# EFFECT OF FAT CONTENT OF THE EVENING MEAL ON POSTPRANDIAL GLYCAEMIA OBSERVED IN A TOLERANCE TEST PERFORMED ON THE NEXT MORNING

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Oral glucose tolerance test (GTT) has been the common feature of several of our previous studies (Sahi et al. 1985; Siddhu et al. 1986; Sud et al. 1988 a, b), frequently the same volunteer has participated in more than one study. We observed considerable intra-individual variation in the postprandial glycemic response. On analysing part of our data, we observed a mean coefficient of variation of 16.2 (SD 1.6) % in 0.5 h values, and 16.8 (SD 4.7) in areas under the 2-h glucose curves. Poor reproducibility of GTT has been reported also by West et al. (1964), Mc Donald et al. (1965) and Harding et al. (1973). All these studies have also reported a variation of about 20% in the postprandial glucose levels. Further, there is no consistent relationship between any obvious characteristic of an individual, and the degree of variability shown by him or her. McDonald et al. (1965) did observe some correlation (r=0.28) between blood glucose values and variability, but found that prediction on this basis was not reliable. The cause of the intra-individual variation thus remains unknown. It has been shown recently that perfusion of the ileum with fats slows the rate of gastric emptying (Read et al. 1984). It is possible that if the subject takes a high fat meal on the evening before GTT, some of the dietary fat may be present in the ileum on the morning of the test. If this fat delays gastric emptying in the same manner as ileal fat infusion in the experiments of Read et al. (1984), it could slow down the rate of delivery of glucose during the GTT, thereby reducing postprandial glycemia. Gastric emptying has, in fact, been reported to be a major determinant of glycemia observed during GTT (Thompson et al. 1982). Since the fat content of the meal consumed by the subject on the evening before the GTT is generally not rigidly controlled, it may be at least partly responsible for the poor reproducibility of GTT. The present study was designed to test this hypothesis on a set of volunteers by doing GTT twice on each subject one preceded by a usual dinner on the evening before the test (control), and once preceded by an identical dinner with 50g additional butter (experimental). Since the gastrointestinal transit of the glucose solution administered during GTT may be regulated differently as compared to that of a solid meal, additional experiments involving a bread meal tolerance test were also included in the present study.

## Methods

The studies, conducted on healthy (age=18-65 y; BMI =17-30) and diabetic (age=40-74; BMI = 16-28) human volunteers, were of two types : those involving oral glucose tolerance test (GTT) and those involving a meal tolerance test using bread (MTT). With the exception of one female volunteer, all volunteers for MTT studies were from among those who volunteered for the GTT studies. The experimental designs of GTT

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and MTT studies were identical. Either study involved two tolerance tests at one week's interval. On the evening before the test, the volunteer had his usual dinner (control). On the evening before the other test, he had the same dinner with 50g butter in addition (experimental). The order of the control and experimental session was randomised. The volunteer was expected to take the last meal at *exactly* the same time on both the evenings, and report at *exactly* the same time on both the mornings for the tolerance test. The interval between the evening meal and tolerance test was kept as close to 12 h as possible. All efforts were made to ensure that the meals taken on the two evenings differed only with respect to butter. In any case, details of the meals taken on the two evenings were recorded by the volunteers on a card. On the card, the volunteer also recorded other factors which could possibly influence the tolerance test, such as undue physical or mental stress, illness and medication.

For the tolerance test, the volunteer reported after a 12 h overnight fast. After a fasting venous blood sample had been drawn, the meal was administered in a volume of 200 ml and was consumed at a steady rate within 5 min in case of GTT and within 10 min in case of MTT. Considering the mid-point between onset and end of ingestion as zero time, blood samples were again collected at 30, 60, 90 and 120 min. The meal in GTT was 50 g glucose, and in MTT it was white bread providing 50 g carbohydrate (96 g white bread).

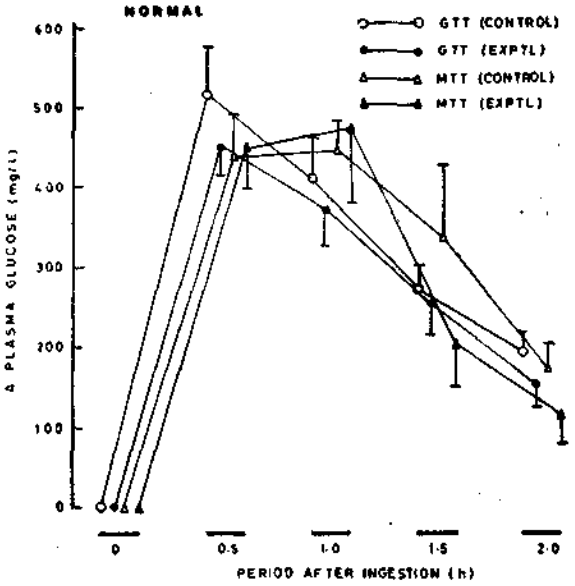
Blood samples were analysed for glucose concentration by the *o*-toluidine method.

