Received: 30 November 2021 | Accepted: 13 May 2022

DOI: 10.1111/1460-6984.12749

International Journal of Language & Communication Disorders

RESEARCH REPORT

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

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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 Standardisation Initiative (IDDSI) framework offers international terminology and standardized methods for texture testing that can address this issue

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

Methods & Procedures: In this observational study, data were collected from 24 long-term care departments 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 ($n = 1276$). To document time-related changes in texture, the STC texture as food left the kitchen was compared with texture 30 min later ($n = 1276$). Finally, to explore the relationship between texture and consumption, estimates were made of single-item food consumption ($n = 3820$) using a subjective evaluation of consumption percentage

Outcomes & Results: A total of 1276 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 that revealed that residents were consuming food that was more difficult to eat than intended by the TMF prescription. In addition, significant changes in food texture were found over time, with texture levels significantly increasing 30 min

after food left the kitchen. Finally, greater consumption was found for softer textures in comparison with regular foods; moreover, food consumption was greatest during breakfast and lowest during lunch.

Conclusions & Implications: Residents requiring TMF received harder textures than intended which required complex swallowing ability, thus introducing a choking risk. Using the 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, particularly in cultures where lunch is the main meal of the day.

KEYWORDS
adults, food consumption, IDDSI, long-term care, standardization, texture-modified foods

What this paper adds

What is already known on the subject

- Despite widespread agreement on the importance of STC, institutional care providers widely use NSTC. The IDDSI framework offers international terminology and standardized methods for texture testing. The clinical importance of using STC is not well understood.

What this paper adds to existing knowledge

- This study found that residents who required texture-modified foods were eating food textures that were more challenging to swallow than intended. Differences were found in food texture between when it left the kitchen compared with texture 30 min later. Pureed texture had greater consumption than regular textured food. Food consumption was found to be the highest during breakfast, and reduced during lunch, which might negatively impact overall nutrient intake.

What are the potential or actual clinical implications of this work?

- Accurate food texture prescription is the first step towards increasing patients' safety. However, food preparation and handling are also very important steps, not to be disregarded. Time-related changes in food texture are remarkable and should be considered in circumstances where patients do not consume food soon after service, as these can compromise patients' safety.

INTRODUCTION

Speech and language pathologists are typically involved in assessing swallowing difficulties (dysphagia) and suggesting interventions, including recommendations for texture-modified foods (TMF) (Cichero et al. 2013; Langmore & Miller 1994) to improve swallowing safety and efficiency and enable sufficient oral intake to meet nutritional needs (Cichero 2013; Garcia et al. 2005; Sura et al. 2012). Following clinical and instrumental assessment, the specific level(s) of modified textures are ideally prescribed based on a patient's specific swallowing biomechanics, structural features, cognition and behaviour.

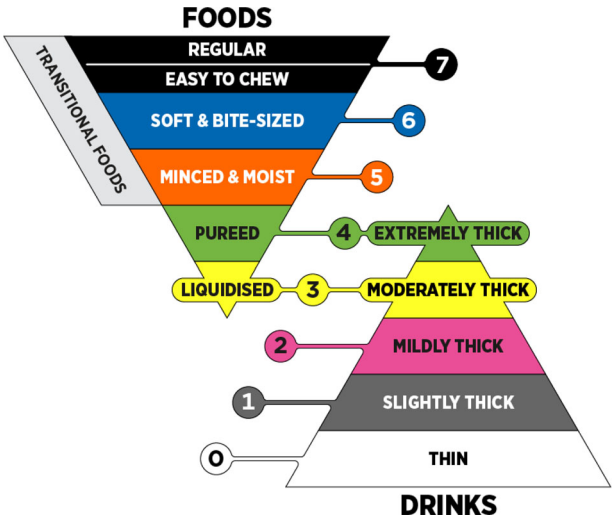

FIGURE 1 The International Dysphagia Diet Standardisation Initiative (IDDSI) framework 2019 (see https://iddsi.org/framework/).
[Colour figure can be viewed at wileyonlinelibrary.com]
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Despite widespread agreement on the importance of standardized texture modification, institutional care providers widely use non-standardized texture classifications (NSTC) and in some cases apply even NSTC inconsistently. Preparing foods and liquids using an incorrect classification can have devastating consequences for individuals with dysphagia (Wu et al. 2020), worsening their swallowing difficulties and increasing their risk of choking. Beyond these immediate patient safety issues, nutritional intake and nutritional status could be affected by the way food handlers prepare the prescribed TMF.

