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

**Abstract
Background:**Texture modified foods (TMF) is a common intervention, aiming to improve swallowing safety and efficiency. Non-standardized texture classification (NSTC) of foods is used worldwide; however, it can introduce unclarity and confusion that can potentially harm patients’ safety. The International Dysphagia Diet Standardization Initiative (IDDSI) framework offers international terminology and standardized methods for texture testing.

**Aims**: To document differences between NSTC and standardized texture classification (STC), and to describe the relationship between food intake and texture level.
**Methods**: In this observational study, data were collected from 24 various long-term care departments during breakfast, lunch and dinner provision. All food textures were classified using NSTC followed with two repeated IDDSI STC, to quantify time-related changes. Additionally, two types of food consumption measurements were taken: whole-tray food consumption and single item consumption. These consisted of subjective evaluation of consumption percentage.  **Results:**A total of 1276 food items were classified. NSTC indicated “lower” levels of food texture, however STC indicated “higher” levels of food texture. Time-related changes in food texture were found. Greater consumption was found for softer textures in comparison regular foods. 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 STC could improve patient safety, oral intake and nutritional statues. Time related changes should be considered. Lastly, reduced food consumption during lunch might negatively impact nutrients consumption.

**Introduction**

Speech and language pathologist are usually involved in swallowing difficulties (dysphagia) assessment and intervention, including recommendations for texture modification (1,2). Following clinical and instrumental assessment, the specific level or levels of modified textures should be personally prescribed based on the patient's swallowing biomechanics, structural features, cognition and behavior. Texture modifications are used to improve swallowing safety and efficiency and enable oral intake (3–5).

The International Dysphagia Diet Standardization Initiative (IDDSI) framework (6) (**Figure 1**) aims to create standardized terminology to improve patient safety (2). IDDSI framework is a texture pyramid for drinks and foods, that describes a graded shift in texture, meaning, the higher the number is, the harder and drier the texture is. IDDSI introduced clinically available testing methods and tools in order to improve texture categorization into the appropriate texture level such as the Flow Test using a syringe for liquids and Fork Pressure test for solids.

*Insert Figure 1 here*

Incorrect classification of foods and drinks could have devastating results (7) and was reported to be high. As little as zero and up to 60% of institutions in New Zealand met IDDSI texture requirements for food items served during meals (8). Unfortunately, the study did not include a description of the gap between the intended IDDSI level and actual food texture level. As one can presume, the bigger the gap, the higher are the risks of chocking and worsening swallowing difficulties. It is also important to take into account that nutritional intake and nutritional status can be impacted by the prescription of TMF. For example, in a study of 32 long-term care facilities in Canada, it was found that residents consuming minced or pureed foods had greater risk of malnutrition (9). Thus, providing residents the wrong food texture level can lead to increased risk of chocking, worse swallowing difficulties and decreased nutritional intake.

The primary aim of the current study was to document the differences between NSTC that was being used in Israel, as in other countries, and IDDSI which provides a standardized framework and testing methods. Classification was conducted during breakfast, lunch and dinner in order to closely descried for the scope of the problem. The secondary aim was to explore the relationship between nutritional intake and food texture level in order to assess whether providing the wrong texture to residents with dysphagia could also affect intake. This information can help emphasis the importance of using STC for people with dysphagia.

**Subjects and Methods**

This was an observational study, using convenience sampling of 22 long term care facilities in Israel, located from north to south, with a total of 24 different adults’ departments included. In each department, at least 40% of residents required texture modification and at least two types of TMF were provided. Data were collected between May 2019 and December 2020. The number of residents in each department is included in **Table 1**. Data were collected during five meal provisions in each department by the research assistances (RA), however in some departments this was not accomplished due to the facility’s lack of will to continue with participation or due to scheduling difficulties. In these cases, fewer number of meals were included. To collect data from five meals, the RAs visited each facility twice (two separate days) and up to five times (five separate days). The RAs were trained prior to data collection by an experienced speech therapist that had experience with and knowledge of IDDSI framework and testing methods (O.S.W). Table 1 includes the number of meals collected by type: breakfast, lunch and dinner. The current study included classification of foods items, including soups, but not drinks.

*Insert Table 1 here*

Due to cultural differences that might exist between countries, 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 includes a cooked meal with either chicken, beef or fish, fresh vegetables, cooked vegetables and cooked carbohydrates.

