Original

Some of Gastrointestinal Functions Among Elderly at Aged Care Center in Hanoi, Vietnam: A Cross-Sectional Study

Linh Thuy Nguyen[1,2*], Ha Ngoc Vu[1], Tuyet Chinh Thi Pham[1], Nga Thanh Ta[1], Hoang Thi Hai Yen[3]

[1]*Department of Nutrition and Dietetics, Ha Noi Medical University Hospital, Hanoi Medical University, Ha Noi, Viet Nam*
[2]*Department of Nutrition and Food Safety, School of Training Preventive Medicine and Public Health, Ha Noi Medical University, Ha Noi, Viet Nam*
[3] *Jumonji University*

ABSTRACT: *Background and purpose*. Aging is associated with a decline in several physiological functions, including gastrointestinal function, that can affect the nutritional status and quality of life of individuals. *Method.* To assess the gastrointestinal function of older adults, a cross-sectional descriptive study was conducted in 100 participants, including assessment of their oral function and gastrointestinal symptoms. Additionally, a pilot study involving ultrasound assessment of gastric emptying in 20 older patients after drinking different fluids (formula, soup, and porridge) was conducted. *Results*. A decline in the oral function of older adults was observed, with 35% oral changes according to their OHAT scores. The participants were observed to not have large gastric volumes when fasting. After 2 hours of eating, the Gastric Volume (GV) after eating porridge were statistically larger than after consuming the semi-hydrolyzed soup (9.92 ± 13.97 ml vs 5.04 ± 22.55 ml). *Conclusion.* The faster gastric emptying for semi-hydrolyzed soup, compared to non-hydrolyzed liquid and semi-liquid, signifies that gastric emptying may be dependent on the nutrient content and density of the liquid.
Keywords: Aging, gastrointestinal symptoms, nutritional status, gastric volume, gastric emptying.

INTRODUCTION

Older adults make up a significant and rapidly increasing proportion of Vietnam's population. The percentage of Vietnamese aged 65 and older is projected to grow from 7.9% in 2020 to 16.3% of the population in 2040 (1). Aging is associated with a decline in several physiological functions, including dental and digestive health, that can impact the metabolic system, nutritional status, and daily routine. The digestive system is composed of the gastrointestinal (GI) tract or the alimentary canal, salivary glands, the liver, and the exocrine pancreas. As a result, the global burden of disease is increasing, as well as the burden of providing healthcare for older adults.

According to the World Dental Federation, impaired oral function is of great concern to global health, especially among the older population. A cross-sectional study conducted with 3220 Dutch nursing home residents showed that poor oral health, primarily problems with eating due to (artificial) teeth problems, was associated with an almost twofold risk for malnutrition in older residents (2). Moreover, chewing difficulty is closely related to food and nutrient intake in older adults and can result in vitamin and mineral intake deficiencies (3).

GISs (Gastrointestinal Symptoms), which include nausea, vomiting, belching, abdominal pain, etc., frequently occur in older adults, as concluded in many studies (4,5). For example, a study conducted in Finland involving 3100 outpatients over 60 years old found that the overall prevalence of upper gastrointestinal symptoms was 43% (5). In addition, 90% of patients in another cross-sectional study in a clinically stable group of geriatric patients in Mexico had at least one GIS. Severe GIS values were associated with poorer nutritional status, as determined by the Malnutrition and Inflammation Score. Nonetheless, they had no association with anthropometry or biochemical value analysis (6).

Aging is associated with an increased prevalence of diseases associated with abnormally delayed gastric emptying (7). Some studies have

* To whom correspondence should be addressed:
linhngthuy@hmu.edu.vn

also described reductions involving liquid and solid emptying, particularly in individuals with low physical activity levels (8,9). The rate of gastric emptying of liquid is dependent on energy density and fat content. However, little is known about the effect of hydrolyzed liquid on gastric emptying time in the elderly. To determine the effect of aging on the gastric emptying, the previous studies have demonstrated that gastric ultrasonography provides valuable information for large gastric fluid volumes. In addition, ultrasonography is a noninvasive and safe tool to evaluate delayed gastric emptying while fasting and after eating in older adults (10,11).

