Performance of a research diet history for use in clinical studies involving pregnant women with and without gestational diabetes mellitus in the Illawarra region, New South Wales

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Abstract

Objective: To assess the validity and reliability of a research diet history for use in clinical studies of gestational diabetes mellitus (GDM) in the Illawarra region, New South Wales.

Design: Diet history interviews conducted at the diabetes service for women with GDM and the prenatal clinic for matched normal glucose tolerant women. The glucose tolerant women provided a repeat diet history two weeks later along with a seven-day weighed food record.

Subjects: Fourteen women with GDM and 19 normal glucose tolerant women provided a diet history. Seventeen glucose tolerant women provided food records, and 17 glucose tolerant women provided a repeat diet history.

Setting: Illawarra area diabetes service and prenatal clinic, Wollongong hospital, NSW.

Main outcome measures: Reported energy and macronutrient intakes.

Statistical analysis: Differences in under-reporting in GDM and normal glucose tolerant women assessed by Chi square analysis. Reliability and relative validity assessed using paired t-tests and Pearson’s product moment correlation. The number and percent of paired diet history-food record values with > 20% discrepancy were examined. Bland-Altman plots were established to view agreement between diet history and food record data and subsequent regression analysis was applied to assess the extent of systematic bias.

Results: The data from the first diet history were plausible. There was no difference between energy and macronutrient data (P > 0.05) and there were correlations between measures (P < 0.05) from repeat diet histories and between diet history and food record data. The degree of discrepancy between diet history and food record data pairs was reasonable. There was no evidence of systematic bias between the diet history and seven-day weighed food record for energy and macronutrient intake measurements.

Conclusions: In the absence of dietary counselling, the diet history in this setting was reliable and provided valid results relative to seven-day weighed food record data and with reference to cut-off limits for plausible reporting of energy intakes. (Nutr Diet 2002;59:127–134)

Key words: diabetes, gestational; diet surveys; reproducibility; validity

Introduction

Gestational diabetes mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy (1). A diagnosis of GDM has implications for the immediate outcome of the pregnancy as well as the long-term health of both the infant and the mother (2). Women develop GDM if they are unable to raise their insulin secretion to overcome the increased peripheral resistance found in pregnancy (3). Insulin resistance in Type 2 diabetes mellitus has been linked to the fatty acid profile of phospholipids in the skeletal muscle membrane (4). In pregnancy, cross-sectional research by our group has suggested in Caucasian women (5) and Chinese women (6) that the development of GDM may be linked to the fatty acid composition of the diet, and these trends have recently been confirmed in an Italian study (7). An intervention trial will test this relationship, but first method development is warranted to assure valid and reliable dietary data in that setting (8). Here it will be necessary to assess usual eating patterns, modify dietary patterns and monitor change and a number of approaches may be required to achieve all three.

In terms of assessment, the food frequency questionnaire (FFQ) has been shown to assess dietary intakes and stages of change in the maternal diet (9,10), but the method does not address meal patterns (which assists counselling for change) and is limited by the foods listed. In contrast, the open-ended diet history has the advantage of capturing meal patterns (11,12) but potentially lacks standardisation. In this sense, the diet history in counselling is quite different to that in research. Food records are often perceived as the standard method in research, but there is an assumption that actual (current) intake equals usual (past) intake and there is an associated respondent burden, amplified if participants are required to weigh food items. The choice of method, therefore, depends on a number of factors, where the main consideration is the study context and the procedures this allows.
Within a clinical research context, a number of approaches may be applied to establish the reliability and validity of the reference dietary assessment method. Reliability of the data is assessed by repeat measures. This assumes a complete replication of dietary behaviour, which is problematic in an everyday sense, and even more so where clinical management intervenes. Validity can be assessed with reference to a criterion measure (such as cut-off limits) and/or relative to data from another method (such as a food record). To assess criterion validity, comparing values for energy intake (EI) to those for basal metabolic rate (BMR) may identify under-reporting of energy intakes. Although large differences have been found between individuals in the metabolic cost of pregnancy the application of cut-off limits based on EI:BMR ratios has been shown to concur with classifications based on measured BMR values within this population. Still, the cut-off values only identify gross bias of energy reports at the individual level. To assess relative validity, reported macronutrient intakes from one method can be compared to data produced from another. Ideally the source of error should be different, such as in food records and diet histories. Food records may affect food intake, whereas diet histories are vulnerable to memory lapses and tendencies to exaggerate or minimise intakes. A range of statistical approaches provides insights into how the two methods compare. An emphasis on variation within the group and variability in repeat measures is also of particular interest, as it reflects the nature of food choice patterns within a study population, and points to foods which may need to be given special attention in an interview setting. The ability of a method to monitor change (responsiveness) is assessed in the intervention context itself, and then with reference to the responsiveness of other methods and biomarkers. With all these issues in mind, the aim of this study was to assess the reliability and validity of a research diet history in the context of a clinical setting involving women with and without GDM in the Illawarra region, NSW.

