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A Reliable, Valid, Sensitive and Simple Method to Quantify Carbohydrate Routine Consumption among Patients with Type 2 Diabetes

Daniel J. Cox1* , Matthew Moncrief1, Harsimran Singh2, Anne Diamond1, Anthony L. McCall3

1Department of Medicine, University of Virginia School of Medicine, Charlottesville, USA

2Department of Endocrinology and Metabolism, Hoag Memorial Hospital, Newport Beach, CA

3Department of Endocrinology and Metabolism, University of Virginia School of Medicine, Charlottesville, USA

***Corresponding author:** Daniel J. Cox, Department of Medicine, University of Virginia School of Medicine, Charlottesville, USA; E-mail: djc4f@virginia.edu

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Abstract

Objective: Growing evidence suggests postprandial hyperglycemia, driven largely by carbohydrate consumption, adversely affects A1c and cardiovascular health. The standard for quantifying carbohydrate intake is 24-hour dietary recall (ASA24), which is tedious, time consuming, under-samples due to a short measurement period, and is often impractical. An alternative is needed.

Research Design and Methods: We developed the Carbohydrate Routine Consumption (CRC) scale, which quantifies weekly servings of 16 common high and low glycemic load foods and takes 5 minutes to complete and score. We administered the CRC and the ASA24 to 204 adults with type 2 diabetes.

Results: The CRC was reliable, correlated with the ASA24 and had similar construct and discriminant validity.

Conclusion: The CRC is psychometrically sound and easily employed by clinicians and researchers to document weekly servings of carbohydrate consumption.

Keywords: Type 2 diabetes mellitus; diet; knowledge; attitude; practices; complications

Introduction

Given that carbohydrates are a major contributor to post prandial glucose (PPG) (1), which in turn is a major contributor to A1c (2), and possibly an independent contributor to diabetic cardiovascular complications (3), researchers and clinicians need to quantify routine carbohydrate consumption. This was made more salient by the 2020 American Diabetes Association Standards of Care (ADA 2020), which states: "Reducing overall carbohydrate intake for individuals with diabetes has demonstrated the most evidence for improving glycaemia and may be applied in a variety of eating patterns"). The 24-hour dietary recall (ASA24) (4) is considered the gold standard for quantifying carbohydrate intake, but it is not practical for clinicians and many researchers. For standardization, the ASA24 requires a trained examiner conducting three 30-minute scheduled telephone interviews using an online form to enter all the nutrients consumed in the past 24 hours, their volume and how the foods were prepared. The data is analyzed by the ASA24 server, and the user must make a batch request for all recalls completed in a study, the results of which are typically available a day later. Consequently, we developed a simpler, self-report questionnaire that quantifies servings of carbohydrates routinely consumed (CRC) in a typical week, that can be administered in five minutes and scored in one minute (see supplemental figure S1).

Materials and Methods

Instrument: To solicit a representative sampling of routinely eaten carbohydrates, the CRC asks: "How many servings of the following foods do you eat in an average week? A serving size is about the size of a deck of cards. A large or a 'supersized' serving is equal to two servings". For brevity and ease of use, the CRC does not list all food varieties and their preparations. Instead, it presents 16 classes of foods with a glycemic load > 10 (items 1-16, CRCHGL), e.g. "potatoes like mashed, baked, fried, white, red, sweet, potato soup, potato pancakes, etc.", and 16 classes of foods with a glycemic load < 7 (items 17-32, CRCLGL), e.g. "green vegetables like peas, spinach, brussel sprouts, broccoli, etc." (1). The CRCHGL and CRCLGL scores are the sum of the reported servings consumed in an average week for items 1-16 and 17-32, respectively. We performed pilot testing to clarify items and affirm initial reliability. This report focuses on the CRCHGL. We hypothesized that the CRCHGL would have significant: 1) test-retest reliability, 2) concurrent validity (a moderate correlation with the ASA24 carbohydrate count), 3) construct validity (a positive correlation with A1c, BMI, calorie intake, depressive symptoms [eating comfort foods]), and 4) discriminant validity (a decreased response to a PPG-lowering intervention, but not to a weight loss intervention, and a pre-post change in A1c correlation only in the PPG-lowering intervention). As a control, we hypothesized that CRCLGL would not demonstrate such relationships except with respect to calories. Since calories come from both low and high glycemic load foods, we hypothesized CRCLGL would mildly correlate with the total calories consumed.

Participants: The sample consisted of 204 adults with type 2 diabetes from a randomized clinical trial (age = 56.0 ± 11.7 [mean ± SEM], duration of disease = 5.2 ± 3.0, BMI = 34.7 ± 6.4, A1c = 8.1 ± 1.3, sex = 58.8% female.

