

# ATLANTIC DIP: Pregnancy Outcome for Women With Pregestational Diabetes Along the Irish Atlantic Seaboard

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**OBJECTIVE** — Prospective evaluation of pregnancy outcomes in pregestational diabetes along the Atlantic seaboard 2006–2007.

**RESEARCH DESIGN AND METHODS** — The Atlantic Diabetes in Pregnancy group, representing five antenatal centers in a wide geographical location, was established in 2005. All women with diabetes for >6 months before the index pregnancy were included. Results were collected electronically via the DIAMOND Diabetes Information System. Pregnancy outcome was compared with background rates.

**RESULTS** — There were 104 singleton pregnancies. The stillbirth rate (25/1,000) was 5 times, perinatal mortality rate (25/1,000) 3.5 times, and congenital malformation rate (24/1,000) 2 times that of the background population. A total of 28% of women received prepregnancy care, 43% received prepregnancy folic acid, and 51% achieved an A1C  $\leq$ 7% at first antenatal visit.

**CONCLUSIONS** — Women are not well prepared for pregnancy, and outcomes are suboptimal. A regional prepregnancy care program and centralized glucose management are urgently needed.

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**R**obust information is lacking on pregnancy outcomes in women with diabetes in the Republic of Ireland. Along the Atlantic seaboard, there are five centers and 11,000 deliveries annually. A partnership occurred in 2005 with a focus on research, audit, clinical care, and professional and patient education (ATLANTIC DIP). This partnership is facilitating a number of projects, the results of which will shape future care. This report outlines the current position regarding pregnancy outcomes in women with established diabetes.

**RESEARCH DESIGN AND METHODS** — The ATLANTIC DIP network established an electronic link be-

tween centers using DIAMOND (Hicom, Woking, U.K.), a diabetes clinical information system for data collection. DIAMOND is hosted at the central location as a secure service. Data captured in the peripheral clinics are consolidated in real time within the central DIAMOND database and made available in anonymized form for analysis and reporting.

We studied women with established diabetes for >6 months before the index pregnancy in 2006–2007. Women were managed according to local guidelines. Five values of A1C at the first visit; at 12, 24, and 36 weeks; and before delivery were chosen to represent the metabolic control. An ophthalmologist evaluated for retinopathy. Information regarding microalbuminuria

(30–300 mg/24 h), diabetic nephropathy (>300 mg/24 h), hypertension (pregestational treatment or a blood pressure >140/90 at first antenatal visit), pregnancy-induced hypertension (blood pressure >140/90  $\times$  two measurements), pre-eclampsia (onset of blood pressure and proteinuria >300 mg/24 h after 20 weeks), preterm delivery <37 weeks gestation, large for gestational age (birth weight >4 kg), and small for gestational age (birth weight <2.5 kg) were recorded. Congenital malformations were those causing death or significant disability or those requiring surgical intervention. Perinatal mortality was defined as fetal death after 24 weeks and within 1 week of delivery. Results were compared with those in the background population (1).

**RESULTS** — A total of 104 pregnancies occurred: 80 in women with type 1 diabetes and 24 in women with type 2 diabetes. Women with type 1 diabetes were younger, with a mean age of  $33 \pm 5.7$  years (means  $\pm$  SD) compared with a mean age of  $36 \pm 4.4$  years in women with type 2 diabetes ( $P = 0.04$ ; 95% CI 0.115–5.02). A total of 8 and 13% with type 1 and 2 diabetes, respectively, were aged >40 years. Diabetes was present for a mean of 14 and 5 years in type 1 and type 2 diabetes ( $P = 0.0001$ ; 95% CI 6.7–11.3). A total of 16 (18%) women had retinopathy, 7 (8%) had renal disease, and 3 (3%) had hypertension at booking. There were 50% who were overweight (BMI >25 to <30 kg/m<sup>2</sup>), and 18% were obese (BMI >30 kg/m<sup>2</sup>).

A total of 28% received prepregnancy care. A formal prepregnancy care clinic occurred centrally with an uptake of 65%. In the four peripheral centers, prepregnancy care occurred in routine diabetes clinics with an uptake of 14%. The folic acid uptake was 43%.