Methods

Subjects

All pregnant women in the Illawarra region are referred to have a test for GDM and about 90% comply. Unless indicated earlier, this is performed at the beginning of the third trimester using a 75 g oral glucose tolerance test. No preliminary challenge test is used. Women are diagnosed with GDM if the fasting glucose is greater than 5.5mmol/L (100 mg%) and/or the two hour glucose is greater than 8.0mmol/L (145 mg%) and/or the two hour glucose is 5.5mmol/L (100 mg%) and/or the two hour glucose is greater than 8.0mmol/L (145 mg%) and/or the two hour glucose is greater than 8.0mmol/L (145 mg%) (23). The incidence of GDM in the Illawarra is 7.2% (24) that converts to approximately 140 cases diagnosed at the clinic per year. In the study reported here, pregnant women referred to the diabetes centre during August 1999 and January 2000 were verbally invited to participate. Two other diet-related studies involving women with GDM were underway at the same time and as these were potentially more interesting to participants they may have limited recruitment to this study. The first diet history was obtained before dietary counselling was provided. Glucose tolerant women (matched for age and prepregnancy weight to the women with GDM) were verbally approached at the prenatal clinic after the results of their glucose tolerance test were known. Thirty-three women agreed to participate in the validation study (14 with GDM and 19 with normal glucose tolerance). This number represented one third of the population sample required for the intervention trial, and was therefore considered sufficient.

Dietary assessment and analysis

The research diet history employed in this study encouraged a narrative style of reporting by participants, but allowed for systematic recording of dietary data by interviewers. Starting with the first meal of the day, participants were asked to describe their usual eating patterns over the last three months and to qualify their account with details of how much and how often individual foods were consumed. The method drew on our previously published research and pilot studies conducted with women attending the GDM screening clinic at Wollongong hospital. In the pilot studies, we identified the range of food groups consumed by these women through analysis of repeat 24-hour recall data from a randomly selected sub-sample from the clinic. We also analysed audio-taped recordings of open-ended diet history interviews with another randomly selected sub-sample, to identify common descriptors for foods and portion sizes, and ways participants described the frequency and amounts of foods consumed. This enabled the development of the structured recording form, with food groups already listed that were likely to be reported (for example, in the breakfast meal, cereals, toast and fruit). The form resembled a meal-based food frequency questionnaire, but interviewers needed to record specifications of foods within food groups and there was space to record foods not listed. At the end of the form, a core food group checklist and a set of questions on food preparation techniques were provided. Food models from commercial suppliers and empty packages of commonly consumed foods were used as prompts. Commercially produced pictures and metric measuring cups and spoons were used to assist with the estimation of portion size.

Four dietitians from the Illawarra diabetes service and the dietetic studies unit at the University of Wollongong collected dietary data. Given the study context, the dietitians could not be blinded to GDM status, as the women with GDM were attending the diabetes service for treatment, and the normal glucose tolerant women were recruited as a matched group. The dietitians were trained in the research dietary history method, and attended a number of meetings to review and compare records. A single dietitian entered the dietary data into the Foodworks nutrition software program (Xyris Software, Brisbane, Queensland, version 2.05, 1999) based on an Australian database on nutrient composition of foods. Assumptions such as substitutes for foods not listed on the database were recorded and made constant. On agreeing to participate, the first diet history was conducted in either the prenatal clinic or the diabetes service, where dietitians also collected data by self-report on age, current weight, prepregnancy weight gain, height, previous diagnoses of GDM and parity. Basal metabolic rate was estimated based on current weight. This enabled an estimation of the plausibility of dietary reports (criterion validity) from the full study sample. As the women with GDM would then undergo specific dietary counselling, it was not possible to

