

Short Report

Use of low-glycaemic index bread to reduce 24-h blood glucose: implications for dietary advice to non-diabetic and diabetic patients

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Running title: Effect of low-GI bread on glucose response

Abstract word count: 189

Article word count: 1183

Abstract

Aim To assess the effect of a simple dietary change on 24-h blood glucose.

Methods In a randomised cross-over design, ten non-diabetic subjects were prescribed a LGI diet and HGI diet. Diets were identical with the exception of the type of bread consumed (LGI or HGI). Glucose concentrations over 24-h were measured using the CGMS.

Results The LGI diet resulted in a lower mean glucose response compared to the HGI diet over 24-h ($P = 0.135$), during the day ($P = 0.171$) and at night ($P = 0.100$). Similarly, the 24-h, daytime and overnight IAUC for glucose following the LGI diet was consistently lower than following the HGI diet ($P = 0.093$, $P = 0.132$ and $P = 0.061$, respectively).

Conclusions The results demonstrate how a very simple dietary change can favourably alter blood glucose concentrations. Such small modifications to diet, if adopted in the long-term, could improve glucose control and consequently reduce the risk of chronic disease in both diabetic and non-diabetic individuals.

Keywords dietary carbohydrate, glucose control, glycaemic index

Abbreviations CGMS, continuous glucose monitoring system; HGI, high-glycaemic index; IAUC, incremental area under the curve; LGI, low-glycaemic index

Introduction

Recent prospective studies have incriminated a high-glycaemic index (HGI) diet in the pathogenesis of insulin resistance and type 2 diabetes [1]. A continuous association between fasting blood glucose and cardiovascular disease in both diabetic and non-diabetic patients suggests that all individuals may benefit from a lowering of blood glucose [2]. An increasing interest in recommending a low-glycaemic index (LGI) diet for weight loss [3] and the promotion of LGI foods for the prevention and effective management of diabetes [4] prompted us to investigate the role a LGI diet may have in lowering blood glucose over a 24-h period. The uniqueness of this study was to feed a standard diet that only differed in the type of bread consumed (LGI or HGI). Critics have claimed that eating a LGI diet may be difficult to sustain due to issues of compliance and acceptability. Changing bread type alone may be a more acceptable and simpler intervention to maintain than requiring a whole new change in eating pattern.

Patients and Methods

Ten Caucasian non-diabetic subjects (5 males), mean age 27 (SD 10) years and mean body mass index (BMI) 22.7 (SD 1.6) kg/m², were recruited to the study. The exclusion criteria were BMI >25 kg/m² and medical conditions or medications known to affect glucose regulation or appetite. Ethical approval for the study was obtained from the University Research Ethics Committee at Oxford Brookes University. All subjects gave written informed consent prior to participation.

In a randomised cross-over design, subjects were prescribed a LGI diet and HGI diet on two non-consecutive days. For the LGI day, meals were made from either a multi-seed bread (British Bakels Ltd,

Bicester, UK; GI = 54) or low-GI white bread (All-in-One, Warburtons Ltd, Bolton, UK; GI = 49). On the HGI day, meals were made from a standard white bread (Somerfield plc, UK; GI = 71). Meals were identical on the two study days, with the exception of the bread component. Breakfast consisted of bread with a low-fat spread and jam; lunch and supper consisted of sandwiches with the following fillings: egg mayonnaise, ham salad, tuna mayonnaise, cheese and tomato, chicken salad. Subjects ate a standardised meal on both occasions. Subjects ate and drink only the food and drinks provided, except for water, which could be taken in moderation.

For each subject, interstitial glucose concentrations were measured using the Medtronic MiniMed (Northridge, CA, USA) continuous glucose monitoring system (CGMS™), using standard procedures [5]. The CGMS™ sensor was fitted at 17:00 on the day prior to each study day, in order to stabilise the sensor, and was removed at 09:00 on the morning following each study day. The data reported here represents 288 glucose readings for each individual over a 24-h period (06:00-06:00).

Statistical analysis was performed using the Statistical Product and Service Solutions software (SPSS version 11.0.1, Chicago, USA). Data are expressed as mean and standard deviation (SD). Data were analysed over 24-h, during the day (06:00-22:00) and at night (22:00-06:00). Differences in mean glucose and incremental area under curve (IAUC) for glucose between LGI and HGI were assessed using the paired t-test. Statistical significance was set at $P < 0.05$.

Results

Table 1 shows the mean glucose concentrations for the different time periods. The LGI diet resulted in a lower mean glucose response compared to the HGI diet over 24-h ($P = 0.135$), during the day ($P = 0.171$) and at night ($P = 0.100$).

In order to standardize the data, the mean change in glucose levels from baseline was determined (Figure 1). The IAUC for glucose following the LGI diet was consistently lower than the HGI diet over 24-h, during the day and at night. The 24-hour IAUC for glucose was 653 (SD 1055) vs. 1368 (SD 171) ($P = 0.093$); the daytime 16-h IAUC for glucose was 619 (SD 619) vs. 1039 (SD 811) ($P = 0.132$); the overnight 8-h IAUC for glucose was 35 (SD 447) vs. 329 (SD 467) ($P = 0.061$).

Discussion

The current study provides evidence that over a 24-h period an improvement in glucose profile can be achieved following a simple change to the diet, namely the exchange of a HGI bread to a LGI bread.

Although focusing on the total amount of carbohydrate is important for diabetic and pre-diabetic patients, our study suggests that the inclusion of a LGI bread, or other LGI carbohydrate foods, could lead to an improved blood glucose control.

The findings of our study suggest that the reduction in glucose response following the consumption of LGI breads compared to a HGI bread may have important clinical significance. Replacing HGI forms of carbohydrate with LGI carbohydrates may not only reduce the risk of type 2 diabetes [6], but also be an

additional health benefit to those who are managing diabetes by diet control [7]. The current study shows how a very simple dietary change can alter blood glucose concentrations. Such small modifications to diet, if adopted in the long-term, could improve glucose control and consequently reduce the risk of chronic disease. Indeed, our study confirms the speculation raised by Hodge et al. [1] who proposed that the substitution of white bread with LGI breads may be an effective way to reduce the risk of type 2 diabetes.

In the UK diet, bread remains a major contributor to both carbohydrate and energy intake. Of the 12 million bread and bakery products produced in the UK daily, white bread, traditionally a HGI food [8], constitutes more than 70% sales [9]. Thus, considering this high consumption of white bread, the identification and promotion of LGI breads that produce a lower glycaemic response may be an important recommendation in the prevention and management of diabetes.

Acknowledgements

We express our thanks to British Bakels Limited and Warburtons Limited for supplying the LGI breads.

Table 1 Mean (SD) glucose concentration (mmol/l)

	LGI	HGI
24-h (06:00-06:00)	4.4 (0.7)	4.8 (0.5)
Day (06:00-22:00)	4.6 (0.5)	4.9 (0.5)
Night (22:00-06:00)	4.0 (0.9)	4.5 (0.5)

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Figure 1 Mean change in glucose over 24-h for ten subjects in response to LGI (—) and HGI (----)