Pregnancy outcome among parturients living in and outside Sagamu: A cement factory town

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ABSTRACT

Cement Dust and Pregnancy Outcome: Cement factory poses major health challenge to human health especially those living around the vicinity. The inhaled particulate matters are deposited in most organs in the body. Some of the pollutants migrate through the placenta which could adversely affect the growing fetus.

Aims: To compare the fetal and maternal outcomes of pregnant women living within to those living outside Sagamu.

Settings and Design: A retrospective study conducted among booked deliveries in Olabisi Onabanjo university teaching hospital in Sagamu from 1st of January 2017 and 31st December 2018.

Subjects and Methods: Case notes were retrieved from central medical records. A total of 848 women were living within Sagamu, whereas 236 women were those living outside Sagamu.

Statistical Analysis Used: Information retrieved was entered into SPSS version 21 and analyzed.

Results: The mean age in years for the study and control group respectively were 29.1 ± 4.9 years and 30.2 ± 5.0 years and the difference was statistically significant (t = 2.723; P < 0.007). The rate of preterm delivery among the study group was significantly higher than the control (x² = 5.29; P = 0.021). The mean gestational age at delivery for preterm babies was 29.6 ± 7.5 weeks (study) and 31.2 ± 6.0 weeks (control) and there was no significant difference (t = 0.843; P < 0.401). The mean packed cell volume of the study and control at booking was 31.7 ± 8.1% and 31.4 ± 4.1% and the difference did not achieve significant level (t = 0.538; P < 0.591). The mean birth weight was 3.2 ± 1.6 kg and 3.3 ± 2.1 kg for the study and control groups respectively and there was no significant difference between the two populations (t = 0.885; P < 0.376).

Conclusions: Pregnant women residing within Sagamu had significant increase risk of preterm deliveries than those living outside Sagamu.

Key words: Atmospheric heavy metals; cement dust pollution; exposure; pregnant women; preterm delivery and Sagamu.

Introduction

Industrialization is central to economic development and improved prospects for human wellbeing.¹ In Nigeria, the growing rate of industrialization is gradually leading to contamination and deterioration of the environment.¹

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Sagamu, South-western Nigeria is home to many industries among which are Lafarge Cement Company. This company operates one of its three plants in Sagamu and one of the largest in Africa because of major deposit of limestone in Sagamu.

High concentrations of cadmium and other toxic metals have been determined in airborne cement dust around Sagamu. The exposure to these metals and metalloids is said to have an impact on human health.

Cement dust has been shown to be associated with lung function impairment, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis and carcinoma of the lungs, stomach and colon. Some other studies have shown that cement dust may enter into the systemic circulation and thereby reaching essentially all the organs of body and affects the different tissues including heart, liver, spleen, bone, muscles, and hairs and ultimately affecting their microstructure and physiological performance.

Some of these heavy metals are filtered by placenta from mother to child and some are directly deposited in growing fetal tissues.

Most of the studies have previously attempted to evaluate the effects of cement dust exposure on the basis of spirometry or radiology, or both.

This study compared the delivery outcomes (maternal and fetal) of patients who live in Sagamu compared to other patients who live outside Sagamu but delivered in Olabisi Onabanjo University Teaching Hospital.

Subjects and Methods

This study was carried out in the Department of Obstetrics and Gynaecology of Olabisi Onabanjo University Teaching Hospital. This hospital is located in Sagamu, Ogun State, Nigeria.

Sagamu is a local government area in Ogun State, South western, Nigeria and is equidistant from Lagos, the commercial capital of Nigeria and Ibadan, one of the largest cities in West Africa. Sagamu has a moderately hot and humid tropical climate. It has tropical rain forest vegetation.

Sagamu is home to a large cement factory, Lafarge cement industry, formerly WAPCO. The implication of this large cement factory is the cement dust from the factory site to the rest of the town. This cement dust contains heavy metals, such as lead, zinc, cadmium, mercury, and arsenic which could constitute health hazards to inhabitants of the town and their unborn babies.

