



ORIGINAL RESEARCH

Dietary Intake and Related Factors of Residents of Assisted Living Memory Care

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ABSTRACT

Assisted living memory care (ALMC) residents present with specific needs and challenges. Knowledge regarding their nutritional intake and the relationship to cognitive ability, demographics, and dining behaviors is limited. This quality improvement project was conducted to determine the dietary intake of ALMC residents and identify factors related to the adequacy of their dietary intake to inform the development of strategies to enhance their dietary intake. Ingested food and fluids and ingestion behaviors were recorded over a 12-hour (7 AM -7 PM) observation. Related factors examined were obtained from chart review. Food Processor Nutritional Analysis Software was used to determine nutrient intake with the calculation of percent of recommended amounts based on BMI, age, and activity level. Thirty-two residents (75% females; mean age 86.5 years, SD=7.84) of four ALMC units (eight per unit) were subjects of this study. Their Global Deterioration Scores ranged from 3 to 7, with 60% at 5 or greater. Average BMI was 25.47 kg/m² (range 14.1-40.4 kg/m²). Major dietary components (protein, calories, carbohydrates) were consumed in adequate amounts based on the percent of recommended. The percent of recommended fiber intake was low (mean 61.57%) with saturated fat intake extremely high (mean 243.80%). Micronutrients were below recommended levels except for cholesterol, vitamin C, sodium, and iron. Four subject groups, relative to level (inadequate, moderately inadequate, adequate, exceeds recommended) of nutritional intake, were identified based on hierarchical clustering with all nutrient data. Using protein intake as a representative nutrient variable, regression analysis indicated that 44.1% of the variance was explained by cognitive ability and setting after adjusting for their interaction. A balance of adequate intake while allowing ALMC residents' choice in food selection is essential. Further research is needed to address dining standards specific to the ALMC population that recognizes cognitive ability, food offerings, and dining behaviors.

Keywords: Dietary intake, dietary reference intakes, assisted living, dementia

Key Practitioners Message

1. A comprehensive assessment of the nutritional status of ALMC residents, inclusive of cognitive ability and setting characteristics, is necessary.
2. Ensure that the menu in ALMC units offers selections that include sources of fiber, are lower in saturated fat, and assist the resident to meet the recommended intake of micronutrients.
3. Provide education to help staff recognize how to support the highest level of function for those

residents who have difficulty in completing a meal for a variety of reasons.

Introduction

Older adults residing in long-term care (LTC) facilities are at high risk of malnutrition as a result of poor dietary intake (Keller et al., 2017). Poor nutritional status and weight loss among this population are associated with falls, poor wound healing,

hospitalization, greater health care use, and diminished quality of life ([Keller et al., 2017](#)). A rapidly growing population in LTC is residents of assisted living memory care (ALMC) units. Although it is recognized that residents of assisted living facilities (ALFs) do not require the level of care of skilled nursing facilities (SNFs) residents, they still experience significant cognitive and physical impairments and multiple chronic conditions ([Harris-Kojetin et al., 2016](#)). The residents of ALMC units present with more cognitive impairments than the AL population in general, thus putting this group at higher risk for inadequate dietary intake.

Several recent systematic reviews have focused on interventions to support food and drink intake for individuals with dementia as well as specifically addressing the eating behavior of individuals with dementia in nursing homes (NH). An interprofessional team conducted a systematic review and meta-analysis of the effectiveness of interventions that directly ([Abdelhamid et al., 2016](#)) or indirectly ([Bunn et al., 2016](#)) support food and drink intake of individuals with dementia. In both reviews, no clear effective, or ineffective interventions were discerned. The small and short-term nature of the intervention studies reviewed was a major limitation. In a scoping review of the literature, [Cipriani, Carlesi, Lucetti, Danti, and Nuti \(2016\)](#) reported that most people with dementia, especially in the later stages, present with abnormal eating behaviors, eating problems, and dietary changes. These authors stress the importance of being aware of the eating problems for the implementation of early interventions. [Liu, Galik, Boltz, Nahm, and Resnick \(2015\)](#) reviewed research specially focused on the effect of interventions on eating performance for older adults with dementia in LTC. Of the 11 studies reviewed, both training programs and the mealtime assistance offered by staff showed effectiveness in improving eating performance.

[Whear et al. \(2014\)](#) focused on the effectiveness of mealtime interventions on behavioral symptoms of NH residents with dementia. The investigators found that music, changes to food service, dining environment alternations, and group conversation improved mealtime behavior. Poor study quality limited the analysis, but there was a trend in favor of improved behavioral symptoms.

