

Awareness of Dysphagia in Hospitalized Patients and Its Impact

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Research Article

Keywords: dysphagia, swallowing disorder, water swallow test, aspiration pneumonia

Posted Date: March 23rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-318340/v1>

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Abstract

Background and aims: Acute illness might affect the swallowing function. However, there have been limited studies regarding dysphagia awareness in hospitalized patients, factors associated with dysphagia, and its outcomes.

Methods: Consecutive patients in an internal medicine ward whom primary physicians prescribed oral diet were prospectively evaluated their swallowing problems by using a water swallow test (WST) and swallowing disturbance questionnaire (SDQ) within 48 hours after admission. Patients characteristics, nutritional status, readmission, and mortality rates were evaluated and compared between patients with and without impaired swallowing.

Results: Among 131 enrolled patients (61 males, mean age 58 ± 21 years), 20 patients (15.3%) had abnormal SDQ and 38 patients (29%) had abnormal WST. 19/20 patients with abnormal SDQ had abnormal WST while 19/38 patients with abnormal WST (50.0%) had abnormal SDQ. Patients with swallowing problems by either abnormal SDQ or WST were significantly older than those without ($p < 0.05$). After adjusting for age, underlying neurological disorders (OR 2.96, 95%CI 1.03-8.47; $p = 0.04$), admission diagnosis of pneumonia (OR 5.29, 95%CI 1.47-19.0, $p = 0.01$), and moderate-to-severe malnutrition (OR 4.14, 95%CI 1.67-10.3, $p = 0.002$) were significantly associated with abnormal WST, while malnutrition (OR 9.88, 95%CI 2.36-41.4; $p = 0.002$) was independently associated with abnormal SDQ. For the follow-up period of 14 months, five patients (26.3%) who had abnormal SDQ/WST had aspiration pneumonia and 2 of them died while one patient with normal SDQ and WST (0.9%) had aspiration pneumonia ($p < 0.001$).

Conclusion: Dysphagia is an underrecognized problem in hospitalized patients. This problem was associated with underlying neurological diseases, malnutrition, the current diagnosis, and readmission due to pneumonia. Screening for dysphagia is recommended in hospitalized patients, particularly in patients at risk.

Introduction

Dysphagia is a common problem with a prevalence of about 1 of 25 adult population in the community.¹ This problem has a significant impact as 25-32% of the affected non-elderly population reported the severity of the problem to be moderate to severe and associated with work abstinence.¹ In community-dwelling adults, the older population age >50 years has a higher prevalence of dysphagia (15-22%) than the younger (6-9%).² Moreover, the elders with dysphagia have higher morbidity from aspiration pneumonia and a higher 30-day mortality rate after admission than those without.³ In addition to age, hospital admission from acute illness can contribute to the presence of dysphagia at approximately 30% evaluated by validated screening questionnaires and volume-viscosity swallowing tests.⁴ Swallowing problems can result in malnutrition and lower respiratory tract infection from aspiration.⁵ On the other hand, malnutrition might also be a cause of swallowing problems as it affects swallowing muscle strength and endurance.⁶ Until now, there have been limited studies regarding the awareness of swallowing problem in hospitalized patients, factors associated with dysphagia, and the outcomes of this problem.^{7, 8}

In this study we planned to 1) investigate the prevalence of abnormal swallowing in patients who were admitted in the hospital and were allowed to have oral feeding using the swallowing disturbance questionnaire (SDQ) and water swallow test (WST) and 2) to evaluate the association between clinical characteristics, short and long-term clinical outcome and SDQ and WST results.

Patients And Methods

The study was conducted in a single tertiary care center (King Chulalongkorn Memorial Hospital, Bangkok, Thailand) in one non-critical general internal medicine ward between September 2018 and April 2020. The inclusion criteria were hospitalized patients whom primary physicians allowed an oral diet. All investigators did not involve in taking care of the patients. Patients completed the SDQ and underwent WST within 48 hours after admission. The exclusion criteria were inability to communicate, unstable vital signs at the time of WST (unstable blood pressure, the respiratory rate of more than 30 breaths per minute, oxygen saturation less than 92%), and concurrent nasogastric, gastrostomy, jejunostomy tube. Nutritional status was evaluated using subjective global assessment (SGA) and nutrition alert form (NAF). The patients' demographic data and nutritional status were analyzed to determine factors associated with abnormal SDQ or abnormal WST during hospitalization. The 30-day readmission and mortality rates were also prospectively evaluated and compared between patients with and without abnormal SDQ or abnormal WST. Admission for elective surgery or prepared procedure or trauma were not included in the readmission rate.