**Food textures classification**

NSTC of all food textures served in the facility was assigned by the department dietitian or speech and language pathologist, prior to study initiation and unrelated to it. To clarify, this classification is part of the usual clinical routine and no formal testing methods were used to assess if indeed the assigned level matched the food texture properties. In each department three to four different food texture levels were served: regular foods which consisted on hard and dry textures; easy to chew (soft) foods which consisted of foods that seemed softer (such as meatballs); and puree food which consisted of food that was blended until it had a puree texture and also naturally puree food (like yogurt). Rarely, a fourth texture called “mashed”/”minced” was served to some of the residents. This texture consisted of food mashed with fork or puree with lumps. In some occasions, different names were used by different institutions to describe the same texture level, for example: “puree”, “blended” or “smooth” were names used to descried the same level of puree foods.

For the purpose of the current study, the non-standardized levels were assigned an equivalent IDDSI level, in order to create the "NSTC" level. This was done to enable a comparison between the department classification (termed NSTC), and IDDSI level (termed STC) that utilized IDDSI testing methods. For the NSTC, the level assignment was based only on the name and informal description of the texture, and did not include any testing methods: regular food was classified as non-standardized (NS) 7-Regular (NS-7R), easy to chew/soft food was classified as NS-7-Easy to chew (NS-7EC), mashed/minced food as NS Level 5 – Minced and moist (NS-5), and puree food was classified as NS Level 4 – Puree (NS-4). From a non-standardized view-point, Level 6 - Soft and bite-sized and Level 3 - Liquidized were not used in the included departments.

For the STC, all food items served during a meal were tested using IDDSI testing methods by the RAs. The appropriate IDDSI tests were utilized, according to IDDSI framework and testing methods manuals (first version). Although Level 7EC was not described in the first edition, it was included in the current study since IDDSI published its addition before the release of the second version (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.

Cooked and prepared items were tested twice: one test was done at the beginning of the serve, and the second test - 30 minutes after the beginning of the serve. This was done in order to test if cooked/prepared items change texture over time and to assess the degree of change. Temperature was measured at each of the two time points using a food temperature meter. The RAs took small samples (equivalent to two tablespoons) from each cooked and prepared food item that was served, and placed it in on a separate plate. Testing was conducted twice on these samples, as described. Pre-packed industrial food items, such as yogurt or 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.

**Food consumption**

For food consumption assessment, each food tray was photographed twice using a smart-phone camera. The first photo of each tray was taken when the food tray was leaving the kitchen to be served, and the second time was 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. The photograph was taken while the camera was positioned above the tray.

Two types of food consumption measurements were taken. One for whole tray food consumption, meaning that the overall consumption of food that was served on the tray was assessed subjectively in percentage from 0% to 100%, with 100% meaning that the whole amount was consumed. The second type was measured for each food item separately in percentage (0-100%). The first type was conducted in departments numbered 1-13 (total of 13 departments), and the second type was conducted in department numbered 14-24 (total of 11 departments) (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 as ordinal scale, thus non-parametric statistics were used. Friedman's test was used to assess for differences between the three classifications. Post-hoc analysis included Wilcoxon signed-rank tests. Temperature difference 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.

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, puree and mashed/ minced food in each department. Data was missing from two department: #13 and #24 in Table 2, due to unwillingness to provide these details by the department.

*Insert Table 2 here*

**Food texture classification:**

Total of 41 breakfasts, 43 lunches and 23 dinners were included in the statistical analysis. Food items were classified into texture levels: 543 of 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, 1277 food items were included and classified. **Table 3** describes the distribution of food items by texture level. Most food items (52.1%) were classified as puree (NS-4) in the NSTC, however in both repeated STC, most food items were classified as IDDSI Level 7R. In addition, there was a wider range of texture levels in both STC 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 according to the NSTC, however according to both STC most food items were classified into IDDSI Level 7R. There was also a different proportion of Level 7EC in the NSTC versus STC, with 21.1% of food items classified as NS-7EC in the NSTC, while approximately 13% were classified as IDDSI 7EC in the STC. In addition, according to the NSTC there were no items in NS Levels 3, however according to first and second STC there were 17.1% and 15.3% of food items in IDDSI Level 3, respectively. Similarly, there were no items in NS Levels 6 according to the NSC, however according to first and second STC there were 4.1% and 3.9% of food items in IDDSI Level 6, respectively. On average, there were small differences in the distribution of food items between the first and second STC. The same trends were found for food items served in lunch and in dinner.

