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# The associations of anthropometric measurements with subsequent gestational diabetes in Aboriginal women

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## KEYWORDS

Gestational diabetes;  
Waist circumference;  
Waist-to-height ratio;  
BMI;  
Aboriginal women

## Summary

**Problem:** To evaluate the associations of different anthropometric measurements on earlier exam with subsequent gestational diabetes mellitus (GDM) in Aboriginal women.

**Methods:** This is a nested case–control study. Anthropometric measurements were conducted at baseline from 1992 to 1995 in a remote Aboriginal community. All subsequent pregnancies among the original participants were identified through review of hospital records of 20 years. Thirty-two women developed GDM and 99 women were hospitalised for pregnancy-related conditions other than GDM. The association between body mass index (BMI), weight, height, waist circumference, hip circumference, waist-to-hip ratio and waist-to-height ratio with subsequent GDM was examined.

**Results:** Our results showed an increased risk of GDM with increase in one standard deviation of BMI (OR=2.0; 95% CI: 1.3, 3.1), weight (OR=1.7; 95% CI: 1.1, 2.7), waist circumference (OR=1.8; 95% CI: 1.1, 3.0) and waist-to-height ratio (OR=2.3; 95% CI: 1.4, 3.9). High BMI (BMI  $\geq$  25 kg/m<sup>2</sup>) was associated with subsequent GDM (OR=2.8; 95% CI: 1.0, 7.8).

**Conclusions:** BMI and waist-to-height ratio are better predictors than other anthropometric indices of GDM in Aboriginal women. Given that these measures are associated with future GDM, interventions to reduce BMI, weight and waist circumference in young women need to be assessed for their potential to prevent GDM.

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## Introduction

Insulin resistance, impaired glucose tolerance, gestational diabetes and Type 2 diabetes are important health problems for Australian Aboriginal people. While this is recognised, many of the risk factors for gestational diabetes mellitus (GDM) are assumed to be the same for Aboriginal and non-Aboriginal women. However, it is possible that risk factors for adverse pregnancy outcomes such as GDM may vary between Aboriginal and non-Aboriginal women, particularly given substantial differences in their body shapes [1–3]. In order to indicate the adiposity distribution, anthropometric measurements are simpler and less expensive to collect than adiposity imaging techniques [4].

Comparison of different anthropometric measurements of Aboriginal women with non-Aboriginal women have shown that Aboriginal women are significantly lighter than other women but have higher waist circumferences and waist-to-hip ratios [5]. These characteristics are associated with some of the most common chronic conditions such as hypertension and type 2 diabetes [6–9], which lead to almost a decade gap in life expectancy between Aboriginal and non-Aboriginal people [10].

Aboriginal women experience higher rates of pregnancy-related complications, such as GDM, than non-Aboriginal women [11]. Pregnancy-related conditions, such as GDM, are associated with adverse long-term outcomes, such as chronic hypertension and diabetes after pregnancy, and a higher risk of maternal and perinatal mortality in severe cases [12–14]. Prevalence of chronic conditions and complications during pregnancy are considerably higher in Aboriginal than non-Aboriginal populations. For instance, from 1999 to 2006, the rates of both GDM and type 2 diabetes increased simultaneously [15].

Campbell et al. assessed the associations of body mass index (BMI) and waist circumference with diabetes in pregnancy in Aboriginal women [16]. However, other anthropometric measurements, such as waist-to-height ratio, could predict GDM better than BMI and waist circumference [8,17]. The association between GDM and anthropometric measurements other than BMI and waist circumference have not been well reported in Aboriginal women and require further investigation.

This study aims to assess the associations of anthropometric measurements, such as waist and hip circumferences, waist-to-hip and waist-to-height ratios, in addition to BMI, measured up to 20 years prior to pregnancy, with GDM in Aboriginal women. The results of this study will assist health carers and health promoters to identify other

obesity related risk factors than BMI, which may be better predictors of GDM in Aboriginal women.

## Materials and methods

This is a nested case–control study. Two existing databases, including baseline and hospitalisation, were used in this study. Participants in this study were members of a remote Aboriginal community in the Northern Territory (NT), Australia aged 5+ years who participated in one or two community-wide health screenings performed in 1992–1996 and in 2004–2006. More than 80% of the adult people (age  $\geq 20$ ), except for menstruating females, and people who were hospitalised or on dialysis, participated in each screening [18]. Each adult participant gave written informed consent to the screening; while parents gave informed consent on behalf of the children.

The hospitalisation database included hospital records and emergency admissions of individuals within the public health system in the NT. The hospitalisation data were recorded according to the International Classification of Disease (ICD) 9 and ICD 10-AM codes (Table 1). All participants were followed up from the date of baseline examination to 31 May 2012, during which a diagnosis of GDM were identified through hospital records. Two databases, the baseline screening and the hospitalisation database, were merged using the patients' hospitalisation registration numbers. Women with the hospital admissions prior or during baseline were excluded, due to the potential impact of the pregnancy on their baseline anthropometric data. The protocol of the screening programmes was approved by the Tiwi Land Council and by the Ethics Committees of the NT Health Services of the Menzies School of Health Research and Territory Health Services and the Behavioural and Social Science Ethical Review Committee of the University of Queensland. This project was approved by the University of Queensland Ethics Committee.

## Pregnancy and GDM ascertainment

From a total of 707 females who participated in the original study, 265 women had a record of pregnancy-related hospitalisations during the follow-up. Of them, 246 women had complete pregnancies (pregnancies without abortive outcomes) and 172 records of pregnancy-related hospital admissions after baseline (Fig. 1). Since the number of participants under the age of 15 at baseline was too small to calculate the z-scores of

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