The International Dysphagia Diet Standardisation Initiative (IDDSI) (Cichero et al. 2017) (Figure 1) began addressing these problems by creating an international, standardized terminology to describe TMF and thickened liquids (Cichero et al. 2013). 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.

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 0% and 60% of residential aged care facilities in New Zealand met IDDSI texture requirements for food items served during meals (Miles et al. 2020). 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 no studies have measured that gap, including the New Zealand study.

Encouraging progress toward the international adoption of the IDDSI framework requires a better understanding of how far the current 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 was to compare the STC texture level as food left the kitchen with STC texture levels 30 min 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 departments in 22 LTC facilities located throughout Israel. In each department, at least 40% of residents required food texture modification. Further, each department provided at least two types of TMF. The number of residents in each department is included in Table 1. In one facility three departments were included: one department of patients with dependent needs (Table 1, #10), and two departments of patients with complex-dependent needs (Table 1, ##5 and 6). 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.

Data were collected between May 2019 and December 2020 by research assistants (RA) who were trained before data collection by the author, an experienced speech therapist familiar with the IDDSI framework and testing methods.

Data were collected by the same RA in each facility during the provision of five meal services in each department, 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

TABLE 1 Number of meals observed in each long-term care department, by type: Breakfast, lunch and dinner

No.	Department type	Number of residents	Number of breakfasts observed	Number of lunches observed	Number of dinners observed
1	Dependent needs	35	2	2	1
2	Dependent needs	29	2	2	1
3	Dependent needs	30	2	1	2
4	Dependent needs	22	1	2	1
5	Complex dependent needs	30	2	2	1
6	Complex dependent needs	25	2	2	1
7	Rehabilitation	42	2	2	1
8	Complex dependent needs	26	2	2	1
9	Dependent needs	22	2	2	1
10	Dependent needs	20	2	2	1
11	Complex dependent needs	32	2	2	1
12	Dependent needs	35	2	2	0
13	Dependent needs	n.a.	2	2	1
14	Dependent needs	23	2	2	1
15	Dependent needs	32	1	1	1
16	Dependent needs	27	2	2	1
17	Dependent needs	32	1	1	1
18	Dependent needs	35	2	2	1
19	Dependent needs	34	2	2	1
20	Dependent needs	31	1	2	2
21	Dependent needs	30	2	2	1
22	Physical disability	12	1	1	0
23	Dependent needs	20	1	2	1
24	Cognitive disabilities	n.a.	1	1	0
Total			41	43	23

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 six departments 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 2 separate days) and up to five times (5 separate days). Table 1 includes the number of meals services collected by type (breakfast, lunch and dinner) and department. The current study included the classification of foods items, including soups, but not drinks.

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

Comparing NSTC and STC food texture classifications

The 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 that 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, such as yogurt. Rarely, a fourth texture called 'mashed' or 'minced' was served to some of the residents. This texture consisted of food mashed with a fork or pureed with lumps. However, not all institutions used the same labels to describe the same texture level. For example, 'pureed', 'blended' and

