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Validation of fingertip whole blood against common blood biomarkers of omega-3 status in a dose-response intervention

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Physiological validation of glycemic load (GL) in 13 iso-energetic mixed meals

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Background

Dietary glycemic load has been introduced to estimate the overall glucose response evoked by a serving of food. However, it has not been validated in the context of mixed meals of varying macronutrient content.

Objectives

To investigate the association between calculated GL of mixed meals and the observed glucose responses in healthy subjects.

Design

In this crossover design study, we investigate the glucose responses of 13 meals tested by two groups of healthy subjects (each group $n = 10$ or 11). The meals were iso-energetic (2000 kJ) but varied in macronutrient content and GL values. The reference white bread with 2000 kJ portion was also tested in both groups of subjects. Capillary blood samples were taken at regular intervals over a two-hour session and assayed for glucose concentration. The observed glycemic responses of 13 mixed meals were compared with calculated GL, GI, macronutrient and fiber content.

Outcomes

The GL and GI were found to correlate strongly with the observed glucose responses to 13 mixed meals (Pearson correlations of $r = 0.78$, $P = 0.002$ and $r = 0.58$, $P = 0.039$) whereas macronutrients and fiber showed weak relations (P values > 0.05). In stepwise linear regression model, only GL was significant and by itself accounted for 31% of the variance in the observed glucose responses of individual subjects.

Conclusion

The findings support the concept of glycemic load as a measure of overall glycemic response. In the context of composite meals of similar energy but varying macronutrient content, the glucose response evoked by meals is best predicted by glycemic load while macronutrients have limited value.

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Validation of fingertip whole blood against common blood biomarkers of omega-3 status in a dose-response intervention

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Background

Blood levels of long chain (LC) ω -3 PUFA may indicate risk for cardiovascular disease. LC ω -3 PUFA levels in whole blood from the fingertip could be a useful tool for assessing LC ω -3 status if validated against commonly measured blood parameters. The ability of fingertip whole blood to reflect changes in dietary LC ω -3 PUFA intake through a dose-response intervention has not been previously investigated.

Objective

We aimed to validate fingertip whole blood against venous erythrocytes (RBC) and plasma as a measure of LC ω -3 PUFA status in healthy women after supplementation with four different doses of fish oil.

Design

30 subjects provided fasting venous and fingertip blood samples before and after an 8-week double-blind, randomized intervention with 0, 0.35, 0.7 or 1.0 g/day LC ω -3 PUFA from DHA-rich tuna oil and/or placebo capsules. Blood fatty acids were analysed using direct transesterification (RBC, plasma) or a modified method (fingertip whole blood) followed by gas chromatography.

Outcomes

There was a strong linear relationship between fingertip whole blood LC ω -3 PUFA levels and those of RBC ($R^2 = 0.83$ - 0.88 , $P < 0.0001$), and plasma lipids ($R^2 = 0.82$ - 0.94 , $P < 0.0001$). Correlations between LC ω -3 PUFA dose and changes in LC ω -3 PUFA levels ranged from $R^2 = 0.54$ - 0.57 ($P < 0.0001$) for all three biomarkers, indicating large variability between individuals in response to LC ω -3 supplementation. Fingertip whole blood EPA + DHA levels (mol %) were unchanged after 0 g/day, and rose from a mean baseline of $3.2 \pm 0.1\%$ to $3.8 \pm 0.3\%$, $5.2 \pm 0.3\%$, and $5.6 \pm 0.4\%$ after 0.35, 0.7 and 1.0 g/day respectively. Similarly, erythrocyte EPA + DHA levels rose from a mean baseline of $4.9 \pm 0.2\%$ to $5.0 \pm 0.4\%$, $5.4 \pm 0.3\%$, $6.9 \pm 0.2\%$ and $7.4 \pm 0.4\%$ after 0, 0.35, 0.7 and 1.0 g/day respectively.

Conclusion

Fingertip whole blood corresponds well with common blood measures of LC ω -3 status, and displays similar sensitivity to changes in dietary LC ω -3 PUFA intake in a dose-response intervention.