**­­ What could go wrong? Non-standardized versus standardized food texture classification**

**Abstract
Background:**Texture modified foods (TMF) is a common intervention for improving swallowing safety and efficiency for people with dysphagia. Non-standardized texture classification (NSTC) of foods is used worldwide. However, as this study documents, it can introduce a lack of clarity and confusion over definitions that can potentially harm patients’ safety. The International Dysphagia Diet Standardization Initiative (IDDSI) framework offers international terminology and standardized methods for texture testing that can address this issue.

**Aims**: To document differences between NSTC and the standardized texture classification (STC) of the IDDSI, to document changes in the STC in the 30 minutes following meal delivery, and to explore the relationship between food intake and texture level.

**Methods**: In this observational study, data were collected from 24 long-term care units during five meals served to 624 residents, including at least one breakfast, lunch, and dinner. To document differences between NSTC and STC, all NSTC food textures used in the LTC facilities were reclassified to match the IDDSI texture level at the time food left the kitchen. To document time-related changes in texture, the STC texture as food left the kitchen was compared to texture 30 minutes later. Finally, to explore the relationship between texture and consumption, estimates were made of whole-tray food consumption and single item food consumption using a subjective evaluation of consumption percentage.  **Results:**A total of 1,276 food items were classified over the course of five meal services (with at least one each from breakfast, lunch, and dinner). Statistically significant differences in NSTC and STC texture levels were found which revealed that residents were consuming food that was more difficult to chew than intended by the TMF prescription. In addition, significant changes in food texture were found over time, with texture levels significantly increasing 30 minutes after food left the kitchen. Finally, greater consumption was found for softer textures in comparison to regular foods; moreover, food consumption was greatest during breakfast and lowest during lunch.**Conclusions:**Residents requiring TMF received harder textures than intended which required complex swallowing ability thus introducing risk of choking. Using a STC as proposed by the IDDSI could improve patient safety, oral intake, and nutritional status. Time related changes should also be considered in circumstances where patients do not consume food soon after service. Lastly, reduced food consumption during lunch might negatively impact overall nutrient intake.

**Introduction**

Speech and language pathologist are typically involved in assessing swallowing difficulties (dysphagia) and suggesting interventions, including recommendations for texture modified foods (TMF) (1,2) to improve swallowing safety and efficiency and enable sufficient oral intake to meet nutritional needs (3–5). Following clinical and instrumental assessment, the specific level or levels of modified textures are ideally prescribed based on a patient's specific swallowing biomechanics, structural features, cognition, and behavior.

Despite [widespread??] agreement on the importance of standardized texture modification, institutional care providers widely use non-standardized texture classifications (NSTC) and in some cases apply even NSTC inconsistently. Preparing foods and liquids using incorrect classification can have devastating consequences for individuals with dysphagia (7), worsening their swallowing difficulties and increasing their risk of choking. Beyond these immediate patient safety issues, nutritional intake and nutritional status can be affected by the prescribed TMF. For example, a study of 32 long-term care facilities in Canada found that residents who consumed minced or pureed foods had a greater risk of malnutrition (9).

The International Dysphagia Diet Standardisation Initiative (IDDSI) (6) (**Figure 1**) aimed to begin addressing these problems by creating an international, standardized terminology to describe texture modified foods and thickened liquids (2). The IDDSI framework consists of a texture pyramid for drinks and foods that applies a numerical grade for shifting texture, with higher numbers indicating food texture that is harder and drier. Beyond developing a standard framework, the IDDSI also introduced clinically available testing methods and tools, such as the Flow Test using a syringe for liquids and Fork Pressure test for solids, in order to improve the accuracy of texture categorization and TMF preparation.

*Insert Figure 1 here*

The challenge is that few institutions around the world have yet to adopt the STC developed by the IDDSI. For example, a recent study noted a range of between zero and 60% of institutions in New Zealand met IDDSI texture requirements for food items served during meals (8). Presumably, the wider the gap between NSTC and the IDDSI texture standards, the greater the risk of choking for patients with dysphagia, but to date there have been no studies that measure that gap, including the New Zealand study. Beyond immediate patient safety issues, patient nutritional intake and nutritional status can be impacted by the prescription of TMF. For example, a study of 32 long-term care facilities in Canada found that residents who consumed minced or pureed foods had a greater risk of malnutrition (9).

Encouraging progress toward international adoption of the IDDSI framework requires a better understanding of how far the current, non-standardized texture classification (NSTC) diverges from the STC developed by the IDDSI in long-term care (LTC) settings. The primary aim of the current study was therefore to document the extent to which NSTC used in a sample of 24 LTC settings in Israel differed from the STC developed by the IDDSI. Additionally, because texture measurements at a point in time may not reflect what patients with dysphagia actually eat, the second aim of this study was to compare the STC texture level as food left the kitchen to STC texture levels 30 minutes later. Finally, taking full advantage of the granular data collection, this study explored the relationship between nutritional intake and food texture level.