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

No.	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	Dependent needs	35	17 (48.6%)	5 (14.3%)	0	13 (45.7%)	18 (51.4%)
2	Dependent needs	29	6 (20.7%)	10 (34.5%)	0	13 (44.8%)	23 (79.3%)
3	Dependent needs	30	15 (50%)	12 (40%)	0	3 (10%)	15 (50%)
4	Dependent needs	22	3 (13.6%)	7 (31.8%)	0	12 (54.5%)	19 (84.4%)
5	Complex dependent needs	30	17 (56.6%)	11 (36.6%)	0	2 (6.6%)	13 (43.3%)
6	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	Complex dependent needs	26	11 (42.3%)	8 (30.8%)	0	7 (26.9%)	25 (57.7%)
9	Dependent needs	22	7 (31.8%)	5 (22.7%)	0	10 (45.4%)	15 (68.2%)
10	Dependent needs	20	5 (25%)	5 (25%)	0	10 (50%)	15 (75%)
11	Complex dependent needs	32	13 (34.2%)	9 (23.7%)	0	10 (26.3%)	19 (65.8%)
12	Dependent needs	35	12 (34.3%)	14 (40%)	0	9 (25.7%)	23 (65.7%)
13	Dependent needs	n.a.	n.a.	n.a.		n.a.	
14	Dependent needs	23	8 (34.8%)	0	9 (39.1)	6 (26.1%)	15 (65.2%)
15	Dependent needs	32	18 (56.2%)	4 (12.5%)	0	10 (31.2%)	14 (43.8%)
16	Dependent needs	27	9 (33.3%)	17 (63%)	0	1 (3.7%)	18 (66.6%)
17	Dependent needs	32	12 (37.5%)	13 (40.6%)	0	7 (21.8%)	20 (62.5%)
18	Dependent needs	35	18 (51.4%)	13 (37.1%)	1 (2.8%)	3 (8.6%)	17 (48.6%)
19	Dependent needs	34	15 (44.1%)	10 (29.4%)	0	9 (26.5%)	19 (55.9%)
20	Dependent needs	31	4 (12.9%)	14 (45.2%)	3 (9.7%)	10 (32.2%)	27 (87.1%)
21	Dependent needs	30	10 (33.3%)	15 (50%)	0	5 (16.6%)	20 (66.6%)
22	Physical disability	12	7 (58.3%)	3 (0.25%)	0	2 (16.6%)	5 (41.7%)
23	Dependent needs	20	11 (55%)	1 (5%)	0	8 (40%)	9 (45%)
24	Cognitive disabilities	n.a.	n.a.	n.a.	n.a.	n.a.	

'smooth' were labels used to describe the same level of pureed foods.

In order to compare the facility's 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 Easy to chew (NS-7EC).
- Mashed/minced and moist food was classified as NS Level 5 (NS-5).
- 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 observed in the study departments.

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 the IDDSI published its edition before the release of the second edition (see https://iddsi.org/). For the flow test, a plastic syringe was used (BD 303134, 61.5 mm from 0 to 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.

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.

A first test of texture was done at the beginning of the meal service and a second test was conducted 30 min later. The 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 min.

Food consumption

For food consumption assessment, each food tray was photographed twice using a smartphone 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 photograph was 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. Information about the intended food texture of the meal was collected to connect between texture and consumption.

Two types of food consumption measurements were taken. First, in LTC departments 1–13, 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. This was done in order to test for differences in consumption between meal types. Second, in LTC departments 14–24, the same subjective percentages were used to assess the extent to which each food item was consumed by food texture level (Table 1). This was done in order to explore the relationship between food texture and food consumption.

Ethics

Ethical approval was obtained from the ethical committee of Ono Academic College (Approval number: 201911ono).

Statistics

Descriptive statistics were used including means, SD, and 95% confidence intervals (CI). Food texture classification levels were treated using an ordinal scale and analysed 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 min later). Post-hoc analysis included Wilcoxon signed-rank tests. Temperature differences were analysed using paired *t*-tests. Food consumption was tested using analysis of variance (ANOVA) to compare for differences between three meal types (breakfast, lunch and dinner), with post-hoc Bonferroni analysis. Finally, ANOVA was used to test differences between the first standardized IDDSI level and consumption per single food item, with post-hoc Bonferroni analysis.

TABLE 3 Food items (number and percentage) served in all three meals together classified into texture levels in three classifications: Non-standardized texture classification, and first and second standardized IDDSI classifications

Texture level	Non-standardized texture 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

Note: IDDSI, International Dysphagia Diet Standardisation Initiative; EC, Easy to chew; R, Regular.

RESULTS

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, 1276 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.

The classification of food items into texture levels during breakfast, lunch and dinner is presented in Appendices 1–3 respectively in the additional supporting information.

TABLE 4 Differences between the three classifications in each meal: Results of post-hoc analysis with Wilcoxon signed-rank tests

Meal	Texture level: comparison between		Results: *Z*-statistics, *p*-value and effect size
Breakfast	First STC	NSTC	$Z = -6.05$, $p < 0.001$, 0.26
	Second STC	NSTC	$Z = -7.58$, $p < 0.001$, 0.32
	First STC	Second STC	$Z = -4.26$, $p < 0.001$, 0.18
Lunch	First STC	NSTC	$Z = -8.96$, $p < 0.001$, 0.41
	Second STC	NSTC	$Z = -10.60$, $p < 0.001$, 0.49
	First STC	Second STC	$Z = -5.03$, $p < 0.001$, 0.23
Dinner	First STC	NSTC	$Z = -3.39$, $p = 0.001$, 0.20
	Second STC	NSTC	$Z = -4.72$, $p < 0.001$, 0.28
	First STC	Second STC	$Z = -3.47$, $p = 0.001$, 0.21

Note: NSTC, non-standardized texture classification; STC, standardized texture classification.