Although 51% had a booking A1C  $\leq$ 7%, the mean booking A1C was 7.8%, decreasing to a mean of 7.4 and 6.2% at the end of the first and second trimester, respectively. A1C rose to a mean of 6.6 and 7.2% at the end of the third trimester and pre-delivery, respectively. A1C was better in women with type 2 diabetes.

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Table 1—Pregnancy outcomes in peripheral and central hospitals of the ATLANTIC DIP collaboration

	Peripheral	Central
<i>n</i>	73	31
Live births	54 (74)	25 (81)
Miscarriage	17 (23)	6 (19)
Stillbirth	2 (3.6)	0
Malformations	2 (3.6)	0
Small for gestational age	4 (7)	0
Large for gestational age	16 (30)	5 (20)
Neonatal unit care	45 (83)*	5 (20)
Prepregnancy care	10 (14)*	20 (65)

Data are *n* (%). \**P* = 0.0001.

There was no significant difference in A1C achieved in central compared with peripheral hospital sites.

Pregnancy-induced hypertension/preeclampsia was three times more common in women with (14%) than in those without (5%) diabetes. Caesarean section rates were greater in women with (43%) than in those without (27%) diabetes. The elective caesarean section rate was similar at 18 and 14%, but emergency caesarean section rates were greater in women with (25%) than in those without (13%) diabetes.

There were 23 (22%) miscarriages, 79 (76%) live births, 2 (2%) stillbirths, and no neonatal deaths. The stillbirth rate (25/1,000) was 5 times greater and the perinatal mortality rate 3.5 times greater than background but similar to reported U.K. Confidential Enquiry to Maternal and Child Health figures. Two babies were born with congenital abnormalities (congenital malformation rate 24/1,000) to mothers with A1C levels of 6.6 and 5.4% at booking. All stillbirths and malformations occurred at peripheral sites, as did a great proportion of miscarriages (Table 1). A total of 83% of babies were born at term. A total of 12 and 3% of babies from mothers with and without diabetes were delivered preterm, and 32 and 17%, respectively, weighed >4 kg at birth. There was a greater proportion of large-for-gestational-age babies at peripheral (30%) compared with central sites (20%). All small-for-gestational-age babies (7%) were born at peripheral sites (Table 1).

There were 48% with, compared to 11% without, diabetes admitted for neonatal unit care. A total of 83 and 20% of babies at peripheral and central locations, respectively, received neonatal unit care (Table 1). Hypoglycemia (32%), polycythemia (14%), jaundice (5%), and respiratory distress (5%) were reported on admission.

**CONCLUSIONS**— The ATLANTIC DIP program is well established, and a number of projects are ongoing. This is the first attempt to systematically examine regional pregnancy outcomes and use a novel mode of data collection (DIAMOND). Diabetic pregnancy outcomes have been reported to be better in central compared with peripheral locations (2), and these findings have been confirmed by this study, where perinatal mortality (stillbirth rate/perinatal mortality rate) and morbidity (neonatal unit admissions, congenital malformation rate, infant size at birth) are more satisfactory at the central compared with the peripheral sites.

Prepregnancy care plays an important role in reducing congenital malformations and improving perinatal (3,4) and infant morbidity (5–10) through a combination of factors such as glucose control, folic acid uptake, and removing teratogenic drugs. Prepregnancy care is lacking in the region, with only 14% in peripheral sites and 65% centrally receiving it. A total of 50% have a suboptimal booking A1C and folic acid uptake. Suboptimal outcomes are proportionally greater in peripheral compared with central locations, where formal prepregnancy care is unavailable. Although A1C values do not differ between locations, prepregnancy care will have addressed the impact of teratogenic drugs, rubella screening, folic acid uptake, and smoking and alcohol intake factors known to influence pregnancy outcome.

Pregnancy outcomes therefore may be improved by a regional protocol-driven prepregnancy care program. The literature would suggest a 50% reduction in adverse events with such a program. Centralization of glucose management using telemedicine technology would complement a prepregnancy care program. These interventions are likely to make a significant contribution to the health of these

women and significantly improve the outcome of their pregnancies.

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