In Vietnam, only a few studies assess the oral function, gastrointestinal symptoms, and gastric residual volume of older adults, especially outpatients in the community. For that reason, we performed this study with the aim of assessing the oral function and gastrointestinal symptoms of older adults at an elderly center in Hanoi, Vietnam. Moreover, our research aimed to clarify the effect of gastric emptying in elderly patients after drinking different fluids by ultrasound.

METHODS

Phase 1:

Design, setting, and sample

This study was a cross-sectional study to assess oral function and functional dyspepdia. It occurred from January to February 2023 in an aged care center with a capacity of 200 beds in the suburban area of Hanoi, Vietnam. At the time of the study, there were a total of 112 older adults who were residing in the center, and 100 of them were included according to the inclusion criteria: (i) age ≥ 60 years old, (ii) only have oral feeding, (iii) can understand to answer questions and (iv) agreed to join the study.

Data collection

Demographic data (such as gender and age) were collected from medical records, caregivers, and subjects.

Denture status assessment was carried out by the trained dietitians using the Oral Health Assessment Tool (OHAT) (12). The OHAT contains eight items relating to objective aspects of oral health: lips, tongue, gums and tissues, saliva, natural teeth, dentures, oral cleanliness, and dental pain. For each category, the examiner must score the seen condition on a three-level scale: 0=normal; 1=mild; 2= severe. Additionally, the number of lost teeth, the remaining natural teeth, and the usage and number of prosthetic dentures were collected.

Functional dyspepsia. Medical doctors used a questionnaire to ask the patients about the presence of functional dyspepsia (FD). The Rome IV criteria define dyspepsia as any combination of 4 symptoms: postprandial fullness, early satiety, epigastric pain, and epigastric burning that are severe enough to interfere with the usual activities and occur at least 3 days per week over the last 3 months with an onset of at least 6 months in advance (13).

Phase 2:

Design, setting, and sample

In addition, to phase 1, pre-post pilot trial comparing the effect of different fluids on gastric emptying in elderly patients for the future direction of intervention was conducted in the same setting. Participants were screened using the inclusion criteria of being able to drink the liquid solution and agreeing to participate in the study. Patients with diabetes, enteral tube feeding, and a history of upper abdominal surgery including gastric surgery were excluded. In the end, 20 subjects were eligible to participate in the ultrasound assessment.

Procedure

The ultrasound procedures assessing the residual fluid after drinking fluid were performed nine times in 3 days by well-trained medical doctors. The 1st ultrasound was implemented before drinking the solution while the second and the third were after drinking 2 hours and 3 hours, accordingly. The subjects were required to fast overnight and drink 200 ml ofliquid solution in the morning with day 1 using non-hydrolyzed formula, day 2 using semi-hydrolyzed soup, day 3 using the porridge.

Formula: 4.57 g protein, 3.69 g lipid, 14.81 g glucid, 110 kcal/ 100 ml

Semi - hydrolyzed soup (Fomeal Care soup): 5.8 g protein, 2.64 g lipid, 10.2 g glucid, 84 kcal/ 100 ml

Porridge was made by stafts of the kitchen at the aged care center: 4g protein, 2.9 g lipid, 10,0g glucid; 82 kcal/100ml.

Data collection

Ultrasound assessment of gastric volume. Patients were scanned in the right lateral decubitus position. We measured the antral cross-sectional area (CSA) using the technique described originally by Bolondi (14) and, subsequently, by Perlas et al. (15-17). Cross-sectional area (CSA) was calculated by using two perpendicular diameters – anteroposterior (AP) and craniocaudal (CC) and the formula for the area of an ellipse:

$CSA = (AP \times CC \times \pi)/4$ with π-value = 3.14.