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-min 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 with the STCs (17.1% and 15.3%, respectively). Similarly, there were no items in NS Levels 6 according to the NSTC, 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 described were found for food items served at lunch and dinner.

Texture changes over time findings

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 ($n = 543$) ($\chi^2(2) = 21.08$, $p < 0.001$), lunch ($n = 462$) ($\chi^2(2) = 205.51$, $p < 0.001$) and dinner ($n = 272$) ($\chi^2(2) = 8.73$, $p = 0.013$).

Post-hoc analysis with Wilcoxon signed-rank tests was conducted. The results are presented in Table 4, including effect size. 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.

TABLE 5 Temperature means and SD during the first and second standardized IDDSI classifications

Meal type	Standardized IDDSI classification	*N*	Mean (°C)	SD
Breakfast	First	185	28.4	16.4
	Second	185	21.7	4.2
Lunch	First	279	41.1	12.6
	Second	279	25.2	4.7
Dinner	First	96	31.4	14.8
	Second	96	22.9	4.5

Note: IDDSI, International Dysphagia Diet Standardisation Initiative.

Temperature and time

Mean temperature (°C) and SD during the first and second STCs are presented in Table 5. Paired *t*-tests revealed significant difference in temperature between the first and second STCs, with items measured on the first STC having higher temperature than in the second STC at all meals: breakfast ($t(184) = 6.28$, $p < 0.001$), lunch ($t(278) = 24.84$, $p < 0.001$), and dinner ($t(95) = 6.74$, $p < 0.001$). Effect sizes (Hedge's *g* average) were 0.55 (medium), 1.67 (large) and 0.77 (large), respectively.

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.

Food consumption

Tests for whole-meal food consumption

To assess mean consumption of food on the tray (by percentage), a total of 1214 trays were analysed: 503 trays during breakfast, 448 during lunch and 263 during dinner. There was a significant difference in food consumption between meals ($F(2, 1211) = 30.88$, $p < 0.001$) and effect size of eta squared = 0.05 (medium). 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).

TABLE 6 Single-food item consumption in percentage, by first standardized classification of IDDSI level (mean, SD and 95% confidence interval (CI))

First standardized IDDSI level	Food items (*n*)	Mean percentage of food consumption	SD	95% CI for the mean	
				Lower bound	Upper bound
3	366	76.8%	36.4	73.1%	80.6%
4	830	64.6%	42.0	61.8%	67.5%
5	353	69.6%	40.2	65.4%	73.8%
6	110	70.6%	40.1	63.1%	78.2%
7EC	491	67.4%	41.1	63.8%	71.1%
7R	1670	59.2%	42.2	57.1%	61.2%
Total	3820	64.4%	41.6	63.1%	65.7%

Note: IDDSI, International Dysphagia Diet Standardisation Initiative; EC, easy to chew; R, regular.

Tests on single food items

To assess consumption for individual food items, 3820 items were included, from 11 departments during 44 meals. Each item was classified into the first standardized IDDSI level. Table 6 presents means, SD and 95% CI for the percentage of food consumption by the first STC level of IDDSI. There was a significant difference in consumption between levels ($F(5, 3814) = 14.19$, $p < 0.001$), and effect size of eta squared = 0.02 (small). Post-hoc analysis was conducted using Bonferroni tests. Results are presented in Table 7. 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.

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 the 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 who 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 with texture 30 min 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 generation 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 a 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 the proportion of easy to chew foods (7EC) between the NSTC and STC means that patients did not receive sufficiently soft 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 food surface may dry 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 (Hadde & Chen 2021), and can be avoided by using moisture, proper heating methods and recipe adjustments. The difference between the first and second STCs conducted 30 min later is attributable to 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 to assure the patient receives the intended texture level.

TABLE 7 Statistically significant results of Bonferroni post-hoc analysis: Differences in food consumption by IDDSI level (first standardized classification)

Standardized classification (IDDSI)	Standardized classification (IDDSI)	SE	*p*-value	95% confidence interval (CI)	
				Lower bound	Upper bound
3	4	2.58	0.000	4.6%	19.8%
	7 EC	2.84	0.015	1.0%	17.8%
	7 R	2.38	0.000	10.7%	24.7%
7 R	4	1.75	0.028	−10.6%	−.32%
	5	2.41	0.000	−17.6%	−3.37%
	7 EC	2.11	0.001	−14.5%	−2.04%

Note: IDDSI, International Dysphagia Diet Standardisation Initiative; EC, easy to chew; R, regular.