assess reliability nor validity relative to seven-day weighed food record data with these participants. However, it was assumed that if all the women displayed similar dietary reporting behaviours prior to dietary counselling, then this would hold for repeated measures obtainable only from the glucose tolerant women. At the time of the diet history interview, the glucose tolerant women were advised on maintaining a seven-day weighed food record, and agreed to provide a repeat diet history two weeks later. Metric cups and spoons and kitchen scales (Salter Slimmers Model 036, Salter Housewares Ltd, Tonbridge, UK) were provided along with recording forms, which were collected at the repeat diet history interview. The human research ethics committee of the University of Wollongong provided ethical approval for the study.

**Statistical analysis**

Dietary data were converted to nutrient values and expressed as mean and standard deviation (SD). Intakes of protein, carbohydrate, fat and alcohol were expressed as a percentage of total energy intake (% protein, % carbohydrate, % fat and % alcohol respectively). Intakes of monounsaturated (MUFA), polyunsaturated (PUFA) and saturated fat (SFA) were expressed as a percentage of the total fat intake (% MUFA, % PUFA and % SFA respectively). Criterion validity was determined by assessing the number of women reporting below the cut-off value of 1.14 for energy intake:basal metabolic rate (Ei:BMR). This value assumed a sedentary level of activity (PAL = 1.55) as described by Goldberg et al (13). The difference in proportions of women with or without GDM reporting below this level was assessed by Chi square analysis.

Reliability and relative validity were assessed using a number of statistical approaches. Differences between the repeat diet histories and between diet history and seven-day weighed food record data were first examined using Student’s t-test. In keeping with the literature (27), the SD of the difference (SDdiff) was used to assess variation in Student’s t-test. In keeping with the literature (27), the SD of the difference (SDdiff) was used to assess variation in

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Age (yrs)</th>
<th>Prepregnancy weight (kg)</th>
<th>Height (cm)</th>
<th>Parity (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational diabetes mellitus</td>
<td>14</td>
<td>32 ± 5</td>
<td>61 ± 14</td>
<td>161 ± 5(a)</td>
<td>2 ± 2(b)</td>
</tr>
<tr>
<td>Normal glucose tolerant</td>
<td>19</td>
<td>30 ± 5</td>
<td>67 ± 20</td>
<td>166 ± 6</td>
<td>1 ± 6</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>31 ± 5</td>
<td>64 ± 18</td>
<td>164 ± 6</td>
<td>1 ± 5</td>
</tr>
</tbody>
</table>

(a) significantly different from normal glucose tolerant at $P < 0.01$
(b) significantly different from normal glucose tolerant at $P < 0.05$

**Results**

**Sample**

Of the study sample, 19 normal glucose tolerant women and 14 women with GDM provided first dietary history. Of these, 17 normal glucose tolerant women provided a seven-day weighed food record, and 17 provided a second diet history (one woman provided neither a diet history nor a food record). The mean age of the study sample was 30.7 ± 5 years. There was no significant difference between the GDM and normal glucose tolerant participants in terms of age and reported prepregnancy weight. However, the subjects with GDM were shorter ($P < 0.05$) and had a greater parity ($P < 0.01$) (Table 1). Three women with GDM and one normal glucose tolerant woman had experienced a previous episode of GDM. Approximately equal numbers of women (eight with GDM and nine normal glucose tolerant) had gained more than 10 kg at the time of the first diet history.

**Criterion validity**

Of the normal glucose tolerant women, one subject consistently reported below the cut-off limits in the diet history and seven-day weighed food record, and another consistently under-reported in the diet history alone. Of the women with GDM, three participants reported below the cut-off limit. There was no significant difference between women with GDM and normal glucose tolerant women in the proportion reporting below cut-off limits. As we did not know the location of this under-reporting in the macronutrient subfracton, data from the five under-reporters were excluded from the analysis comparing intakes by GDM status (Table 2). This analysis showed no significant differences in energy and macronutrient intakes, with the exceptions of total energy and % fat ($P < 0.05$). As expected, reported alcohol consumption...
yielded SDs which were greater than the mean alcohol intake, bearing in mind that a number of subjects (10 normal glucose tolerant and seven GDM) reported not consuming alcohol at all, and that the intakes of the other subjects were highly variable.