*Insert Table 4 here*

*Insert Table 5 here*

*Insert Table 6 here*

Friedman's test was used to assess for differences between the three classifications in 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, in all meals: breakfast (*t*(184) = 6.28, *p* < .001), lunch (*t*(278) = 24.84, *p* < .001) and dinner (*t*(95) = 6.74, *p* < .001).

Temperature (in Celsius) means 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) in breakfast, 34.98 min (10.23) in lunch and 30.87 min (6.12) in dinner.

*Insert Table 8 here*

**Whole-meal food consumption:**

For assessing mean percentage consumption of food on tray, a total of 1214 trays were analyzed: 503 trays were included 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 lower 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 found with a decrease in standardized IDDSI level, meaning a “lower” texture in the texture pyramid.

**Consumption per single food item:**

For assessing consumption percentage per food item, 3820 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 being used in Israel, as in other countries, and STC according to IDDSI framework. A gap between STC and NSTC 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 complex to swallow than intended. NSTC was based mainly on food appearance and the results of the current study emphasis the inaccuracy of this method and the need for STC. The secondary aim was to explore the relationship between nutritional intake and food texture level. Puree texture had greater consumption than regular textured food, meaning that texture that require minimal oral processing had increased consumption.

**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, thus 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 require for swallowing Puree (Level 4). Regular foods require proper dentation and creation of enough pressure in the oral and pharyngeal muscles in order to allow for sufficient breakdown of food particles, complete bolus preparation and avoid post swallow residues. Failure to achieve those can increase the risk of aspiration and choking.

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, careful selection of foods that can be processed into Level 4 should be made.

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. Loss of moister and properties such as dry top-surface can occur during preparation or reheating, leading to change in classification. These unwanted changes can lead to choking (10), and can be avoided by using moisture and proper heating methods and adjustment of recipes. The difference between the first and second STC conducted approximately 30 min apart, can be explained by the lower temperature and loss of moisture from food items during the second measure. Since food texture solidified over time, it is advised 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 the 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 resident 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 their eating and swallowing more challenging; thus, their intake was reduced. Considering the fact that in ISsrael proteins from animal sources (meat, poultry and fish) are served during lunch, the reduced intake might negatively affect B12, iron and protein consumption (12).

Whole meal food consumption and single item food consumption indicated that “lower” textures in the texture pyramid have higher consumption than “higher” textures, meaning harder and drier and require more complex swallowing abilities. Food items classified as Level 3 (liquidized texture) had the highest consumption and Level 7R (regular texture) – 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 used to eat them in their home environment, they tend to be fully consumed. Level 7R might have lower consumption since it might have been served to resident that require a “lower” texture level, as was previously discussed.

Another reason for higher consumption of “lower” texture levels of the texture pyramid might be related to independence in daily activity such as eating. Residents that consume liquidized or pureed textures tend to require eating assistance. This might explain greater consumption, as care-givers usually put an emphasis on finishing the food on the plate. Support to this claim was found in an observational study in long term care facilities, where it was found that residents that 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 puree 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. This might lead to an even greater 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).

Mean of 58.7% of residents 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, with 15% to 30% consuming MTF (19). The current study findings support increasing awareness to the use of different levels of TMF for dysphagia, and training the kitchen stuff, nursing and all other team members involved in food 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 for the food consumed, however weighting each food served pre- and post-meal would have allowed for a more accurate measurement of consumption. However, a disadvantage of this method is that it would impose a greater burden on the department as it can cause delays in food delivery in such large-scale study. In addition, it is possible 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 a certain facility, inter-rater agreement was not tested. When the RAs were uncertain regarding the classification of 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 provided them with different textures than those prescribed by the speech and language pathologist. Lastly, it is not known which patients required help feeding and if this influenced their food intake.

**Conclusions**

Residents with dysphagia received harder textures than intended. These textures required complex swallowing ability, meaning complex oral processing including chewing, greater lingual strength and greater pharyngeal strength. Thus, increased risk of choking was introduced to the residents. In addition, food intake might also be negatively affected. Using STC can improve patient safety and nutritional statues. Time related changes should be considered as these caused changes in food classification. Therefore, it is important to consider when to measure food texture in relation to food preparation and serving. Lastly, in comparison to other meals, reduced food consumption was found during lunch. This can be partly explained by technical reasons which can be solved, in order to increase nutrients consumption during lunch.

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**Tables**

Table 1

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Department type | Number of residents | Number of breakfasts observed | Number of lunches observed | Number of diners 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 puree 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 | Puree 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