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Prevalence of Diabetes in Pregnancy At A Tertiary Care Institution And Associated Perinatal Outcomes

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Abstract:
Background: *Diabetes in pregnancy has implications for the health of the mother and her baby in the immediate, short-term and long-term. Studies have shown that diabetes in pregnancy can influence maternal and neonatal outcomes negatively hence the need to assess the prevalence of diabetes in pregnancy and its association with adverse perinatal outcomes.*
Methods:*This was a retrospective cross sectional record review conducted at a tertiary hospital in Zimbabwe. Stratified random sampling was used to select 532 antenatal records from 2010 to 2014. The data were collected using record review checklists. The outcome was diabetes in pregnancy. The data were analysed for descriptive statistics through the Statistical package for Social Sciences (SPSS) for Windows, Version 20. Multiple logistic regression was conducted to determine factors associated with having diabetes in pregnancy.*
Results:*Participants' mean age was 26.9. Prevalence of diabetes in pregnancy was 8.5%. Risk factors associated with diabetes in pregnancy were a family history of diabetes mellitus 36 (6.8%) and high blood pressure 124 (23.3%). As for maternal outcomes 93 (17.5%) had caesarean delivery and 58 (10.9%) had either pregnancy induced hypertension or pre-eclampsia. Twenty-four (4.5%) participants had neonatal death while 12 (2.3%) had still births. The commonest neonatal outcomes were birth weight below 2 500g or a low Apgar score which were found in 73 (13.7%) cases. While there was 5% (OR=0.054, 95% CI = 0.00031, 0.98) increased chance of having pregnancy-induced hypertension or pre-eclampsia among people with diabetes the odds of having macrosomia was 12.96 (95% CI = 3.45; 48.68).*
Conclusion:*The prevalence of diabetes in pregnancy was 8.5% and was associated with some adverse perinatal outcomes*

Key-words:*diabetes, pregnancy, prevalence, perinatal outcomes*

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I. Introduction

Diabetes in pregnancy can either be pre-existing type I or type II diabetes, or gestational diabetes mellitus (GDM), which is defined as glucose intolerance of variable severity that is first recognised during pregnancy(Australian Institute of Health and Welfare, 2010; Gilmartin, Ural, & Repke, 2008). Diabetes in pregnancy has implications for the health of the mother and her baby in the immediate, short-term and long-term (Australian Institute of Health and Welfare, 2010). It is estimated that type II diabetes affects about 92 million women of reproductive age worldwide, and up to 14% of pregnant women will have GDM (Macaulay, Dunger, & Norris, 2014). Hyperglycaemia complicates 17% of pregnancies, including women with diagnosed and undiagnosed types 1 and 2 diabetes, and gestational diabetes mellitus (GDM).

Diabetes in pregnancy will increase in many LMIC, as pregnancy becomes more common in wealthier, older, and more obese women (Goldenberg, McClure, Harrison, & Miodovnik, 2016). The prevalence of hyperglycaemia in pregnancy can only be approximated because numerous tests and criteria for abnormal glucose levels are used worldwide and approximately half of women with hyperglycaemia in pregnancy are undiagnosed (Goldenberg et al., 2016). In some ethnic groups, the prevalence of GDM ranges from 1 to 14% depending on different screening methods, diagnostic criteria and the population screened (Gasim, 2012).According to the European Association of Perinatal Medicine, 8%-10% of the 5,000,000 women who give birth each year suffer from diabetes during the course of pregnancy (European Association of Perinatal Medicine, 2012). According to the International Diabetes Federation, an estimated 14% of live births in Europe are affected by hyperglycaemia during pregnancy where it affects non-white immigrant mothers that account for a significant proportion of pregnancies(The Barcelona Declaration On Hyperglycaemia in Pregnancy For Europe, 2016).