The facility is one of the two teaching hospitals for referral from all clinics, maternity homes, and hospitals in all the local government areas in Ogun state. Due to its proximity to Lagos State and Ibadan, olabisi onabanjo university teaching hospital (OOUTH) also receives patients from parts of Lagos State and Ibadan.

This study was a retrospective study involving booked deliveries in the teaching hospital between January 2017 and December 2018. Case notes were retrieved from medical records and reviewed in respect of the address of patients, age, parity, gestational age at booking, mode of delivery, outcomes of the newborn and mother, and hematological parameters.

The women recruited into the study through their case files must have lived within Sagamu township for a year or more including the duration of index pregnancy (study group). Those who fall under the control must have lived outside Sagamu for a year or more including the current pregnancy. For those who lived in Sagamu, the cement factory is the epicenter and 5 km radius from the epicenter was taken as within Sagamu. For those who lived outside Sagamu, a radius of 10 km and more from the epicenter was used.

Recruited patients were called to confirm how long they stayed in a particular location before and during pregnancy if there is any need to confirm.

Results

A total of 848 pregnant women who have lived for a year or more in Sagamu and 236 pregnant women who also lived outside Sagamu for a year or more were recruited into the study.

Table 1 shows the social demographic details of the women. The mean age in years for the study and control group respectively was 29.1 ± 4.9 years and 30.2 ± 5.0 years and the difference was statistically significant ($t = 2.723; P < 0.007$).

For the study group, the 25–29 years and 30–34 years of age group constituted 39.3% and 29.4% respectively of the population, whereas in the control, the 30–34 years (36.4%) and 25–29 years (34.7%) were the majority.

In the study, the types of occupation was almost evenly distributed among the four types of occupation with the unskilled and semiskilled constituting 27.3% and 25.9%,
respectively, whereas in the control, the skilled (29.6%), the professional (23.9%), semiskilled (23.5%), and the unskilled (23.0%), respectively.

Graduates of tertiary and secondary education constituted 55.0% and 29.4% respectively of the study group, whereas graduates of tertiary and secondary education make 59.3% and 28.7% of the control population, respectively.

Majority of the two populations were Christians and pregnant women of Yoruba ethnic stock were 81.1% and 74.2% of the study and control groups respectively and the difference was significant ($\chi^2=9.163; P < 0.027$).

Table 2 depicts the clinical parameters of the two study populations.

In the study group, 46.9% and 36.7% were para 1–2 and nulliparous women, whereas in the control, 50% and 32.6% were para 1–2 and nulliparous women. The mean parity of the two groups was 1.3 ± 1.3 and 1.3 ± 1.3 respectively and the difference was not significant ($t=-0.135; P<0.893$).

A total of 55.4% and 27.4% of the study group booked at gestational age of 14–26 and 27–40 weeks, respectively. In the control, 45.1% and 39.0% booked at gestational age of 14–26 weeks and 27–40 weeks, respectively. The mean gestational age at booking for the study and the control was 21.8 ± 8.2 weeks and 23.3 ± 9.2 weeks respectively and the difference reached significant level ($t=-2.207; P<0.028$).

A total of 45.8% and 42.9% of the study group women were 161–170 cm and 151–160 cm tall at booking. Correspondingly in the control 47.0% and 38.2% were 151–160 cm and 161–170 cm tall. The mean height at booking for the study and control groups were 160.9 ± 7.1 cm and 160.8 ± 6.6 cm respectively and there was no significant difference between the two groups ($t=0.277; P=0.782$).