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 LTC facilities that investigated differences in food consumption between breakfast, lunch and dinner. In a survey of non-institutionalized adults (45 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 with lunch and dinner (Krok-Schoen et al. 2019).

Reduced consumption during lunch might be the result of a short time gap between breakfast and lunch, meaning that the residents were not particularly hungry 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 perhaps made eating and swallowing more challenging, thus reducing intake. Considering the fact that in Israel proteins from animal sources (meat, poultry and fish) are served at lunch, the reduced intake might negatively affect B12, iron and protein consumption, and overall nutrition (Rodd et al. 2021).

Single-item food consumption indicated that 'lower' textures in the texture pyramid have higher consumption than the 'higher' texture 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 many industrial dairy products are classified as Level 3, and because they are usually well-liked, tasty and people are accustomed to eating them prior to living in the LTC facility, they tend to be fully consumed. Level 7R might have lower consumption since those foods may have been served to residents requiring 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 intakes (Keller et al. 2017).

It should be mentioned that pureed food might have lower nutritional density (Bannerman & McDermott 2011) due to the need to add liquids in order to create smooth textures (Hotaling 1992). Thus, higher consumption, as found in the current study, does not necessarily mean better nutritional status (Wright et al. 2005; Wu et al. 2020). The current study finding differs from the results of a study conducted in aged care facilities in New Zealand, which found higher consumption of regular food texture compared with puree texture (Miles et al. 2020). 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 reduced food consumption. Dysphagia and malnutrition are interrelated; dysphagia can result in malnutrition or exacerbate existing malnutrition (Hotaling 1992) and lack of nutrition can exacerbate existing dysphagia (Hudson et al. 2000; Maeda et al. 2017).

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, 15–30% consume TMF (Keller et al. 2012). 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 the lack of a standardized measure to assess 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 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. The possibility that residents received additional food portions or food items during their meals from the working staff was not incorporated into this study.

Another limitation is related to interrater 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 photographs and videos of the food items and consulted with the author 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 or working staff to make ad-hoc decisions regarding food texture. Lastly, it is not known which patients required help feeding themselves and whether such help influenced their food intake.

CONCLUSIONS

This is the first study to measure the gap between NSTC and the IDDSI texture standards and included contextualized changes of food texture over time in a variety of LTC facilities. Clinically significant gaps were found and indicated that some residents were at risk of choking since they received harder food textures than intended. Delays of 30 min caused changes in food texture classification. In addition, this is the first study to assess the relationship between nutritional intake and food texture level in each type of meal: breakfast, lunch and dinner. In LTC facilities, greater food consumption was found at breakfast. Food items classified as Level 3 (liquidized texture) had the highest consumption and Level 7R (regular texture) had the lowest. Using STC based on the IDDSI can improve patient safety and oral intake.

ACKNOWLEDGMENTS

The following third-year students served as research assistants in the current study and were responsible for data collection: Bar Tehila, Bitan Shilat, Buskila Zohar, Diamant Liat, Glik Mali, Haeytan Tzipora, Lipkin Efrat, Maimon Roni, Sela Shira, Shuv Ruhama and Wolf Rachel. Permission from all persons named in the acknowledgments was obtained prior to submission. This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CONFLICT OF INTEREST

The author is a member of Israel IDDSI reference group.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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REFERENCES

Bannerman, E. & McDermott, K. (2011) Dietary and fluid intakes of older adults in care homes requiring a texture modified diet: the role of snacks. *Journal of the American Medical Directors Association*, 12(3), 234–239. https://doi.org/10.1016/j.jamda.2010.06.001

Cichero, J.A. (2013) Thickening agents used for dysphagia management: Effect on bioavailability of water, medication and feelings of satiety. *Nutrition Journal*, 12(1), 54. https://doi.org/10.1186/1475-2891-12-54

Cichero, J.A.Y., Lam, P., Steele, C.M., Hanson, B., Chen, J., Dantas, R.O. et al. (2017) Development of international terminology and definitions for texture-modified foods and thickened fluids used in dysphagia management: the IDDSI framework. *Dysphagia*, 32(2), 293–314. https://doi.org/10.1007/s00455-016-9758-y