The study was approved by the Ethics Committee of Faculty of Medicine, Chulalongkorn University, Thailand, and was conducted according to the good clinical practice guideline, as well as the Declaration of Helsinki. Written informed consent was obtained from all study participants.

Swallowing Disturbances Questionnaire (SDQ)

SDQ was firstly developed and validated for screening dysphagia in patients with Parkinson's disease.⁹ It was then validated in patients with different diagnoses such as neurologic disorders, gastrointestinal diseases, head and neck cancer.¹⁰ There are 15 questions in the questionnaire. Question numbers 1 to 14 were rated by a score from 0 to 3 which were ranged by frequency of symptoms during the past month. The first five questions evaluated the oral phase of swallowing and the next nine questions evaluated the pharyngeal phase of swallowing. Question number 15 regarding previous respiratory infection during the past year was a yes-no question. The investigators asked patients all the questions and recorded all the answers. Abnormal SDQ in this study was defined as a score equal to or more than 11 because of higher sensitivity and specificity although it was performed in patients with Parkinson's disease.⁹ This cut-point has been studied to be associated with an abnormal fiberoptic endoscopic evaluation of swallowing (FEES).

Water swallow test (WST)

WST used in this research was trials of progressive increasing volumes of water. At the beginning, baseline oxygen saturation was measured by pulse oximeter then a patient was asked to sip 5 ml of water. Clinical and oxygen saturation was then recorded during the one-minute after the first drinking and the test was recorded as passed or not passed. A patient was then asked to sip consecutive 5 ml three times and the last 50 ml of water. Oxygen saturation was measured 1 minute after each time the patient had finished drinking the water. The

abnormal test was defined as having either choking, coughing, voice changing, breathing difficulty, inability to swallow the total amount of water, or a decrease of oxygen saturation at least 2% from baseline at any of 5 mL or 50 mL of water swallow test.^{11, 12}

Nutritional assessment

The Subjective Global Assessment (SGA) was used for evaluating nutritional status based on history and physical examination.¹³ The patient's history included dietary intake change, weight change, gastrointestinal symptoms, functional capacity, and metabolic requirements. Physical examination comprised loss of subcutaneous fat, muscle wasting at quadriceps and deltoids, edema at ankles and sacral area, and presence of ascites. SGA was categorized into 3 classes: well-nourished (SGA A), moderately malnourished (SGA B), and severely malnourished (SGA C).

The Nutrition Alert Form (NAF) was a nutritional assessment tool modified from SGA. The NAF was validated in Thai hospitalized patients.¹⁴ Level of serum albumin and total lymphocyte count associated with malnutrition were added in the assessment for calculating NAF score instead of weight and height if not available. NAF is easy to use because of the exclusion of physical signs indicating the state of malnutrition which requires evaluation by trained personnel. A score is classified into 3 groups. Scores of 0-5 (NAF A) indicate normal to mild malnutrition. Scores of 6-10 (NAF B) define moderate malnutrition. Scores of 11 or more (NAF C) indicate severe malnutrition.

In this study, the investigators asked patients all the questions in SGA and NAF and recorded all the answers both from patients and medical records within 48 hours after admission.

Statistical analysis

All data were analyzed by SPSS for Windows version 22.0 (SPSS Inc., Chicago, IL, USA). Demographic characteristics were presented as frequency, mean, standard deviation (SD), percentage, maximal, and minimal values as appropriate. The association between dysphagia and malnutrition as well as readmission rate were analyzed. The sample size was calculated based on achieving 80% power and dysphagia as a primary outcome.