**Methods**

This observational study used a convenience sample of 24 adult care units in 22 long-term care (LTC) facilities located throughout Israel. In each unit at least 40% of residents required food texture modification. Further, each unit provided at least two types of TMF. Data were collected between May 2019 and December 2020 by [NUMBER] research assistants (RA) who were trained prior to data collection by an experienced speech therapist (O.S.W) familiar with the IDDSI framework and testing methods (see **Table 1**).

Data were collected by the same RA in each facility during the provision of five meal services in each unit, with observations recorded for at least one breakfast, one lunch, and one dinner. As meals vary across cultures, it is important to clarify that in Israel, dinner and breakfast consist of lighter meals that are based on dairy products, cooked eggs, fresh vegetables, and bread. Additionally, breakfast in Israeli LTC facilities usually includes porridge, and dinner includes a dairy bake of some sort. Lunch is the day’s main meal and typically includes chicken, beef or fish, fresh vegetables, and cooked vegetables and carbohydrates. Of the initial 24 LTC units, observations were not completed in [NUMBER] units due to the facility’s lack of cooperation or to scheduling difficulties. In these cases, fewer meal services were included.

To collect data, the RAs visited each facility at least twice (on two separate days) and up to five times (five separate days). Table 1 includes the number of meals services collected by type (breakfast, lunch, and dinner) and unit. The current study included classification of foods items, including soups, but not drinks.

Below are the methods used to assess each of the study’s three aims.

*Insert Table 1 here*

**Comparing NSTC and STC food texture classifications**

NSTC of all food textures served in the facilities are assigned by the department dietitian or speech and language pathologist prior to study initiation and unrelated to it. This classification is part of the facility’s usual clinical routine and no formal testing methods were used to determine if the assigned level matched the food texture properties as served to residents. In each department three to four different food texture levels were served: regular foods which consisted of hard and dry textures; easy to chew, soft foods (such as meatballs); and pureed food, including food that was blended or was naturally pureed, like yogurt. Rarely, a fourth texture called “mashed” or ”minced” was served to some of the residents. This texture consisted of food mashed with fork or pureed with lumps. Of note, not all institutions used the same names to describe the same texture level. For example, “pureed”, “blended”, or “smooth” were names used to describe the same level of pureed foods.

In order to compare the facility’s non-standardized texture classification (NSTC) and the STC of the IDDSI, each facility’s non-standardized texture levels were assigned an equivalent IDDSI level based on the name given to the food at the facility and its informal description of the food texture. No formal testing methods were used. The texture classifications were as follows:

* Regular food was classified as non-standardized (NS) 7-Regular (NS-7R),
* Easy to chew/soft food was classified as NS-7 and Easy to chew (NS-7EC),
* Mashed/minced and moist food was classified as NS Level 5 (NS-5), and
* Pureed food was classified as NS Level 4 – Puree (NS-4).

From a non-standardized viewpoint, Level 6 (Soft and bite-sized) and Level 3 (Liquidized) were not used in the study units.

**Assessing change in food texture over time**

To determine whether cooked and prepared food items changed texture over time, and by how much, the RAs took small samples (equivalent to two tablespoons) from each cooked and prepared food item that was served and placed them on a separate plate to measure its texture and temperature. All food items served during a meal were tested by the RAs using IDDSI testing methods as per the IDDSI framework and testing methods manuals (first edition). Although Level 7EC was not described in the first edition, it was included in the current study since IDDSI published its edition before the release of the second edition (https://iddsi.org/). For the flow test, a plastic syringe was used (BD 303134, 61.5 mm from 0-10 mL). For the fork drip test and fork pressure test, a standard metal fork was used. For the spoon tilt test, a standard metal spoon was used. The fork and spoon were taken from the department kitchen.

 A first test of texture was done at the beginning of the meal service and a second test was conducted 30 minutes later. Temperature was measured at each test using a food temperature meter. Pre-packed industrial food items, such as yogurt and cottage cheese, were tested only once during the whole study since it was found, in a pilot study, that the texture was stable after 30 minutes.

**Exploring the relationship between food texture and consumption**

For food consumption assessment, each food tray was photographed twice using a smart-phone camera held above the tray. The RA took the first photograph when the food tray was leaving the kitchen to be served, and the second photo taken when the food tray was returned to the kitchen at the end of the meal. Each tray was numbered in order to match the trays pre- and post-meal.

Two types of food consumption measurements were taken. First, in LTC Units numbered 1 through 13, the extent to which the entire meal was consumed was assessed subjectively using percentages from 0% to 100%, with 100% indicating that all of the food was consumed. Second, in LTC units numbered 14 through 24, the same subjective percentages were used to assess the extent to which each food item was consumed (see Table 1).

**Ethics**

Ethical approval was obtained from the ethical committee of Ono Academic Collage.