| Variable | Study group $n$ (%) | Control group $n$ (%) | Test | $P$ |
|----------|---------------------|-----------------------|------|-----|
| Age group (yrs) | | | | |
| <20 | 18 (2.2) | 3 (1.3) |  | |
| 20-24 | 111 (13.7) | 21 (9.3) |  | |
| 25-29 | 319 (39.3) | 78 (34.7) |  | |
| 30-34 | 239 (29.4) | 82 (36.4) |  | |
| ≥35 | 125 (15.4) | 41 (18.2) |  | |
| Mean ± SD | 29.1 ± 4.9 | 30.2 ± 5.0 | 2.723** | 0.007 |
| Occupation | | | | |
| Unskilled | 223 (27.3) | 53 (23.0) | 3.449* | 0.327 |
| Semiskilled | 212 (25.9) | 54 (23.5) |  | |
| Skilled | 205 (25.1) | 68 (29.6) |  | |
| Professionals | 177 (21.7) | 55 (23.9) |  | |
| Total | 817 | 230 |  |  
| Educational status | | | | |
| Informal | 44 (5.8) | 7 (3.3) | 2.643* | 0.450 |
| Primary | 75 (9.6) | 18 (8.6) |  | |
| Secondary | 224 (29.4) | 60 (26.7) |  | |
| Tertiary | 420 (55.0) | 124 (53.9) |  | |
| Total | 763 | 209 |  |  
| Religion | | | | |
| Christianity | 629 (75.7) | 182 (80.2) | Not valid* | |
| Islam | 201 (24.2) | 45 (19.8) |  | |
| Traditional African religion | 1 (0.1) | 0 (0.0) |  | |
| Total | 831 | 227 |  |  
| Tribe | | | | |
| Yoruba | 688 (81.1) | 175 (74.2) |  | |
| Igbo | 91 (10.7) | 29 (12.3) |  | |
| Hausa | 10 (1.2) | 2 (0.3) |  | |
| Others | 59 (7.0) | 30 (12.7) |  | |
| Total | 848 | 236 |  |  

Table 1: Sociodemographic details of the pregnant women

Table 2: Clinical parameters of the pregnant women
A total of 34.5%, 22.1% and 21.5% of the study group weighted at booking 56–65 kg, 46–55 kg, and 66–75 kg respectively, whereas in the control group 27.0%, 24.2%, and 21.8% of the women weight 56–65 kg, 46–55 kg, and 66–75 kg, respectively.

The mean weight at booking for the study and control groups was 63.9 ± 13.8 weeks and 66.4 ± 14.7 weeks, respectively, showing that the control was significantly heavier at booking than the control (t=-2.249; P < 0.025).

Most of the babies in the two groups presented cephalic at delivery (96.0%) and (92.6%), respectively.

Table 3 shows estimated age at delivery and labor outcomes in the two groups. A total of 66.3% and 18.6% of pregnant women in the study group delivered at gestational age of 37–40 weeks and more than 40 weeks, respectively. In the control, 72.3% and 19.0% delivered at 37–40% and >40 weeks gestation. The mean gestational age at delivery for the study and control was 37.9 ± 4.7 weeks and 38.5 ± 3.1 weeks, with the study group delivering at significantly lower gestation but within term (t= 2.150; P < 0.032). A total of 15.1% and 8.7% of the study and control groups delivered preterm babies. The rate of preterm delivery amongst the study group was significantly higher than the control (x² = 5.29; P = 0.021). The mean gestational age at delivery for preterm babies was 29.6 ± 7.5 weeks (study) and 31.2 ± 6.0 weeks (control) and there was no significant difference (t=0.843; P < 0.401).

A total of 75.7% and 70.7% of women in the study and control were fully dilated in 2–12 h, with overall mean of 10.0 ± 5.5 h and 11.0 ± 6.5 h for the study and control respectively and the difference did not reach significant level (t=1.665; P = 0.098).

In the second stage of labor, majority of the women in the study and control groups had delivered within 30 min (95.4%) and (95.7%), respectively. The mean duration of the second stage for the study and control groups were 19.3 ± 150.7 and 10.9 ± 10.5 min and the difference was not significant (t=0.657; P < 0.511).

A total of 76.2% and 64.9% of the women in the study and control groups had spontaneous vertex delivery respectively, whereas 20.9% of the study group and 33.3% of the control were delivered by caesarean section. There was significant difference in the delivery of the two groups (x² = 16.684; P < 0.001).