Results

Consecutive 131 patients who were admitted to one non-critical care internal medicine ward were enrolled in the study. The patients' mean age was 57.6 ± 20.9 (range 18-92) years and 61 patients were males (46.6%). The median of hospital stay was 7 days (range 1-148 days). The most common comorbidity was hypertension (35.9%). Twenty-six patients (19.8%) had neurological disorders consisted of cerebrovascular diseases, dementia, Parkinson's disease, epilepsy, brain tumors, encephalitis, and chronic pachymeningitis. Twenty patients (15.3%) had cancer (lung cancer 4 patients (3.1%), no head and neck, or esophageal cancer). There were 15 patients (11.5%) without underlying disease. The most common diagnosis at admission was infection (57 patients, 43.5%) including infection of the respiratory tract, gastrointestinal tract (acute gastroenteritis), skin and soft tissue, and urinary tract. Of these, 22 patients had respiratory tract infections [pneumonia 17 patients (77.3%), tracheobronchitis/infected bronchiectasis 4 patients (18.2%), and lung abscess 1 patient (4.5%)].

Before admission, 76.3 % of the patients had a regular diet and 23.7 % had a soft diet (23.7%). Oral feedings were allowed in all patients by primary physicians.

Swallowing disturbance questionnaire and water swallow test results

All patients completed SDQ and underwent the WST within 48 hours after their admission. Twenty patients (15.3%) had abnormal SDQ and 38 patients (29%) had abnormal WST. Ninety-five percent (19 patients) of those who had abnormal SDQ had abnormal WST. On the contrary, of 38 patients with abnormal WST, only 19 patients (50.0%) had abnormal SDQ. Probability of agreement between WST and SDQ results was moderate (Kappa of 0.569, $p < 0.001$).

The SDQ results showed that 85% (17 patients) of the patients with abnormal SDQ had both oral and pharyngeal phases affected, while 3 patients (15%) had predominantly affected the pharyngeal phase. There were 7 patients (35%) having previous respiratory tract infections including bronchitis and pneumonia during the past year.

Regarding WST results, after drinking the 1st, 2nd, 3rd time of 5 ml of water, and the last 50 ml of water, there were 7 (5.3%), 4 (3.2%), 6 (5.0%), and 21 (18.4%) patients who were unable to pass the test, respectively. The abnormal clinical findings during the WST were coughing (31.9%), unable to swallow 5 ml of water or unable to finish 50 ml of water within 1 minute (31.6%), voice change (23.7%), and choking (13.2%). In addition to a physical change after swallowing water, objective data including oxygen saturation were monitored. The mean oxygen saturation at the beginning of the test measured from pulse oximetry was 98 ± 2 %. A decline in oxygen saturation of $\geq 2\%$, which was implied as a marker for aspiration, was shown in 84.2% (32/38 patients) of patients with abnormal water swallow tests. All patients who had desaturation had either choking, coughing, voice changing, or unable to swallow. Interestingly, 11 (91.7%) out of 12 patients who were unable to swallow 5 mL of water or finish drinking 50 ml of water had desaturation of $\geq 2\%$ without choking, coughing, or voice changing and were described as silent aspirators.

Clinical characteristics of the patients with abnormal SDQ and abnormal WST

The demographic characteristics, clinical features and nutritional status comparing between patients with abnormal SDQ, abnormal WST, normal SDQ, and normal WST were demonstrated in table 1. Patients who had abnormal SDQ or abnormal WST were significantly older and had higher prevalence of neurological disorders as the pre-existing condition than those without ($p < 0.05$). The nutritional status that was evaluated by using SGA and NAF within 48 hours after admission showed that patients with abnormal SDQ or WST had higher prevalence of malnutrition defined by SGA class B or C more than those with normal SDQ or WST. The result was also similar to the nutritional status assessed by NAF (both $p < 0.001$). Current diagnosis of pneumonia and aspiration pneumonia were more common in patients with abnormal SDQ or WST ($p < 0.05$). In addition, length of stay in patients with abnormal swallowing was significantly longer than those without ($p < 0.05$). Patients with only abnormal WST but normal SDQ had lower prevalence of moderate to severe malnutrition (SGA B/C) than patients with abnormal both WST and SDQ (52.6% (10/19) vs. 84.2% (16/19), $p = 0.04$) whereas age, comorbidities, and length of stay were not significantly different between groups ($p > 0.05$).