Following ACSA computation, each subject's stomach total volume ("expected volume") was calculated using a mathematical model that has previously been examined and approved by other investigators:

$GV\ (ml) = 27.0 + 14.6 \times \text{right-lat CSA} - 1.28 \times \text{age}$

Data processing

Data were analyzed by Stata 16.0 software. Data is cleaned before analysis. Data are presented as

n, %, mean ± SD. The chi-square test and Fisher's exact test were used to compare proportional variables. Continuous variables were compared with paired t-tests for variables with normal distribution and paired Wilcoxon tests for abnormally distributed variables. A probability level of $p<0.05$ was considered statistically significant. Univariate and multivariate logistic regression analyses were used to determine the relationship between dental and digestive conditions with other factors such as medical conditions and nutritional status.

RESULTS

Phase 1

The characteristics of 100 subjects and their association with oral function were demonstrated in Table 1. Most participants were older or equal to 75 years old (61%) as well as most were female (64%). Nearly half of the subjects had less than 20 natural teeth (45%) and oral changes (35%) according to OHAT scores. Based on the MNA-SF score, only 14% of participants were classified under the normal nutritional status group, 49% in the risk of malnutrition group, and 37% in the malnourished group. Moreover, elders with less than 20 natural teeth and oral changes have a significantly higher prevalence of being malnourished or at risk of being malnourished than ones that had more than 20 teeth and a healthy oral function group ($p=0.044$, $p=0.003$, respectively). By using univariate analysis, higher odds of having less than 20 natural teeth were significantly associated with advancing age, people who were dependent or required some help for general function, dementia patients, malnutrition or at risk of malnutrition, and liquid or soft diet. Additionally, to the aforementioned factors, elderly who had more than 3 comorbidities, took more than 3 medicines, and had stayed at the nursing home more than 2 years were more likely to have poor oral function (oral changes) based on OHAT score. The associated factors to elderly functional dyspepsia are depicted in Table 2. Among 100 participants, 43% of them had functional dyspepsia (FD). Subjects with FD were 8.69 times (95% CI, 2.31 – 32.73) and 4.17 times (95% CI, 1.63 – 10.64) more likely to have gastrointestinal diseases and totally depend on others in everyday function than those without FD, respectively. **Phase 2**

Study 2 is a pre-post pilot trial conducted on 20 elderly people with an average age of 80.65 ± 9.19 years old, the youngest age is 70 years old, and the oldest age is 95 years old. There was no significant difference between the antral CSA of the three different liquids and food before and after 3 hours of consumption (Figure 1). However, after 2 hours of eating, the antral CSA and the gastric volume (GV) after eating porridge were statistically larger than after consuming the semi-hydrolyzed soup (4.96 ± 1.98 cm2 vs 2.74 ± 0.99 cm2 for CSA, and 9.92 ± 13.97 ml vs 5.04 ± 22.55 ml for GV; Table 3).

Table 4 indicated that there was no difference in the antral CSA after ingesting different liquid and semi-solid food and the participants' functional dyspepsia