**Statistics**

Descriptive statistics were used including means, SD and 95% confidence intervals. Food texture classification levels were treated using an ordinal scale and we analyzed using non-parametric statistics . Friedman's test was used to assess differences between the three classifications (NSTC, STD as meals were served, and STD 30 minutes later). Post-hoc analysis included Wilcoxon signed-rank tests. Temperature differences were analyzed using unpaired t-tests. Food consumption was tested using ANOVA to compare for differences between three meal types (breakfast, lunch, and dinner), with post-hoc Bonferroni analysis. Pearson correlation was used to test for association between whole-tray food consumption and the first standardized IDDSI level.

Finally, ANOVA was used to test differences between the first standardized IDDSI level and consumption per single food item, with post-hoc Bonferroni analysis.

**Results**

Twenty-four different departments in 22 different facilities were included in the study (Table 1). In one facility three departments were included: one department of patients with dependent needs (#10 in Table 1), and two departments of patients with complex-dependent needs (#5, #6 in Table 1). In total, 17 departments of dependent patients were included, four departments of dependent patients with complex needs, one physical disability department, one cognitive disability department, and one rehabilitation department. In total, 624 residents were in these departments at the time of data collection. On average, 58.7% of them received TMF meaning dysphagia was very prevalent. **Table 2** provides the number and percentage of residents receiving regular, easy to chew/soft, pureed and mashed/ minced food in each department. Data are missing from departments #13 and #24 due to their unwillingness to provide these details.

*Insert Table 2 here*

**Food texture classification findings:**

A total of 41 breakfast, 43 lunch, and 23 dinner services were included in the statistical analysis. Food items were classified into texture levels: 543 food items (42.5%) classified were served during breakfast, 462 items (36.2%) were served during lunch, and 272 items (21.3%) were served during dinner. In total, 1,277 classified food items were included in the study. **Table 3** describes the distribution of food items by texture level. Marked differences were noted between the NSTC and both STCs, with STCs more likely to be classified at higher and thus more difficult to chew texture levels. For example, most food items (52.1%) were classified as pureed (NS-4) in the NSTC; however, in both repeated STCs, most food items were classified as IDDSI Level 7R. In addition, there was a wider range of texture levels in both STCs than the range in NSTC, as can be seen in Table 3.

*Insert Table 3 here*

The classification of food items into texture level during breakfast, lunch and dinner is presented in **Tables 4**, **5** and **6** respectively. Most food items served during ***breakfast*** were classified into NS-Level 4 (56.2%) according to the NSTC; however, according to both the initial and 30-minute STC, most food items were classified into IDDSI Level 7R (40% and 43.6%). The proportion of Level 7EC foods in the NSTC versus STC was higher, with 21.1% of food items classified as NS-7EC in the NSTC and approximately 13% classified as IDDSI 7EC in the STC. In addition, according to the NSTC there were no items in NS Levels 3 compared to the STCs (17.1% and 15.3%). Similarly, there were no items in NS Levels 6 according to the NSC, whereas the STCs found 4.1% and 3.9% of food items in IDDSI Level 6, respectively. On average, there were only small differences in the distribution of food items between the first and second STC. The same trends were found for food items served at lunch and at dinner.

*Insert Table 4 here*

*Insert Table 5 here*

*Insert Table 6 here*

Friedman’s test was used to assess differences between the three classifications at each meal. There was a statistically significant difference in food texture level between the three classifications: NSTC, first STC and second STC during breakfast (χ2(2) = 21.08, *p* < .001), lunch (χ2(2) = 205.51, *p* < .001) and dinner (χ2(2) = 8.73, *p* = .013).

Post-hoc analysis with Wilcoxon signed-rank tests was conducted. The results are presented in **Table 7**. In all meals, the first STC was of a higher texture level than the NSTC, the second STC was of higher texture level than the NSTC, and the second STC was higher than the first STC.

*Insert Table 7 here*

Unpaired t-tests revealed significant difference in temperature between the first STC and the second STC, with items measured on the first STC having higher temperature than in the second STC at all meals: breakfast (*t*(184) = 6.28, *p* < .001), lunch (*t*(278) = 24.84, *p* < .001), and dinner (*t*(95) = 6.74, *p* < .001).

Mean temperature (in Celsius) and SD during the first and second STCs are presented in **Table 8**. The mean times and SD between the first and second STCs were 37.36 min (9.83) for breakfast, 34.98 min (10.23) for lunch, and 30.87 min (6.12) for dinner.

*Insert Table 8 here*

**Association between consumption and texture**

*Tests for whole-meal food consumption:*

For assessing mean percentage consumption of food on tray, a total of 1,214 trays were analyzed: 503 trays during breakfast, 448 during lunch, and 263 during dinner. Mean percentage consumption of food on tray by meal type is presented in **Figure 2**. There was a significant difference in food consumption between meals (*F*(2, 1211) = 30.88, *p* < .001). Post-hoc Bonferroni analysis revealed significant differences between all three meal types, with the highest consumption during breakfast (76.6% ± 26.5), then dinner (68.2% ± 31.0), and the lowest consumption during lunch (61.1% ± 33.0).

