



Dysphagia and Functional Limitations Among Adults in the United States: Findings from the 2022 National Health Interview Survey

Ickpyo Hong¹ · Rocío S. Norman² · Hee-Soon Woo³ · Yeonju Jin⁴ · Timothy A. Reistetter⁵

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Abstract

Dysphagia or swallowing dysfunction is associated with reduced quality of life and poor long term outcomes. While standard dysphagia treatment focuses on improving swallowing function, it is not clear if people with dysphagia also have difficulties performing daily tasks. This study aimed to determine if individuals with dysphagia had difficulties with participating in daily tasks requiring physical function, as compared to those with no dysphagia. We conducted a secondary data analysis using the responses of 24,107 adults aged 18 years or older who completed the 2022 National Health Interview Survey. The independent variable was report of swallowing problem during the past 12 months, and the dependent variables were report of difficulty in physical function tasks (e.g., self-care, mobility, working, social participation). We utilized propensity score methods to balance demographic and clinical variables between groups, and examined if individuals with dysphagia had more difficulties with the physical function tasks. The propensity score methods balanced the demographic and clinical variables (absolute standardized differences < 0.1). People with dysphagia had significantly higher odds ratios (ranged from 1.23 to 1.70, all $p < 0.05$) of having difficulties in physical function tasks than those without dysphagia. The findings revealed an association between experiencing dysphagia and encountering difficulties in self-care, mobility, working, and social participation in the general adult population in the US. Results of our study indicate that during the course of rehabilitation, healthcare professionals should consider the potential impact of dysphagia symptoms on clients' ability to partake in independent activities in their community settings.

Keywords Deglutition disorders · Activities of daily living · Mobility limitation · Health survey · Propensity score

Introduction

Dysphagia is a common medical condition, and approximately 1 in 25 adults reported having a swallowing problem in the United States (US) in 2012 [1]. Dysphagia often increases the risk of critical health conditions, such as pneumonia [2], malnutrition [3], poor long-term outcomes [4], disability and death [5]. Because of the high prevalence rate of dysphagia and the finding that unmanaged symptoms can impact the well-being of the US population, the majority of dysphagia research has focused on effective interventions [6].

In clinical settings, clinicians or healthcare professionals should consider the complete well-being of the patient, including both cognitive and physical status, when designing treatment interventions. Both clinical practice and research underscore the importance for speech-language pathologists

treating dysphagia to account for the patient's physical limitations in the plan of care [7–13]. For instance, Madhavan highlighted a close relationship between dysphagia and frailty, suggesting that physical frailty resulting from dysphagia might exacerbate cognitive decline in older adults [7]. While understanding the broad connections between dysphagia and frailty at a macro level is crucial in clinical settings, it is not still clear which specific physical limitations or daily activities are associated with dysphagia in the general adult population in the US. Establishing evidence regarding the link between dysphagia and limitations in activities of daily living would be a significant contribution to the literature. Furthermore, confirming the complicated relationship between dysphagia and individual physical limitations or daily tasks could be valuable within the scope of working with dysphagic patients. A feasible solution to address the current research gap is to compare people with and without dysphagia and determine if the two groups have differences completing various functional tasks (e.g., ADLs,

Extended author information available on the last page of the article

mobility, community participation). By elucidating those associations, clinicians can efficiently prioritize or coordinate dysphagia as well as other physical function-related interventions in their clinical settings.

The use of national panel surveys presents an opportunity to investigate these differences using robust study data sets. Comprehensive survey items related to dysphagia, demographics, and clinical information collected are readily available to researchers from a nationally representative sample [1, 14]. Typically, national panel surveys are based on the census sampling methods (e.g., 2-stage sampling) that allow national estimates of swallowing and communication disorders [15]. In 2012, the specific supplement related to voice, speech and swallowing problems in the National Health Interview Survey (NHIS) was used to determine the prevalence of dysphagia and voice problems among adults in the United States (US) [1, 14]. For instance, Bhattacharyya (2014) utilized the national survey and found that 9.4 million American adults reported experiencing a swallowing problem in 2012. In addition to the dysphagia-related survey items, the specific supplement includes demographic, lifestyle, physical function, chronic conditions, and healthcare service utilization information. In 2022, the NHIS included a dedicated section on voice and swallowing disorders again, similar to the one in the 2012 survey [15]. The NHIS dataset offers the potential to pursue research opportunities that identify associations between a history of dysphagia and the numerous social and clinical variables; however, to our knowledge, no studies have attempted to provide representative national estimates over the last decade.