The European Society for Clinical Nutrition and Metabolism (ESPEN) recognized that nutritional problems are part of the trajectory of the dementia disease process, thus putting these persons at high risk for malnutrition. ESPEN developed evidence-based guidelines for nutrition care for those with dementia-related to the risk of malnutrition. Twenty-six recommendations were developed in the categories of screening and assessment, strategies to support oral nutrition, provision of oral supplements, and artificial nutrition and hydration ([Volkert et al., 2015](#)).

Even though there have been recent systematic reviews on nutrition for those with dementia as well as the establishment of the ESPEN guidelines, only two

studies have specifically addressed the intake of a resident of ALMC units. [Reed, Zimmerman, Sloane, Williams, and Boustani \(2005\)](#) reported observational data related to the amount of food and fluid intake among AL and NH residents with dementia. The results of the study indicated that both groups had low food and fluid intake (54% of AL; 62% of NH). Similar results were reported by [Simmons, Coelho, Sandler, and Schnelle \(2018\)](#) based on a quality improvement (QI) project that was implemented to provide a system to manage feeding assistance care processes for residents of ALMC. They found that a significant proportion of ALMC residents consumed less than 50% of their meals. Observations were completed to collect the intake in both studies, but actual dietary intake was not recorded.

The purpose of this QI project was to determine the dietary intake of ALMC residents and identify factors associated with food intake and nutritional status. Factors explored include: 1) participant characteristics (i.e., age, cognitive ability); 2) perception of factors influencing intake of food and fluid; 3) ingestion behaviors (behaviors demonstrated during any ingestion session and level of assistance provided); 4) engagement at meals, and 5) community of residence.

Materials and Methods

Population

Thirty-two residents (8 men, 24 women) living in one of the four ALMC facilities in Florida, South Dakota, and Minnesota were participants in this observational study. The study was done as a facility-wide QI project, consisting of several components, including meal observation. The SQUIRE 2.0 Standards for Quality Improvement Reporting ([SQUIRE, 2015](#)) served as a guide for this quality improvement project due to the low potential of harm or burden to the participants with a potential to improve the quality of life and safety of the select population. The project was approved as exempt status by the Institutional Review Board of the University of Minnesota (STUDY00002165).

Measurements and Data Collection

Food and fluid intake and ingestion behaviors were captured by two experienced research nurses (PG and CS) through an observational process. Observation of dietary intake was completed in common areas of the unit (not in residents' private apartments) over 12 hours. They had completed a pilot observational study to refine the written instrument and clarify the categories for the amounts consumed and ingestion behaviors. The pilot observation study revealed a 92% inter-rater reliability. One observer was responsible for recording consumed amounts and behaviors for a maximum of four residents with both observers present at the same time at each facility.

The amount, type, and time of food and fluid ingestion were recorded from 7 AM through 7 PM. Neither food nor beverages were typically consumed after 7 PM. The amount of food and fluid consumed was observed

before, during, and after mealtime. Observation during the meal allowed the capture of total food and fluid intake as well as that spilled or taken from another resident. The level of assistance required for the majority of each meal was also recorded. Behaviors that influence intake that was identified in the pilot and the literature were also captured during the observation. Refer to the results sections for specific behaviors.

During the 12-hour observation, the resident engagement during meals, planned, and unplanned activity was recorded. The “Daily Engagement Observation Rating Tool for the Montessori-Inspired Lifestyle Program” was used to record the engagement level. This author developed a tool that was used to capture the level of engagement for residents in the memory care units of the facilities. The engagement was observed for seven ten-minute periods (three meals, two planned activities, and two unplanned activities) during the 12 hours. The engagement was recorded as positive, neutral, negative, or failed for each minute of the 10-minute periods.

Health records were abstracted to obtain demographic and other characteristics of the residents, including age, gender, height, weight, cognitive ability, and prescribed medications. Weights were not measured during the time of the study, but rather the most recent weight in residents’ charts was used for this study.

The Global Deterioration Scale (GDS) (Reisburg, 2005) score available in the health record was obtained as a measure of cognitive ability. The GDS was used for assessment of primary degenerative dementia and was completed a minimum of every six months or if the condition changed. The scale has the following levels: 1 = no cognitive decline, 2 = very mild cognitive decline (age-associated memory impairment), 3 = mild cognitive decline (mild cognitive impairment), 4 = mild cognitive decline (mild dementia), 5 = moderately severe cognitive decline (moderate dementia), 6 = severe cognitive decline (moderately severe dementia), and 7 = very severe cognitive decline (severe dementia) (Reisburg, 2005).

