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Original Research

Evaluation of the Importance of Proper Health Education and Information on Lifestyle to be Adopted during Pregnancy

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Abstract

Background: Proper health education and lifestyle information to be adopted during pregnancy are crucial for the well-being of the pregnant women and the health of the child. The aim of our study was to evaluate the impact of proper health education and lifestyle information to be adopted during pregnancy on obstetrical, neonatal and infant outcomes. **Methods**: A retrospective single-center cohort study was carried out including all consecutive pregnant women admitted to our Institution, from December 2019 to February 2021. The study outcomes were the difference in obstetrical, neonatal and infant outcomes between women differentiated by Body Mass Index (BMI) at the end of pregnancy (i.e., normal weight vs overweight, and normal weight vs obese), physical activity (yes vs no), and smoking during pregnancy (yes vs no). **Results**: Ninety-one women were included. Compared with normal weight women, obese women showed an increased incidence of major maternal pathologies ($p = 0.048$) and caesarean delivery ($p = 0.042$). Regarding physical activity, significant differences were observed between pregnant women who do and do not perform physical activity with a lower value of the incidence of spontaneous vaginal delivery ($p = 0.025$) in sedentary women. Compared with non-smoking groups, smoking women showed significantly higher BMI at the end of pregnancy ($p = 0.036$), lower neonatal weight ($p = 0.001$) and lower Apgar index ($p = 0.033$). Lastly, the percentage of infants with weight and height percentiles within the mean value did not differ significantly among mothers stratified by BMI, physical activity and smoking. **Conclusions**: Our data, in agreement with the literature, confirm that the proper information and education about lifestyle changes, particularly regarding BMI and smoking during pregnancy, can improve the health of the women and newborn.

Keywords: Apgar index; lifestyle; pregnant women; BMI; growth percentile

1. Introduction

In the medical field, the definition of lifestyle includes several factors, such as diet and adequate hydration, physical activity, smoking habit, and alcohol consumption. The lifestyle adopted by women during pregnancy is crucial both their well-being and the health of the baby [1–4]. Inappropriate nutrition, obesity and maternal smoking can lead to digestive/respiratory problems in the mother and child, low neonatal weight and reduced foetal size. An increased risk of perinatal death was observed in infants exposed to environmental tobacco smoke compared with unexposed infants [2,3,5–7]. Neonatal deafness due to smoking or alcohol abuse during pregnancy has also been reported [8–10].

Furthermore, an increased risk of caesarean delivery and complications has been observed in obese women as maternal obesity may be associated with poor perinatal outcomes due to early placental and foetal dysfunction [4,11,12].

During pregnancy, the Hydrogen potential (pH) of the vagina becomes more alkaline and less acidic, riche in sugar and infections can easily develop [13]. As a result of these infections, cases of spontaneous abortion, premature induction of childbirth, the presence of oral Candida in the newborn have been reported, although rarely. Hence the importance of adopting a proper lifestyle, such as drinking plenty, eating a balanced diet, low in sugar and fat.

In pregnancy, an unbalanced diet can stimulate the onset of oxidative stress, which may be at the basis of the development of pre-eclampsia, spontaneous abortion, fetal growth restriction, and increased risk of hypertensive disorders [14–16].

Therefore, proper health education and information during pregnancy is essential to promote the most appropriate choices regarding both lifestyles to be adopted and therapeutic treatments to be used in conditions such as vaginal infections [17,18], gestational diabetes [19,20], and skin dermatoses [21–24] with better outcomes for the mother and fetus.

Based on these considerations, the aim of this study was to evaluate the impact of lifestyle adopted during pregnancy on obstetrical, neonatal, and infant outcomes.

2. Materials and Methods

2.1 Study Protocol

The study was designed as a single-center observational retrospective cohort study, according to an a priori defined study protocol. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and checklist [25,26] were followed in writing the entire study.

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki.

The medical records and clinical electronic databases were searched for all consecutive pregnant women admitted to the Obstetrics and Gynaecology Unit of the University Hospital "San Giovanni di Dio e Ruggi d'Aragona", Salerno, Italy, from December 2019 to February 2021. We included women older than 18 years with available extractable on lifestyle and obstetrical and neonatal outcomes.