Reliability

There were no significant differences in reported energy and macronutrient intakes between the first and second diet histories (Table 3). The SD\text{diff} was comparable to the SD for the mean intake for most macronutrients, but the SD\text{diff} for energy and for SFA were slightly higher indicating greater variability within these measurements. This was accentuated in the case of alcohol, where the SD\text{diff} was greater than the mean difference. There were significant correlation coefficients between repeat diet history values for all macronutrient assessments ($P < 0.01$ for protein, fat, carbohydrate, MUFA and SFA), and these values compared well with a previous study involving the narrative style research diet history conducted through our centre involving perimenopausal women (18). The correlation coefficient for energy was lower than observed in the previous study and was not significant ($r = 0.30, P > 0.05$).

Relative validity

The mean values for reported energy and macronutrient intakes from diet history and seven-day weighed food record data were not significantly different (Table 4). With the exception of alcohol, the mean differences for reported energy and macronutrient intakes were not large, and the SD\text{diff} compared well with the SD values for diet history and seven-day weighed food record data alone. The number of subjects reporting to within 80% agreement between methods varied from five for PUFA to 17 (all subjects) for MUFA (Table 5). The seven subjects reporting agreement for alcohol did not consume alcohol at all. The Bland-Altman plots yielded no significant systematic bias for any measures of energy and macronutrient intake (Figures 1 and 2). There was a slight tendency for the diet history to overestimate energy and protein intakes relative to the seven-day weighed food record, and perhaps for under-reporting carbohydrate intakes. The plot for alcohol figures displayed large variation in measurements for consumption of this nutrient, reflecting non-consumers and variable intakes for others, with some tendency to under-report in the diet history. One subject was a high consumer of alcohol, and appeared to substantially over-report in the diet history. The plots for SFA, PUFA and MUFA displayed distinctive patterns, however, regression analysis failed to show a significant association between bias and level of intake, as was the case for all other dietary variables ($r = 0.46, P > 0.05$). There was a very narrow range in reported MUFA consumption and the extent of bias was much smaller than that seen for PUFA and SFA data. There was a wide spread in the SFA data, with a tendency to over-report with higher intakes, but again this was not a significant association ($r = 0.44, P > 0.05$).

### Table 2. Reported energy and macronutrient intakes from the diet history (mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Women with gestational diabetes mellitus (n = 11)</th>
<th>Women with normal glucose tolerance (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (E, kJ)</td>
<td>8311 ± 2509</td>
<td>10238 ± 1576 (a)</td>
</tr>
<tr>
<td>Protein (%E)</td>
<td>19.14 ± 4.37</td>
<td>17.55 ± 2.35</td>
</tr>
<tr>
<td>Fat (F, %E)</td>
<td>29.32 ± 8.10</td>
<td>32.76 ± 7.42 (a)</td>
</tr>
<tr>
<td>Carbohydrate (%E)</td>
<td>48.79 ± 6.94</td>
<td>47.58 ± 6.94</td>
</tr>
<tr>
<td>Alcohol (%E)</td>
<td>0.57 ± 1.06</td>
<td>0.26 ± 0.54</td>
</tr>
<tr>
<td>SFA (%F) (b)</td>
<td>42.52 ± 7.78</td>
<td>41.05 ± 7.83</td>
</tr>
<tr>
<td>PUFA (%F) (c)</td>
<td>20.88 ± 10.37</td>
<td>16.93 ± 6.59</td>
</tr>
<tr>
<td>MUFA (%F) (d)</td>
<td>36.60 ± 5.36</td>
<td>36.02 ± 2.52</td>
</tr>
</tbody>
</table>

(a) significantly different from gestational diabetes mellitus group at $P < 0.05$
(b) SFA Saturated fat
(c) PUFA Polyunsaturated fat
(d) MUFA Monounsaturated fat