One limitation of using this nationally representative dataset, however, lies in the ability to make comparisons between subgroups of individuals. For instance, a comparison of adults with dysphagia and adults without dysphagia could suffer from too many individual-level differences (e.g., demographics, health conditions, healthcare utilization) [16] that would make it difficult to interpret the data. In other words, the direct comparisons between the two groups could potentially result in biased estimations due to selection bias [17–19]. Alternatively, propensity score matching methods can sufficiently balance these group differences [17–19]. By accounting for the different individual-level characteristics between the two comparison groups, propensity score matching methods can mimic a randomized clinical trial [17–19].

Therefore, the study purpose was to: (1) balance the different individual-level characteristics between those with dysphagia and without dysphagia using propensity score matching approaches and (2) determine if individuals with dysphagia had difficulties in conducting various physical function-related daily tasks compared to those with no dysphagia using nationally representative adult samples. We hypothesized that (1) propensity score matching approaches

could sufficiently balance the various individual characteristics between the two comparison groups, and (2) the adults with dysphagia would have more difficulties conducting physical function-related daily tasks compared to those without dysphagia.

Methods

Study Data

The National Health Interview Survey (NHIS) is a household-based annual survey that collects health-related data from civilian noninstitutionalized individuals in the US [20]. The NHIS is sponsored by the US Centers for Disease Control and Prevention's National Centers for Health Statistics (<https://www.cdc.gov/nchs/nhis/index.htm>). This national survey has collected data annually since its beginning in 1957. While the core questionnaire of the NHIS is fairly consistent over the years, often various sets of questions are implemented to reveal current health topics. In 2022, the NHIS included a sample adult interview file section, called “VSL: Voice, Swallowing, Speech, and Language Communication Disorders.” This interview is the second largest scale survey that collected health information related to voice, speech, and swallowing from adults aged 18 and older [15].

This study was approved by the institutional review board of Yonsei University. The study data files are publicly available de-identified data sets that do not require consent from the study sample. This study adheres to all STROBE guidelines for reporting the study findings [21].

Participants

The 2022 NHIS dataset includes 27,651 adults. The cohort selection criteria were: (1) adults aged 18 years or older, and (2) the survey participants who completed the same adult interview questionnaire. The NHIS excluded individuals who are active duty military personnel, civilians living on military bases, living in long-term care institutions or correctional facilities [19]. Among the total survey participants in the 2022 NHIS, we excluded individuals who refused to answer the swallowing problem question, did not know or not ascertained about a swallowing problem ($n=1105$, 4.0%) or those with missing data on the demographics ($n=2097$, 7.6%) or clinical variables ($n=342$, 1.2%). This resulted in a total sample of 24,107.

Swallowing Problem

The primary independent variable was a swallowing problem question, “DURING THE PAST 12 MONTHS, did you

have problems or difficulty with SWALLOWING, such as having difficulty eating solid food, taking pills, or drinking liquids?”. This question was extracted from the sample adult interview file. The survey participants’ responses were collected by trained survey interviewers using face-to-face interviews in the respondent’s home.

Functional Measures: Self-Care, Mobility, and Social Participation

We used six survey items as measures of function: self-care, walking or climbing steps, walking 1/3 miles, walking up or down 12 steps, social participation, and working. The NHIS defined the self-care variable as “Do you have difficulty with self-care, such as washing all over or dressing?”. The mobility variables included (1) having difficulty walking or climbing steps, (2) having difficulty walking a third of a mile on level ground, and (3) difficulty walking up or down 12 steps. In addition, the social participation variable was defined as “Because of a physical, mental, or emotional condition, do you have difficulty participating in social activities such as visiting friends, attending clubs and meetings, or going to parties?”, and the limited work variable was defined as “Are you limited in the kind OR amount of work you can do because of a physical, mental or emotional problem?”. The responses of the functional measures were dichotomized (yes, no) for statistical analyses. We selected these survey items as functional measures because these daily task and mobility survey items have been shown to be valid measures of functional status for community-dwelling adults with other national datasets [22, 23].