*Insert Figure 2 here*

In addition, a correlation between whole meal consumption and first STC level was found(*r* (1148) = -.14, *p* < .001), whereby an increase in consumption was associated with a decrease in standardized IDDSI level, meaning a “lower” texture in the texture pyramid.

*Tests on single food items:*

To assess consumption for individual food items, 3,820 items were included, from 11 departments during 44 meals. Each item was classified into the first standardized IDDSI level. **Table 9** presents means, SD, and 95% CI for percentage of consumption by first STC of IDDSI level. There was a significant difference in consumption between levels *F*(5, 3814) = 14.19, *p* < .001. Post-hoc analysis was conducted using Bonferroni tests. Results are presented in **Table 10**. Level 3 was characterized by greater consumption than Levels 4, 7EC, and 7R. Additionally, Level 7R had lower consumption than Levels 4, 5, and 7EC.

*Insert Table 9 here*

*Insert Table 10 here*

**Discussion**

The primary aim of the study was to document the differences between NSTC that is currently used in Israel, as in other countries, and STC according to IDDSI framework. A gap between STC and NSTC texture levels was found. The STC findings indicated that some residents were at risk of choking since residents that required TMF were eating food textures that were harder and more challenging to swallow than intended. NSTC was based mainly on food appearance and the results of the current study emphasize the inaccuracy of this method and the need for STC. The secondary aims were to document time-related changes in food texture, and to explore the relationship between nutritional intake and food texture level. Significant differences were found in food texture between when it left the kitchen compared to texture 30 minutes later. Finally, pureed texture – food that requires minimal oral processing – had greater consumption than regular textured food.

**Food texture classification**

While 52.1% of the items served in all meals together were classified as Puree (NS Level 4) in the NSTC, only 15% of food items were found to fit into the descriptors of Level 4 of the STC, indicating that almost 35% of food items were misclassified as Level 4. In addition, most food items (approximately 45%) were classified as Level 7R in the STC, while according to the NSTC, only 23.5% of food items were supposed to be served at Level 7R. These findings highlight the problem severity, since the gap between Level 4 and Level 7R is the biggest gap possible according to the IDDSI pyramid.

Regular foods (Level 7R) require different functional abilities than those required for swallowing pureed foods (Level 4). Regular foods require proper dentation and the creation of enough pressure in the oral and pharyngeal muscles to allow for sufficient breakdown of food particles, complete bolus preparation, and avoidance of post swallow residues. Without these functional abilities, the risk of aspiration and choking increases.

Possible explanations for the failure to achieve the intended puree texture might be related to lack of adequate kitchen equipment needed to process the food into smooth non-sticky puree, without lumps, as required by IDDSI descriptors for this level. In addition, not all food items can be processed into smooth puree. For example, beef can be too stringy, even following adequate processing. Therefore, there should be careful selection of foods that can be processed into Level 4.

The difference in proportion of easy to chew foods (7EC) between the NSTC and STC means that patients did not receive soft enough foods, as prescribed by the speech and language pathologist. Instead, it is likely that these patients received regular food. Cooked food items that are intended to be soft and easy to chew can easily become hard to chew during the preparation process. The drying of the food surface can occur during preparation or reheating, leading to a loss of moisture and other such properties, and a change in classification. These unwanted changes can lead to choking (10), and can be avoided by using moisture, proper heating methods, and recipe adjustments. The difference between the first and second STC conducted 30 minutes later can be explained by the lower temperature and moisture loss from food items at the second measurement. Since food texture solidified over time, it is important to serve food promptly after preparation in order to assure the patient receives the intended texture level.

**Food consumption**

In this observational study, food consumption was found to be the highest during breakfast. This finding is unique as there are no existing observational studies in long term care facilities that investigated differences in food consumption between breakfast, lunch and dinner. In a survey of noninstitutionalized adults (45 years to over 70 years), breakfast was reported to be consumed by most adults over 70 years; however, lunch was reported to be skipped more often by adults in all age groups. Intake of grain and dairy food was highest at breakfast in comparison to lunch and dinner (11).

Reduced consumption during lunch might be the result of a short time gap between breakfast and lunch, meaning that the residents were not hungry enough during lunch. In addition, between breakfast and lunch residents receive a fruit dish, as required by the Israeli Ministry of Health, which might also reduce their appetite. Another explanation might be related to another finding of the current study, whereby most food items served during lunch were actually classified as Level 7R which might have made eating and swallowing it more challenging, thus reducing intake . Considering the fact that in Israe,l proteins from animal sources (meat, poultry and fish) are served during lunch, the reduced intake might negatively affect B12, iron, and protein consumption, and overall nutrition (12).

Whole meal food consumption and single item food consumption indicated that “lower” textures in the texture pyramid have higher consumption than the “higher” foods which are harder, drier, and require more complex swallowing abilities. Food items classified as Level 3 (liquidized texture) had the highest consumption and Level 7R (regular texture) had the lowest. This difference might be because there are many industrial dairy products that are classified as Level 3 and since they are usually tasty and people are accustomed to eating them in their home environment, they tend to be fully consumed. Level 7R might have lower consumption since it might have been served to residents who require a “lower” texture level, as previously discussed.