### Table 3. Reliability of diet history data (unless stated otherwise values are mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Diet history 1 (n=17)</th>
<th>Diet history 2 (n=17)</th>
<th>SD\text{difference}</th>
<th>Correlation coefficients ($r$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (E, kJ)</td>
<td>10283 ± 1577</td>
<td>9606 ± 1252</td>
<td>1733</td>
<td>0.30</td>
</tr>
<tr>
<td>Protein (%E)</td>
<td>17.55 ± 2.38</td>
<td>16.74 ± 2.51</td>
<td>1.55</td>
<td>0.65 (b)</td>
</tr>
<tr>
<td>Fat (F, %E)</td>
<td>32.76 ± 7.42</td>
<td>31.73 ± 7.03</td>
<td>5.22</td>
<td>0.73 (b)</td>
</tr>
<tr>
<td>Carbohydrate (%E)</td>
<td>47.58 ± 6.94</td>
<td>49.19 ± 6.97</td>
<td>5.63</td>
<td>0.62 (b)</td>
</tr>
<tr>
<td>Alcohol (%E)</td>
<td>0.26 ± 0.54</td>
<td>0.35 ± 0.46</td>
<td>0.48</td>
<td>0.56 (c)</td>
</tr>
<tr>
<td>SFA (%F) (d)</td>
<td>47.05 ± 7.83</td>
<td>47.17 ± 7.00</td>
<td>12.80</td>
<td>0.51 (c)</td>
</tr>
<tr>
<td>PUFA (%F) (e)</td>
<td>16.93 ± 6.59</td>
<td>16.72 ± 5.93</td>
<td>6.45</td>
<td>0.47 (c)</td>
</tr>
<tr>
<td>MUFA (%F) (f)</td>
<td>36.02 ± 2.52</td>
<td>36.12 ± 3.18</td>
<td>2.31</td>
<td>0.71 (b)</td>
</tr>
</tbody>
</table>

(a) using narrative style research diet history
(b) significant at $P < 0.01$
(c) significant at $P < 0.05$
(d) SFA Saturated fat
(e) PUFA Polyunsaturated fat
(f) MUFA Monounsaturated fat
Table 4. Relative validity of diet history data: differences between methods (unless stated otherwise values are mean ± SD)

<table>
<thead>
<tr>
<th>Diet history 1</th>
<th>Seven-day weighed food record</th>
<th>P value(α)</th>
<th>Mean difference ± (SD diff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=17)</td>
<td>(n=17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy (E, kJ) 10238 ± 1576</td>
<td>9804 ± 1443</td>
<td>0.41</td>
<td>373 ± 1833</td>
</tr>
<tr>
<td>Protein (%E) 17.55 ± 2.38</td>
<td>16.72 ± 2.75</td>
<td>0.13</td>
<td>0.95 ± 2.5</td>
</tr>
<tr>
<td>Fat (F, %E) 32.76 ± 7.42</td>
<td>32.41 ± 5.46</td>
<td>0.84</td>
<td>-0.35 ± 6.0</td>
</tr>
<tr>
<td>Carbohydrate (%E) 47.57 ± 6.94</td>
<td>48.62 ± 5.50</td>
<td>0.46</td>
<td>-1.16 ± 6.3</td>
</tr>
<tr>
<td>Alcohol (%E) 0.26 ± 0.54</td>
<td>0.31 ± 0.52</td>
<td>0.79</td>
<td>-0.04 ± 0.6</td>
</tr>
<tr>
<td>SFA (%F) 47.05 ± 7.83</td>
<td>46.71 ± 4.90</td>
<td>0.99</td>
<td>0.02 ± 8.72</td>
</tr>
<tr>
<td>PUFA (%F) 19.93 ± 6.59</td>
<td>17.24 ± 4.49</td>
<td>0.88</td>
<td>-0.26 ± 7.3</td>
</tr>
<tr>
<td>MUFA (%F) 36.01 ± 2.52</td>
<td>36.03 ± 1.63</td>
<td>0.72</td>
<td>0.25 ± 2.8</td>
</tr>
</tbody>
</table>

