Inherent flaws in a method of estimating meal intake commonly used in long-term-care facilities

VICTORIA HAMMER CASTELLANOS, PhD, RD; YVETTE N. ANDREWS, MS

ABSTRACT

Objective To evaluate the accuracy of a method used to estimate nursing home residents' meal consumption, where the meal tray is assessed as a whole and assigned a value of 0%, 25%, 50%, 75%, or 100% consumed, under both routine and controlled conditions.

Subjects/setting This study was conducted with certified nursing assistants at a 180-bed long-term-care facility in Miami, Fla.

Methods Study 1 evaluated the method under routine conditions by comparing nursing assistants' estimates to actual meal consumption of 42 residents over 109 meals. A second study evaluated the method in a controlled setting where nursing assistants were free of disincentives and distractions that might contribute to inaccurate reporting. In a crossover design, nursing assistants estimated consumption on 4 manipulated trays under conditions of both immediate and delayed reporting.

Statistical analysis An intraclass correlation coefficient and percent agreement were used to compare nursing assistants' estimates to weighed meal intakes.

Results Under routine conditions, the intraclass correlation coefficient between nursing assistants' estimates and the actual resident meal consumption was weak at 0.464 (95% confidence interval=0.146 to 0.664). The correct estimate was recorded 44% of the time. In the controlled setting, the nursing assistants' estimates for percent consumed agreed with weighed intakes 44% and 38% of the time with immediate and delayed recording, respectively.

Applications/conclusions This 1-step method of estimating meal consumption with an overall percentage is not sufficiently accurate to identify residents who are eating less than 75% of most meals. J Am Diet Assoc. 2002;102:826-830.

Researchers and clinicians agree that it is imperative to develop a reliable food intake method for tracking food intake in long-term-care settings (1-4). Dietitians use this information for the initial and ongoing risk assessment of residents’ nutritional status and to evaluate the effectiveness of nutrition interventions. These figures are also used when completing the Comprehensive Resident Assessment/Minimum Data Set, which is mandated by the Omnibus Senate Reconciliation Act of 1987 (OBRA). Per OBRA guidelines, a physical and health reassessment of a resident is triggered when a resident is eating 75% or less of most meals (5). In addition, state inspectors include these records in the governmental monitoring process.

A number of studies have reported inaccuracies in the recording of food intake in nursing homes (1-3,6). Such studies have demonstrated that nursing assistants regularly and significantly overestimate food consumption for the majority of residents, and underestimate food intake less frequently. The factors leading to estimation errors have been shown by previous studies to include lack of knowledge or training as it relates to the assessment method, an assumption by nursing assistants that a resident’s intake is a reflection of their job performance, subjective judgments as to what constitutes an adequate intake, insufficient staffing, high staff turnover, and a delay in reporting food consumption figures into the medical record (1,3,7). Unfortunately, from the studies published to date (1-3,6) it is impossible to know how much of the estimation error that has been observed is due to the factors listed above and how much is due to the inadequacy of the specific measurement method that was used.

The goal of our studies was to evaluate the accuracy of a widely used method of estimating nursing home resident food
intake wherein meal trays are assessed as a whole and assigned a value of 0%, 25%, 50%, 75%, or 100% consumed (1). With this method, the intake figure is typically recorded at some later time, usually from memory, into an intake log. To understand the limitations of this method for estimating food consumption, the system was evaluated under both routine and controlled conditions.

METHODS

Studies were performed at a 180-bed nursing home in Miami, Fla. Protocols were approved by the Institutional Review Board at Florida International University.

Study 1: Routine Conditions

For a purpose unrelated to this study, 24-hour meal intakes were determined for 42 residents who required some level of assistance during meals and who received 100% of their nourishment orally. Approximately half of the residents were studied in January 2000 and half 7 months later on the same day of the cycle menu. Residents were randomly distributed across the 3 units of the 180-bed facility and thus were provided care by a variety of nursing assistants. It is common for the same nursing assistant to estimate a given resident’s intake at both breakfast and lunch and for a different nursing assistant to estimate dinner intake. Due to missing data points, both weighed values and nursing assistant estimates of meal intake, obtained from the nursing intake logs, were available for 109 of 126 meals served. Residents or their legal representatives gave informed consent.

