

Child Growth and Type 2 Diabetes Mellitus in a Queensland Aboriginal Community

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This thesis contains references to, and photographs of, people who may have died.

Statement of authorship

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

All research procedures reported in the thesis were approved by the relevant Ethics Committee.

Signed

Date

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Notes on terminology

Aboriginal / Indigenous / Murri

The definition of Indigenous used in this study pertains to those people who satisfy three criteria. Firstly, that they must have Indigenous genetic heritage; secondly, that they identify themselves as Indigenous; and thirdly, that they are recognised and accepted by the community as such (Council for Aboriginal Reconciliation 1994). This study focuses more on the social contexts that might promote diabetes rather than on any genetic predisposition, and hence the 'quantity' of an individual's Indigenous genetic heritage is not considered.

'Indigenous' refers inclusively to both Aboriginal and Torres Strait Islander people, whereas 'Aboriginal' is more specific relating to the Australian mainland and Tasmania. The term 'Murri' specifically refers to Aboriginal people from the region of Queensland where the study took place. By far the majority of people in Cherbourg identify themselves as Aboriginal (Murri).

Acculturation

In this thesis, acculturation refers to the degree to which Indigenous groups have adopted, or been compelled to adopt, a more Westernised (see below) lifestyle.

Black and white

These terms are principally used to situate the field-site in its historical context and in the comparisons made between the study community and its nearby towns. 'Black' refers to people who identify themselves as Aboriginal, while 'white' refers to people primarily of European descent, such as the settlers to the area in the nineteenth century. The terms 'non-Aboriginal' and 'non-Indigenous' are more inclusive than 'white'.

Traditional / pre-colonial / pre-European / contemporary

It has been noted by de Courten *et al.* (1998) and others that the use of 'traditional' to describe broad characteristics of lifestyle can be problematic; it could refer to both pre-colonial or remote contemporary groups and implies discontinuity between pre- and post-contact with Europeans. The term also masks the variation in modes of living that occur in different communities. The term 'traditional' refers to aspects of lifestyle that are pre-industrial, signifying aspects of a gathering and hunting lifestyle, and 'contemporary' and 'pre-European' or 'pre-colonial' is used to qualify the time-period under discussion where necessary. For example, O'Dea and

Spargo (1982) use the term ‘contemporary traditional’ to refer to communities where a hunting and gathering lifestyle is maintained post-colonially.

Type 2 diabetes

In Aboriginal Australia, Type 1 diabetes mellitus accounts for an estimated 1-2% of diabetes cases (de Courten *et al.* 1998), while Type 2 diabetes mellitus is a far more important health issue (Chapter Three). Gestational diabetes (diabetes first diagnosed during pregnancy) plays a not insignificant role. When ‘diabetes’ is used in this dissertation without further qualification, it refers to Type 2 diabetes.

Westernisation / modernisation

‘Westernisation’ or ‘modernisation’ implies a predetermined end point with a defined set of stages, as if it is the same experience for all ‘Westernised’ populations. While there are certainly some similarities between experiences, the manners and the methods, in addition to the sociocultural context, differ greatly. ‘Westernised’ is used in this thesis in preference to ‘modernised’ as it carries with it less of an implied notion of value. It is used to refer in particular to broad patterns of lifestyle change, namely increases in quantity and changes to quality of nutritional intake and reductions in physical activity. Caldwell and Caldwell (1996) make a distinction between these two terms: ‘modernisation’ refers to underlying structural economic changes while ‘Westernisation’ refers to any accompanying lifestyle changes.

Abbreviations

ABS	Australian Bureau of Statistics
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIHW	Australian Institute of Health and Welfare
AIM	Australian Inland Mission
ANOVA	analysis of variance
BACCA	Barambah Aboriginal Community Case Agency
BMI	body mass index (weight (kg) / height (m) ²)
BSL	blood sugar (glucose) level, measured in mmol/l
CDC	Centers for Disease Control and Prevention (USA)
CDEP	Community Development Employment Projects
CHD	coronary heart disease
CVD	cardiovascular disease
DAIA	Department of Aboriginal and Islander Affairs (later Advancement) (Queensland)
DOGIT	Deed of Grant in Trust
ESRD	end-stage renal disease
FBSL	fasting blood sugar (glucose) level
FFA	free fatty acids
FFQ	food frequency questionnaire
HBW	high birthweight (>4500g)
HPA	hypothalamic-pituitary-adrenal axis
IFT	impaired fasting glucose
IGF	insulin-like growth factors
IGT	impaired glucose tolerance
IHC	infant health clinic
IHD	ischaemic heart disease
IUGR	intrauterine growth retardation
LBW	low birthweight (<2500g)
LGA	large for gestational age
LMP	last menstrual period
NCHS	National Center for Health Statistics (USA)
NHMRC	National Health and Medical Research Council
OGTT	oral glucose tolerance test
PI	ponderal index (height ³ √weight (kg))
SES	socioeconomic status
SGA	small for gestational age
SLA	statistical local area
SMR	standardised mortality ratio
SSF: TSF	subscapular: triceps skinfold ratio
UTI	urinary tract infection
W//A	weight-for-age
W//H	weight-for-height
WHO	World Health Organization
WHR	waist-hip ratio
YACCA	Youth and Community Care Agency