Table 4 shows the laboratory parameters of the two groups at booking. A total of 49.9% and 35.0% of the study group had PCV of 31–35% and 26–30%, whereas in the control group 44.6% and 34.8% had PCV of 31–35% and 26–30%. The mean PCV of the study and control at booking were 31.7 ± 8.1% and 31.4 ± 4.1% and the difference did not achieve significant level (t=0.538; P < 0.591).

A total of 0.5% of the study group had reactive venereal disease research laboratory (VDRL) compared to 1.2% for the control and without any significant difference (x²=1.161; P < 0.274). A total of 4.7% of the study group were HIV positive, whereas 5.0% were HIV positive in the control and without any significant difference. (x²=0.386; P < 0.534).

In the two groups, hepatitis B was positive in 6.4% of the study group women, whereas it was 4.8% in the control and the difference was not significant (x² = 0.598; P < 0.439). There was only two (1.8%) of the mothers in the control group who had hepatitis C, whereas there was none in the study group and there was significant difference between the two group (x² = 7.921; P < 0.041).

Table 3: Estimated gestational age at delivery and labor outcomes in the pregnant women

| Variable                        | Study group | Control group | Test | P    |
|---------------------------------|-------------|---------------|------|------|
| EGA (weeks) at delivery         |             |               |      |      |
| ≤36                             | 105 (15.1)  | 17 (8.7)      | 0.843| 0.401|
| 37-40                           | 460 (66.3)  | 141 (72.3)    |      |      |
| > 40                            | 129 (18.6)  | 37 (19.0)     |      |      |
| Mean ± SD                       | 37.9 ± 4.7  | 38.5 ± 3.1    | 2.150| 0.032|
| Preterm delivery                | 105         | 17            |      |      |
| Total                           | 694         | 195           |      |      |
| First stage of labor (h)        |             |               |      |      |
| <2                              | 9 (1.6)     | 1 (0.7)       |      |      |
| 2-12                            | 434 (75.7)  | 99 (70.7)     |      |      |
| 13-18                           | 85 (14.8)   | 20 (14.3)     |      |      |
| >18                             | 45 (7.9)    | 20 (14.3)     |      |      |
| Mean ± SD                       | 10.0 ± 5.5  | 11.0 ± 6.5    | 1.665| 0.098|
| Total                           | 573         | 140           |      |      |
| Second stage of labor (min)     |             |               |      |      |
| ≤30                             | 558 (95.4)  | 135 (95.7)    |      |      |
| 31-60                           | 21 (3.6)    | 6 (4.3)       |      |      |
| 61-120                          | 1 (0.2)     | 0 (0.0)       |      |      |
| >120                            | 5 (0.9)     | 0 (0.0)       |      |      |
| Mean ± SD                       | 19.3 ± 150.7| 10.9 ± 10.5   | 0.657| 0.511|
| Total                           | 585         | 141           |      |      |
| Mode of delivery                |             |               |      |      |
| SVD                             | 632 (76.2)  | 150 (64.9)    | 16.684| 0.001|
| Forceps                         | 5 (0.6)     | 0 (0.0)       |      |      |
| Vacuum                          | 19 (2.3)    | 4 (1.7)       |      |      |
| Caesarean section               | 173 (20.9)  | 77 (33.3)     |      |      |
| Total                           | 829         | 231           |      |      |

NB: ** = Student’s ‘t’ test, * = Chi-square test
In Table 5, 54.3% and 36.7% of the study group had APGAR scores of 8–10 and 5–7 respectively in the first minute, whereas 51.8% and 35.1% of the control had APGAR scores of 8–10 and 5–7, respectively.

The mean APGAR scores in the first minute was $7.0 \pm 1.8$ and $6.8 \pm 2.1$ in the study and control respectively and there was no significant difference between the two groups ($t=1.389; P < 0.166$). In the APGAR scores of the fifth minute, 88.2% and 87.3% of the study and control groups had scores of 8–10 and 5–7, respectively. The mean APGAR scores of 8.7 ± 1.8 and 8.6 ± 2.1 were recorded for the study and control groups respectively and the difference did not achieve significant level ($t=0.836; P=0.403$).