Table 1. Characteristics of total Subjects (n, %) by oral function

Variable		All n = 100 (n, %)	Number of natural teeth < 20 teeth n = 45 n (%)	Number of natural teeth ≥ 20 teeth n = 55 n (%)	OR (95%CI)	OHAT 4-16: oral changes n = 35 n (%)	OHAT 0-3: healthy n = 65 n (%)	OR (95%CI)
Age	≥ 75	61 (61.0)	34 (75.6)	27 (49.1)	3.21 (1.35–7.58)	23 (65.7)	38 (58.5)	1.36 (0.58 – 3.20)
	<75	39 (39.0)	11 (24.4)	28 (50.9)		12 (34.3)	27 (41.5)	
	p		***0.007***			*0.478*		
Gender	Male	36 (36.0)	13 (28.9)	23 (41.8)	0.57 (0.24 – 1.31)	14 (40.0)	22 (33.9)	1.3 (0.56 – 3.05)
	Female	64 (64.0)	32 (71.1)	32 (58.2)		21 (60.0)	43 (66.1)	
	p		*0.18*			*0.541*		
Comorbidities	≥ 3 diseases	22 (22.0)	11 (24.4)	11 (20.0)	1.29 (0.50 – 3.34)	10 (28.6)	8 (12.3)	2.85 (1.01 – 8.08)
	< 3 diseases	78 (78.0)	34 (75.6)	44 (80.0)		25 (71.4)	57 (87.7)	
	p		*0.594*			***0.043***		
Medicines	>3 medicines	31 (31.0)	14 (31.1)	17 (30.9)	1.01 (0.43 – 2.37)	16 (45.7)	15 (23.1)	2.81 (1.16 – 6.77)
	≤ 3 medicines	69 (69.0)	31 (68.9)	38 (69.1)		19 (54.3)	50 (76.9)	
	p		*0.983*			***0.02***		
Length of stay in nursing home	< 2 years	44 (44.0)	17 (37.8)	27 (49.1)	0.59 (0.26 – 1.31)	10 (28.6)	35 (53.8)	0.34 (0.14 – 0.83)
	≥ 2 years	56 (56.0)	28 (62.2)	28 (50.1)		25 (71.4)	30 (46.2)	
	p		*0.257*			***0.015***		
General functional status	Totally dependent	43 (43.0)	26 (57.8)	17 (30.9)	1.00	26 (74.3)	17 (26.1)	1.00
	Requires some help	17 (17.0)	8 (17.8)	9 (16.4)	1.72 (0.55 – 5.34)	2 (5.7)	15 (23.1)	11.47 (2.32 – 56.65)
	Independent	40 (40.0)	11 (24.4)	29 (52.7)	4.03 (1.60 – 10.17)	7 (20.0)	33 (50.8)	7.21 (2.60 – 19.98)
	p		***0.01***			***0.000***		
Dementia	Yes	64 (64.0)	35 (77.8)	29 (52.7)	3.14 (1.30 – 7.56)	28 (80.0)	36 (55.4)	3.22 (1.23 – 8.43)
	No	36 (36.0)	10 (22.2)	26 (47.3)		7 (20.0)	29 (44.6)	
	p		***0.009***			***0.014***		
Malnutrition (MNA-	Malnutrition	37 (37.0)	19 (42.2)	18 (32.7)	1.00	20 (57.1)	17 (26.2)	1.00

Variable		All n = 100 (n, %)	Number of natural teeth < 20 teeth n = 45 n (%)	≥ 20 teeth n = 55 n (%)	OR (95%CI)	OHAT 4-16: oral changes n = 35 n (%)	OHAT 0-3: healthy n = 65 n (%)	OR (95%CI)
SF)	Risk of malnutrition	49 (49.0)	24 (53.3)	25 (45.5)	1.1 (0.47 – 2.58)	14 (40.0)	35 (53.8)	2.94 (1.20 – 7.20)
	Normal	14 (14.0)	2 (4.5)	12 (21.8)	6.33 (1.24 – 32.32)	1 (2.9)	13 (20.0)	15.29 (1.81 – 129.25)
	p		***0.044***			***0.003***		
Food's texture	Liquid	19 (19.0)	13 (28.9)	6 (10.9)	1.00	7 (10.8)	12 (34.3)	1.00
	Soft and small	16 (16.0)	9 (20.0)	7 (12.7)	1.69 (0.42 – 6.71)	11 (16.9)	5 (14.3)	0.27 (0.06 – 1.09)
	Normal	65 (65.0)	23 (51.1)	42 (76.4)	3.96 (1.33 – 11.8)	47 (72.3)	18 (51.4)	0.22 (0.08 – 0.66)
	p		***0.024***			***0.016***		