Covariates

We included various characteristics as covariates, such as demographics, medical service utilization, chronic physical conditions, and psychological conditions to isolate their effect on functional measures and accurately estimate the relationship between a swallowing problem and function measures, including self-care, mobility, and social participation [24]. Demographics included age (continuous), sex (male, female), race (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, non-Hispanic all other race groups), Hispanic (Hispanic, non-Hispanic), educational attainment (less than high school, high school, college degree, greater than college degree), marital status or living arrangement (married, living with a partner together as an unmarried couple, neither), federal poverty level (less than 100%, 100–199%, 200–399%, greater than 400%) [15], body mass index (underweight, normal weight, overweight, obesity), a history of medical related activities during the past 12 months, including flu vaccine (yes, no), number of times in emergency room or department (0, 1, more than 2),

number of doctor’s office/clinic visit (0, 1, 2–3, 4 or more), time since last seen/talked to health professionals (less than 12 months, greater than 12 months).

Eight chronic conditions with dichotomous responses (yes, no) were included: hypertension, arthritis, asthma, cancer, diabetes, coronary heart disease, stroke, and chronic fatigue syndrome. One cognitive problem item (remembering or concentrating) and two psychological conditions (depression and anxiety) with dichotomous responses (yes, no) were also included. Finally, we included a self-reported health status survey item (poor, fair, good, very good, excellent) that demonstrates a good concordance with physical disability metrics [23, 25].

Statistical Analysis

We conducted univariate analyses to examine the differences between the two groups (adults with and without dysphagia) in the demographic and clinical variables. A Chi-square test was used for categorical variables, and the Wilcoxon rank-sum test was used for continuous variables.

We utilized propensity score matching with inverse probability of treatment weighting adjustment (PS-IPTW) to account for the different individual-level characteristics between the two comparison groups and mimic a randomized clinical trial [17–19]. We utilized the PS-IPTW approach to estimate the average treatment effect (ATE) and accurately compare the likelihood of having difficulty in functional measures between the two groups by minimizing the effects of confounding factors [18]. First, the propensity score was estimated from the likelihood of having a swallowing problem in a logistic regression model that accounted for the demographics and clinical variables (Table 1). We utilized the IPTW with the normalized weights method [17]. Next, we calculated absolute standardized differences in means of all covariates [19, 26] as a balance diagnostic to check if the distributions of demographics and clinical variables were balanced by the PS-IPTW method. We considered a value of less than 0.1 in absolute standardized differences in means for all covariates as a good match between the two comparison groups [27]. If any covariates were not balanced by the PS-IPTW method, we additionally controlled for these in the logistic regression models. In addition to the PS-IPTW method, we utilized a 1:1 greedy matching algorithm (1:1 PS matching) in case of severely skewed proportions of the comparison groups [17–19]. We conducted a series of individual logistic regression models with the PS-IPTW method and 1:1 PS matching method for the six function measures.

Lastly, using the logistic regression models, we examined the likelihood of reporting difficulty with one of the six individual function measures (dependent variables) between adults with a history of a swallowing problem

Table 1 Demographic and clinical characteristics between adults with a swallowing problem during the past 12 months and those who did not have the swallowing problem in 2022, *n* (%)