Another reason for higher consumption of “lower” texture levels of the texture pyramid might be related to independence in daily activity skills, such as eating. Residents who consume liquidized or pureed textures tend to require eating assistance. This might explain greater consumption, as caregivers usually put an emphasis on finishing the food on the plate. Support for this claim was found in an observational study of LTC facilities showing that residents who required eating assistance had higher intake (13).

It should be mentioned that pureed food might have lower nutritional density (14) due to the need to add liquids in order to create smooth textures (15). Thus, higher consumption, as found in the current study, does not necessarily mean better nutritional status (7,16). The current study finding is different than a study conducted in aged care facilities in New Zealand that found higher consumption of regular food texture than puree texture (8). However, it was reported that pureed foods actually met IDDSI criteria in the New Zealand study, which was not the case in many instances in the current study.

The current study indicated that regular food items had the lowest consumption. Possibly, the difference between the intended food texture and the actual food texture can explain the low consumption. When regular food textures are given to residents who lack the physiological ability to efficiently swallow them, consumption can be low, contributing to weight loss that is associated with dysphagia and with reduced food consumption. Dysphagia and malnutrition are inter-related; dysphagia can result in malnutrition or exacerbate existing malnutrition (15) and lack of nutrition can exacerbate existing dysphagia (17,18).

An average of 58.7% of residents across the 22 study facilities consumed TMF, which indicates that many residents can be affected by mistakes in the processes of preparation and serving of TMF. This is higher than reported in residential aged care facilities where, more typically, 15% to 30% consume TMF (19). This study supports the need for increased awareness of the importance of standardized texture levels in prescribed TMF for dysphagia, together with adequate training of all staff involved in food preparation, handling, and serving to residents with dysphagia.

**Study limitations**

Study limitations include lack of a standardized measure to assess for food consumption. The current study used pre- and post-meal photographs of the food tray in order to assess the amount of food consumed; however, weighing each food item pre- and post-meal would have allowed for a more accurate measurement of consumption. Nevertheless, greater accuracy must be weighed against the disadvantage of imposing a greater burden on staff and likely delays in food delivery, given the large scale of the current study. Not accounted for in any case would be the possibility that residents received additional food portions or food items during their meals from the working staff.

Another limitation is related to inter-rater agreement, since each RA was the sole measurer of food textures in each facility. To address this limitation at least partially, when the RAs were uncertain regarding the classification of a specific food item, they sent photos and videos of the food items and consulted with the PI (O.S.W) while they were on-site.

Another limitation is that personal information for each resident was not collected. Thus it is possible that some patients had unreported dysphagia that might have influenced the kitchen staff or working staff to make ad-hoc decisions regarding food texture and provide them with different textures than those prescribed by the speech and language pathologist. Lastly, it is not known which patients required help feeding themselves and whether such help influenced their food intake.

**Conclusions**

This study showed that residents with dysphagia living in LTC facilities using NSTC received harder food textures than intended, requiring complex swallowing ability and complex oral processing, including chewing, greater lingual strength and greater pharyngeal strength, and increasing risk of choking. In addition, the study indicated that food intake might also be negatively affected by inappropriate texture levels. The study showed that using STC based on the IDDSI can improve patient safety and nutritional status. The study also documents the importance of timely meal consumption, as delays of 30 minutes caused changes in food texture classification. Lastly, in comparison to other meals, reduced food consumption was found during lunch. This can be partly explained by preparation and serving processes, which can be improved in order to increase nutrient consumption during lunch.

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**Tables**

Table 1

Number of meals observed in each department, by type: breakfast, lunch, and dinner

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Department type | Number of residents | Number of breakfasts observed | Number of lunches observed | Number of dinners observed |
| 1 | LTC -Dependent needs | 35 | 2 | 2 | 1 |
| 2 | LTC- Dependent needs | 29 | 2 | 2 | 1 |
| 3 | LTC- Dependent needs | 30 | 2 | 1 | 2 |
| 4 | LTC- Dependent needs | 22 | 1 | 2 | 1 |
| 5 | LTC -Complex dependent needs | 30 | 2 | 2 | 1 |
| 6 | LTC -Complex dependent needs | 25 | 2 | 2 | 1 |
| 7 | Rehabilitation | 42 | 2 | 2 | 1 |
| 8 | LTC -Complex dependent needs | 26 | 2 | 2 | 1 |
| 9 | LTC- Dependent needs | 22 | 2 | 2 | 1 |
| 10 | LTC- Dependent needs | 20 | 2 | 2 | 1 |
| 11 | LTC -Complex dependent needs | 32 | 2 | 2 | 1 |
| 12 | LTC- Dependent needs | 35 | 2 | 2 | 0 |
| 13 | LTC- Dependent needs | NA | 2 | 2 | 1 |
| 14 | LTC- Dependent needs | 23 | 2 | 2 | 1 |
| 15 | LTC- Dependent needs | 32 | 1 | 1 | 1 |
| 16 | LTC- Dependent needs | 27 | 2 | 2 | 1 |
| 17 | LTC- Dependent needs | 32 | 1 | 1 | 1 |
| 18 | LTC- Dependent needs | 35 | 2 | 2 | 1 |
| 19 | LTC- Dependent needs | 34 | 2 | 2 | 1 |
| 20 | LTC- Dependent needs | 31 | 1 | 2 | 2 |
| 21 | LTC- Dependent needs | 30 | 2 | 2 | 1 |
| 22 | LTC-Physical disability | 12 | 1 | 1 | 0 |
| 23 | LTC- Dependent needs | 20 | 1 | 2 | 1 |
| 24 | LTC -Cognitive disabilities | NA | 1 | 1 | 0 |
| **Total** | **41** | **43** | **23** |