The final measurement of Body Mass Index (BMI) was performed after delivery (end of pregnancy). The timing was the same for all women included in the study, and BMI was measured in the first week after delivery for all pregnant women enrolled.

The study outcomes were the difference in obstetrical, neonatal, and infant outcomes between: women who were normal weight (i.e., BMI 18.5–24.99 kg/m^2) and overweight (i.e., BMI 25–29.99 kg/m^2) at the end of pregnancy; women who were normal weight (i.e., BMI 18.5–24.99 kg/m^2) and obese (i.e., BMI $\geq$30 kg/m^2) at the end of pregnancy; women who smoked and non smoked during pregnancy; and women who exercised and women who did not.

Obstetric, neonatal, and infant outcomes considered were as follows: type of delivery (caesarean delivery, spontaneous vaginal delivery, ventouse suction cup-assisted delivery); major (e.g., gestational diabetes, gestational hypertension, deep vein thrombosis, placenta praevia, etc.) or minor (e.g., urinary tract infections, constipation, bladder incontinence, etc.) maternal pathologies; neonatal weight; Apgar index; major (e.g., hypoglycemia, childbirth cancer respiratory distress) or minor (e.g., neonatal jaundice, caput succedaneum) neonatal pathologies; perinatal death; infant growth percentile at six months; infant pathologies at six months.

2.2 Statistical Analysis

The results were expressed as mean $\pm$ standard deviation (SD). The comparison between the parametric mean values was performed with the Student's *t*-test for paired data when detected in the same group and for unpaired data when detected in different groups. The comparison between the percentage values was performed with Chi-Square test (χ^2). A value of $p < 0.05$ was considered statistically significant.

3. Results

3.1 Study Population

During the study period, 91 pregnant women were included in the study. Demographic characteristics of the women are shown in Table 1. Mean age was 32.6 $\pm$ 6.1 years (range: 19–50 years). In particular, most women belonged to the 31–36 years group (38%), while the 5% was 43–50 years old (Table 1). Schooling was reported as low in 23%, medium-high at 44% of the enrolled subjects, while 33% reported university education. Most of the women (45%) were housewives. The remaining 52%: included employees in the public administration or small retail and self-employed professionals (as lawyers, dentists, nutritionists, engineers, pharmacists, psychologists, etc.), while 3% were unemployed.

3.2 BMI

At the first month of pregnancy, women showed a mean weight of 63.9 $\pm$ 12.9 kg, with a mean BMI of 24 $\pm$ 4.9 kg/m^2. At the end of pregnancy, the mean weight was 75.5 $\pm$ 13.3 kg (increase of 11.5 $\pm$ 4.3 kg), with a mean BMI of 28.5 $\pm$ 5.1 kg/m^2 ($p < 0.01$, Table 1). At the end of pregnancy, 26 women showed normal weight (BMI = 23.2 $\pm$ 1.3 kg/m^2), 33 overweight (BMI = 27.4 $\pm$ 1.3 kg/m^2) and 32 obesities (BMI = 33.9 $\pm$ 4.0 kg/m^2) (Table 2).

Comparison of normal and increased BMI pregnant women at the end of pregnancy showed a significant: increased incidence of major maternal pathologies (p = 0.048) and caesarean delivery (p = 0.042) in obese pregnant women; decreased incidence of spontaneous vaginal delivery in obese (p = 0.004) women compared with normal weight women. Other obstetrical outcomes showed no significant differences among groups (Table 2).

In addition, no perinatal deaths were observed in normal, overweight, or obese pregnant women enrolled.

3.3 Physical Activity

Before and during pregnancy, 31 (34%) pregnant women reported mild-moderate physical activity (such as walking, swimming, water aerobics, dancing, pilates), while the remaining 60 (66%) did not engage in any physical activity.

Table 1. Demographic characteristics of enrolled patients.