A total of 84.6% and 84.1% of the study and control groups delivered babies weighing 2.5–3.9 kg, respectively. The mean birth weight was $3.2 \pm 1.6$ kg and $3.3 \pm 2.1$ kg for the study and control groups respectively and there was no significant difference between the two populations ($t=0.885; P<0.376$).

Birth asphyxia (21.4%), prematurity (19.0%), low birth weight (9.5%), and neonatal jaundice (9.5%) were the commonest indications for admission into neonatal unit in the study group, whereas birth asphyxia (40.0%), neonatal sepsis (10.0%), and congenital anomaly (10.0%) were the commonest indications for admission into the neonatal unit of the control.

Table 6a shows indications for caesarean section. Previous caesarean section (37.1%), malpresentation (17.0%), and cephalopelvic disproportion (CPD)/obstructed labor (15.7%) were the most indications for the study group, whereas previous caesarean section (45.1%), malpresentation (14.1%), and CPD/obstructed labor (11.3%) were the most frequent indications for caesarean section for the control group.

Table 6b illustrates the maternal outcome. Two mothers each died in the study (0.2%) and control (0.9%) groups respectively without significant difference ($\chi^2=1.925; P<0.165$). A total of 1.9% of the women in the study group had morbidities, whereas in the control group it was 4.4% and the difference reached significant level ($\chi^2=4.594; P<0.032$).

While Table 6c indicates the foetal outcome. A total of 5.2% of fetal fatalities were recorded in the study group and 10.1% in the control group and there was significant difference between the two groups ($\chi^2=3.764; P<0.052$).

Discussion
This study tried to assess the effect of environment of a cement producing town on both maternal and fetal outcomes.
Table 6a: Indications for caesarean section

| Indications              | Study group n (%) | Control group n (%) | χ²   | P   |
|--------------------------|-------------------|---------------------|------|-----|
| Fetal distress           | 15 (9.4)          | 3 (4.2)             | 9.670| Not valid |
| Malpresentation          | 27 (17.0)         | 10 (14.1)           |      |     |
| CPD/obstructed labor     | 25 (15.7)         | 8 (11.3)            |      |     |
| Failed induction         | 4 (2.5)           | 2 (2.8)             |      |     |
| Previous c/s             | 59 (37.1)         | 32 (45.1)           |      |     |
| Multiple gestation       | 7 (4.4)           | 3 (4.2)             |      |     |
| APH                      | 3 (1.9)           | 1 (1.4)             |      |     |
| Severe pre-eclampsia     | 5 (3.1)           | 4 (5.6)             |      |     |
| Uterine rupture          | 4 (2.5)           | 1 (1.4)             |      |     |
| Prolonged labor          | 0 (0.0)           | 0 (0.0)             |      |     |
| HIV infection            | 3 (1.9)           | 0 (0.0)             |      |     |
| Poor progress of labor   | 4 (2.5)           | 2 (2.8)             |      |     |
| Other                    | 3 (1.9)           | 5 (7.0)             |      |     |
| Total                    | 159               | 71                  |      |     |

Table 6b: Illustrates the maternal outcome

| Variable              | Study group n (%) | Control group n (%) | χ²  | P   |
|-----------------------|-------------------|---------------------|-----|-----|
| Maternal mortality    |                   |                     |     |     |
| Alive                 | 825 (99.8)        | 225 (99.1)          | 1.925 | 0.165 |
| Dead                  | 2 (0.2)           | 2 (0.9)             |     |     |
| Total                 | 827               | 227                 |     |     |

| Maternal morbidity    |                   |                     |     |     |
| Yes                   | 16 (1.9)          | 10 (4.4)            | 4.594 | 0.032 |
| No                    | 809 (98.1)        | 215 (95.6)          |     |     |
| Total                 | 825               | 225                 |     |     |

Table 6c: Indicates the foetal outcome

| Fetal outcome | Study group n (%) | Control group n (%) | χ²  | P   |
|---------------|-------------------|---------------------|-----|-----|
| Alive         | 417 (94.8)        | 107 (89.9)          | 3.764 | 0.052 |
| Dead          | 23 (5.2)          | 12 (10.1)           |     |     |
| Total         | 440               | 119                 |     |     |

it found out that women who had tertiary education are more likely to register for antenatal care before estimated gestational age of 17 weeks.[7] About a quarter of the women booked after second trimester, this was consistent with study done by Lamina et al.[8] at this center.