Participants were interviewed following the observation to complete the Ingestion Perception and Feelings Survey. The survey explored participants’ reasons for eating and drinking, as well as factors influencing ingestion behavior. These factors were identified in the literature as well as in the pilot.

Assessment of Dietary Intake and Dietary Reference Intakes (DRI) Adherence

Dietary intake data, including foods and beverages, were entered in Food Processor Nutritional Analysis Software (version 11.2.274, ESHA Research, Salem, OR). Most food data were manually entered into Food Processor using standardized Sysco (food product wholesaler) recipes, and remaining foods were entered using the Food Processor food database. DRI adherence was determined using Food Processor, which compared actual intake to current recommendations.

Recommended intake of energy and nutrients was standardized to 100% DRI based on age, sex, body mass index (BMI), and physical activity level. Because activity level was not known, all DRIs were based on the assumption that residents were sedentary.

Statistical Analysis

Statistical analyses were performed in SAS 9.4 (SAS Institute, Cary, NC) and R 3.5.2 (R Core Team, Vienna, Austria). Baseline characteristics were reported as means and standard deviation (SD) for continuous variables and frequencies for categorical variables. Dietary intake was reported across categories of prescribed medications and adjusted for age, sex, BMI, and energy intake. Intake of specific food groups was reported as means and SD. Hierarchical clustering was implemented to identify groups of residents based on profiles of nutrient intake.

Results

Participant Characteristics

There were 32 ALMC residents observed, mean age 83.5 ± 7.84 years and 75%, female. Baseline characteristics of residents are shown in [Table 1](#). The average BMI was 25.47 kg/m² (range 14.1-40.4 kg/m²). Fifty percent of the residents were overweight or obese; however, three women were underweight. The average number of medications prescribed was more than nine (range 1-19). The prevalence of polypharmacy (five or more medications prescribed) among the residents was 31.3%, and the prevalence of excessive polypharmacy (10 or more medications prescribed) was 53.1%. Additionally, 36.7% of residents scored 5 on the GDS, and 23.3% scored 6 or higher. The vast majority (81.2%) of residents were independent in feeding.

Table 1
Baseline Characteristics of Residents Living in Assisted Living Memory Care

	Mean (SD)		
	Men (n=8)	Women (n=24)	All (n=32)
Age, Years	83.5 (±7.84)	87.5 (±7.10)	86.5 (±7.37)
BMI, Kg/m ²	24.79 (±3.39)	25.69 (±6.30)	25.47 (±4.86)
Underweight	0	3 (12.50%)	3 (9.4%)
Normal Weight	5 (62.5%)	8 (33.33%)	13 (40.6%)
Overweight	3 (37.5%)	10 (41.67%)	13 (40.6%)
Obese	0	3 (12.5%)	3 (9.4%)
Cognitive Ability (Global Deterioration Scale Score), n (%)			
3	0	3 (12.5%)	3 (9.4%)
4	4 (50%)	5 (15.6%)	9 (28.1%)
5	0	11 (34.3%)	11 (34.3%)
6 and Above	3 (37.5%)	4 (12.5%)	6 (21.8%)
Not Documented	1 (12.5%)	1 (3.1%)	2 (6.3%)
Level of Assistance During Meals n (%)			
Total Independence	7 (87.5%)	19 (79.2%)	26 (81.2%)
Partial Dependence	1 (12.5%)	3 (12.5%)	4 (12.5%)
Total Dependence	0	2 (8.3%)	2 (6.3%)

Ingestion Behaviors and Perception of Factors

Fifteen participants presented with one or more ingestion behaviors with 17 participants not presenting with any of the listed behaviors. Those behaviors that were specifically observed were (number of residents

with behavior): inappropriate use of fingers (n = 7), spilling (n = 5), inappropriate use of utensils (n = 4), unable to maintain attention during the meal (n = 4), inappropriate reaching (n = 1), dozing (n = 1), bite-size too large (n = 1), chews and spits out food (n = 1), and could not terminate meal (n = 1). Not observed were unable to locate all food, coughing, choking, drooling, difficulty swallowing, hoarding food in the mouth, and stealing food. The occurrence of the observed behaviors was categorized as “noted” (occurred, but not consistently) and “consistently noted” (occurred at several of the meals consistently). Five participants demonstrated more than one behavior during the observation with two of these five participants demonstrating four different behaviors. The frequency of the behaviors is presented in a previous publication ([Gaspar, Scherb, and Rivera-Mariani, 2019](#)).