In univariate analysis, factors associated with abnormal SDQ and abnormal WST were age >70 years, pre-existing neurological disorders, cancer, current diagnosis of pneumonia, and moderate to severe malnutrition ($p < 0.05$). Logistic regression analysis after adjusted by age and gender showed that moderate to severe malnutrition (SGA class B/C) (OR 9.88, 95%CI 2.36-41.4; $p = 0.002$) were independently associated with abnormal SDQ, while underlying neurological disorders (OR 2.96, 95%CI 1.03-8.47; $p = 0.04$), admission diagnosis of pneumonia (OR 5.29, 95%CI 1.47-19.0, $p = 0.01$), and moderate to severe malnutrition (OR 4.14, 95%CI 1.67-10.3, $p = 0.002$) were independently associated with abnormal WST. (Table 2)

Short and long-term clinical outcomes of abnormal SDQ or abnormal WST

After discharge from the hospital, 116/129 patients (89.9%) were followed for at least 30 days and 92/129 patients (71.3%) had long-term follow-up for the median time of 14 months (IQR = 11-15 months). The possible impacts of abnormal SDQ and WST including aspiration pneumonia, readmission, and mortality were evaluated.

Aspiration pneumonia

For the whole study period, there were 9 of 131 patients had aspiration pneumonia and two of them died from this condition. Among 9 patients who had aspiration pneumonia, 6 of them had abnormal both SDQ and WST, 2 had abnormal WST but normal SDQ, and 1 patient had normal SDQ and WST at baseline admission. The prevalence of aspiration pneumonia during admission and the follow-up period among patients with either abnormal SDQ or WST was significantly higher than those with normal SDQ and WST [20.5% (8/39) vs. 1.1% (1/92), $p < 0.001$].

Mortality and readmission

Two patients died during the admission. One patient had advanced-stage mesothelioma with vocal cord paralysis developed aspiration pneumonia and died at 23 days after admission. This patient had abnormal both SDQ and WST. The other one had recurrent sigmoid cancer with liver metastasis died at 10 days after admission due to septic shock. This patient had normal both SDQ and WST.

No patients died within 30 days after discharge while 11 patients (10.7%) died during long-term follow-up [abnormal both SDQ and WST ($n=2$), normal both SDQ and WST ($n=9$)]. The all-cause mortality rate during admission and long-term mortality in the follow-up patients with either abnormal SDQ or WST were not different from the normal both SDQ and WST group (admission 1/39 (2.6%) vs. 1/92 (1.1%), long-term 2/30 (6.7%) vs. 9/73 (12.3%), abnormal SDQ/WST vs. normal SDQ and WST, respectively, both p -value > 0.05).

The 30-day readmission rate was 9.5% [11/116 patients; abnormal both SDQ and WST ($n=2$), abnormal WST but normal SDQ ($n=1$), normal SDQ and WST ($n=8$)] while long-term readmission rate was 36.9% [38/103 patients; abnormal both SDQ and WST ($n=8$), abnormal WST but normal SDQ ($n=4$), normal both SDQ and WST ($n=26$)]. The long-term readmission rate in the follow-up patients with either abnormal SDQ or WST were higher than the normal both SDQ and WST group but it did not reach statistical significance (40% vs 35.6%, $p=0.68$), while the 30-day readmission rates were comparable between groups (8.8% vs 9.8%, $p=1.00$).

SDQ versus WST for dysphagia screening in hospitalized patients

We further performed the ROC curve between SDQ score and abnormal WST and demonstrated the optimal SDQ score of ≥ 3 to predict abnormal WST with sensitivity and specificity of 89.5% and 83.9%, respectively (AUC = 0.936). Also, we performed subgroup analysis to evaluate using SDQ of ≥ 3 as the screening test in the hospitalized patients to predict aspiration pneumonia. We found that patients who had SDQ ≥ 3 had 15.8 times (95%CI 1.91-130.69) as likely to have an aspiration pneumonia during the whole period of follow-up than those with SDQ < 3 ($p=0.01$), whereas patients with abnormal WST had 24.5 times (95%CI 2.95-204.25) as likely to have an aspiration pneumonia during the whole period of follow-up than those without ($p=0.003$).

Discussion

This study showed that the swallowing problem in hospitalized patients is underrecognized. Among patients who were clinically stable and allowed to take oral diet by primary physicians, 15% of them had abnormal SDQ and 29% had abnormal WST. