# Prevalence of abnormal oral glucose tolerance with concomitant dyslipidaemia: implications for cardiovascular risk assessment in prediabetes

A report from Norway published in 1994 indicates incidence of up to 45% in abnormal oral glucose tolerance tests (OGTTs), including 33% which suggest prediabetes.[1] Some 18 years after publication of that report, there continues to be a lack of corroborative data from other countries. Recent publications indicate that glucose measurement identifies only approximately 10% of adults, although the authors acknowledged that "epidemiology of prediabetes depends on the diagnostic method used".[2] Although OGTT has been regarded as inconsistent, inconvenient and poorly reproducible,[3] it continues to provide predictive advantage to the use of fasting blood glucose (FBG) alone. Thus, its abandonment is not recommended.[3,4] Indeed, it remains a cornerstone in the recent recommendations on the diagnosis and classification of hyperglycaemia in pregnancy.[5–7]

The present work reviews data from the South West Pathology Service (SWPS) of NSW Health, which covers the south-western region of New South Wales, as well as the adjoining north-east region of Victoria, Australia. The first objective is to determine, using archived clinical pathology data (ACPD) on OGTT, the prevalence of prediabetes in an Australian region.

In a previous report,[8] the authors recommended that in order to perform appropriate logistic regression to generate a working screening model for assessment of cardiovascular risk in prediabetes (ACRP), there needs to be baseline measurements of the required variables during the prediabetes phase. The rationale was that such an approach would be more accurate, even without controlling for medication, when levels of the variables are taken at baseline and then at the time of diagnosis of diabetes and cardiovascular co-morbidity on the same set of individuals.[8]

The second objective is to determine epidemiological data on the subpopulation of prediabetes with baseline values that would qualify for inclusion in a longitudinal study for ACRP.

This work was supported by Albury South West Pathology, a unit of the Western Pathology Cluster of NSW Health Australia. The Ethics Committee of the Area Health Service approved the use of deidentified data. The database comprised 10 years of archived clinical pathology data (ACPD) from January 1999 to December 2008. All OGTT tests ($n$=5126) performed in the 10-year period were audited. This included 615 antenatal and 4511 other cases. Prediabetes in this report refers to all cases reported to be consistent with either impaired glucose tolerance or impaired fasting glucose. Dyslipidaemia refers to reports indicating a total cholesterol (TC):high-density lipoprotein (HDL) ratio >5.5.

Counts of cases reported as indicating diabetes mellitus, gestational diabetes or prediabetes were determined. These were evaluated as the percentage of antenatal and other subpopulations to determine the prevalence of gestational diabetes and prediabetes, respectively. Fasting blood glucose results and lipid profiles were evaluated for dyslipidaemia associated with fasting hyperglycaemia. Comparison between the normal subpopulation and abnormal subpopulations was performed. Cholesterol profile data were available in the reports for normal ($n$=324), diabetes ($n$=101) and prediabetes ($n$=206) subgroups. Comparison using multivariate analysis of variance

**Table 1.** Comparative descriptive statistics of FBS and cholesterol profile between subgroups.

| | | TC | Trig | HDL | TC/HDL | FBS |
|---|---|---|---|---|---|---|
| Mean | Control | 5.2 | 1.6 | 1.3 | 4.1 | 5.1 |
| | DM | 5.4 | 2.5 | 1.1 | 5.0 | 7.3 |
| | PreDM | 5.2 | 2.2 | 1.3 | 4.3 | 5.9 |
| Median | Control | 5.1 | 1.3 | 1.2 | 3.8 | 5.1 |
| | DM | 5.5 | 2.1 | 1.1 | 5.0 | 6.9 |
| | PreDM | 5.2 | 1.6 | 1.2 | 4.2 | 5.8 |
| SD | Control | 1.1 | 1.0 | 0.4 | 1.4 | 0.5 |
| | DM | 1.2 | 1.7 | 0.3 | 1.5 | 1.8 |
| | PreDM | 1.0 | 2.6 | 0.4 | 1.3 | 0.7 |

FBS: Fasting blood glucose result prior to 75g glucose; DM: diabetes mellitus; PreDM: prediabetes; TC: total cholesterol (mmol/L); Trig: triglycerides; TC/HDL: total cholesterol over high-density lipoprotein ratio.