Cichero, J.A.Y., Steele, C., Duivestein, J., Clavé, P., Chen, J., Kayashita, J. et al. (2013) The need for international terminology and definitions for texture-modified foods and thickened liquids used in dysphagia management: foundations of a global initiative. *Current Physical Medicine and Rehabilitation Reports*, 1(4), 280–291. https://doi.org/10.1007/s40141-013-0024-z

Garcia, J.M., Chambers, E. & Molander, M. (2005) Thickened liquids. *American Journal of Speech–Language Pathology*, 14(1), 4–13. https://doi.org/10.1044/1058-0360(2005/003)

Hadde, E.K. & Chen, J. (2021) Texture and texture assessment of thickened fluids and texture-modified food for dysphagia management. *Journal of Texture Studies*, 52(1), 4–15. https://doi.org/10.1111/jtxs.12567

Hotaling, D.L. (1992) Nutritional considerations for the pureed diet texture in dysphagic elderly. *Dysphagia*, 7(2), 81–85. https://doi.org/10.1007/BF02493438

Hudson, H.M., Daubert, C.R. & Mills, R.H. (2000) The interdependency of protein–energy malnutrition, aging, and dysphagia. *Dysphagia*, 15(1), 31–38. https://doi.org/10.1007/s004559910007

Keller, H., Chambers, L., Niezgoda, H. & Duizer, L. (2012) Issues associated with the use of modified texture foods. *The Journal of Nutrition, Health & Aging*, 16(3), 195–200. https://doi.org/10.1007/s12603-011-0160-z

Keller, H.H., Carrier, N., Slaughter, S.E., Lengyel, C., Steele, C.M., Duizer, L. et al. (2017) Prevalence and determinants of poor food intake of residents living in long-term care. *Journal of the American Medical Directors Association*, 18(11), 941–947. https://doi.org/10.1016/j.jamda.2017.05.003

Krok-Schoen, J.L., Jonnalagadda, S.S., Luo, M., Kelly, O.J. & Taylor, C.A. (2019) Nutrient intakes from meals and snacks differ with age in middle-aged and older Americans. *Nutrients*, 11(6), 1301. https://doi.org/10.3390/nu11061301

Langmore, S.E. & Miller, R.M. (1994) Behavioral treatment for adults with oropharyngeal dysphagia. *Archives of Physical Medicine and Rehabilitation*, 75(10), 1154–1160. https://doi.org/10.1016/0003-9993(94)90094-9

Maeda, K., Takaki, M. & Akagi, J. (2017) Decreased skeletal muscle mass and risk factors of sarcopenic dysphagia: a prospective observational cohort study. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 72(9), 1290–1294. https://doi.org/10.1093/gerona/glw190

Miles, A., Liang, V., Sekula, J., Broadmore, S., Owen, P. & Braakhuis, A.J. (2020) Texture-modified diets in aged care facilities: nutrition, swallow safety and mealtime experience. *Australasian Journal on Ageing*, 39(1), 31–39. https://doi.org/10.1111/ajag.12640

Rodd, B.G., Tas, A.A. & Taylor, K.D.A. (2021) Dysphagia, texture modification, the elderly and micronutrient deficiency: a review. *Critical Reviews in Food Science and Nutrition*, 1–17. https://doi.org/10.1080/10408398.2021.1913571

Sura, L., Madhavan, A., Carnaby, G. & Crary, M.A. (2012) Dysphagia in the elderly: management and nutritional considerations. *Clinical Interventions in Aging*, 7, 287–298. https://doi.org/10.2147/CIA.S23404

Wright, L., Cotter, D., Hickson, M. & Frost, G. (2005) Comparison of energy and protein intakes of older people consuming a texture modified diet with a normal hospital diet. *Journal of Human Nutrition and Dietetics*, 18(3), 213–219. https://doi.org/10.1111/j.1365-277X.2005.00605.x

Wu, X.S., Miles, A. & Braakhuis, A. (2020) Nutritional intake and meal composition of patients consuming texture modified diets and thickened fluids: a systematic review and meta-analysis. *Healthcare*, 8(4), 579. https://doi.org/10.3390/healthcare8040579

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Sella-Weiss, O. (2022) What could go wrong? Non-standardized versus standardized food texture classification. *International Journal of Language & Communication Disorders*, 57, 1244–1254. https://doi.org/10.1111/1460-6984.12749