LTC – long-term care

Table 2

Number and percentage of residents receiving regular, easy to chew, minced and moist and pureed food (termed by non-standardized classification), by department

|  |  |  |  |
| --- | --- | --- | --- |
| # | Department type | Number of residents | Food texture |
| Regular food | Easy to chew food | Minced and moist food | Pureed food | Any type of modified texture  |
| 1 | LTC -Dependent needs | 35 | 17 (48.6%) | 5 (14.3%) | 0 | 13 (45.7%) | 18 (51.4%) |
| 2 | LTC- Dependent needs | 29 | 6 (20.7%) | 10 (34.5%) | 0 | 13 (44.8%) | 23 (79.3%) |
| 3 | LTC- Dependent needs | 30 | 15 (50%) | 12 (40%) | 0 | 3 (10%) | 15 (50%) |
| 4 | LTC- Dependent needs | 22 | 3 (13.6%) | 7 (31.8%) | 0 | 12 (54.5%) | 19 (84.4%) |
| 5 | LTC -Complex dependent needs | 30 | 17 (56.6%) | 11 (36.6%)  | 0 | 2 (6.6%) | 13 (43.3%) |
| 6 | LTC -Complex dependent needs | 25 | 13 (52%) | 7 (28%) | 2 (8%) | 3 (12%) | 12 (48%) |
| 7 | Rehabilitation | 42 | 22 (52.4%) | 15 (35.7%) | 0 | 5 (11.9%) | 20 (47.6%) |
| 8 | LTC -Complex dependent needs | 26 | 11 (42.3%) | 8 (30.8%) | 0 | 7 (26.9%) | 25 (57.7%) |
| 9 | LTC- Dependent needs | 22 | 7 (31.8%) | 5 (22.7%) | 0 | 10 (45.4%) | 15 (68.2%) |
| 10 | LTC- Dependent needs | 20 | 5 (25%) | 5 (25%) | 0 | 10 (50%) | 15 (75%) |
| 11 | LTC -Complex dependent needs | 32 | 13 (34.2%) | 9 (23.7%) | 0 | 10 (26.3%) | 19 (65.8%) |
| 12 | LTC- Dependent needs | 35 | 12 (34.3%) | 14 (40%) | 0 | 9 (25.7%) | 23 (65.7%) |
| 13 | LTC- Dependent needs | NA | NA | NA |  | NA |  |
| 14 | LTC- Dependent needs | 23 | 8 (34.8%) | 0 | 9 (39.1) | 6(26.1%) | 15 (65.2%) |
| 15 | LTC- Dependent needs | 32 | 18 (56.2%) | 4 (12.5%) | 0 | 10 (31.2%) | 14 (43.8%) |
| 16 | LTC- Dependent needs | 27 | 9 (33.3%) | 17 (63%) | 0 | 1 (3.7%) | 18 (66.6%) |
| 17 | LTC- Dependent needs | 32 | 12 (37.5%) | 13 (40.6%) | 0 | 7 (21.8%) | 20 (62.5%) |
| 18 | LTC- Dependent needs | 35 | 18 (51.4%) | 13 (37.1%) | 1 (2.8%) | 3 (8.6%) | 17 (48.6%) |
| 19 | LTC- Dependent needs | 34 | 15 (44.1%) | 10 (29.4%) | 0 | 9 (26.5%) | 19 (55.9%) |
| 20 | LTC- Dependent needs | 31 | 4 (12.9%) | 14 (45.2%) | 3 (9.7%) | 10 (32.2%) | 27 (87.1%) |
| 21 | LTC- Dependent needs | 30 | 10 (33.3%) | 15 (50%) | 0 | 5 (16.6%) | 20 (66.6%) |
| 22 | LTC-Physical disability | 12 | 7 (58.3%) | 3 (0.25%) | 0 | 2 (16.6%) | 5 (41.7%) |
| 23 | LTC- Dependent needs | 20 | 11 (55%) | 1 (5%) | 0 | 8 (40%) | 9 (45%) |
| 24 | LTC -Cognitive disabilities | NA | NA | NA | NA | NA |  |