	Total N=24,107	Adults with Dysphagia N = 1578 (6.5)	Control N = 22,529 (93.5)	<i>p</i>	Absolute standardized differences in means	
					Before PS-IPTW	After PS-IPTW
Age yr, mean (SD)	53.4 (18.4)	55.7 (19.2)	53.3 (18.3)	<0.0001	0.129	0.020
Sex				<0.0001	0.110	0.013
Male	11,061 (45.9)	644 (40.8)	10,417 (46.2)			
Female	13,046 (54.1)	934 (59.2)	12,112 (53.8)			
Race				<0.0001	0.153	0.039
Non-Hispanic White	18,947 (78.6)	1328 (84.2)	17,619 (78.2)			
Non-Hispanic Black	2832 (11.8)	135 (8.6)	2697 (12.0)			
Asian	248 (1.0)	11 (0.7)	237 (1.1)			
Others	2080 (8.6)	104 (6.6)	1976 (8.8)			
Hispanic				0.0338	0.038	0.013
Hispanic	2290 (9.5)	126 (8.0)	2164 (9.6)			
Non-Hispanic	21,817 (90.5)	1452 (92.0)	20,365 (90.4)			
Educational attainment				0.0845	0.069	0.041
< High school	159 (7.3)	126 (8.0)	1633 (7.3)			
High school	5960 (24.7)	394 (25.0)	5566 (24.7)			
College degrees	12,598 (52.3)	844 (53.5)	11,754 (52.2)			
College degrees +	3790 (15.7)	214 (13.6)	3576 (15.9)			
Marital status				<0.0001	0.126	0.014
Married	11,290 (46.8)	649 (41.1)	10,641 (47.2)			
Living w/ a partner unmarried	1550 (6.4)	103 (6.5)	1447 (6.4)			
Neither	11,267 (46.7)	826 (52.3)	10,441 (46.3)			
Federal poverty level				<0.0001	0.269	0.033
< 100%	2234 (9.3)	246 (15.6)	1988 (8.8)			
100–199%	4045 (16.8)	326 (20.7)	3719 (16.5)			
200–399%	6920 (28.7)	438 (27.8)	6482 (28.8)			
400% +	10,908 (45.3)	568 (36.0)	10,340 (45.9)			
Body mass index				0.0004	0.061	0.006
Underweight	387 (1.6)	32 (2.0)	355 (1.6)			
Normal weight	7692 (31.9)	482 (30.5)	7210 (32.0)			
Overweight	8223 (34.1)	485 (30.7)	7738 (34.4)			
Obesity	7805 (32.4)	579 (36.7)	7226 (32.1)			
Flu vaccine (yes)	12,702 (52.7)	880 (55.8)	11,822 (52.5)	0.0113	0.066	0.006
ER visit				<0.0001	0.360	0.040
Never	19,254 (79.9)	1040 (65.9)	18,214 (80.9)			
1	3150 (13.1)	296 (18.8)	2854 (12.7)			
2+	1703 (7.1)	242 (15.3)	1461 (6.5)			
Doctor's office/clinic visit				<0.0001	0.248	0.087
Never	16,439 (68.2)	916 (58.1)	15,523 (68.9)			
1	4047 (16.8)	308 (19.5)	3739 (16.6)			
2–3	2782 (11.5)	252 (16.0)	2530 (11.2)			
4+	839 (3.5)	102 (6.5)	737 (3.3)			
Time since last visit				<0.0001	0.227	0.080
< 12 months	20,756 (86.1)	1440 (91.3)	19,316 (85.7)			
12 months +	3351 (13.9)	138 (8.8)	3213 (14.3)			
Self-rated health status				<0.0001	0.605	0.033
Poor	843 (3.5)	197 (12.5)	646 (2.9)			

Table 1 (continued)