## Statistical analysis

The glucose levels at 0.5, 1, 1.5 and 2.0 h, and areas under the 2-h glucose curves on a tolerance test performed after a control dinner were compared with the corresponding parameters on the same tolerance test after an experimental dinner. Differences were evaluated by Student's *t*-test for paired data, and were considered significant at a level of $P<0.05$.

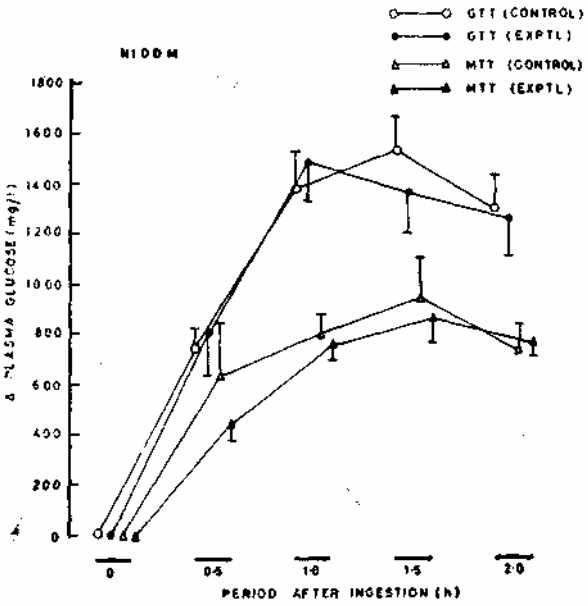
## Results

The plasma glucose values of diabetics had so much inter-individual variation that it was considered appropriate to pool only the incremental glucose levels. The incremental plasma glucose levels in different groups have been shown in Figs. 1 and 2. There is no significant




difference between the control and experimental tolerance tests in any group with respect to incremental plasma glucose level at any point in time or AUC. However, there was a trend towards lower incremental glucose levels at 0.2 h in diabetic subjects when the MTT followed a high-fat dinner the evening before (Fig. 2). Another distinct finding, unrelated to the aims of this study, was that the glycemic response to glucose and bread

did not differ much in normal subjects (Fig. 1) but was much lower on the bread meal in diabetic subjects (Fig. 2).




## Discussion

The results do not support the hypothesis that fat content of the meal taken on the evening before GTT or MTT might affect the postprandial glycaemia observed during the tests. The hypothesis was based on the study of Read et al. (1984). The failure to substantiate a hypothesis based on extrapolation from the study is possibly because the extrapolation involved some untested assumptions. It was assumed that an appreciable part of the dietary fat consumed at dinner would be present in the ileum 12 h after the meal. Given normal digestion and absorption, this may be true for only a small quantity of fat. In ileostomy subjects, consuming an average of 102 g fat per day, the mean 24-h ileostomy effluent fecal excretion was 16.1 g (Sandberg et al. 1986). Extrapolating these results to our subjects, one may be justified in assuming some fat to remain unabsorbed upto the terminal ileum. But it is not known how much fat, if any, would be present in the ileum rather than the colon 12 h after the meal. In the study of Read et al. (1984) ileal fat infusion delayed the appearance of breath hydrogen following a lactulose meal to 8 h after ingestion. That makes it likely but not certain that a small amount of dietary fat would be present in the ileum 12 h after ingestion. But apparently this quantity of ileal fat is insufficient to delay gastric emptying to extent that would affect postprandial glycaemia in tolerance test. If the quantity of dietary fat were increased, or if the subject had malabsorption, it might have such an effect. The weak trend towards lower 0.5 h postprandial glucose levels in diabetic subjects when the MTT was preceded by a high fat dinner (Fig. 2) makes this speculation plausible. However, the present study suggests that a moderately high fat evening meal taken 12 h before a GTT or MTT does not influence the outcome of the test. Hence variation in the fat content of the meal taken on the evening before a tolerance test cannot explain the poor reproducibility of tolerance test.

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Fig 1. Incremental plasma glucose response observed during glucose tolerance test (GTT) or meal tolerance test (MTT) in normal Subjects. EXPTL, experimental session which was preceded by dinner containing 50g additional butter on the evening before the test. Points are mean values, with their standard errors represented bs vertical bars.

Fig. 2. Incremental plasma glucose response observed during glucose tolerance test (GTT) of meal tolerance test (MTT) in non insulin-dependent diabetic (NIDDM) subjects EXPTL, experimental session which was preceded by dinner containing 50g additional butter on the evening before the test. Points are mean values, with their standard errors represented by vertical bars.