(MANOVA) was performed on randomly selected equal-sized groups ($n$=101 per group, based on the diabetes group) using S-Plus.

A summary of the results shows that, on average, 19.5% of antenatal cases were suggestive of gestational diabetes. 53.8% of other cases were abnormal, including 33.5% and 20.3% reported as consistent or indicative of prediabetes and diabetes, respectively. Descriptive statistics of the subpopulations studied are presented in Table 1. Further evaluation for dyslipidaemia associated with hyperglycaemia showed 28% of those reported as consistent with diabetes have dyslipidaemia, of which all presented with FBG ≥5.6 mmol/L. Seventeen percent of each of those reported as normal and those indicative of prediabetes had dyslipidaemia, but there was apparent disparity in the fractions associated with fasting hyperglycaemia (Fig. 1).

This brief evaluation shows that 53.8% of OGTTs, including 33.5% prevalence of prediabetes, require follow-up for either clinical or subclinical diabetes management. These observations are in accord with those from Norway.[1] A position statement by the Australian Diabetes Society indicated the prevalence of prediabetes in Australia to be approximately 16%;[9] however, the epidemiological data from the authors' region indicates that the prevalence may now be greater.

A cursory evaluation of the descriptive statistics (Table 1) may not reveal apparent differences between subpopulations reported as normal, diabetes or prediabetes. However, critical evaluation shows 100% and 74% dyslipidaemia was associated with fasting hyperglycaemia at the time of laboratory diagnosis of diabetes mellitus and prediabetes, respectively, and a 61% association in the normal group (Fig. 1).

There are concerns that the current definition of prediabetes may underestimate the implication of this disorder, especially in high-risk individuals who have lower glucose levels.[5,6] Considering the additional risk effect of dyslipidaemia to hyperglycaemia in causing diabetic complications, the present evaluation contributes additional laboratory evidence-based data to that already available regarding cardiovascular risk.

The information presented here represents laboratory evidence of a higher prevalence of prediabetes than previously published, and a demonstration of the potential of ACPD to identify correctly the prevalence of prediabetes and those subjects who would qualify for cardiovascular risk assessment.

In conclusion, the prevalence of patients with abnormal OGTT, fasting hyperglycaemia and concomitant dyslipidaemia indicates that a larger proportion of the prediabetes subpopulation has normolipidaemia at the time of diagnosis. Furthermore, the use of ACPD would facilitate longitudinal study and appropriate logistic regression to generate a screening model for cardiovascular risk assessment. □

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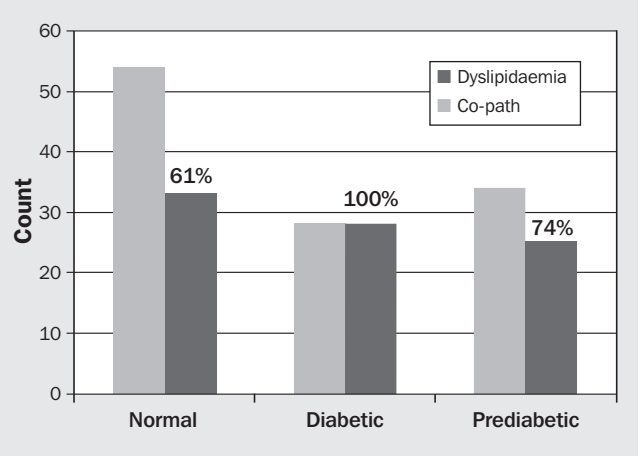


**Fig. 1.** Comparison of dyslipidaemia associated with fasting hyperglycaemia.

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