Table 2. Characteristics of total subjects (n, %) by functional dyspepsia

Variable		All participants n = 100 (n, %)	Functional dyspepsia (FD)		
			Have n (%)	Do not have n (%)	OR (95%CI)
Age	≥ 75	61 (61.0)	29 (47.5)	32 (52.5)	1.62 (0.71 – 3.69)
	<75	39 (39.0)	14 (35.9)	25 (64.1)	
	p		*0.251*		
Gender	Male	36 (36.0)	16 (44.4)	20 (55.6)	1.10 (0.48 – 2.50)
	Female	64 (64.0)	27 (42.2)	37 (57.8)	
	p		*0.827*		
Comorbidities	≥ 3 diseases	22 (22.0)	11 (50.0)	11 (50.0)	1.44 (0.56 – 3.72)
	< 3 diseases	78 (78.0)	32 (41.0)	46 (59.0)	
	p		*0.453*		
Gastrointestinal diseases	Yes	17 (17.0)	14 (82.4)	3 (17.6)	8.69 (2.31 – 32.73)
	No	83 (83.0)	29 (34.9)	54 (65.1)	
	p		***0.000***		
Medicines	>3 medicines	31 (31.0)	13 (41.9)	18 (58.1)	0.94 (0.40 – 2.21)
	≤ 3 medicines	69 (69.0)	30 (43.5)	39 (56.5)	
	p		*0.885*		
Length of stay in nursing home	< 2 years	44 (44.0)	17 (38.6)	27 (61.4)	0.73 (0.33 – 1.62)
	≥ 2 years	56 (56.0)	26 (46.4)	30 (53.6)	
	p		*0.435*		
General functional status	Totally dependent	43 (43.0)	25 (58.1)	18 (41.9)	1.00
	Requires some help	17 (17.0)	8 (47.1)	9 (52.9)	1.56 (0.51 – 4.83)
	Independent	40 (40.0)	10 (25.0)	30 (75.0)	4.17 (1.63 – 10.64)
	p		***0.009***		
Malnutrition (MNA-SF)	Malnutrition	37 (37.0)	16 (43.2)	21 (56.8)	1.00
	Risk of malnutrition	49 (49.0)	23 (46.9)	26 (53.1)	0.86 (0.36 – 2.03)
	Normal	14 (14.0)	4 (28.6)	10 (71.4)	1.90 (0.50 – 7.20)
	p		*0.472*		
Food's texture	Liquid	19 (19.0)	10 (52.6)	9 (47.4)	1.00
	Soft and small	16 (16.0)	4 (25.0)	12 (75.0)	3.33 (0.78 – 14.16)
	Normal	65 (65.0)	29 (44.6)	36 (55.4)	1.38 (0.50 – 3.84)
	p		*0.234*		