Twenty-three of the 32 residents (72%) could provide a meaningful response to questions regarding their perception of factors that may affect the intake of food and fluids. Over half of the respondents identified that feeling hungry and having food that looks and tastes good increases their intake. Eleven respondents (48%) indicated that feeling thirsty increases their intake, but that they seldom experience thirst. Limited dietary intake included feelings of fullness, experiencing nausea or stomach upset, fear of leaking urine, and fear of falling. [Table 2](#) provides a summary of the responses of the residents. For both ingestion behaviors and perception of factors, the number of participants with each response limited the statistical analysis.

Engagement during meals was recorded as neutral approximately 70% of the time for the participants at all meals; indicating that there was little or no attempt at conversation and they were focused on eating. Two of the sites each had 54% of the meal engagement minutes as neutral, with the other 46% as positive engagement. Conversations between residents and/or staff were noted as positive engagement. The other two sites had 88% and 83% of the 10 minutes recorded as neutral. These differences are incorporated in the analysis when a site is used as a variable.

Dietary Intake

Measures of central tendency of the dietary intake for study participants for the 24-hour meal observation period are presented in [Table 3](#). Many nutrients were consumed in adequate amounts except for fiber, vitamin A, vitamin B6, calcium, and potassium. Large individual differences, according to range and SD, were found for nutrients, vitamins, and minerals.

After adjusting for age, BMI, and energy (kcal) intake, statistically significant differences ($p = 0.02 - 0.04$) were found between men and women for grams (g) of protein per kilogram (kg) of body weight, milligram (mg) of sodium, and mg of sodium per 1000 kcal. On average, women consumed 0.2 g protein per kg more than men per day ($p = 0.04$). Men consumed significantly more sodium than women per day ($p =$

0.02). Sodium intake per 1000 calories was 2329 mg/kcal for men and 1718 mg/kcal for women ($p = 0.03$).

Table 2

Participant Responses Regarding Limiting or Increasing Food and Fluid Intake

Perception	N	Limits Intake		Increases Intake	
		n	%	n	%
Feeling of Fullness	23	6	26.09%		
Fear of Leaking Urine	23	4	17.39%		
Fear of Falling	23	3	13.04%		
Fear That Legs Will Swell	23	1	4.35%		
Nausea or Stomach Upset	23	5	21.74%		
Hunger	23	1 (never)	4.35%	13 (seldom)	56.52%
Thirsty	23			11	47.83%
Dining Experience	23			9	39.13%
Food Looks Good	23			16	69.57%
Food Tastes Good	23			17	73.91%
Being Offered	23			8	34.78%
Participating in Activities	23			4	17.39%

Note. The responses of the participants to the questions about fears, emotions and experiences that limit or increase food and fluid intake are presented in the table.

As shown in [Table 4](#), the mean daily intake of fruit juice was 1.33 (8-ounce servings), fruit intake was 1.74 cups (total fruit intake was 3 cups), 1.6 cups of vegetables, 0.34 servings of whole grain, and 0.91 servings of dairy products. The mean servings of sweet food products consumed per day were 3.45.

Table 3

Measures of Central Distribution for Percent of the Recommended Amount for Each Dietary Component, Micronutrient, and Vitamin Analyzed by Food Processor for Assisted Living Memory Care Residents (N=32).

Dietary Component and Micronutrients	Mean	Median	SD	Min.	Max.
Calories % of Recommended	148.20	137.79	37.52	77.40	232.72
Calories from Fat % of Recommended	219.85	213.46	65.99	79.60	360.80
Calories from Saturated Fat % of Recommended	243.80	239.23	83.11	69.97	422.50
Protein % of Recommended	156.83	148.38	45.83	83.56	268.07
Carbohydrates % of Recommended	121.26	112.59	34.19	62.46	212.74
Total Fiber % of Recommended	61.57	57.03	22.20	29.07	127.57
Fat % of Recommended	220.15	214.23	65.99	79.57	360.80
Saturated Fat % of Recommended	243.80	239.23	83.11	69.97	422.50
Cholesterol % of Recommended	130.13	109.74	58.51	56.74	247.66
Water % of Recommended	40.73	38.24	17.55	13.15	106.83
Vitamin A RAE % of Recommended	36.62	31.24	30.18	0.54	132.64
Vitamin B6 % of Recommended	83.55	74.14	29.28	46.05	159.76
Vitamin C % of Recommended	228.80	202.62	133.52	8.37	651.46
Calcium % of Recommended	60.86	58.73	21.82	30.97	133.20
Iron % of Recommended	144.82	130.52	45.91	83.43	245.70
Magnesium % of Recommended	27.59	20.74	24.30	4.33	109.10
Potassium % of Recommended	49.99	47.84	13.66	23.26	88.85
Sodium % of Recommended	184.82	164.80	69.79	95.45	386.34
Zinc % of Recommended	90.53	71.37	46.18	39.29	196.09