	Study population		p
	n = 91 pregnant women		
	First month of pregnancy	End of pregnancy	
Age, year			
Mean ± SD	32.6 ± 6.1	32.6 ± 6.1	>0.05
Median (range)	32 (19–50)	32 (19–50)	
Height, m			
Mean ± SD	1.6 ± 0.06	1.6 ± 0.06	>0.05
(range)	(1.47–1.78)	(1.47–1.78)	
Weight, kg			
Mean ± SD	63.9 ± 12.9	75.5 ± 13.3	<0.01
(range)	(43–111)	(53–115)	
BMI, kg/m^2			
Mean ± SD	24.0 ± 4.9	28.5 ± 5.1	<0.01
(range)	(17–41)	(20–44)	
BMI categories, %			
Underweight	7	0	<0.01
Normal weight	62	29	<0.01
Overweight	21	36	<0.01
Obese	11	35	<0.01
Age group %			
19–24 years	10		
25–30 years	25		
31–36 years	38		
37–42 years	21		
43–50 years	5		

Table 2. Obstetric outcomes at the end of pregnancy: normal weight women vs overweight women, and normal weight women vs obese women.

Outcomes	Normal weight women	Overweight women	p	Obese women	p
	N = 26	N = 33		N = 32	
	Newborns: N = 26	Newborns: N = 33		Newborns: N = 32	
BMI at the end of pregnancy, kg/m^2, mean ± SD	23.2 ± 1.3	27.4 ± 1.3	0.001	33.9 ± 4.0	0.001
Spontaneous vaginal delivery, %	54	45	0.052	37.5	0.004
Caesarean delivery, %	46	55	0.052	59.4	0.042
Ventous suction cup-assisted delivery, %	0	0	1	3.1	-
Minor Maternal pathologies, %	38	42	0.758	44	0.684
Major Maternal pathologies %	8	6	0.805	28	0.048
Neonatal weight. g, mean ± SD	3092 ± 438	3157 ± 383	0.546	3139 ± 452	0.691
Apgar index, mean ± SD	8.9 ± 0.2	8.9 ± 0.5	1.000	8.6 ± 0.99	0.135
Minor Neonatal pathologies, %	8	6	0.805	6.5	0.829
Major Neonatal pathologies, %	0	3	-	6.5	-

The comparative analysis between these two groups showed, at the end of pregnancy, a significantly lower value of the caesarean section rate (39% vs 62%), and an increase in the number of spontaneous vaginal delivery (61% vs 36%) in pregnant women who performed physical activity vs sedentary pregnant women. The remaining, differences in obstetric and neonatal outcomes were not statistically significant (Table 3). In addition, no perinatal deaths were evident in either of the observed subgroups.

3.4 Smoking during Pregnancy

Concerning smoke during pregnancy, 16 women were smoking and 75 were no smoking. Comparing the two groups of women, smoking women's group showed a significantly: higher BMI at the end of pregnancy ($p = 0.036$); lower neonatal weight ($p = 0.001$); lower Apgar index ($p = 0.033$, Table 4).

Not statistically significant differences were observed in other obstetrical and neonatal outcomes.

Table 3. Obstetrical outcomes: women performing physical activity vs sedentary women before and during pregnancy.

Outcomes	Women performing physical activity	Sedentary women	*p*
	N = 31	N = 60	
	Newborns N = 31	Newborns N = 60	
BMI at the end of pregnancy, kg/m^2, mean ± SD	28.1 ± 5.2	28.7 ± 5.0	0.593
Weight gain at the end of pregnancy, kg, mean ± SD	10.5 ± 4.6	12.1 ± 4.1	0.093
Spontaneous Vaginal Delivery, %	61	36	0.025
Caesarean Delivery, %	39	62	0.037
Ventous suction cup-assisted Delivery, %	0	2	-
Minor Maternal pathologies, %	35	42	0.568
Major Maternal pathologies, %	23	15	0.368
Neonatal weight, g, mean ± SD	3041 ± 473	3179 ± 386	0.138
Apgar index, mean ± SD	8.8 ± 0.3	8.8 ± 0.8	1.000
Minor Neonatal Pathologies, %	3	5	0.696
Major Neonatal Pathologies, %	3	3	0.978

Table 4. Obstetrical outcomes: women smoking during pregnancy vs no smoking women.