Diabetes in pregnancy has also increased markedly in the Asian region. Multi-ethnic studies have highlighted the increased risk of gestational diabetes mellitus among the different Asian populations (Tutino et al., 2014). A study conducted in Saudi to estimate the burden of diabetes and to explore the adverse pregnancy outcomes associated with diabetes in pregnancy revealed prevalence of 24.2% and 4.3% for gestational and pre-gestational diabetes respectively (Wahabi, Fayed, Esmaeil, Mamdouh, & Kotb, 2017). The prevalence of GDM and pre-GDM in the Saudi pregnant population is among the highest in the world. Diabetes in pregnancy was mainly associated with age more than 25 years, body mass index, family history of diabetes, history of intra uterine death, gestational diabetes in previous pregnancy, candidiasis and thyroid disease (Renji, Lekshmi, & Chellamma, 2017). In a recent nationwide Chinese survey, 3% of women aged between 30 and 39 years had diabetes, with an additional 9.2% being affected by impaired glucose tolerance (Yang et al., 2010).Majority of pregnancies complicated by hyperglycaemia are attributable to gestational diabetes (Yang et al., 2010).

In the United States (US), approximately 6-7% of pregnancies are affected by diabetes, 85% of which are due to gestational diabetes mellitus, with the remainder attributable to pre-gestational diabetes mellitus (Fong, Serra, Herrero, Pan, & Ogunyemi, 2014). One study done in the US revealed a prevalence of diabetes in pregnancy of 4.3 per 100 deliveries over an 11-year period (Albrecht et al., 2010). Of an estimated 1,863,746 hospital delivery discharges containing a diabetes diagnosis, GDM accounted for 84.7%, followed by type I (7%), type II (4.7%), and unspecified diabetes (3.6%). From 1994 to 2004, the rates for all diabetes, GDM, type I diabetes, and type II diabetes significantly increased overally and within each age-group (15-24, 25-34, and > or =35 years) ($P < 0.05$) (Albrecht et al., 2010). Significant predictors of diabetes at delivery included age ≥ 35 years vs. 15-24 years (OR 4.80, CI 4.72-4.89), urban versus rural location (OR 1.14, CI 1.11-1.17), and Medicaid/Medicare versus other payment sources (OR 1.29, CI 1.26-1.32). In 2009, the prevalence of diabetes was higher among women in older age groups, living in ZIP codes with lower household incomes, or with public insurance (Correa, Bardenheier, Elixhauser, Geiss, & Gregg, 2015). From 1993 to 2009, age-standardized prevalence of diabetes per 100 deliveries increased from 0.62 to 0.90 for pre-gestational diabetes mellitus and from 3.09 to 5.57 for GDM.

Diabetes in pregnancy is also common in Australia where it affects about 1 in 20 pregnancies. From 2005–2007 pre-existing diabetes in pregnancy affected less than 1% of pregnancies, and gestational diabetes mellitus (GDM) affected about 5% (Australian Institute of Health and Welfare, 2010). Pre-existing diabetes affecting pregnancy is 3 to 4 times as common among Aboriginal and Torres Strait Islander mothers, while GDM is twice as common. The rate of type II diabetes in indigenous mothers was 10 times as high. Mothers born in high-diabetes-risk regions, such as Polynesia, Asia and the Middle East, were slightly more likely to have type II diabetes, and 3 times as likely to have GDM, as mothers born in Australia (Australian Institute of Health and Welfare, 2010).

The prevalence of diabetes in pregnancy is relatively unknown in Africa (Jiwani et al., 2012). Some of the reasons prevalence of diabetes in pregnancy is relatively unknown in Africa are the selective screening approach for GDM and the unclear estimated percentage of the pregnant women that are screened (Jiwani et al., 2012).Despite high prevalence and mortality rates due to diabetes in low and medium income countries, there is little information about the burden of GDM in these countries (Kanguru, Bezawada, Hussein, & Bell, 2014). Studies conducted in East and West Africa have reported prevalence ranging from 6%-14% (Kuti et al., 2011; Mwanri, Kinabo, Ramaiya, & Feskens, 2014). Data from Africa is limited and no geographical patterns of the prevalence of GDM can be confirmed (Kanguru et al., 2014). Type I and type II diabetes mellitus in pregnancy and in the post-partum period are generally neglected areas (Kanguru et al., 2014). Results of a systematic review of GDM prevalence, classification and diagnostic criteria revealed a prevalence ranging from 0% in Tanzania to 13.9% in Nigeria (Kanguru et al., 2014).Findings of a study conducted in South Africa by Chola et al. (2017) revealed a prevalence of diabetes during pregnancy of 3% (144 women) of all women who reported ever being pregnant (Chola et al., 2017). The majority of the women who had ever had diabetes were African (70%), unemployed (51%) and lived in rural areas (76%). Factors strongly associated with diabetes during pregnancy were age, family history of diabetes and race.