The amount of food served was determined by averaging the weights of portions set aside from the tray line at each meal (3 each of regular, mechanical soft, and pureed). Tray contents were recorded as they left the tray line and the bottoms of drink containers were marked in the event that drinks were traded between residents. Unconsumed food was weighed on an electronic balance. The calculation of total percentage of food eaten (weight of food missing from tray/weight of food served x100) included all energy-providing foods and beverages (at breakfast, coffee or tea was served to some residents, data not available).

Study 2: Controlled Conditions

Study 2 was conducted 6 months after completion of Study 1. Nursing assistants who had been employed full time for at least 3 months were eligible to participate. Volunteers were recruited from the afternoon and morning shifts across all units of the facility. The group consisted of 4 Hispanic, 7 Caribbean, and 1 African-American females, aged 19 to 55 years (mean age=39 years). Nursing assistants gave informed consent and were compensated for participation with a gift basket.

One week before the study, all volunteers were retrained in the meal intake estimation method, even though this method had been used for a number of years by the facility. Under the supervision of the facility’s consultant dietitian, nursing assistants were instructed by a graduate research assistant to evaluate the tray as a whole, including both food and beverage.

For the study, 3 identical trays from both breakfast and lunch were set aside from the tray line. One tray from each meal remained unmanipulated and was available for reference as how the trays looked when served. These trays were also used to define the weight of food served for calculation purposes. Portions of the foods and drinks on the remaining trays were systematically removed to simulate resident meal intake. The calculation of total percentage of simulated food consumed (weight of food missing from tray/weight of food served x100) included all foods and beverages, because nursing assistants were specifically instructed to consider all foods and beverages in their retraining session.

Study 2 consisted of 2 conditions, namely “immediate” and “delayed” reporting of food consumed. Each nursing assistant viewed the same 4 trays twice to allow for comparison between conditions. For immediate recording, the nursing assistants were required to log their estimates while viewing the trays. For delayed recording, they were asked to first view the trays and then remove them from the table. After the removal, a time lapse of approximately 2 minutes, they recorded food consumption. The immediate and delayed conditions were separated by a short lapse of time, approximately 10 minutes, during which the nursing assistant left the room and was distracted by conversation and other activities. Because meal trays are normally associated with a resident, each tray had a card labeled with a name. To avoid systematic bias, half of the nursing assistants had the immediate condition first and half had the delayed condition first, different nursing assistants saw different combinations of names on the trays, and the 4 trays were rearranged between viewings.

Data Analysis

Statistical analysis was performed using SPSS for Windows (version 10.0, SPSS Inc, Chicago, Ill). For Study 1, both intraclass correlation coefficient and determination of percent agreement were used to compare meal consumption estimates recorded in the food intake log to the actual percent of food eaten (8). The actual percent of food eaten was assigned using weighed food intakes as follows: 0% to 9% of foods and drinks consumed=0%; 16% to 34%=25%; 41% to 59%=50%; 66% to 84% =75%; and 91% to 100%=100% of food eaten. If weighed intakes fell between specified ranges, then the values on either side would both be considered to be the actual value. For example, if 37% of food was eaten, estimates of either 25% or 50% would be considered to be correct. If there were 2 possible correct answers as in the example above, for the purposes of the statistical analysis we assigned the actual value that was closest to the nursing assistant’s recorded estimate.

For Study 2, percentage agreement between nursing assistants’ estimates of consumption and simulated food consumption was determined. The agreement between the immediate and the delayed recording conditions was also determined.

RESULTS

Study 1

The nursing assistants’ estimates were in poor agreement with actual resident meal consumption, with an intraclass correlation coefficient of 0.464 (95% confidence interval=0.146 to 0.664). There was only 44% agreement between nursing assistants’ estimates and actual consumption; 48 out of 109 estimates were correct (Table 1). Nursing assistants tended to overestimate consumption, especially at the lower levels of intake. Only 25% of meal intakes below 75% consumed were accurately identified, and intake logs had accurate records for only 35% of meals in which less than 50% was consumed. Of the 109 weighed meal intakes, 62 meals (57%) were recorded as 100% of the meal eaten, when in fact only 27 (25%) of those meals should have been recorded as 100% consumed (Table 1). Underestimation of intake occurred rather infrequently, roughly 6% of the time.
Of the 33 residents for which we had complete data for breakfast, lunch, and dinner, 14 ate less than 75% of 2 out of 3 meals served. Only 5 of these 14 residents could have been identified as eating 75% or less at most meals by staff examining the intake log.