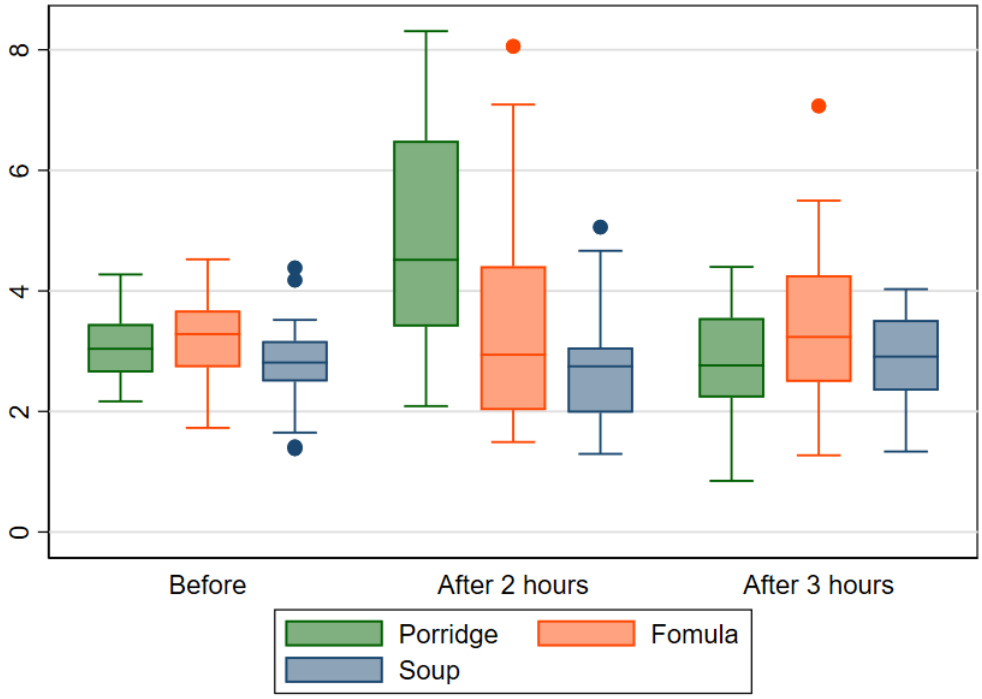

Figure 1. The evaluation of antral CSA between the porridge, formula, and soup groups

Table 3. Comparative ultrasound assessment of gastric emptying between liquid and semi-solid food in elderly patients

	Time	Formula	Hydrolyzed soup	Porridge	p-value		
		mean ± SD			Formula vs Soup	Porridge vs Soup	Porridge vs Formula
Before eating	CSA (cm^2)	3.22 ± 0.72	2.79 ± 0.77	3.12 ± 0.62	0.084	0.130	0.447
	Gastric volume (ml)	0	0	0			
After eating 2 hours	CSA (cm^2)	3.46 ± 1.96	2.74 ± 0.99	4.96 ± 1.98	0.136	***0.000***	0.067
	Gastric volume (ml)	25.03 ± 52.04	5.04 ± 22.55	9.92 ± 13.97	0.375	***0.032***	0.515
After eating 3 hours	CSA (cm^2)	3.46 ± 1.40	2.90 ± 0.74	2.81 ± 0.88	0.069	0.740	0.129
	Gastric volume (ml)	11.87 ± 36.73	0	0.08 ± 0.36	0.500	0.317	0.524

**CSA=Antral cross-sectional area; FD=Functional dyspepsia*

Table 4. Participants' antral cross-sectional area by their functional dyspepsia (n=20)

CSA (cm^2) Mean ± SD		FD (n = 9)	No FD (n=11)	p
After eating 2 hours	Formula	3.24 ± 1.74	3.64 ± 2.19	0.659
	Soup	2.60 ± 0.59	2.85 ± 1.25	0.597
	Porridge	4.38 ± 1.80	5.43 ± 2.07	0.247
After eating 3 hours	Formula	3.45 ± 1.70	3.48 ± 1.18	0.968
	Soup	2.84 ± 0.61	2.95 ± 0.86	0.752
	Porridge	2.52 ± 0.99	3.06 ± 0.73	0.176

**CSA=Antral cross-sectional area; FD=Functional dyspepsia*

DISCUSSION

A cohort study of 36,283 Chinese older adults suggested that compared to those with 20+ teeth, tooth loss was associated with a gradual increase in mortality (18). This study elucidated that the prevalence of elderly having 0-19 natural teeth was 45%, which indicated that it is also a concerning problem in Vietnam, given its rapid increment of aging population. In addition, 50.9% of older adults aged 60–75 have 20 or more natural teeth, which is slightly lower than the 2008 Korean National Health and Nutrition Examination Survey with a prevalence of 53.6% (19). Furthermore, within the older than 75 years of age population, the same indicator was 49.1%, also lower than Japan's report in 2016 which was 51.2% (20).

The oral hygiene and health of the institutionalized elderly are frequently described as inadequate. Bad oral hygiene and health have often been reported (21). According to OHAT, our research reported that the proportion of older adults having a healthy oral score was 65%. This prevalence is 2 times higher than the result of Siyue Liu and et.al.'s study on 1280 individuals from nursing homes in China (2023) with only 28.5% of residents having a healthy mouth, and 71.5% showing changes requiring monitoring and an unhealthy mouth giving cause for concern (22). This divergence may come from the difference in the residences of the nursing homes in each study. Moreover, both studies found that there was a correlation between the number of intake medicines and OHAT scores in Liu's study 43.2% had to take more than 5 medicines while in our study only 31% took more than 3 medicines.