Outcomes	Smoking	No smoking	*p*
	N = 16	N = 75	
	Newborns = 16	Newborns = 75	
BMI at the end of pregnancy, kg/m^2, mean ± SD	30.9 ± 6.8	28.0 ± 4.5	0.036
Weight gain during pregnancy, kg, mean ± SD	11.6 ± 6.6	11.5 ± 3.7	1
Spontaneous Vaginal Delivery, %	44	46	0.908
Caesarian Delivery, %	56	53	0.832
Ventous suction cup-assisted delivery %	0	1	-
Minor Maternal pathologies %	31	45	0.301
Major Maternal pathologies %	25	15	0.312
Neonatal weight, g, mean ± SD	2872.3 ± 523	3156.0 ± 399	0.001
Apgar index, mean ± SD	8.4 ± 0.5	8.8 ± 0.7	0.033
Minor Neonatal pathologies, %	6.5	4.0	0.690
Major neonatal pathologies, %	6.5	4.0	0.690

3.5 Infant Growth Percentile and Neonatal Pathologies at Six Months of Age

Height and weight and presence of infants' pathologies at six months of age were recorded in 39 infants (51% girls and 49% boys). In relation to the World Health Organization (WHO) growth curves [27], data analysis showed that the growth percentile was within the mean value (15°–85°P) in 28.2% of the infants in weight, and at 46.1% for height. The 10.3% of infants showed a percentile much lower than the mean (<3°P) for weight and height, while 7.7% had a percentile much higher than the mean (>97°P) for height (Table 5).

Infant pathologies were observed in 36% (N = 14) of the 39 infants. Specifically, neonatal reflux, lactose intolerance, transient monolateral deafness and constipation were evidenced in 15% of the girls; while congenital malformation, cryptorchidism, neonatal reflux, and lactose intolerance were observed in 21% of the boys.

Collection of BMI at the end of pregnancy, physical activity and smoking of the mothers of the 39 infants evaluated showed that 10% (N = 4) were normal weight, 54% (N = 21) overweight, 36% (N = 14) obese, 18% (N = 7) engaged in physical activity, and 26% (N = 10) smoked.

Comparison of infant weight and height percentiles among mothers stratified by BMI, physical activity and smoking showed no significant differences in the percentages of infants with weight and height percentiles within the mean value (15°–85°P, Table 6A,6B,6C).

4. Discussion

This study showed that proper health education and information during pregnancy is essential to promote the most appropriate choices regarding lifestyles to be adopted.

Based on published data, our study confirmed that the lifestyle adopted during pregnancy can have an impact on obstetric, neonatal and infant outcomes. In particular, women who are obese at the end of pregnancy show a significantly increased incidence of major maternal pathologies and caesarean delivery compared with normal weight women. Moreover, smoking during pregnancy may be associated with lower neonatal weight and Apgar index, and higher BMI at the end of pregnancy. The physical activity seems to help spontaneous vaginal delivery.

Table 5. Percentage (%) of infants by growth percentile at six months of age (infants, N = 39) in relation to WHO growth curves.

Percentile value	% of infants for weight (N of infants)	% of infants for height (N of infants)
<3°P	10.3%	10.3%
(much lower than the mean value)	(N = 4)	(N = 4)
3°–15°P	56.4%	28.2%
(slightly below average)	(N = 22)	(N = 11)
15°–85°P	28.2%	46.1%
(within the mean value)	(N = 11)	(N = 18)
85°–97°P	5.1%	7.7%
(slightly above average)	(N = 2)	(N = 3)
>97°P	0%	7.7%
(much higher than the mean value)	(N = 0)	(N = 3)

Table 6A. Comparison of the percentage of infants with growth percentile for weight within the mean value (15°–85°) at six months of age among: mothers with normal weight, overweight, and obesity.

Parameter	Normal weight mothers (N = 4) (%)	Overweight mothers (N = 21) (%)	*p*	Obese mothers (N = 14) (%)	*p*
Infants with 15°–85° percentile for weight at six months age, %	25	38	0.723	14	0.676
Infants with 15°–85° percentile for height at six months age, %	50	43	0.871	43	0.877

Table 6B. Comparison of the percentage of infants with growth percentile for weight within the mean value (15°–85°) at six months of age among: mothers performing physical activity and sedentary mothers.

