Dietary assessment

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Predictive equation helps estimate misreporting of energy intakes in dietary surveys

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Misreporting of dietary intake under free-living conditions in nutritional epidemiological studies can't be easily captured. A predictive equation for total daily energy expenditure derived from the largest doubly labelled water dataset to date can help improve evaluation of the accuracy of self-reported dietary intake.

National dietary and public health policies are often informed by large-scale surveys of dietary intakes, but almost all dietary intake measures have a large subjective component because they are self-reported. This creates a discrepancy between what people eat and what they say they eat[1]. A 2015 consensus statement by the Energy Balance Measurement Working Group highlighted that the inaccuracies of self-report data make findings in many studies questionable, incorrect or misleading[2]. Misreporting of food intake can be accurately measured in the laboratory, but not yet under free-living conditions[1]. Improved measures of free-living dietary intake and misreporting are urgently needed because no single biomarker can currently validate energy and nutrient intake[1]. The doubly labelled water (DLW) method is considered the 'gold standard' for estimating daily energy expenditure under free-living conditions.

Now, writing in *Nature Food*, Speakman and colleagues[3] exploit the most comprehensive DLW dataset available in the world using easily measured inputs (age, sex, height, weight and elevation above sea level) to derive a predictive equation for total daily energy expenditure. These regression estimates of energy expenditure were then used with 95% predictive limits to assess the correspondence between self-reported energy intakes and predicted energy requirements[4], thereby estimating the degree of dietary energy 'misreporting'.

An accurate dietary report is one that measures true intake over a study period and isn't compromised by changing dietary patterns or behaviours and false memories. Determining the absolute validity of self-report dietary intakes is impossible because there are no independent, gold-standard, ground truth measures (for example, biomarkers) to corroborate food intake in the free-living environment. Researchers have often relied on comparison of one self-reported intake method with another (concurrent validation), which can provide false validity because all such methods tend to be misreported[1]. It has therefore been suggested that energy intakes could be compared to estimated energy requirements as an objective evaluation of the plausibility of energy intakes[5]. There have been several approaches to assess the plausibility of self-reported energy intakes, each with their own assumptions, but inconsistencies in their use has added to confusion over the extent and prevalence of misreporting across different populations[1]. The DLW method has often been used to evaluate the plausibility of self-reported energy intake. The majority of these studies observed a discrepancy between intake and expenditure, indicative of under-reporting of energy intake[4]. The Energy Balance Measurement Working Group [2]., an international group of experts in the measurement of energy expenditure and intake, argued that it is unacceptable to use inaccurate self-report instruments to assess energy intake.

The predictive equation of total daily energy expenditure derived by Speakman and colleagues is the best estimate to date of the correspondence between self-reported energy intakes and predicted energy requirements, with the benefit of associated confidence estimates, in nutrition survey samples. Yet, although this equation may help to identify misreported energy intakes, it does not directly assess the relationship between what people actually eat and what they report eating. As there is no objective external validation of this approach, it therefore remains an informed estimate, based on principles and assumptions related to energy balance physiology. Although an extremely large DLW dataset was used, the predictive model only explained 69% of the variability in total daily energy expenditure, producing absolute errors of 11.2% in the test dataset[3]. The estimate assumes that individuals are in energy balance over the period of dietary intake measurement (which they may not be), and the equations cannot be applied to those with unusual energy requirements such as athletes, pregnant or lactating women, or groups with unusually high physical activity[3].

Critically, the paper by Speakman and colleagues does not help to restore missing data created by the large prevalence of misreporting of dietary energy intakes[1]. Screening data using this equation to predict total daily energy expenditure leads to large percentages of the data falling outside the predictive interval, mainly from under- rather than

over-reporters of energy intake. If these data are removed from, or erroneously included in, the dataset, patterns between dietary intake and disease prevalence may be distorted[1]. This raises questions of what to do with data classified as misreported and how to correct for – or model – data that is missing owing to under-reporting. There are as yet no simple answers, particularly as we still cannot reliably predict who is more likely to misreport dietary intake at the individual level. Various approaches have been proposed to adjust data apparently missing because of misreporting or to compare different approaches to excluding misreporters (for example, see ref. 6). However, all of these approaches make a number of specific assumptions that may not necessarily hold in large-scale diet surveys.

Given the importance of the difference between 'true' intake and self-reported intake in nutritional epidemiology studies, it is important to put more effort into trying to quantify discrepancies between actual and reported intake, which cannot be predicted. This approach by Speakman and colleagues could be further supported by combining dietary assessment methods with mathematical models of energy balance[7], digital tracking of energy balance behaviours and biomarkers of misreporting of food intake to develop cost-effective means to improve individual dietary intake measures. The use of continuous wearable video cameras combined with 3D modelling of foods consumed may improve estimates of actual food intake and reduce misreporting of food intake[8]. Improved estimates of physical activity and daily energy expenditure may be achieved by applying machine learning models to sensor outputs from wearable devices, calibrated against gold-standard, ground-truth measures of energy expenditure[9]. Using cloud-connected weighing scales to track body weight (energy storage) offers a means to consider these estimates of energy intake and expenditure in the context of energy balance[10]. But these developments are still a long way from scalable application in large nutritional surveys, and even improving the accuracy of food intake measurement still leaves some uncertainty about the specific nutritional composition of the foods ingested.

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Competing interests

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