. The model established has a very high forecast capacity.

Keywords: Diabetes; Essentiel Blood Pressure; IMC; Diastolic Blood Pressure; Systolic Blood Pressure.

1. Introduction

Hypertensive pathologies during pregnancy have been the subject of many studies that have characterized a direct link between their occurrence and the life-threatening condition of the mother and her newborn. In pregnant women, high blood pressure (hypertension) is a major cause of maternal and fetal morbidity and mortality [1]. Arterial hypertension during pregnancy is a topical issue whose epidemiological importance is increasingly growing to the point where, according to the World Health Organization (WHO), 8 to 10% of these pregnancy-related hypertensive disorders will constitute a major public health problem worldwide. Hypertension is detected in 2 to 3% of pregnancy cases [2]. Today, it is widely known that risk factors for the occurrence of pre-eclampsia are associated with maternal or sister antecedents, which increase pre-eclampsia incidence by a factor of 3 to 5, nulliparity, primiparity, donor insemination, short period of exposure to father's sperm (condoms), change of partner, advanced maternal age, maternal conditions, history of pre-eclampsia, high blood pressure, obesity, diabetes, familial thrombophilias, chronic nephropathies, long intervals between pregnancies, multiple pregnancies, etc [3, 4, 5, 6, 7, 8].The occurrence of pre-eclampsia and its evolution are unpredictable, and unfortunately, there is currently no effective treatment, except the termination of pregnancy [4].

In the absence of predictive performance markers for the pre-conception arterial hypertension, the present study offers a predictive index that is based on the combination of the most discriminating clinical, biological and functional parameters.

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2. Methods

Ethics approval was obtained from the Regional Ethic Committee for University Hospital center. This is a cross-sectional observational study that was carried out over a period of 6 years (from 2006 to 2011), in the Obstetrics and Gynecology Department of the Specialized Mother-Child Hospital Structure of the University Hospital Center in the city of Tlemcen (Northwestern Algeria). Only pregnant women were included. The selected women were then monitored until delivery.

2.1. Statistical analyses

Nakache &Josiane (2003) proposed a logistic study in order to formulate a predictive model for identifying women at risk of developing gestational hypertension (GH), using measured factors [9]. Here, the response variable was noted Y; it counts the subjects developing gravid arterial hypertension (1) as well as healthy ones (0). The value (1) is taken as a reference. These numerical treatments were performed using the Minitab 16 software. Statistical tests proving the linearity of all continuous factors, except the baby's weight factor, were coded, as shown in the tables in the appendix.

1) Model 1, which is given in Table 1 below, was obtained by using an ascending step-by-step elimination of confusion factors.

2) Model 2, which is given in Table 2 below, was obtained by using an ascending step-by-step elimination of confusion factors.

The choice between the two models was made, on the one hand, using the receiver operating characteristic (ROC) curves given in Figure 1; these curves were obtained by applying the predictive models M1 and M2 to the learning data:

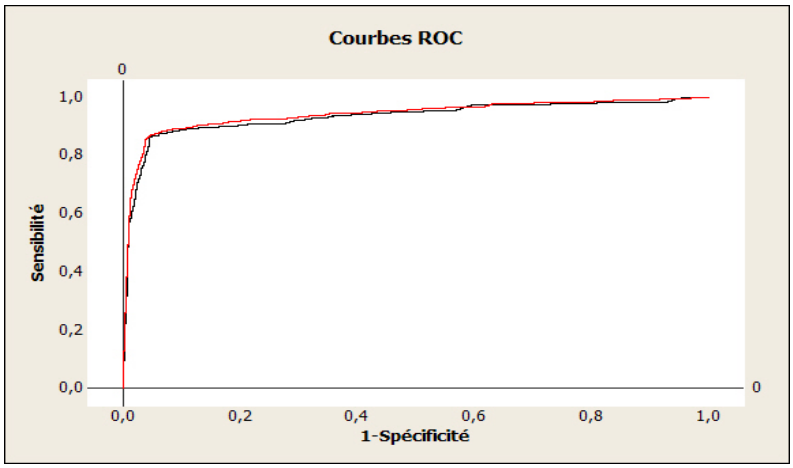

Figure 1 Curve plots - Black color for Model 1; Red color for Model 2.

For Model 1, the Area Under Curve (AUC) is equal to 0.93 while for Model 2 it is 0.94. It is worth noting that the two models are almost identical, with a 1% difference. Moreover, the measures of association between the Response Variable and the Probability Forecast (Predictive Ability) for the two models were also carried out. A very high percentage of matching pairs was found (89% for Model 1 and 90% for Model 2).Somer's Delta(Somers' D), Goodman-Kruskal's Gamma and Kendall's Tau-a are summaries of concordant and discordant pairs. These measures are generally between 0 and 1, where the highest values indicate that the model has better forecasting capabilities. In our case, the first two measures, exceeding 80% for both models, imply a very strong forecasting capacity. Moreover, Kendall's Tau-a gives a relatively good forecasting capacity; it is 0.08 for both models. In addition, it can be seen that the association measures are very close.

Finally, concerning the goodness-of-fit testforModel1, it was found that only the Brown test (Symmetric Alternative) accepts adjustment, with a P-Value of 0.528. Regarding Model 2, it turns out that the Hosmer-Lemeshow test accepts the adjustment with a P-Value of 0.146, and the Brown test (Symmetric Alternative) accepts the adjustment with a P-Value of 0.587.

Since the goodness-of-fit tests are in favor of Model 2, then the second model was chosen. This confirms the data already in the literature [10].

3. Results

The evaluation by the logistic model allowed us to check the impact of all the risk factors related to gravid arterial hypertension (GAHP) on the one hand and to assess the effects of these risk factors on the mother and fetus, on the other. The frequency distribution of pregnant woman who does not belong to this age group (OR = 1.17, 95% CI = 1.08-1.27, significance level P <0.001), as shown in Table 1. It is interesting to know that advanced maternal age is likely to cause gravid arterial hypertension (GAHP). The average gestity for women was 1.6 ± 1.41. It is significantly related to gravid arterial hypertension (OR = 2.94, 95% CI = 2.16-04.01, significance level P <0.001). As for parity, it had a mean value equal to 1.54 ± 0.7, and remains significantly related to the GAHP (OR = 0.37, 95% CI = 0.27- 0.51, significance level P <0.001). The essential arterial hypertension was found in 1.25% of cases (OR = 0.01, 95%CI = 0.01-0.02, significance level P <0.001). With regard to the measurement of blood pressure, it appeared that more than 7.4% of patients had moderate hypertension, which nevertheless remains significantly associated with gravid arterial hypertension (GAHP). It should be noted that a pregnant woman with a systolic blood pressure greater than 90 mmHg is at risk of having gravid arterial hypertension (GAHP) multiplied by 11 (OR = 11.29, 95%CI = 1.91-66.78, significance level P = 0.008); this is also true for the measurement of the diastolic blood pressure. A pregnant woman with a diastolic blood pressure greater than 140 mmHg is at risk of having gravid arterial hypertension (GAHP) multiplied by a factor greater than 15 (OR = 15.84, 95%CI = 2.67-66.78, significance level P = 0.002) . Regarding the risk of gestational diabetes, only 0.76% of pregnant women had diabetes during pregnancy. Gestational diabetes exposes the pregnant woman to a risk three times greater and is significantly related to pre-eclampsia (OR = 2.89, 95% CI = 1.65- 5.06, significance level P <0.001). With regard to the presence of pre-gestational diabetes, it was found that the percentage of insulin-dependent diabetic women was 0.32%, and non-insulin-dependent diabetic women were about half that figure (0.15%), with no significance level (P> 05). It is important to know that in the case of overweight and obesity, a pregnant woman can easily develop gravid arterial hypertension (GAHTfor a body mass index greater than 25. It is clear that overweight increases the risk of occurrence of gravid arterial hypertension (GAHT) by 25 (OR = 25.31, 95% CI = 18.45-34.71, significance level P <0.001). The impact of GAHT on the mother is pre-eclampsia with an incidence of 2.87% (OR = 0.39, 95% CI = 0.30-0.49, significance level P <0.001). In addition, it is noted that 26% of pregnant women deliver by Caesarean section (OR = 1.70, 95% CI = 1.43- 2.02; significance level P <0.001). As for the impact of GAHT on the fetus, it is worth mentioning the intra-uterine fetal death in 1.9% of cases; it is not significantly related to gravid arterial hypertension (P> 0.05).

Table 1 Study results of the Simple Logistic Regression for Model 1

Predictor	**Coefficients**	**Z**	**Significance level P**	**Odds Ratios (ORs)**	**95% confidence intervals for the odds ratios (ORs)**
Constant	-5.99200	-45.56	0.000		
Gestity	0.154989	2.68	0.007	1.17	(1.04; 1.31)
Child birth type	0.404653	4.75	0.000	1.50	(1.27; 1.77)
Baby'sweight					
1	1.34318	12.06	0.000	3.83	(3.08; 4.77)
2	1.38988	8.30	0.000	4.01	(2.89; 5.57)
Eclampsia	0.496445	2.46	0.014	1.64	(1.11; 2.44)
Gestational diabetes	0.946373	3.47	0.001	2.58	(1.51; 4.40)
Overweight	3.10658	16.40	0.000	22.34	(15.42; 32.39)
Systolic blood pressure	2.56807	2.81	0.005	13.04	(2.17; 78.42)
Diastolic blood pressure	2.30369	2.52	0.012	10.01	(1.66; 60.24)

However, Model 1, which is very similar to Model 2, gives the weight of newborns; one can clearly see that 11.7% of them are hypotrophic. Also, among newborns in this category, the same OR (4) was found for the three classes defined in the birth weight distribution table (See Appendix), which explains its exclusion from Model 2.