Procedure: At baseline, participants completed the CRC and the Patient Health Questionnaire (PHQ9) (5) to measure symptoms of depression. A1c and BMI were also measured. The following week, participants were called on two weekdays and one weekend day to administer the ASA24. To assess test-retest reliability, a subset of 20 participants also completed the CRC one week after baseline assessment.

Participants were then randomized into a 2-month lifestyle intervention for diabetes that compared 6 hours of weight reduction (caloric restriction, N= 36) to 6 hours of PPG reduction (carbohydrate restriction, N= 168). The PPG participants were divided into three sub-groups that varied the amount of blood glucose feedback they received concerning the impact of food and activity choices. We repeated the assessment three months after treatment.

Results

Participants reported eating 32.9 ± 16.2 servings/week of CRCHGL foods, similar to that reported previously (33.3 ± 15.9) (6). Over three days of ASA24 reporting, an average of 223 ± 58.6 g of carbohydrates were eaten (54% of participants' daily nutrient intake). The standard errors for these measures were 1.13 and 7.18 respectively. The control variable, CRCLGL, demonstrated good test retest reliability ($r = .82$, $p < .001$) and correlated with total calories consumed ($r = .20$, $p = .03$), but did not relate significantly to the CRCHGL, the ASA24, or to any of the validity variables as hypothesized.

Reliability: The CRCHGL demonstrated significant test-retest reliability ($r = .62$). The ASA24 from day 1 to 3 reliability was $r = .35$. See Table 1).

Construct validity: Baseline CRCHGL correlated significantly with the ASA24's total carbohydrates eaten ($r = .37$, $p < .001$). The change in carbohydrates from baseline to post-treatment follow-up was correlated for these two metrics ($r = .35$, $p < .001$).

Concurrent validity: The CRCHGL correlated significantly with BMI, calories consumed, and depressive symptoms. The ASA24's total carbohydrates correlated significantly with BMI and total calories.

Discriminant validity: Only the change in CRCHGL correlated significantly with change in A1c reduction for PPG groups but not for the WL group. Only the PPG groups reduced carbohydrate consumption, (t-tests) as quantified by both the CRCHGL and the ASA24.

Discussion

The CRCHGL is a simple and broadly focused (servings of high glycemic load foods in the past week) metric for quantifying routine carbohydrate consumption. The psychometric properties of the CRCHGL were similar to those of the ASA24. In addition, the CRCHGL related to depressive symptoms. Reductions in the CRCHGL were related to reductions in A1c; reductions in the ASA24 were not. While construct validity correlates were anticipated to be moderate, they were low in the present data set. The only metric favoring the ASA24 was its higher relationship to total calories consumed. This higher correlation may be attributed to the ASA24's total carbohydrates and total calories coming from the same interview, reviewing the same 24 hours, while the CRCHGL reflects eating behavior from the previous 7 days. Further, the relatively small and restricted (participants in a research study) sample, justifies replication of these data incorporating larger and more representative individuals with T2D.

Conclusion

These data suggest that clinicians and researchers may use the CRCHGL to quickly and easily gain insight into a person's routine carbohydrate consumption and whether or not it changes over time. Based on the CRC results from the current and a previous study, a patient consuming 49 servings/week (one SD above the mean) would be ingesting a high carbohydrate load. A patient who decreased their consumption by 16 servings would be significantly reducing their routine carbohydrate load. Further, the CRC can be used as an education tool for a low carbohydrate diet, i.e. avoid foods 1-16 and embrace foods 17-32. However, if a clinician/investigator wants a broad nutritional analysis (e.g. precise measurement of total energy, macronutrients and micronutrients) of a specific day's eating behavior, the ASA24 is the only choice.

References

1. Augustin L S, Kendall C W, Jenkins D J, Willett W C, Astrup A et al. (2015). Glycemic index, glycemic load and glycemic response: an International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). Nutr Metab Cardiovasc Dis, 25:795-815.
2. Liu A G, Most M M, Brashear M M, Johnson W D, Cefalu W T et al. (2012). Reducing the glycemic index or carbohydrate content of mixed meals reduces postprandial glycemia and insulinemia over the entire day but does not affect satiety. Diabetes care, 35:1633-1637.
3. Ceriello A, Davidson J, Hanefeld M, Leiter L, Monnier L et al. (2006). Postprandial hyperglycaemia and cardiovascular complications of diabetes: an update. Nutr Metab Cardiovasc Dis, 16:453-456.
4. Subar A F, Kirkpatrick S I, Mittl B, Zimmerman T P, Thompson F E et al. (2012). The Automated Self-Administered 24-hour dietary recall (ASA24): a resource for researchers, clinicians, and educators from the National Cancer Institute. J Acad Nutr Diet, 112(8), 1134-1137.
5. Kroenke K, Spitzer R L, & Williams J B (2001). The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med, 16:606-613.