Note. SD = standard deviation, Min. = minimum value, Max. = maximum value

To classify the patients based on the profiles of nutrient intake, hydration, and demographics, hierarchical clustering was implemented ([Table 5](#)). Four clusters were identified: cluster 1 with 2 subjects, cluster 2 with 13, cluster 3 with 7, and cluster 4 with 10. With these clusters, the medians were compared based on the following categories: hydration variables, nutrients, vitamins, and minerals. When considering the gender for each cluster, an even distribution was evident in cluster 1, but for the other three clusters, the majority were females. Another demographic variable considered was the setting/sites (A, B, C, D) of the residents. The residents in cluster 1 were both from setting A. Cluster 2 was mainly in settings A and B, cluster 3 was mainly in set C, and cluster 4 was mainly in setting D. Lastly, the GDS was also considered among

the demographics among the cluster groups. Residents in clusters 1 and 2 generally were at GDS level 4. Nevertheless, the highest proportion of GDS for clusters 3 and 4 was level 5; cluster 4 also having residents at GDS levels 6 and 7.

Table 4
Comparison of Food Group Intake of Assisted Living Memory Care Residents With 2015-20 Dietary Guideline for Americans

Food Group	Mean (SD) [serving/day]	Recommendations (2000 calories/day)
Fruit	1.74 (±1.32)	^a 2 cups
Fruit Juice	1.33 (±1.24)	1 (8 oz equivalent) serving/day
Vegetables	1.63 (±1.10)	^b 2.5 cups/day
Whole Grains	0.34 (±0.60)	3 (1 oz equivalent) servings/day
Refined Grain	3.03 (±1.44)	^c 3 (1 oz equivalent) servings/day
Dairy	0.91 (±0.73)	3 (8 oz equivalent) servings/day
Lean Meat	1.28 (±0.72)	^d 5.5 (1-ounce equivalent) servings of protein/day, vary your protein, limit saturated fat to 22 g/day
Red/Processed Meat	1.97 (±0.82)	^e 5.5 (1 oz equivalent) servings/day
Sweets	3.45 (±1.47)	^f 50 g/day
Coffee	1.30 (±1.33)	^g 3-5 (8 oz equivalent) servings/day

Note 1. The footnotes descriptions used in the table are presented below.

^a 1 cup of fruit is equal to 1 cup raw or cooked fruit, 1/2 cup dried fruit, or 1 cup 100% fruit juice. At least half of the recommendation should come from whole fruit.

^b Vary vegetables, consuming dark-green, starchy, red and orange, beans and peas, and other types of vegetables.

^c Consume half of grains from whole grains for a total of 6 ounces per day.

^d Vary protein foods for a total of 5.5 ounces per day. Limit saturated fat to 22 grams/day.

^e Vary protein foods for a total of 5.5 ounces per day. Limit saturated fat to 22 grams/day or 10% of daily calories.

^f Limit added sugars to no more than 50 g/day or 10% of daily calories.

^g Moderate coffee consumption may be incorporated into healthy eating styles, but individuals who do not currently consume caffeinated beverages are not encouraged to start.

For energy, macronutrient, and hydration variables, cluster 1 had the highest (or second-highest) median for all variables except for cholesterol, saturated fat, and saturated fat calories. For variables in which cluster 1 was the highest or second-highest, cluster 2 was the lowest. Interestingly, cluster 2 did not record a value that was highest among all groups. Cluster 3 recorded the highest values for carbohydrates, fat, calories from fat, calories from saturated fat, and water. Cluster 4 recorded the highest values for cholesterol. Cluster 1 recorded the highest medians for all vitamins. On the contrary, cluster 2 recorded the lowest medians for all vitamins. As with vitamins, and most variables, cluster 1 recorded the highest medians for all of the minerals. Again, similar to vitamins, cluster 2 reported the lowest medians of the minerals except for calcium and sodium. In conclusion, after performing hierarchical clustering with energy, macronutrients, vitamins, and minerals, four groups were identified, and each with distinct profiles of demographics, hydration, energy, macronutrients, vitamins, and minerals.

Table 5
Differences Between Clusters

Cluster	N	Setting ^a	GDS ^b	Intake
1	2	A	4	The highest intake of almost all nutrients, vitamins, and minerals
2	13	A & B	4 (1,5 & 6)	Lowest intake of almost all nutrients, vitamins, and minerals
3	7	C	5 (4,6)	Highest intake of carbohydrates, fat and saturated fat calories, and water
4	10	D	5 (3,6,7)	Highest intake of cholesterol

Note 1. ^a Most represented, ^b Most represented; other scores

Discussion

The dietary intake of this ALMC population was compared to DRIs and the Dietary Guidelines for Americans (DGA) prepared by the U.S. Department of Health and Human Service and the U.S. Department of Agriculture (HHS & USDA, 2015). The median intake of calories and macronutrients exceeded DRI recommendations, while the median intake of fiber, vitamin A, vitamin B6, calcium, and potassium were below recommendations. Several nutrients were consumed over recommendations. Percent calories (% kcal) from fat, % kcal from saturated fat, fat (g), saturated fat (g), vitamin C, and sodium were in excess of 200% of daily recommendations. Calories from saturated fat should be no more than 10% of total daily calories according to the DGA. Sodium is another nutrient that should not be consumed in excessive amounts, especially among older adults, as it increases the risk of heart disease and stroke (CDC, 2016). According to the DGA, sodium intake should not exceed 2300 mg per day, and the mean intake of the residents in the study far exceeds that by nearly 2000 mg (HHS & USDA, 2015). The intake of the majority of vitamins and minerals was below the recommendations.

Previous research that addressed the dietary intake of AL residents with dementia reported that a significant proportion of the AL residents had inadequate food and fluid intake (Reed et al., 2005; Simmons et al., 2018). A comparison with actual nutrient intake could not be made, as these studies based intake on the percent of the meal ingested.

The systematic review of seven studies of protein and calorie intake of patients with Alzheimer’s disease (AD), both community-dwelling and in LTC facilities, compared to those considered cognitively normal was conducted by Doorduijn, van de Rest, van der Flier, Visser, and de van der Schueren (2019). No difference in intake was found between the two groups, yet the heterogeneity across articles was a limitation. A review of the results of each study does indicate that the energy and protein intake of the subjects with AD was lower than the mean intake of energy and protein intake of the participants of this project, except for one that had similar results to the present study. The study of Volkert, Pauly, Stehle, and Sieber (2011) also found that the NH residents who ate orally had a mean daily energy intake of 1535 (±413) kcal and mean protein intake of 54.2 (±9)g/d. These averages are significantly lower than the mean energy intake of 2320.1 (±472) kcal and mean protein intake of 78.76 (±19) g/d of the participants of this project.

The study of Goes et al. (2014), which reported the average percent of the recommended intake for 24 nutrients for a sample of 30 community-dwelling individuals with probable AD, provided results that allowed the best comparison with the nutritional intake amounts reported in this study. It is recognized that this sample is community-dwelling and the level of cognitive ability of the sample is less impaired than the participants of this study. The overall intake of nutrients

had a similar trend for the participants of this study and subjects of the [Goes et al. \(2014\)](#) study. For those nutrients that the mean intake was over 100% of the recommended for the participants of this study, their actual intake was higher than the Goes et al. participants except sodium was slightly lower, even though it was extremely high for both groups.

Comparison of the nutrient intake of the participants could also be made with the report of [Akner and Flöistrup \(2003\)](#), which included 54 NH residents, of whom 39 had a diagnosis of dementia. They based the dietary intake of their NH sample on the 5-day weighed method, similar to [Goes et al. \(2014\)](#), the sample of this study had a comparable trend in the nutrients analyzed. The average intake of the participants of this study for those nutrients that were greater than 100% of the recommended amount was also higher than the intake of the NH residents in the study conducted by [Akner and Flöistrup \(2003\)](#). An important finding of the study was the individual heterogeneity of the dietary intake of the NH sample. Even when individual requirements based on body weight were considered, there was a variation of at least two-three-fold for most nutrients and some micronutrients. The variation in the nutrient intake among the participants of this project was also wide.

The residents' food group intake was compared to the 2015-2020 DGA ([HHS & USDA, 2015](#)). The DGA recommends three servings daily for whole grain and dairy products and 2.5 servings for vegetables; which participants did not consume in adequate amounts. Because the mean intake of whole fruit was greater than the mean intake of fruit juice, the diet pattern is consistent with the recommendation of consuming more fruit as whole fruit. Participants did not consume adequate amounts of whole grain, vegetable, or dairy products. Refined grains, added sugar (as represented by intake of sweet food products [e.g., cake, cookies, pie]) and fruit juice was consumed over recommendations ([HHS & USDA, 2015](#)). The excess ingestion of these energy-dense foods may have contributed to the high-calorie intake among some residents.

While the facility menus of the present study meet the dietary guidelines, allowing residents to make choices in their meal and snack selection may have created an opportunity for ingestion of more energy-dense, rather than nutrient-dense foods and fluids. This highlights an opportunity for the culinary department to develop healthier menu options. For example, Greek yogurt parfaits can replace ice cream sundaes for dessert or snacks.

The cluster analysis identified two factors, cognitive ability, and setting, that accounted for 44% of the variance in protein intake, which served to represent overall nutritional intake. The levels of cognitive ability for each cluster, with consideration of the nutritional intake, reflect that those participants with the highest abilities (GDS of 4) and those with the most impairment (GDS of 6 and 7) had the highest nutritional intake. It is

surmised that staff has been trained on how to serve a meal and how to feed those who are dependent. A similar finding was supported in the work of [Gaspar \(1988\)](#) and [Gaspar et al. \(2019\)](#), related to the group with the lowest fluid intake. The challenge is helping staff recognize how to support the highest level of function for those residents who have difficulty in completing a meal for a variety of reasons. Identification of the cues for a resident who cannot independently complete the meal is essential so that appropriate verbal prompts and/or physical assistance can be provided.

The setting was identified as the second factor in the cluster analysis. Several differences in settings existed. Three of the settings had fully implemented the Montessori Inspired Lifestyle (MIL) as a foundation for care. One of these settings had a group of residents who were at a lower physical and cognitive ability than the other two communities, limiting their full participation in the MIL environment. This was reflected in the level of engagement among the participants. The two settings with the lowest nutritional intake were more likely to be recorded as neutral, rather than positive, for engagement. Another difference between settings was the staff level of involvement in the dining experience. Staff at one setting sat with the residents and joined them in the meal. They were able to prompt residents at the table with ingestion as well as engage in conversation. Participants' intake of food at this setting was higher for most nutrients than at the other settings.

The identification of these two factors (cognitive ability and setting) supports the need for interventions and staff training for the implementation of interventions that will enhance intake for select ALMC residents. Specific interventions for promoting the dietary intake of residents of ALMC have not been tested. [Simmons et al. \(2018\)](#) reported on the implementation of a QI project that demonstrated that the intake of the residents can be enhanced through sustained levels of mealtime feeding assistance and between-meal snacks.

Several recent systematic reviews have been conducted to determine if any specific interventions have improved the food and fluid intake of LTC residents with dementia. Neither of the systemic reviews completed by [Abdelhamid et al. \(2016\)](#) or [Bunn et al. \(2016\)](#) identified any strong evidence on effectiveness or lack of effectiveness of specific interventions enhancing ingestion via direct support or by indirect support for those with dementia respectively. [Liu et al. \(2015\)](#) and [Liu, Cheon, and Thomas \(2014\)](#) in 2 different systematic reviews evaluated the effects of interventions on mealtime difficulties among older adults with dementia. Nutritional supplements, mealtime assistance, and training/education of staff were supported as approaches to optimize eating performance. The systematic review conducted by [Whear et al. \(2014\)](#) focused on mealtime interventions to improve

behavioral symptoms. Only one of the studies included in this review was conducted in an ALMC unit and had only five subjects. Results were promising, but not conclusive on the effectiveness of any intervention. The ESPEN guidelines on nutrition in dementia ([Volkert et al., 2015](#)) provides 26 recommendations that were developed by a multi-disciplinary working group. These guidelines propose recommendations related to assessment, environment, support, and use of supplements across the span of cognitive abilities. The grade of evidence is very low or low for 21 of the 26 recommendations with the group recognizing the need for further study. The other authors also note that the quality of the studies that were used in the systematic reviews was of low quality with moderate quality at best for several studies.

Participants identified factors that they perceived as influencing food and fluid intake including a feeling of fullness, experiencing nausea or stomach upset, fear of leaking urine, and fear of falling. Even though the numbers are limited as some of the participants could not respond in a meaningful way to the survey, their responses are important. [Bunn, Hooper, and Welch \(2018\)](#) in a scoping review of existing policies and guidelines addressing dehydration and malnutrition in residential care indicate that insight from residents themselves is needed to identify factors related to intake. The need to follow up with residents regarding the reasons for not eating is essential, as there may be an underlying cause such as a medication causing nausea.

The observed ingestion behaviors such as inappropriate use of fingers, spilling, inappropriate use of utensils, and unable to maintain attention during the meal are not uncommon among those with dementia. [Volicer \(1987\)](#) indicated that the ability to self-feed is lost within eight years after the onset of dementia. Addressing these behaviors to ensure the adequacy of nutrient intake needs to be included in an individualized resident-centered approach. It is important to recognize the presence of each of these behaviors as a plan of care is developed for the resident.