	Total N = 24,107	Adults with Dysphagia N = 1578 (6.5)	Control N = 22,529 (93.5)	<i>p</i>	Absolute standardized differences in means	
					Before PS-IPTW	After PS-IPTW
Fair	2720 (11.3)	345 (21.9)	2375 (10.5)			
Good	7105 (29.5)	480 (30.4)	6625 (29.4)			
Very good	8446 (35.0)	418 (26.5)	8028 (35.6)			
Excellent	4993 (20.7)	138 (8.8)	4855 (21.6)			
Chronic conditions (yes)						
Hypertension	9015 (37.4)	750 (47.5)	8265 (36.7)	< 0.0001	0.221	0.006
Arthritis	6537 (27.1)	694 (44.0)	5843 (25.9)	< 0.0001	0.385	0.008
Asthma	3434 (14.2)	374 (23.7)	3060 (13.6)	< 0.0001	0.262	0.029
Cancer	3149 (13.1)	348 (22.1)	2801 (12.4)	< 0.0001	0.257	0.023
Diabetes	2573 (10.7)	231 (14.6)	2342 (10.4)	< 0.0001	0.129	0.015
Coronary heart disease	1546 (6.4)	194 (12.3)	1352 (6.0)	< 0.0001	0.220	0.001
Stroke	879 (3.7)	122 (7.7)	757 (3.4)	< 0.0001	0.192	0.010
Chronic fatigue syndrome	514 (2.1)	105 (6.7)	409 (1.8)	< 0.0001	0.242	0.022
Cognition problems (yes)						
Remembering/concentrating	5144 (21.3)	721 (45.7)	4423 (19.6)	< 0.0001	0.578	0.037
Psychological conditions (yes)						
Depression	4602 (19.1)	607 (38.5)	3995 (17.7)	< 0.0001	0.474	0.028
Anxiety	4292 (17.8)	546 (34.6)	3746 (16.6)	< 0.0001	0.421	0.042

PS-IPTW propensity score matching with inverse probability of treatment weighting, ER emergency room, SD standard deviation

during the past 12 months and those without the same swallowing problem (independent variable). We calculated the point estimate as an odds ratio (OR) and 95% confidence interval (CI) in each regression model with the PS-IPTW and 1:1 PS matching method. We utilized SAS statistical software version 9.4 (SAS Institute, Inc.) for all statistical analyses and data management. Statistical significance was considered as less than 0.05 with a 2-tailed test.

Results

Table 1 presents the demographic and clinical characteristics of the study sample. Among a total sample of 24,107 who have non-missing observations in the study variables, there were 1578 people (6.5%) with a swallowing problem during the past 12 months in the 2022 NHIS database. The majority of the sample was non-Hispanic white ($n = 18,947$, 78.6%), with a college degree ($n = 12,598$, 52.3%), married ($n = 11,290$, 46.8%), and federal poverty level greater than 400% ($n = 10,908$, 45.3%). In addition, the prevalent chronic conditions were hypertension ($n = 9015$, 37.4%), arthritis ($n = 6537$, 27.1%), and cognitive problems ($n = 5144$, 21.3%).

Propensity Score Approach

Before applying of the PS-IPTW method, the two groups showed statistically significant differences in 24 demographic and clinical characteristics, excluding educational attainment (all $p < 0.05$, Table 1). In addition, the absolute standardized differences in means of all covariates, except for Hispanic, education attainment, body mass index, and flu vaccine, were greater than 0.100 (range = 0.110–0.605) between the two groups, meaning that there could be effects of confounding factors when estimating odds ratios for having difficulty with function measures. However, those absolute standardized differences in means values for all covariates decreased to less than 0.100 (range = 0.001–0.087) with the PS-IPTW method (Table 1). In other words, all demographic and clinical variables were sufficiently balanced so that confounding bias was less likely between the two comparison groups.

Risk of having Limitations in Functional Measures

Table 2 presents the odds ratios for functional limitations of adults with a swallowing problem compared to the control group by accounting for the demographics and clinical variables with various adjustment methods, including the conventional multivariate logistic regression model,

Table 2 Risks of having difficulties in function measures in adults with and without a swallowing problem during the past 12 months in the 2022 NHIS database