The Figure represents how well nursing assistants’ estimates reflected overall daily intake in individual residents, that is, average of 3 meals. Approximately 39% of the time daily intake was overestimated by greater than 25%.

Study 2
When meal tray items were weighed and totaled, it was determined that all 4 test trays should have been estimated at 50% consumed (Table 2). This was true whether or not foods and drinks were considered together or if consumption was based on foods alone. If food alone was considered (excluding the beverages), simulated consumption was 59% for all 4 meals except lunch tray 2, which was 54%. On the other hand, the simulated consumption of the food on the main plate varied across trays: breakfast 1=62%, breakfast 2=50%, lunch 1=51%, and lunch 2=29%.

Whether either immediate or delayed reporting was used in this experimental paradigm, the nursing assistants’ reported consumption agreed with weighed consumption less than 45% of the time (44% for immediate, 38% for delayed). Estimation errors were more likely to be overestimates, 33% and 38% of the time in the immediate and delayed reporting conditions, respectively. Underestimation was also a significant problem under both reporting conditions (23% and 25% of total estimates). Nine tray estimates were correct under conditions of immediate reporting but incorrect with delayed reporting, and 6 of the estimates were correct when there was a recording delay but incorrectly recorded while trays were viewed.

Discussion
Although the apparent simplicity of the method under evaluation here makes it appealing, an overall estimate of meat intake does not have an acceptable level of accuracy, even under optimal conditions. Under both routine and controlled conditions, nursing assistants’ estimates were correct less than 45% of the time. Although the OBRA guidelines require an assessment to be conducted when a resident eats 75% or less of most meals (1), under routine conditions only 25% of single meal intakes below 75% were accurately identified in the medical record. Staff failed to identify 65% of residents eating poorly (<75%) at 2 out of 3 meals (see Figure). In many facilities weights are recorded only monthly and, without accurate food consumption estimates, the diagnosis of an acute illness or depression could be delayed and could result in a resident’s death (1).

This percentage method appears to be inherently inaccurate, as agreement between nursing assistants’ estimates and weighed values was not improved under controlled conditions as compared to routine ones. These data suggest that an estimate of meal intake, established by considering all of the foods and drinks on a tray at 1 time, is more difficult than it would seem. The fact that most of the error occurred as overestimates under routine conditions, compared to a more even distribution of error under controlled conditions, indicate that this method is also undermined by subjective bias. It may be nearly impossible to achieve acceptable levels of accuracy using this method on a daily basis.

Evaluation of the food intake estimation method under the controlled conditions of Study 2 provides some insight into the nature of this method’s limitations. Even though the simulated amount eaten was similar on all trays, nursing assistants tended to overestimate intake on the breakfast trays and underestimate on the lunch trays. Although it was impossible to be certain as to the cause of this pattern, it is likely that at least some nursing assistants were paying disproportionate attention to the items on the main plate. Such items were consumed to a greater extent on the breakfast plates (French toast) and less on the lunch plates (chicken, collard greens, and corn bread). This supposition was supported by spontaneous comments elicited from the nursing assistants during the retraining session that revealed a propensity by some to concentrate on the main plate of the practice trays. In addition, some nursing assistants apparently did not consider beverage consumption in their overall estimate. The research assistants noted that some nursing assistants lifted opaque drink containers in order to “feel” how much had been consumed; others did not. It likely made no difference whether or not beverages were considered in Study 2 because the correct estimate was 50% whether or not drinks were considered. It is also possible that some of the variability in estimation accuracy was due to the menu itself; some studies have found that certain types of meal items are more difficult than others to estimate accurately (9,10).

A number of school plate waste studies and other types of studies have shown that it is possible to accurately estimate intake of individual foods (9-14), at least with dietitians, nurses, or research assistants acting as observers. Few studies have tested the estimation abilities of other groups of people, although 1 study tested schoolchildren (11) and found they were able to achieve moderately accurate intake estimates of some foods but not others (r=0.39 to r=0.84 for various foods).
To achieve overall estimates of meal intake from estimates of individual foods, it is necessary to perform some sort of calculation. There are any number of methods in common use, none of them validated, in which points or percentages are assigned to individual foods and subsequently added together or otherwise manipulated to arrive at an overall tray total (1,15). Kayser-Jones (1) has reported that nursing assistants do not always understand how to use complex methods and often recorded the percentage without referring to them. Although using food consumption estimates of individual foods to calculate an overall meal intake value may potentially be more accurate than making an overall tray estimate in 1 step, future research should consider exactly how individual food estimates should be combined to arrive at an overall meal estimate. Which staff members are most appropriate for making estimations of individual foods and who should perform the relatively complex calculations required to arrive at an overall tray estimate should be investigated, as well.