(a) Comparison of two methods with paired t-test

Table 5. Relative validity of diet history data: correlations and agreement

<table>
<thead>
<tr>
<th>r (CI)</th>
<th>No. with &gt; 80% agreement (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (E, kJ) 0.27 (0.20, 0.64) 12</td>
<td></td>
</tr>
<tr>
<td>Protein (%E) 0.56 (0.15, 0.80)(a) 14</td>
<td></td>
</tr>
<tr>
<td>Fat (F, %E) 0.47 (0.03, 0.73) 9</td>
<td></td>
</tr>
<tr>
<td>Carbohydrate (%E) 0.42 (0.03, 0.73) 15</td>
<td></td>
</tr>
<tr>
<td>Alcohol (%E) 0.31 (-0.67, 0.67) 7(b)</td>
<td></td>
</tr>
<tr>
<td>SFA (%F) 0.13 (-0.34, 0.54) 12</td>
<td></td>
</tr>
<tr>
<td>PUFA (%F) 0.16 (-0.31, 0.56) 5</td>
<td></td>
</tr>
<tr>
<td>MUFA (%F) 0.14 (0.38, 0.55) 17</td>
<td></td>
</tr>
</tbody>
</table>

(a) significant at P < 0.05
(b) all abstainers from alcohol

Discussion

In this study we examined the validity and reliability of a research diet history for use in clinical studies involving pregnant women with and without GDM. Given potential changes in lifestyle and possible adverse reactions to food, pregnancy is a difficult period in which to study dietary habits (9). There is little reported on the dietary habits of pregnant women generally in Australia but our results confirm that, with care, reasonable data can be achieved. We made the assumption that the reporting behaviour of the normal glucose tolerant women and women with GDM at about 28 weeks gestation would be similar prior to targeted counselling for GDM, and the low level of under-reporting in both groups suggested this to be the case. As women advanced in pregnancy, it was likely that the whole sample was exposed to nutrition information, and while parity may have implied that the GDM women had more exposure, it still should not have had the same impact as individual dietary counselling for GDM at the time of dietary assessment. With this in mind, criterion validity of the diet history method was assessed in the whole sample, but the analysis of reliability and relative validity was limited to data from normal glucose tolerant women. To address this limitation, and in keeping with the planned clinical studies, we ensured the normal glucose tolerant women were matched to those with GDM for age and prepregnancy weight. These limitations reflect the impact of the clinical context on the research process. This includes the inability to assess responsiveness until we actually conduct the trial. Responsiveness assessment is recommended as a component of intervention studies (22), and while this quality has been reported for food records (22), we have found the diet history performs in a similar fashion in the intervention context (32). Likewise, the selection of dietary assessment methods and the sequence in which the data could be collected were influenced by the accessibility of participants and their willingness to undertake the tasks required. The diet history is appropriate in the clinical research context as it allows for ensuing dietary counselling. Both the food record and diet history contaminate the reporting of the other and it is not possible to escape this bind. While the weighed food record may be a more accurate method the respondent burden may also have limited the number of study participants. Finally, the study would have been subject to selection bias, that is, the women who agreed to participate may self-select as accurate and reliable reporters in the two methods of assessment, but we do not have the opportunity to address this with non-participants. However, it is also likely that our participants will volunteer for the intervention trial, thus reflecting the referent study population. With these limitations in mind, the results were reasonable.

In terms of participant characteristics, the GDM group was shorter and had greater parity, two features which have been previously identified in GDM women (33). The GDM group reported consuming significantly less energy than the normal glucose tolerant group, but this may reflect their shorter stature and subsequent lower energy requirements. Alternatively, higher variation in alcohol consumption in the GDM data could be responsible for a skew in energy data. The differences in reported macronutrient intakes is consistent with our previous work (5, 6) and is less likely to reflect a social desirability bias (34) as presumably this would affect both groups of women.

Criterion validity

Doubly-labelled water studies involving pregnant women have shown that pronounced changes in BMR only occur in the last trimester when the weight gain is greater than 10 kg, and that the cut-off values from the non-pregnant population concur with findings up to that stage (15). About half the study sample (much the same number from both categories) gained more than 10 kg which implies a lower cut-off value. This, combined with the assumption
of a sedentary lifestyle (PAL 1.55) may have biased results towards an underestimation of the problem, particularly if any of the subjects was more active (14, 15). Being a statistically derived figure, it will also only identify gross bias at the individual level (14). The ideal situation would involve measuring the metabolic cost of the pregnancy for each woman, at some cost. However, as we found no categorical differences in under-reporting, albeit using a ‘blunt measure’, we concluded that the performance of the diet history in assessing overall dietary intake was comparable between women with and without GDM.