Statistical model	Daily task	Mobility			Community-based tasks	
	Self-care OR (95% CI)	Walking/steps OR (95% CI)	Walking 1/3 miles OR (95% CI)	Walking 12 steps OR (95% CI)	Social participation OR (95% CI)	Working OR (95% CI)
Unadjusted	4.58 (3.94, 5.32)	3.29 (2.97, 3.65)	2.44 (2.14, 2.79)	2.49 (2.17, 2.85)	4.24 (3.78, 4.76)	3.23 (2.91, 3.59)
Multivariate regression	1.75 (1.46, 2.11)	1.69 (1.47, 1.96)	1.43 (1.21, 1.69)	1.36 (1.14, 1.61)	1.76 (1.52, 2.04)	1.52 (1.33, 1.74)
PS-IPTW	1.70 (1.42, 2.05)	1.44 (1.27, 1.63)	1.25 (1.06, 1.47)	1.26 (1.06, 1.49)	1.65 (1.43, 1.90)	1.37 (1.21, 1.56)
1:1 PS matching	1.66 (1.10, 2.52)	1.47 (1.23, 1.77)	1.37 (1.14, 1.65)	1.37 (1.13, 1.67)	1.47 (1.19, 1.81)	1.23 (1.03, 1.47)

OR odds ratio, CI confidence interval, PS-IPTW propensity score matching with inverse probability of treatment weighting

the PS-IPTW method, and a 1:1 PS matching method. The adults with a swallowing problem were more likely to have difficulty in the six functional measures compared to those who did not have a swallowing problem even after accounting for covariates.

In the two propensity score adjustment method results, including PS-IPTW and 1:1 PS matching, adults with dysphagia were at significantly higher odds of having difficulty with self-care (ORs ranged 1.66–1.70, all $p < 0.05$), walking or steps (ORs ranged 1.44–1.47, all $p < 0.05$), walking a third of a mile on level ground (ORs ranged 1.25–1.37, all $p < 0.05$), walking up or down 12 steps (ORs ranged 1.26–1.37, all $p < 0.05$), social participation (ORs ranged 1.47–1.65, all $p < 0.05$), and working (ORs ranged 1.23–1.37, all $p < 0.05$) than those without dysphagia. While the multivariate regression model demonstrated slightly higher odds ratios compared to the point estimates from the two propensity score matching methods, all results were statistically significant, indicating that the point estimates were robust across different adjustment models.

A sensitivity analysis was conducted with non-proxy respondents ($n = 23,697$). All study variables were balanced by the PS-IPTW method (absolute standardized mean differences < 0.1) and the point estimations did not change (ORs ranged from 1.26 to 1.74, all $p < 0.05$; Online Appendix Table 1), indicating that the results support the use of the proxy and non-proxy sample. We also accounted for the complex survey sampling weights, strata, and clusters to calculate population-based estimates. The point estimations and their significance level with the complex survey data sets did not change either (ORs ranged from 1.28 to 1.75, all $p < 0.05$; Online Appendix Table 2).

Discussion

The nationally representative survey data revealed that adults with a swallowing problem were more likely to have functional limitations in self-care, mobility, social participation, and work than those without a swallowing problem. In

this study, the subjects were the survey participants living in community settings. The findings indicate that adults with dysphagia could be at risk for experiencing functional limitations in their homes and living area social environments.

We utilized two different propensity score approaches to balance generic differences for people with and without dysphagia [16–19]. In this study, we controlled for demographics, chronic conditions, cognitive problems, health status, as well as healthcare utilization (Table 1). For instance, we controlled for ER visits and the time since the last visit to a hospital, which are proxies for general health status. We also controlled for self-rated health which is a sensitive indicator of morbidity and mortality [28]. In other words, the propensity score approach successfully balanced the known group differences except for the presence of dysphagia and mimicked a randomized clinical trial. These findings supported the study hypotheses. However, future clinical trials with true random group assignments are needed to validate the study findings.

In this study, a comparison of the chronic conditions between people with and without dysphagia clearly shows that those with dysphagia had substantively higher proportions of chronic conditions, cognitive problems, and psychological conditions. Regardless of the presence of dysphagia, the presence of any of these conditions could increase the likelihood that physical activities are impacted. To address this challenge, we utilized various statistical adjustment models, including conventional regression, PS-IPTW, and 1:1 PS matching. While there were slight variations in the point estimates, all study results were statistically significant, meaning that the point estimates were robust. In addition, in the case of the uneven proportion of adults with and without dysphagia, we mimicked a conventional clinical trial by using 1:1 PS matching [17–19] and the point estimates were also significant.