LTC – Long-term care

Table 3

Food items (number and percentage) served in all three meals together classified into texture levels in three classifications: non-standardized classification, first, and second standardized IDDSI classification.

|  |  |  |  |
| --- | --- | --- | --- |
| Texture level | Non-standardized classification | First standardized IDDSI classification | Second standardized IDDSI classification |
| 0 | 0 | 3 (0.2%) | 3 (0.2%) |
| 1 | 0 | 0 | 0 |
| 2 | 0 | 1 (0.1%) | 1 (0.1%) |
| 3 | 0 | 169 (13.2%) | 142 (11.1%) |
| 4 | 665 (52.1%) | 203 (15.9%) | 200 (15.7%) |
| 5 | 22 (1.7%) | 124 (9.7%) | 104 (8.1%) |
| 6 | 0  | 36 (2.8%) | 36 (2.8%) |
| 7EC | 290 (22.7%) | 157 (12.3%) | 159 (12.5%) |
| 7R | 300 (23.5%) | 584 (45.7%) | 631 (49.4%) |
| **Total** | **1277** | **1277** | **1276** |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

Table 4

Food items (number and percentage) served during breakfast classified into texture levels in three classifications: non-standardized classification, first, and second standardized IDDSI classification

|  |  |  |  |
| --- | --- | --- | --- |
| Texture level | Non-standardized classification | First standardized IDDSI classification | Second standardized IDDSI classification |
| 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 93 (17.1%) | 83 (15.3%) |
| 4 | 305 (56.2%)\*\*\* | 85 (15.7%) | 85 (15.7%) |
| 5 | 17 (3.1%) | 51 (9.4%) | 44 (8.1%) |
| 6 | 0  | 22 (4.1%) | 21 (3.9%) |
| 7 EC | 106 (21.2%) | 75 (13.8%) | 73 (13.4%) |
| 7 R | 115 (21.2%) | 217 (40%) | 237 (43.6%) |
| **Total** | **543** | **543** | **543** |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

Table 5

Food items (number and percentage) served during lunch classified into texture levels in three classifications: non-standardized, first, and second standardized IDDSI classification

|  |  |  |  |
| --- | --- | --- | --- |
| Texture level | Non-standardized classification | First standardized IDDSI classification | Second standardized IDDSI classification |
| 0 | 0 | 3 (0.6%) | 3 (0.6%) |
| 1 | 0 | 0  | 0  |
| 2 | 0 | 1 (0.2%) | 1 (0.2%) |
| 3 | 0 | 26 (5.6%) | 16 (3.5%) |
| 4 | 190 (41.1%) | 55 (11.9%) | 51 (11%) |
| 5 | 4 (0.9%) | 49 (10.6%) | 42 (9.1%) |
| 6 | 0 | 9 (1.9%) | 10 (2.2%) |
| 7 EC | 143 (31%) | 62 (13.4%) | 64 (13.9%) |
| 7 R | 125 (27.1%) | 257 (55.6%) | 275 (59.5%) |
| **Total** | **462** | **462** | **462** |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

Table 6

Food items (number and percentage) served during dinner, classified into texture levels in three classifications: non-standardized, first and second standardized IDDSI classification

|  |  |  |  |
| --- | --- | --- | --- |
| Texture level | Non-standardized classification | First standardized IDDSI classification | Second standardized IDDSI classification |
| 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 50 (18.4%) | 43 (15.8%) |
| 4 | 170 (62.5%) | 63 (23.2%) | 64 (23.5%) |
| 5 | 1 (0.4%) | 24 (8.8%) | 18 (6.6%) |
| 6 | 0 | 5 (1.8%) | 5 (1.8%) |
| 7 EC | 41 (15.1%) | 20 (7.4%) | 22 (8.1%) |
| 7 R | 60 (22.1%) | 110 (40.4%) | 119 (43.8%) |
| **Total** | **272** | **272** | **271** |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

Table 7. Differences between the three classifications in each meal: results of post-hoc analysis with Wilcoxon signed-rank tests

|  |  |  |  |
| --- | --- | --- | --- |
| Meal | Comparison between |  | Result |
| Breakfast | first standardized classification | non-standardized classification | *Z* = -6.05, *p* < .001 |
| second standardized classification | non-standardized classification | *Z* = -7.58, *p* < .001 |
| first standardized classification | second standardized classification | *Z* = -4.26, *p* < .001 |
| Lunch | first standardized classification | non-standardized classification | *Z* = -8.96, *p* < .001 |
| second standardized classification  | non-standardized classification  | *Z* = -10.60, *p* < .001 |
| first standardized classification  | second standardized classification  | *Z* = -5.03, *p* < .001 |
| Dinner | first standardized classification | non-standardized classification | *Z* = -3.39, *p* = .001 |
| second standardized classification | non-standardized classification  | *Z* = -4.72, *p* < .001 |
| first standardized classification  | second standardized classification  | *Z* = -3.47, *p* = .001 |