Another study conducted by Ozumba et al. (2004) in Nigeria revealed a prevalence of diabetes mellitus among pregnant mothers of 1.7%(Ozumba, Obi, & Oli, 2004). Pre-gestational diabetes mellitus accounted for 39% of cases while gestational diabetes was responsible for 61% of them. Another study conducted in Nigeria found 122 cases of diabetes from a total of 14, 521 deliveries (8.4 per 1000 deliveries), 21 cases of which were pre-gestational diabetes mellitus , and 101 cases were gestational diabetes mellitus (1.45 per 1000 deliveries and 6.96 per 1000 deliveries respectively) (John, Alegbeleye, & Otoide, 2015).No prevalence studies on diabetes in pregnancy have been done in Zimbabwe. It is essential that the condition is well understood in order to suggest policy changes regarding screening for GDM, in turn preventing the effects of GDM on the mother and baby thus reducing the financial and health burden to a country(Kanguru et al., 2014).

II. Methodology

The retrospective cross sectional record review was done using records from 2010-2014. The study was conducted at Harare Central Hospital, Zimbabwe. A total of 532 maternal records were selected randomly using the delivery register as the sampling frame. Records of women who had either booked their pregnancy or given birth at the hospital were included in the study. on the other hand, records for women who terminated pregnancy before term and rape victims were excluded from the study. Pregnancy-related self-care in such vulnerable women could have been affected owing to unplanned or unexpected pregnancy. The study was approved by the Medical Research Council of Zimbabwe and the Clinical Director at the Hospital. The data were collected using record review checklists. The outcome was diabetes in pregnancy. The data were analysed for descriptive statistics through the Statistical package for Social Sciences (SPSS) for Windows, Version 20. Multiple logistic regression was conducted to determine factors associated with having diabetes in pregnancy.

III. Results

3.1 Biographic data

The mean age of the participants was 26.9 years (SD=6.7 year). The modal age was 26 years. The participant's height and body mass were both normally distributed. The mean height was 159 cm (SD=7.4cm) while the mean body mass was 71.7kg (SD=13.6kg). The participants' body mass indices (BMI) were negatively skewed (Median=27.9 kg/m^2; IQR=7.0 kg/m^2). Most participants, 149 (28.0%) were aged between 25 and 29 years; 17 (3.2%) were in the 40 to 45 years age range. The participants comprised 520 (97.7%) married women. Three hundred and ninety (73.3%) participants had only attained ordinary level education. It is not surprising that 393 (73.9%) were unemployed. However, 442 (83.1%) stayed in an urban area. In terms of religious affiliation 440 (82.7%) were Christians while 2 (0.4%) were traditionalists. The prevalence of diabetes among the pregnant women was 8.5% (95% CI 6.4; 11.2).

Table 1: Participants' Demographic characteristics (n=532).

Variable	Frequency	Percentage
Age group (years)		
15-19	65	12.2
20-24	134	25.2
25-29	149	28.0
30-34	102	19.2
35-39	64	12.0
40-45	17	3.2
Marital Status		
Single	10	1.9
Married	520	97.7
Widowed	2	0.4
Level of Education		
Primary	27	5.1
Zimbabwe junior certificate	70	13.2
Ordinary level	390	73.3
Advanced level	21	3.9
Tertiary	22	4.1
Employment status		
Unemployment	393	73.9
Self employed	72	13.5
Employed	60	11.3
Other	4	0.8
Place of residence		
Urban	442	83.1
Peri-urban	40	7.5
Mining	5	0.9
Farming	29	5.5
Rural	14	2.6
Religion		
Christianity	440	82.7
Traditionalism	2	0.4
Apostolic faith	79	14.8
Other	8	1.5
Diagnosed with diabetes		
Yes	45	8.5
No	487	91.5
Total	**532**	**100**

1.2. Obstetric history

Overall, the participants' number of pregnancies were more than the number of full term deliveries; which in turn were more than the number of participants' living children. These parameters were all positively skewed. The participants had had between zero and eight pregnancies (Median=2, IQR=2). On the other hand the participants had had between zero and six children (Median=1; IQR=2). The participants had between none and five live children (Median=1; IQR=2). The trend is summarised in the box plot below (Figure 1).