Table 2 Study results of the Simple Logistic Regression for Model 2.

Predictor	**Coefficients**	**Z**	**Significance level P**	**Odds Ratios (ORs)**	**95% confidence intervals for the odds ratios (ORs)**
Constant	-5.17678	-44.74	0.000		
Mother'sage	0.158869	4.02	0.000	1.17	(1.08; 1.27)
Gestity	1.08011	6.84	0.000	2.94	(2.16; 4.01)
Parity	-0.997068	-6.08	0.000	0.37	(0.27; 0.51)
Child birth type	0.530853	5.98	0.000	1.70	(1.43; 2.02)
Essential arterial hypertension	-4.48993	-11.79	0.000	0.01	(0.01; 0.02)
Pre-eclampsia	-0.949399	-7.80	0.000	0.39	(0.30; 0.49)
Gestational diabetes	1.06120	3.72	0.000	2.89	(1.65; 5.06)
Overweight	3.23113	20.05	0.000	25.31	(18.45; 34.71)
Systolic blood pressure	2.42401	2.67	0.008	11.29	(1.91; 66.78)
Diastolic blood pressure	2.76244	3.04	0.002	15.84	(2.67; 93.91)

4. Discussion

Table 2 gives the equation $C(X) = \beta_0 + \beta_1 X_1 + \ldots + \beta_p X_p$, where X_j refer to the predictors actually retained in the logistic model (significance level P < 0.05), with the coefficients β_j that are assigned to them. Note that if for some values of Xj, $C(X) > 0$, then P(Y=1) > 0.5, and consequently the individual is exposed to gravid arterial hypertension (GAHP). The results obtained in this study show that the prevalence of gravid arterial hypertension (GAHP) is significantly high in women over 40 years old. Our data are found to be in agreement with those of Vincent-Rohfritsch et al (2012) who showed that advanced maternal age may be responsible for the occurrence of GAHP [11]. Gestity and parity are all contributing factors for gravid arterial hypertension (GAHP). It is worth pointing out that multiple pregnancies increase the risk of gravid arterial hypertension (GAHP); indeed, that risk was multiplied by three in our study. Recently, several cohort studies have confirmed these findings [12]. Furthermore, the essential arterial hypertension is a hypertensive syndrome corresponding to very heterogeneous clinical aspects. This disease is quite common as it affects about 10 to 15% of pregnant women [4]. However, even if parameters like age, parity, gestity, body mass index, diabetes, are actually known to enhance the risk of developing gravid arterial hypertension (GAHT), the arterial hypertension when taken separately is sufficiently discriminating [13]; the elevation of the diastolic and systolic blood pressures is very often well documented [14, 15, 16].

Furthermore, an abnormal carbohydrate tolerance was observed in our patients during pregnancy, with a percentage equal to 0.76%; it is significantly associated with an elevated risk of developing gravid arterial hypertension (GAHP). Indeed, a lot of data available in the literature confirm the link existing between GAHP and gestational diabetes [17, 18]. As for our study, it shows that diabetes does not seem to contribute significantly to the risk of contracting GAHP, unlike what has been reported in other studies [19].

It is worth noting that this survey reveals that maternal obesity remains an important risk factor; this survey also indicates that maternal obesity has a highly significant relationship with the onset of GAHT. These findings confirm several others found in the literature [20, 21].

Nowadays, a lot of research is being conducted on the relationship that exists between gravid arterial hypertension and the incidence of pre-eclampsia.Gravid arterial hypertension (GAHP) is a major cause of maternal and fetal morbidity; it is also the first documented cause of intrauterine fetal death [22, 23]. Pre-eclampsia, which is viewed as a major risk factor for developing GAHT, showed an incidence of 2.8%; a significant link exists between GAHT and pre-eclampsia. It was found that our population presented a risk comparable to that observed in other populations [24].

The rate of caesareans performed during this study (26.66%) was far lower than that reported in the literature [23]; this rate was significantly associated with GAHT.

In addition, the intra-uterine fetal death, found in 1.9% of cases, was not significantly related to GAHT (P> 0.05). Recorded data on hypotrophy and perinatal mortality were higher in the population of hypertensive mothers, with a statistically significant difference for Model 1, with P<0.05[25].

5. Conclusion

The proposed predictive model makes it possible to better identify subjects at risk for gravid arterial hypertension (GAHT) on the one hand, and assess the maternal and fetal effects, in the absence of national data and predictive markers for gravid arterial hypertension.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

As the corresponding author I declare on behalf of all authors that there have not a direct or indirect interest (financial or nature) with a private, industrial or commercial organization relationship with the subject presented.

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