Table 8

Temperature (in Celsius) means and SD during the first and second standardized IDDSI classifications

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Meal type | Standardized IDDSI classification | n | Mean (in Celsius)  | SD |
| Breakfast | First  | 185 | 28.41 | 16.40 |
| Second  | 185 | 21.75 | 4.16 |
| Lunch | First  | 279 | 41.15 | 12.59 |
| Second  | 279 | 25.16 | 4.74 |
| Dinner | First  | 96 | 31.40 | 14.79 |
| Second  | 96 | 22.89 | 4.49 |

IDDSI - International Dysphagia Diet Standardization Initiative

Table 9

Percentage of nutritional consumption by first standardized classification of IDDSI level (mean, SD and 95% CI)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| First standardizedIDDSI level | n | Mean | SD | 95% Confidence Interval for Mean |
| Lower Bound | Upper Bound |
| 3 | 366 | 76.80 | 36.44 | 73.06 | 80.55 |
| 4 | 830 | 64.61 | 42.02 | 61.75 | 67.47 |
| 5 | 353 | 69.62 | 40.18 | 65.41 | 73.82 |
| 6 | 110 | 70.64 | 40.14 | 63.05 | 78.22 |
| 7EC | 491 | 67.41 | 41.08 | 63.77 | 71.05 |
| 7R | 1670 | 59.15 | 42.20 | 57.12 | 61.17 |
| Total | 3820 | 64.39 | 41.61 | 63.06 | 65.71 |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

Table 10

Results of Bonferroni post-hoc analysis: nutritional consumption by IDDSI level (first standardized classification).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| (I) standardized classification | (J) standardized classification | Mean Difference (I-J) | SE | p value | 95% CI |
| Lower Bound | Upper Bound |
| 3 | 4 | 12.195\* | 2.58 | .000 | 4.59 | 19.80 |
| 5 | 7.186 | 3.07 | .294 | -1.85 | 16.23 |
| 6 | 6.167 | 4.48 | 1.000 | -7.01 | 19.34 |
| 7 EC | 9.394\* | 2.84 | .015 | 1.03 | 17.76 |
| 7 R | 17.658\* | 2.38 | .000 | 10.66 | 24.65 |
| 4 | 3 | -12.195\* | 2.58 | .000 | -19.80 | -4.59 |
| 5 | -5.009 | 2.62 | .842 | -12.71 | 2.69 |
| 6 | -6.028 | 4.18 | 1.000 | -18.32 | 6.27 |
| 7 EC | -2.801 | 2.34 | 1.000 | -9.70 | 4.10 |
| 7 R | 5.463\* | 1.75 | .028 | .32 | 10.61 |
| 5 | 3 | -7.186 | 3.07 | .294 | -16.23 | 1.85 |
| 4 | 5.009 | 2.62 | .842 | -2.69 | 12.71 |
| 6 | -1.019 | 4.50 | 1.000 | -14.25 | 12.21 |
| 7 EC | 2.208 | 2.87 | 1.000 | -6.25 | 10.66 |
| 7 R | 10.472\* | 2.41 | .000 | 3.37 | 17.57 |
| 6 | 3 | -6.167 | 4.48 | 1.000 | -19.34 | 7.01 |
| 4 | 6.028 | 4.18 | 1.000 | -6.27 | 18.32 |
| 5 | 1.019 | 4.50 | 1.000 | -12.21 | 14.25 |
| 7 EC | 3.227 | 4.35 | 1.000 | -9.56 | 16.01 |
| 7 R | 11.491 | 4.06 | .070 | -.44 | 23.42 |
| 7 EC | 3 | -9.394\* | 2.84 | .015 | -17.76 | -1.03 |
| 4 | 2.801 | 2.34 | 1.000 | -4.10 | 9.70 |
| 5 | -2.208 | 2.87 | 1.000 | -10.66 | 6.25 |
| 6 | -3.227 | 4.35 | 1.000 | -16.01 | 9.56 |
| 7 R | 8.264\* | 2.11 | .001 | 2.04 | 14.49 |
| 7 R | 3 | -17.658\* | 2.38 | .000 | -24.65 | -10.66 |
| 4 | -5.463\* | 1.75 | .028 | -10.61 | -.32 |
| 5 | -10.472\* | 2.41 | .000 | -17.57 | -3.37 |
| 6 | -11.491 | 4.06 | .070 | -23.42 | .44 |
| 7 EC | -8.264\* | 2.11 | .001 | -14.49 | -2.04 |

IDDSI - International Dysphagia Diet Standardization Initiative; EC- Easy to chew; R - Regular

**Legends for figures**

Figure 1

The International Dysphagia Diet Standardisation Initiaive (IDDSI) framework 2019 (<https://iddsi.org/framework/>) Licensed under CreativeCommons attribution Sharealike 4.0 Licencse

Figure 2

Mean percentage nutritional consumption by meal type: breakfast, lunch, and dinner, with 95% CI Error bars



Figure 1



Figure 2