Interestingly, the adults with dysphagia also demonstrated a high odds ratio of having difficulties with social activities (i.e., social participation, working, or getting around for other purposes) that does not necessarily include the eating task. It is worthwhile to presume that accomplishing

social activities introduces a higher cognitive load on an individual than completing personal care. In other words, cognitive function could be a critical component in understanding the relationship between swallowing problems and being successful at completing daily tasks requiring high-level cognitive skills. While we utilized functional activities as primary outcome variables, a higher overall comorbidity burden could function as a mediator between dysphagia and physical function, meaning that it could contribute to more difficulty with functional activities. A future path analysis study would be needed to elucidate the potential indirect effect of dysphagia through comorbidity burden to physical function.

Falsetti and colleagues (2009) reported that swallowing problems correlate with poor functional status [29]. In addition, typically, instrumental activities of daily living tasks, like social participation and working, require physical and cognitive function to work in tandem. For instance, individuals require functional cognition, such as memory, orientation, calculation, executive function, and attention to successfully conduct a shopping task [30]. Jo et al. also reported that severity of dysphagia correlated with cognitive dysfunction [31].

Similarly, social participation has been associated with cognitive declines in memory and executive function [32, 33]. Our findings indicate that there was a significant association between swallowing problems and social participation. This finding couple with prior research [33] suggests a need to look more closely at cognition. Although we attempted to controlled for cognitive limitation with the NHIS remembering or concentration item, this variable likely did not capture the complexity between cognition, dysphagia and social participation. Even after balancing the difference in memory and cognitive problems between the two comparison groups, the adults with dysphagia still demonstrated a higher risk of having difficulty in community-based tasks suggesting the need to further examine social participation and cognition as a mediating variable for dysphagia.

The relationship between dysphagia and social participation could also be potentially influenced by the fact that many social events are often centered around eating meals. Previous studies have shown that adults with dysphagia may experience anxiety over attending social events surrounding mealtimes and dysphagia can impact swallowing-related quality of life [34, 35]. A study by Ekberg and colleagues found that over one-third of individuals with dysphagia reported avoiding eating with others because of their swallowing problems [35]. Social participation may also be influenced by the underlying cognitive issues identified in adults with dysphagia ($n=721$, 45.7%, Table 1). The finding indicate that healthcare professionals should take into account the patient's dysphagia, access to healthcare services, physical limitations in the home or community, and

potential cognitive deficits because dysphagia is frequently associated with cognitive deficits in the underlying diagnosis of people with dysphagia.

The results of our study have implications for patient-care and the management of swallowing disorders in the clinic and in rehabilitation settings. Our study sheds light on the functional consequences of swallowing disorders as it establishes a relationship between dysphagia and social participation and daily tasks. This relationship amplifies the need for proper monitoring and management of swallowing disorders as there are consequences beyond reduced nutritional intake. Furthermore, this study helps clinicians and medical providers understand that swallowing disorders impact self-care and social participation, and thus, this information will enable them to develop patient-centered goals that focus on life participation and community reintegration.

Limitations

The study had several limitations. First, the measurement of dysphagia was based on self-report only and did not include any type of clinical or instrumental assessments. For instance, a swallowing problem was identified when individuals experienced difficulty eating solid food, taking pills, or drinking liquids. However, this does not necessarily mean that the person has dysphagia. Many patients who don't have functional dysphagia may still report difficulty in taking pills. Similarly, although trained survey interviewers conducted face-to-face interviews in the respondent's home, it remains unclear whether the interviewers were able to confirm the presence of the presenting dysphagia.