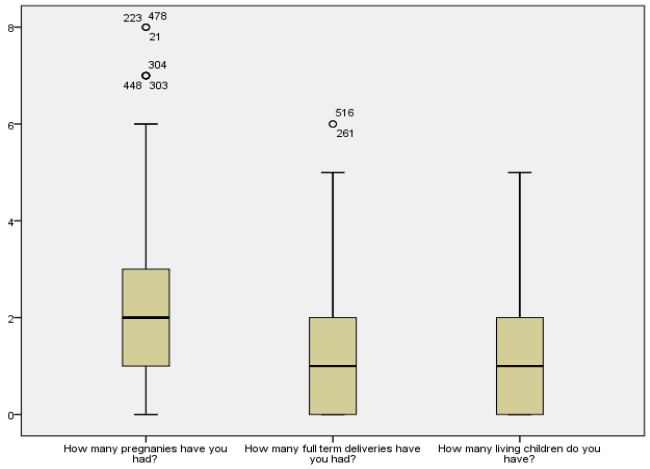

Figure 1: Previous pregnancies and its outcomes.

Forty-eight (9.0%) had had at least one child with low-birth weight, 19 (3.8%) macrosomia, 43 (8.1%) pregnancy induced hypertension. Fifteen (2.8%) participants had had a pre-term baby and, lastly, 51 (9.6%) had had a still birth. The participants' obstetric history is summarised in Table 2 below.

Table 2: Participants' obstetric history (n=532).

Variable	Frequency	Percentage
Previous low birth weight (less than 2500g)		
Yes	48	9.0
No	484	91.0
Previous macrosomia (more than 4500g)		
Yes	19	3.6
No	513	96.4
Pregnancy induced hypertension/ pre-eclampsia		
Yes	43	8.1
No	489	91.9
Preterm delivery		
Yes	15	2.8
No	517	97.2
Still birth		
Yes	51	9.6
No	481	90.4
Total	**532**	**100**

While nobody among participants had a history of kidney disease, liver disease, abnormal lipids, depression, ovarian cysts or thyroid problems, some participants had risk factors for diabetes mellitus. For instance, 36 (6.8%) had a family history of diabetes mellitus and 124 (23.3%) had high blood pressure. The distribution of diabetic risk factors among participants are summarised in table 3 below.

Table 3: Participants risk factors for Diabetes mellitus (n=532).

Variable	Frequency	Percentage
Family history of diabetes mellitus		
Yes	36	6.8
No	496	93.2
High Blood pressure		
Yes	124	23.3
No	408	76.7
Heart disease		
Yes	16	3.0
No	516	97.0
Kidney disease		
No	532	100

Liver disease		
No	532	100
Abnormal lipids		
No	532	100
Peripheral neuropathy		
Yes	6	1.1
No	526	98.9
Depression		
No	532	100
Eye problems		
Yes	11	2.1
No	521	97.9
Ovarian cyst		
No	532	100
Thyroid disease		
No	532	100
Dental problems		
Yes	12	2.3
No	520	97.7
Total	**532**	**100**

Maternal outcomes

Maternal outcomes are shown in table 4 below. There was a generally low prevalence of poor maternal outcomes. For instance, there was no maternal death, diabetic ketoacidosis nor cystitis or pyelonephritis. Ninety-three (17.5%) had Caesarean delivery and 58 (10.9%) had either pregnancy induced hypertension or pre-eclampsia.