Additionally, our study also revealed an association between oral health and malnutrition in Vietnamese older adults in nursing homes. This result is in consensus with several review articles that have been published before on the association between oral health and nutritional status (23-25). According to an epidemiological study, having more than 20 natural teeth is ideal for maintaining a balanced diet (26). Poor oral functions such as decreased ability to chew and swallow lead to unfavorable changes in food choices and a poor quantity and quality of food intake among older adults. Inadequate dietary intake is a risk factor for malnutrition. Thus, it is important to give dietary counseling to improve dietary intake and nutritional status in older persons with tooth loss (27).

Not only oral function but aging also affects all functions of the gastrointestinal system such as motility, digestion, and absorption. Functional dyspepsia may be harder to detect and treat in older adults since common gastrointestinal diseases might resemble illnesses in the elderly. Our study was one of the first studies to evaluate the prevalence of FD in institutionalized elders in Vietnam with 43%, higher than the results of other studies. The most recent study on the worldwide prevalence of uninvestigated dyspepsia showed a pooled value of 21% (95% CI, 18-24%); meanwhile, in a national survey in Korea, the prevalence of FD at ≥ 60 years was 11% (28, 29).

In our study, liquids and digestible semi liquid are emptied in the digestive period that lasts 2-3 hours after a meal. Similarly, the studies in different populations demonstrated that carbohydrate drinks were emptied after 2 hours of the last ingestion.

After 3 hours, the gastric volume is 0ml in 100% of the participant's soup ingested. These results demonstrate the rapid gastric emptying time of hydrolyzed liquid compared to non-hydrolyzed liquid and semi liquid solid. Yasuyuki demonstrated that the delaying effect of lipid on gastric emptying is accentuated in the elderly (30). In addition, the rate of gastric emptying responses to feeding with protein solutions are independent of the degree of protein fractionation (31). Therefore, in our study, the rapid gastric emptying of semi-hydrolyzed soup maybe related to the low content fat and low density calorie liquid.

In our study, gastric volume was calculated using the formula developed from a prior study performed in a different patient population. Therefore, the result may differ from our patients' actual gastric volume.

However antral CSA in the soup group was smaller than in the formula group. Lionel Bouvet et

al. suggest interest in estimating that a single ultra sonographic measurement of the antral area could be of preoperative gastric contents status (32). Moreover, measurement of the antral area is simpler, even if probably less accurate, than the assessment of antropyloric volume. Hence, repeated measurements of antral area are widely used for assessing gastric emptying time in diabetic and dyspeptic patients and for clinical research in obstetrical anaesthesia (14, 33). However, the cut-off value of CSA probably varies according to the age and height of patients (34).

This study has several limitations. Firstly, gastric volume was calculated using the formula developed from a prior study performed in a different patient population. Second, the gastric ultrasound requires a certain amount of training periods to ensure the results of assessments. Thirdly, a considerable number of the patients in our study do not have the ability to answer questions themselves. Thus, there is a possibility of bias caused by the answering of the carers. Fourthly, there is also a possibility of sampling bias and participation bias as the sample does not represent older Vietnamese adults.

In conclusion, the oral function of the geriatric population is generally deficient with an elevated prevalence of tooth loss. The proportion of functional dyspepsia in older adults was fairly high, affecting the quality of patients' lives. Participants do not have large gastric volumes in fasting in all group. The faster gastric emptying for semi-hydrolyzed soup compared to non-hydrolyzed liquid and semi liquid signifies that gastric emptying may be dependent on nutrient content and density of liquid. The antral CSA after ingesting different liquid and semi-solid food are independent of the participants' functional dyspepsia.

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