Large percentages of the women are of parity 1–4. This may suggest that the inorganic content of cement has no effect on the reproductive potential of the women living in Sagamu and compared to those living outside Sagamu.

In this study, the Sagamu group had significant higher rate of preterm delivery than the control, as the percentage of preterm delivery among those living in Sagamu was twice that of the controls. This was in support of the study conducted by Yang et al.[9] This increased preterm birth was reported to be due to the effect of air pollutant causing reduction in oxygen saturation in the body.

The difference in booking weight of the two groups was statistically significant. Although there was no evidence to support the finding, the effect of cofounder such as dietary intake, extent of physical activity, the gestational age at booking, and individual weight gain in pregnancy could have been responsible for this observation, especially in view of the fact that control group booked at significantly late gestational age than the study group. The duration of first and second stages of labor were not different in the two groups, suggesting that the particulate matter of cement have no effect on the uterine contractility while mode of delivery by caesarean section in the two groups of women were significantly higher among the control than the study group.

The review of packed cell volume of the two groups was not statistically significantly different, even though, there were more women in the control than the study group with bad anemic state (10–25%). This differs from a study conducted by Farheen et al.,[10] where hemoglobin concentration and packed cell volume of those exposed to cement were significantly lower than the unexposed. This distinction could be as a result of interobserver error and difference in methodology. The latter study is a prospective longitudinal study whereas the present study is a retrospective study. The other blood parameters like the viral markers were comparable in study and the control groups.

In this study, the control recorded significantly higher maternal and fetal deaths than the study group indicating that women living in environments of cement laden atmosphere are not at increased risk of poor maternal and fetal outcomes. Also, the control had a significantly more morbidities than the study group that were mainly obstetrics events.

Majority of the study population (>60%) were within the age group of 25 and 34 years and this was consistent with previous studies, as this coincides with active reproductive age of women. The control group was significantly older at booking than the study group. Both the skilled and professional women made up of large percentage of the two populations. Over 50% of pregnant women in both groups had tertiary education which can be attributed to reason we had between 60 and 70% of women enrolling for antenatal care before end of second trimester. This finding was similar to a study carried out in a tertiary center in the north where
Other parameters of new born that would have informed us of the effect of the contaminated environment were not statistically significantly different.

Unlike previous studies which suggested that living in environment concentrated with heavy metals produced from production of cement would affect the fetal outcome, this study did not show that. This was further evidenced by having comparable mean APGAR scores in both groups.

Previous studies have also shown conflicting reports about the effect of heavy metal on birthweight. In a study carried out by West et al., they found presence of increased level of heavy metal (lead) did not affect the birthweight.[11] In a related study done in Japan they found an increase birthweight in babies with increased serum level of heavy metals.[11] However, a study carried out in Iran found a decreased in birthweight in babies with elevated levels of heavy metals (lead).[12] These differences in fetal outcomes can be attributed to the methodologies used by the different studies.

It is important to note that all over the world especially in the developed countries where government policies are strictly complied with, “closed limestone blasting and processing” is the process of cement production as against what obtains in Nigeria where “open limestone blasting and processing” is condoned. With closed system, the pollution of the environment is appreciable reduced by over 90%. So, the federal government needs to come up with a policy in this regard.

The communities where these cement factories are sited should encourage the population to put on face mask when venturing outside their homes and the cement companies should be made to carry out on 5 yearly basis studies on the impact of cement dust on the environment and the people and takes drastic steps to address the negative findings.

Conclusion

From this study, we can suggest that heavy metals in cement, which are present in the atmospheric air when inhale by pregnant women, may lead to increased risk of preterm labor and delivery and that we are unable to establish from these results any further adverse outcomes of pregnant women living in Sagamu over those living outside Sagamu.

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Conflicts of interest

There are no conflicts of interest.

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