Table 4: Maternal outcomes (n-532)

Variable	Frequency	Percentage
Maternal death		
No	532	100
Pregnancy induced hypertension or pre-eclampsia		
Yes	58	10.9
No	574	89.1
Caesarean delivery		
Yes	93	17.5
No	439	82.5
Diabetic ketoacidosis		
No	532	100
Hypoglycaemic attacks		
Yes	4	0.8
No	528	99.2
Pre-term labour		
Yes	4	0.8
No	528	99.2
Cystitis or pyelonephritis		
No	532	100
Vaginitis or candidiasis		
Yes	10	1.9
No	522	98.1
Miscarriage		
Yes	17	3.2
No	515	96.8
Still birth		
Yes	26	4.9
No	506	95.1
Other perinatal outcomes		
Yes	3	0.6
No	529	99.4
Total	**532**	**100**

1.3. Neonatal outcomes

Twenty-four (4.5%) participants had neonatal death while 12 (2.3%) had still births. The commonest neonatal outcomes were birth weight below 2 500g or a low Apgar score which were found in 73 (13.7%) cases. However, no hyperbilirubinemia nor shoulder dystocia were reported. Neonatal outcomes are summarised in Table 5 below.

Table 5: Neonatal outcomes (n=532)

Variable	Frequency	Percentage
Neonatal death		
Yes	24	4.5
No	508	95.5
Preterm birth		
Yes	16	3.0
No	526	97,0
Low Apgar score		
Yes	73	13.7
No	459	86.3
Birth weight more than 4 500g		
Yes	27	5.1
No	505	94.9
Birth weight less than 2 500g		
Yes	73	13.7
No	459	86.3
Hypoglycaemia		
Yes	4	0.8
No	528	99.2
Hyperbilirubinemia		
No	532	100
Shoulder dystocia		
No	532	100
Birth injury		
Yes	2	0.4
No	530	99.6
Still birth		
Yes	12	2.3
No	520	97.7
Total	**532**	**100**

3.5.Factors associated with having diabetes mellitus in pregnancy

Statistically significant factors associated with having diabetes in pregnancy are shown in table 6 below. While there was 5% (OR=0.054, 95% CI = 0.00031, 0.98) increased chance of having pregnancy-induced hypertension or pre-eclampsia among people with diabetes the odds of having macrosomia was 12.96 (95% CI = 3.45; 48.68).

Table 6: Factors associated with diabetes in pregnancy.

Variable	Odds ratio	Standard error	95% confidence interval
Pregnancy included hypertension/ pre-eclampsia	0.054	0.081	0.0031; 0.98
Miscarriage	5.58	3.53	1.61; 19.31
Birth weight more than 4 500g	12.96	8.75	3.45; 48.68
Constant	0.012	0.028	0.00014; 1.089

IV. Discussion

4.1. Sociodemographic data

The majority of the participants fell in the age group 20-34 years (72.4%), with a mean age of 26.9 (SD=6.7). This shows that the mothers in the study were relatively young mothers. Under normal circumstances one would expect to have very few maternal complications and a very low prevalence of diabetes in this age group. Only 65(12.2%) were teen mothers and 81(15.2%) were mothers within the age range 35-45 years. These two groups have been proven to have more age related risk factors for maternal and neonatal complications as compared to the 20-34 year age group.

4.2. Prevalence of diabetes in pregnancy

In this study diabetes in pregnancy had a prevalence of 8.5%(45). This is similar to the prevalence and incidence reported in other studies.The prevalence of diabetes in pregnancy in Europe ranges from 8% to 10% (European Association of Perinatal Medicine, 2012).Prevalence of gestational diabetes in Asian countries ranges from 1% to 20%, but varies substantially with screening strategy and diagnostic criteria applied (Tutino et al., 2014). However, Lepercq, 2012, reported a prevalence of pre-existing diabetes associated with pregnancy of 0.5 to 1%. A third of this being type 1 diabetes and two-thirds type twodiabetes. Thereis a great need to deliberately monitor and manage the prevalence and incidence of diabetes in pregnancy to prevent adverse perinatal outcomes associated with it.

4.3. Participants risk factors for Diabetes mellitus in pregnancy

Studies have revealed that risk factors for diabetes mellitus include family history of diabetes mellitus, high blood pressure, heart disease, kidney disease, liver disease, abnormal lipids, peripheral neuropathy, depression, eye problems, ovarian cyst, thyroid disease and dental problems. In our study, history of high blood pressure had the highest prevalence 23.3%(124) followed by family history of diabetes mellitus 6.8%(36). Heart diseases , dental and eye problems shared almost the same prevalence , ranging between 2-3%.