The delay between when meal trays are cleared and when estimates are logged in the medical record may be a substantial contributor to food intake estimation errors. We did see a slight improvement in accuracy when food intake was reported while the tray was being viewed compared to when there was a very short delay between viewing and recording. Much longer delays in recording than those tested here have been reported in the practice setting, that is, hours to days (1). In 1 study (1) it was reported that most nursing assistants recorded the percentage eaten by residents at the end of the workday, calculating it from memory based on the general impression of what residents ate. In some cases, nursing assistants did not chart the amount eaten until the following day, even though they each fed a large number of residents. These longer delays in recording, combined with the large number of residents fed by each nursing assistant, up to 12 to 15 residents at a single meal in some nursing homes (7,16), are likely to have a dramatic effect on the accuracy of food intake estimates. Indeed, Pokrywka and coworkers (3) found that only 15 of the 27 lunch meal estimates recorded in the medical record were the same as the estimates that were verbally reported immediately after the meal. Therefore, although our study did not show a large effect associated with brief recording delay, in the practice setting a recording delay is likely to hinder the accuracy of estimates. It is important to note that when the estimation method is inherently flawed, estimation errors will continue even if intakes are immediately reported.
Table 2
Nursing assistants' estimates of food consumed under conditions of both immediate and delayed recording

<table>
<thead>
<tr>
<th></th>
<th>Breakfast tray 1 (n=12)</th>
<th>Breakfast tray 2 (n=12)</th>
<th>Lunch tray 1 (n=12)</th>
<th>Lunch tray 2 (n=12)</th>
<th>4-Meal totals (n=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulated meal consumption*</td>
<td>55</td>
<td>44</td>
<td>46</td>
<td>48</td>
<td>...</td>
</tr>
<tr>
<td>Immediate reporting consumption estimates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25%</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>50%</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>75%</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>100%</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Agreement (%)*</td>
<td>25</td>
<td>42</td>
<td>67</td>
<td>42</td>
<td>44</td>
</tr>
</tbody>
</table>

| Delayed reporting consumption estimates |                        |                        |                     |                     |                      |
| 0%                    | 0                       | 0                       | 0                   | 0                   | 0                    |
| 25%                   | 1                       | 0                       | 5                   | 6                   | 12                   |
| 50%*                  | 2                       | 6                       | 4                   | 6                   | 18                   |
| 75%                   | 6                       | 6                       | 3                   | 0                   | 18                   |
| 100%                  | 0                       | 0                       | 0                   | 0                   | 0                    |
| Agreement (%)*        | 17                      | 50                      | 33                  | 50                  | 38                   |

*Total of food and beverage, percent consumed by weight.
*Values represent the number of nursing assistants recording each estimate.
*Correct estimate.
*Percent of nursing assistants in agreement with actual percent of food consumed by weight (correct estimates/12).

APPLICATIONS

In choosing a meal intake estimation method for a facility, the following should be considered:
- The method where the meal tray assessed as a whole and assigned a value of 0%, 25%, 50%, 75%, or 100% consumed is inherently flawed and unlikely to yield sufficiently accurate estimates of resident intake.
- An optimal system requires the recording of intake estimates into the record while the estimator is viewing the tray.
- Because no method for estimating meal intake has been shown to be valid under routine nursing home conditions, practitioners should rely on body weight measures to assess whether food intake is adequate to meet residents' energy needs.

References

This study was supported, in part, by grant No. 90AM0889 and No. 90AM2389 from the Administration on Aging, US Department of Health and Human Services. Grantees undertaking projects under government sponsorship are encouraged to express freely their findings and conclusions. Points of view or opinions do not, therefore, reflect official Department of Health and Human Services policy.

The authors thank Armando Tiran for data collection, entry, and analysis of resident food intake in Study 1; Martha Georgian, Raquel Castillo, and Stephanie Wade for their assistance with Study 2; and Sharon Clewis, RD, for supervising the nursing assistant training.