Parameter	Mothers performing physical activity N = 7	Sedentary mothers N = 32	*p*
Infants with 15°–85° percentile for weight at six months age, %	29	28	0.986
Infants with 15°–85° percentile for height at six months age, %	43	44	0.978

Table 6C. Comparison of the percentage of infants with growth percentile for weight within the mean value (15°–85°) at six months of age among: mothers smoking and no-smoking during pregnancy.

Parameter	Smoking mothers N = 10	No-smoking mothers N = 29	*p*
Infants with 15°–85° percentile for weight at six months age, %	20	31	0.609
Infants with 15°–85° percentile for height at six months age, %	50	41	0.770

Lifestyle can be defined as a set of behaviours that individuals engage in daily life that significantly influence quality of life and perceived well-being [1]. Various environmental, social, cultural, and individual factors can influence lifestyle and thus people's quality of life, both positively and negatively.

The World Health Organization (WHO) identified several factors (e.g., smoking, hypertension, alcoholism, overweight, sedentary habit, and the use of drugs of abuse) that can negatively affect the quality of life of pregnant women, infants and children [1,28,29].

Regarding physical activity, it should be noted that these terms mean and bodily movement that requires energy expenditure, thus not only sports activities, but all daily movements, such as walking, dancing, walking the dog, etc. Some studies have reported that regular physical activity (i.e., at least 30 minutes a day) can improve health status and therefore thu individual well-being [30,31].

Quitting smoking, is known to result in health benefits, such as improved physical resistance, breathing, and skin tone and elasticity, and reduced risk of developing cancer, cardiovascular and respiratory diseases [3,32]. Quitting smoking also leads to improved fertility and reduction in pregnancy complications, risk of miscarriages and low birth weight [5,33].

Moreover, giving up alcohol in pregnancy is important because of the negative consequences it may entail (e.g., risk of spontaneous abortion, pre-mature birth, intellectual deficit for the child) [34,35].

Our study confirms the impact of lifestyles adopted during pregnancy on obstetric and neonatal outcomes. In particular, given the impact of BMI at the end of pregnancy, it seems crucial to provide information on the diet to be followed during pregnancy. Moreover, in agreement with other studies in the literature [5–7,36], we found a significant reduction in neonatal weight and Apgar index in newborns of smoking mothers compared with those of non-smoking mothers. On the other hand, we found no significant differences in obstetric outcomes in women stratified by physical activity during pregnancy. Also, no significant differences were found in infant outcomes based on BMI, physical activity and smoking habit during pregnancy. However, despite an a priori defined study protocol, our results may be limited by a small sample size and a percentage of lost to follow-up higher than 5% in infants. This is a limitation of our study due to data collection problems.

Larger studies are needed to confirm and further investigate these findings.

5. Conclusions

The lifestyle adopted during pregnancy can have an impact obstetric and neonatal outcomes. In particular, a BMI in the obesity range at the end of pregnancy appears associated with major maternal morbidity and caesarean delivery. Furthermore, smoking during pregnancy seems related to lower neonatal weight and Apgar index, and higher BMI at the end of pregnancy. In addition, physical activity appears to be associated with an increased incidence of spontaneous vaginal delivery. No significant differences were found in infant outcomes. In conclusion, our data, in agreement with the literature, confirms that proper information and education about lifestyle changes, in particular regarding BMI and smoking during pregnancy can improve the health of women and their newborns.

Availability of Data and Materials

Data are contained within the article.

Author Contributions

MC, IS and RO designed the research study. MC, IS, DS and RO performed the research. IS, DS, RO, BS, DDP, CS, VDR and MF acquired data. MC, AR, VC, GC, BS, MBM, CS and VDR analyzed the data. AM and AF interpreted the data. MC, AR, VC, GC, BS, MBM, DDP, MF, AM and AF wrote the manuscript. MC, AR, VC, GC, AM and AF revised the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

We did not require ethics committee approval because of the retrospective observational design of our study. In our study, all patients gave their informed consent for the study participation, treatment, and publication of the personal data and the University hospital has also given the authorization to carry out the study. The study was conducted in accordance with the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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