

Invited Commentary

Invited Commentary: Dietary Misreporting as a Potential Source of Bias in Diet-Disease Associations: Future Directions in Nutritional Epidemiology Research

Michelle A. Mendez*

* Correspondence to Dr. Michelle A. Mendez, Department of Nutrition, Carolina Population Center and Lineberger Cancer Center, University of North Carolina at Chapel Hill, McGavran-Greenberg 2205A, Chapel Hill, NC 27599-7461 (e-mail: mmendez@email.unc.edu).

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Error and bias in self-reported intakes make estimating relationships among dietary factors, obesity, and related health outcomes a complex challenge in observational studies. In the absence of measures that can be applied in calibration adjustments of dietary data, simple methods to identify persons who misreport their intakes have been used to assess the impact of screening out reports characterized by energy intakes that are implausible when compared with estimated energy needs. Sensitivity analyses in cross-sectional studies have shown these methods to yield more plausible associations between diet and obesity, but few longitudinal studies have evaluated this approach. In this issue of the *Journal*, findings reported by Rhee et al. (*Am J Epidemiol.* 2015;181(4):237) underscore the need for caution in drawing conclusions on how self-reported diet may influence such outcomes based on cross-sectional associations but suggest that this approach might have little impact on the more credible associations derived from prospective analyses. However, other prospective studies have found that diet-disease relationships emerge or are substantially strengthened with the use of calibration adjustments using recovery biomarkers. To better understand the influence of diet on obesity-related health outcomes, efforts to reduce dietary measurement error through improved collection, evaluation, and analysis of consumption data are still urgently needed.

body mass index; energy intake; implausible reporting; measurement error

Abbreviation: BMI, body mass index.

Dietary misreporting, which is characterized by reports of habitual energy intakes that are implausibly low when compared with requirements estimated using methods such as doubly labeled water measures or prediction equations, is common. Although it is a concern for all methods of dietary assessment, some, though not all, studies have suggested that this type of misreporting might be a particular concern with food frequency questionnaires (1–3). Because misreporting is often associated with weight status, as well as with reported diet quality (1, 3–11), associations between dietary intakes and obesity may be especially vulnerable to bias related to this phenomenon.

In the present issue of the *Journal*, Rhee et al. (12) evaluate associations between intakes of selected food groups and both body mass index (weight (kg)/height (m)²; BMI) and weight change, exploring the possible effects of several

approaches commonly used to screen out diet reports that are characterized by implausible energy intakes. Using longitudinal data from the Nurses' Health Study, they found that increases over time in intakes of sweets/desserts were positively associated with changes in BMI over 4 years, whereas associations with increases in fruit and vegetable consumption were negative. However, in cross-sectional analyses, associations between these food groups and BMI were reversed. It is uncertain to what extent either random error or bias in dietary reporting may explain these disparate results. Systematic error might contribute to the unexpected associations observed in the cross-sectional analysis because the extent to which the reported intakes fail to reflect true habitual diet might vary in a manner that is correlated with a person's current weight status.

In a series of sensitivity analyses, the Rhee et al. then used several alternative methods to evaluate the potential impact of

screening out dietary reports characterized by implausible energy intakes, applying strategies previously developed and described in the nutritional epidemiology literature (13–15). In these sensitivity analyses, Rhee et al. (12) found that the unexpected associations between food group intakes and BMI observed in their cross-sectional analyses became consistent with results found in their longitudinal analyses. Importantly, excluding the smaller proportion of subjects whose reported energy intakes fell outside the boundaries recommended for identifying extreme energy intakes at the population level did not have this effect. In contrast, however, accounting for misreporting did not strongly influence the longitudinal associations observed between changes in food intakes and changes in BMI. This finding, which was consistent with those from some previous prospective studies (16, 17), strongly suggests that longitudinal data could be much less vulnerable than those from cross-sectional analyses to this potential source of bias. Future longitudinal research is needed to confirm this reassuring finding and to assess the extent to which biases related to misreporting might contribute to disparities in results versus findings from cross-sectional studies. It is important to note, however, that persons who misreported their dietary intakes in that study (hereafter referred to as misreporters) were identified based on baseline intakes and not on subsequent reports used to estimate changes in intake.

An important concern noted by Rhee et al. (12) is that one cannot ascertain to what extent excluding misreporters who were characterized using energy requirements estimated based on body weight might induce a correlation between dietary factors associated with misreporting and attained BMI, the latter of which is also related to body weight. Additional research that compares the impact of using objective markers with that of using prediction equations to assess the potential effect of energy intake misreporting is needed to more fully assess this issue. However, in studies in which doubly labeled water was used to identify misreporters, prediction equations performed well (7), and some studies (3, 9, 10) have reported associations between misreporting and both diet quality and weight status that were similar to those described in studies using prediction equations (18). For example, associations between intakes of dietary factors such as sugar-sweetened beverages and BMI have been strengthened after excluding misreporters who were identified using doubly labeled water (19, 20), and objective but not self-reported energy intake was found to predict future weight gain (21). In the study by Rhee et al., it is also uncertain whether the impact of excluding participants characterized as misreporters might have been in part attributable to omitting any subjects who reported low energy intakes as a consequence of intentional weight-loss diets. In the absence of adjustments to account for weight change, estimates of misreporting of energy intake using these simple methods assume that subjects are in energy balance (18).

HOW SHOULD DIETARY MEASUREMENT ERROR BE ADDRESSED?

These findings suggest that measurement error that can be identified using simple error-propagation equations for energy misreporting might not have an important impact in prospective studies. However, it is important that dietary researchers

keep in mind that these simple methods are proposed for use in the absence of stronger measures that are suitable for accounting for dietary measurement error. Indeed, publications from the Women's Health Initiative (22, 23), in which the availability of recovery biomarkers of intake facilitated calibration of self-reported dietary data, suggested that measurement error can have an important influence in prospective analyses. For example, although biomarker-calibrated energy and protein intakes were strongly associated with the incidence of obesity-related cancers, unadjusted estimates from food frequency questionnaires were generally unassociated with these outcomes. Calibration had little effect on associations with non-obesity-related cancers. Findings of this type emphasize the continued need to strive for data collection methods that reduce error and bias in self-reported intakes and to develop and explore strategies for critically evaluating and improving the quality of these data (24, 25). It is important to note, however, that as a predictor of dietary measurement error, BMI has been a key component of these calibration equations. Further study is needed to evaluate how to best implement such measurement-error correction methods while ensuring that the risk of overadjustment bias is minimized. Identifying novel biomarkers to capture additional dimensions of dietary intake is an important component of these efforts because objective markers of intake may help to reduce the potentially important effects of random error and bias on estimated associations between diet and health (26–30).

CONCLUSIONS

Overall, the results reported by Rhee et al. (12) encourage continued caution in interpreting cross-sectional studies relating diet to obesity and related outcomes. Consistent with previous literature, their findings further suggest that the results of longitudinal analyses are more robust against bias from energy misreporting; there may be little or no gain in these studies from using simple methods to identify and account for likely misreporters. Despite these promising findings, however, results from other recent studies have continued to demonstrate the urgent need to develop methods for reducing random error or imprecision, as well as bias, in self-reported data on specific dimensions of dietary intake.

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Author affiliation: Department of Nutrition, Carolina Population Center and Lineberger Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina (Michelle A. Mendez).

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