[Murphy, Holmes, and Brooks \(2017\)](#) conducted focus groups and interviews with front-line NH staff to develop a model of day-to-day application for delivering food and nutrition for people with dementia in care homes (Making the Most of Mealtime). They identified “person-centered nutritional care” as the overarching theme of the model. Person-centered nutritional care captures the specific ingestion and dining behaviors of the resident as well as their perceptions of their lack of eating. Residents of ALMC may be struggling to maintain their highest level of function while they are losing function. It is a challenge for staff to help residents who are struggling with progressive loss of their independence and yet assist them to meet their nutritional needs. Techniques that provide meaningful prompts when the resident is

distracted or unable to focus on the meal are needed. Individualized care also needs to address when physical assistance with eating should start during a meal.

The Making the Most of Mealtime team developed a comprehensive conceptual framework that views the food intake of LTC residents as based on multi-level and inter-related determinants of food intake. The framework was used to develop a tool for the evaluation of several factors that influence the mealtime experience in LTC ([Murphy et al., 2017](#)). The research of this group and others who use the tool will contribute to the understanding of the mealtime experience, and hopefully will examine the subpopulation of those in LTC with dementia in the future.

Strengths and Limitations

A methodological strength of the study is that meal observation is one of the most reliable dietary assessment tools ([Baglio et al., 2004](#)). Additionally, inter-rater reliability was high, and the researchers were able to observe a manageable number of residents at once. Our study has helped identify a gap in the literature and highlights the unique needs of this population. The ALMC population has cognitive impairments that require 24-hour supervision, but residents have the ability to make decisions at the moment. They are provided with food choices at meals and snacks as part of the focus on resident-centered care. Even though the daily menus provide the recommended daily requirements needed, the resident choices and actual intake are respected. For example, there is a whole grain choice for each meal, but residents generally do not select that choice. Therefore, our study contributes to the literature and provides direction in improving our understanding of dietary intake and the factors that may influence it in this population. This improved understanding may help develop future interventions in the ALMC setting.

The present study has some limitations. The 12-hour observation period introduces the possibility that foods and fluids were missed between 7 PM and 7 AM. Some residents may have taken medications and been offered snack foods during these evening hours. However, because this was a memory care unit, the residents were closely monitored and were not able to hoard food in their private rooms, which reduces the possibility that residents may have consumed food throughout the night. No information regarding dietary supplement intake was recorded. If residents were taking supplements, the inclusion of this additional nutrient information in the analysis may have altered the results, potentially eliminating findings of diet inadequacy. There was some concern that staff behavior was altered due to the presence of observers, as they may have been working more attentively and adhering to the standards better than usual. However, it would have been difficult for staff to alter usual behavior throughout the entire 12-hour observation period. The small sample size and characteristics of the study population limit the generalizability of the study,

as the residents were White and resided only in memory care units owned/managed by one company. Generalization of findings to other long-term memory care settings should be done with caution, particularly because of the small study size and short observation duration.

Implications

The intake of several dietary components, including the majority of vitamins and minerals, was below the recommended daily intake for the majority of the ALMC participants. Yet there was a high intake of carbohydrates, saturated fat, and sodium and adequate intake of protein by the majority of the participants. A focus on providing choices that will provide for adequate nutrient and micronutrient intake as well as offer lower ingestion of sodium, carbohydrates, and saturated fat is necessary. Residents should be monitored frequently for weight changes as consistent intake of excessive calories could lead to weight gain. On the other hand, low food ingestion and low caloric intake could contribute to weight loss. Additionally, poor intake of essential nutrients from foods like vegetables, whole grains, and dairy could result in nutrient deficiencies and other symptoms.

A focus on resident-centered care is essential. Recognition of residents' cognitive and physical abilities during the eating and dining experience, providing them with the level of assistance that helps them maintain their highest level of function and addressing the behaviors and perceptions that potentially influence behavior will enhance their intake.

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Conflict of Interest

- There are several financial conflicts to report. At the time of the project Dr. Gaspar, Ms. Finsaas, and Mr. Holmes were full-time employees for The Goodman Group, which was the owner or oversaw the management of the sites that the study was conducted. Dr. Scherb had a consultant contract with The Goodman Group for this project. Ms. Risley was a graduate student at the time of the project but was

hired by The Goodman Group to assist with the dietary analysis. She did a project for her Master's degree using the database used for this manuscript. None of the authors have a personal conflict to report.

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