It is then of great importance communities are educated on the importance of preventing high blood pressure and the essence of adherence on those who are already on hypertension management regimen. This will go a long way in reducing the risk of one developing Diabetes mellitus and ultimately leading to the reduction in the prevalence of adverse perinatal outcomes associated with diabetes mellitus.

4.4. Maternal outcomes related to diabetes in pregnancy

The study revealed that, 17.5%(94) of those who had diabetes in pregnancy had caesarean delivery, 10.9%(58) had pre-eclampsia, 3.25(17) had miscarriages, 4.9%(26) had still births, 0.8%(4) had pre-term labour, 1.9%(10) had vaginitis and 0.8%(4) had hypoglycaemic attacks. In other studies , diabetes in pregnancy has mainly associated with age more than 25 years, body mass index, family history of diabetes, history of intra uterine death, gestational diabetes in previous pregnancy, candidiasis and thyroid disease (Renji et al., 2017). Approximately 21.4 million live births in 2013 in China were complicated by hyperglycaemia, of which 16% resulted from pre-existing diabetes complicating pregnancy, with gestational diabetes accounting for the rest (International Diabetes Federation, 2013).

This study revealed that there was statistically significant association between diabetes in pregnancy and the following maternal outcomes: In this study, the following factors had a statistically significant association with the occurrence of diabetes in pregnancy: Pregnancy included hypertension/ pre-eclampsia OR 0.054 CI (0.0031; 0.98), Miscarriage 5.58 CI (1.61; 19.31), Birth weight more than 4 500g OR 12.96 CI (3.45; 48.68). From this study it seems diabetes in pregnancy had a protective effect in one getting pre-eclampsia contrary to what other studies have found. This may be explained by the fact that most diabetics are frequentlychecked for blood hence there is a high probability of ruling out pre-eclampsia by frequent blood measurements.A study in Japan revealed an associationpregnancy-induced hypertension with pre-gestational body mass index, gestational weight gain, chronic hypertension, and nulliparity but not with 75-g oral glucose tolerance test(Sugiyama et al., 2014).

4.5. Neonatal outcomes related with diabetes in pregnancy

Adverse neonatal outcomes have been associated with diabetes in pregnancy. Our study revealed that the following adverse neonatal outcomes occurred in pregnant women with diabetes mellitus: Neonatal death 4.5%(24), pre-term birth 3%(16), Low Apgar score 13.7%(73), birth weight more than 4500g 5.1%(27), low birth weight 13.7%(73), hypoglycaemia 0.8%(4), birth injury 0.4%(2) and still births 2.3%(12).

Similar studies has also shown that there is a significant association diabetes in pregnancy and neonatal outcomes. A similar study in the United States showed associations of diabetes to higher rates of prematurity, birth weight >90th centile, newborns admitted to neonatal intensive care unit (NICU), instrumental delivery and cesarean delivery (all $p<0.005$).Planned pregnancy was found to be a significant protective factor (odds ratio, 0.15; $p <0.001$).

A study in Southern Thailand revealed that pre-term birth and foetal intrauterine growth restriction are associated with diabetes in pregnancy (Hanprasertpong & Hanprasertpong, 2015). In this study, there were nostill birth but low Apgar score was also an adverse neonatal outcome in child born of women with diabetes in pregnancy. It is then clear from these studies that effective managemet of diabetes in pregnancy will go a long in improving neonatal outcomes. This inlvoves effective treatment and lifestyle adjustment.

Conclusion

The study confirmed that diabetes in pregnancy is quiet high in Zimbabwe. Diabetes in pregnancy has been proven in this study to be associated with poorer maternal and neonatal outcomes and there is a strong need for further research on how risk factors associated with adverse pregnancy outcomes, particularly in type 2 diabetes can be averted. Policy makers have to formulate effective strategies to improve maternal and neonatal outcomes for women with diabetes in pregnancy. A collaborative effort and mutual agreement between servces providers and recepients of care is a prerequisite for the successful management of diabetes in pregnancy and this eventually leads to better maternal and neonatal outcomes.

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