Secondly, while we controlled for the survey questions regarding remembering or concentrating, we were not able to include other covariates that related to progressive neurologic conditions (e.g., multiple sclerosis [MS], dementia, or Parkinson's disease [PD]). The NHIS contains a study variable regarding dementia that specifically indicates Alzheimer's disease; however, there were only 291 (1.21%) survey participants who had this chronic condition. So, this variable was not utilized because it caused unstable and underpowered point estimates that led to biased study results. Similarly, the study finding would be more convincing if we compared differences in physical activities between those with and without dysphagia for the presence of complications such as pneumonia because this chronic condition is a well-known disease that can severely affect physical functioning and lead to loss of independence in daily tasks [36]. While the 2022 NHIS supplement did not include this disease, we controlled for several proxy variables for respiratory disorders, including flu shot history, asthma, and chronic fatigue syndrome.

Third, while we accounted for a number of covariates between the two groups, it was limited to available survey

items in the 2012 NHIS database. Advanced covariate adjustments (e.g., instrumental variable analysis) would be needed to minimize selection bias [37, 38]. In addition, our study was a cross-sectional design; therefore, an evaluation of causal relationships between dysphagia and functional limitations is limited. For instance, it is not clear that the swallowing disorders specifically impact self-care but rather persons with swallowing disorders have a higher incidence of physical limitations more related to the underlying medical diagnosis than is associated with the presenting dysphagia. Therefore, self-care may be impacted by the deficits from the underlying diagnosis and not necessarily the dysphagia. Therefore, prospective longitudinal cohort designs are needed to further validate our study findings.

This study has generic limitations with survey databases, such as (1) the study cohort is a subset of a larger subset so may not be truly representative, (2) the age group is young meaning that the study findings cannot be generalizable to the older population, (3) the ER/clinic visit variables do not provide a specific time frame of those events, and (4) a lack of reliable severity score for the comorbid conditions. Lastly, since the study findings were based on a cross-sectional design, clinicians should be aware that the association with functional ability may also be due to other underlying organic diseases (e.g., PD, arthritis, MS, etc.). For instance, approximately 80% of individuals with PD experience dysphagia [39], and 43% of those with MS also face this condition [40]. While we controlled for arthritis in the regression model, PD and MS were not part of the NHIS databases. Consequently, these significant chronic conditions were not accounted for in the study's point estimate.

Conclusion

Traditionally, dysphagia research has focused on testing the effectiveness of treatments for reducing swallowing problem symptoms or on developing accurate evaluation tools. However, individuals with swallowing problems could face limitations in areas aside from swallowing function. In this study, we found an association between experiencing swallowing problems and encountering difficulties in self-care, mobility, working, and social participation in the general adult population in the US. The etiology of swallowing problems is multifactorial and requires further study. Nonetheless, these findings suggest that healthcare professionals need to consider a comprehensive rehabilitation program that goes beyond swallowing problems to address patient-centered goals focused also on improving clients' function and participation in their community.

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Declarations

Conflict of interest The authors have no conflict of interest, including financial conflict to declare.

Ethical approval This study utilized publicly available de-identified data. This study has been reviewed and approved by the Institutional Review Board of Yonsei University.

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Ickpyo Hong PhD, OTR

Rocío S. Norman PhD, CCC-SLP

Hee-Soon Woo PhD

Yeonju Jin BS, OT

Timothy A. Reistetter PhD, OTR

Authors and Affiliations

Ickpyo Hong¹  · Rocío S. Norman²  · Hee-Soon Woo³  · Yeonju Jin⁴  · Timothy A. Reistetter⁵ 

✉ Hee-Soon Woo
otprime@wku.ac.kr

Ickpyo Hong
ihong@yonsei.ac.kr

Rocío S. Norman
NormanR@uthscsa.edu

Yeonju Jin
yjin1@yonsei.ac.kr

Timothy A. Reistetter
reistetter@uthscsa.edu

¹ Department of Occupational Therapy, College of Software and Digital Healthcare Convergence, Yonsei University, Wonju, Korea

² Department of Communication Sciences and Disorders, University of Texas Health Science Center San Antonio, San Antonio, TX, USA

³ Department of Occupational Therapy, Wonkwang University, Iksan, Korea

⁴ Graduate School, Yonsei University, Wonju, Korea

⁵ Department of Occupational Therapy, University of Texas Health Science Center San Antonio, San Antonio, TX, USA