Reliability

Estimates of reliability are based on how well repeated measures compare with each other. Correlation coefficients were slightly higher for protein, fat, carbohydrate and MUFA values, and lower for PUFA, SFA and total energy compared with data from a previous study involving perimenopausal women (18). The reported variability in alcohol consumption and possibly also in food sources of fats may explain these results, bearing in mind that true repeatability is difficult to achieve under free-living conditions. As most people vary their diet from day to day, providing reliable accounts of average intakes remains a cognitive challenge.

Relative validity

There was good agreement between the seven-day weighed food record and diet history data, with no significant difference between the mean values for the two data sets for energy and macronutrients. With the exception of alcohol, the mean differences between data pairs were not large. The variation in the differences between methods (SDdiff) was comparable to variation within each method (SD), indicating that the problems in estimating dietary intakes were similar for both methods. From this perspective both methods appeared to be measuring the same thing, however, the correlation co-efficients between methods were much lower than for the repeat diet history analysis, suggesting that each method was subject to different measurement effects. If these differences were constant, then a form of systematic bias may emerge, but the wide confidence intervals indicated the bias was more likely random. Noting the degree of discrepancy between data pairs provided some insights into the possible locations for error. The poor level of agreement on alcohol data would be expected, but the opposite results achieved for PUFA (30% agreement) and MUFA data (100% agreement) were perplexing. Bland-Altman plots did not reveal any significant systematic bias for any of the dietary variables. Despite the poor correlation, there was little difference (and no significant direction for bias) in the reporting of MUFA intakes between the diet history and

Figure 1: Bland-Altman plots for the association between bias diet history-food record (DH-FR) and the mean energy, protein, carbohydrate and alcohol intakes
the seven-day weighed food record. Participants reported MUFA consumption in a very narrow range of energy proportions, which explains the high level of agreement between data pairs. In this sense the low correlations were of no practical interest. In contrast, Bland-Altman plots demonstrated that the range of mean SFA and PUFA intakes was much wider. The small range of foods in a Western diet that have an impact on MUFA intake compared to the wide range of foods containing SFA and PUFA may account for these differences. These findings suggest that interviewers need to be aware of the range of SFA- and PUFA-rich foods and be sure to cover them adequately when assessing usual dietary intakes. Likewise, the alcohol data displayed extremes in intakes known to cause problems with measuring this component of the diet. Interviewers need to ensure that questions are included on alcohol and that attention is paid to deriving an accurate estimation of actual consumption patterns, with all its variations. The slight tendency to over-report energy and protein in the diet history compared to the food record could have been due to under-eating during the period of food record keeping—a phenomenon recognised in the literature, but not emphasised here.

**Conclusion**

The purpose of this study was to assess the validity and reliability of a research diet history for use in clinical studies involving women with and without GDM in the Illawarra region. A substantial amount of preliminary work was conducted on developing the method for the study population. Following that, the clinical research context set a number of challenges that we have attempted to address. We were only able to assess the plausibility (criterion validity) of reports from the full study sample and assume that the reliability and relative validity assessments from the normal glucose tolerant women applied to the others, had the latter not been treated for GDM. As stated earlier, the diet history in the clinical research context enables an assessment of usual eating patterns, modification of dietary patterns and the monitoring of change. Criterion validity assessments demonstrated plausible reporting, with the meal-based accounts providing a useful reference for advice on dietary change. Reliability assessments indicated that the diet history provided reasonably precise accounts of usual dietary intakes, bearing in mind the impact of natural variation in food consumption patterns. Relative validity assessments found the diet

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**Figure 2:** Bland-Altman plots for the association between bias diet history-weighed food record (DH-FR) and mean fat, monounsaturated (MUFA), polyunsaturated (PUFA) and saturated (SFA) fat intakes.
history and seven-day weighed food records provided much the same data, and that any differences in measurement tended to be random rather than systematic. This latter analysis also highlighted the need to focus on alcohol consumption and food sources of fatty acids as potentially variable elements that may limit the accuracy of reports. We will assess the responsiveness of the diet history to dietary change under trial conditions, but the results of methodological work thus far suggest that this instrument, specifically developed for our study population, performs well in the context of clinical research.

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