Abstract

Globally, the prevalence of Type 2 diabetes is rising. The most affected populations are those that have undergone recent and rapid transition towards a Western lifestyle, characterised by energy-dense diets and physical inactivity.

Two major hypotheses have attempted to explain the variation in diabetes prevalence, both between and within populations, beyond the contributions made by adult lifestyle. The thrifty genotype hypothesis proposes that some populations are genetically well adapted to surviving in a subsistence environment, and are predisposed to develop diabetes when the dietary environment changes to one that is fat and carbohydrate rich. The programming hypothesis focuses on the developmental environment, particularly on prenatal and early postnatal conditions: nutritional deprivation *in utero* and early postnatal life, measured by low birthweight and disrupted child growth, is proposed to alter metabolism permanently so that risk of diabetes is increased with subsequent exposure to an energy-dense diet. Both hypotheses emphasise discord between adaptation (genetic or developmental) and current environment, and both now put forward insulin resistance as a likely mechanism for predisposition.

Diabetes contributes significantly to morbidity and mortality among Australia's Indigenous population. Indigenous babies are more likely to be low birthweight, and typical patterns of child growth include periods of faltering and rapid catch-up. Although there have been numerous studies in other populations, the programming hypothesis has not previously been tested in an Australian Indigenous community. The framework of the programming hypothesis is thus expanded to consider exposure of whole populations to adverse prenatal and postnatal environments, and the influence this may have on diabetes prevalence.

The present study took place in Cherbourg, a large Aboriginal community in southeast Queensland with a high prevalence of diabetes. Study participants were adults with diagnosed diabetes and a random sample of adults who had never been diagnosed with diabetes. Data were collected on five current risk factors for diabetes (general and central obesity, blood pressure, age and family history), in addition to fasting blood glucose levels. A lifestyle survey was also conducted. Participants' medical records detailing weight growth from birth to five years were analysed with regard to adult diabetes risk to determine whether childhood weight and rate of weight gain were associated with subsequent diabetes. Adult lifestyle factors were

also explored to determine whether variation in nutrition and physical activity was related to level of diabetes risk.

Approximately 20% of adults in Cherbourg have diagnosed diabetes. Prevalence may be as high as 38.5% in females and 42% in males if those who are high-risk (abnormal fasting glucose and three additional factors) are included. Among those over 40 years, total prevalence is estimated to be 51% for females and 59% for males.

Patterns of early childhood growth may contribute to risk of diabetes among adults. In particular, relatively rapid weight growth to five years is associated with both general and central obesity among adult women. This lends some qualified support to the programming hypothesis as catch-up growth has previously been incorporated into the model; however, although the most consistent association was found among those who gained weight more rapidly, it was also found that risk is increased among children who are heavier at any age.

No consistent associations were found between intrauterine growth retardation (as determined by lower than median birthweight and higher than median weight growth velocity to one and three months) and diabetes risk among women or men. A larger study sample with greater statistical power may have yielded less ambiguous results.

Among adults, levels of physical activity may be more important than nutritional intake in moderating diabetes risk, although features of diet, such as high intake of simple carbohydrates, may contribute to risk in the community overall, especially in the context of physical inactivity. A genetic component is not ruled out. Two additional areas which require further investigation include stress and high rates of infection, both of which are highly relevant to the study community, and may contribute to the insulin resistance syndrome.

Some accepted thresholds indicating increased diabetes risk may not be appropriate in this population. Given the relationship between waist circumference and other diabetes risk factors and the propensity for central fat deposition among women even with low body mass index (BMI), it is recommended that the threshold where BMI is considered a risk be lowered by 5kg/m^2 for women, while no such recommendation is made for men.

There are a number of social barriers to better community health, including attitudes to exercise and obesity, patterns of alcohol and tobacco use and consumption of fresh foods. Some of these barriers are exacerbated by gender roles and expectations.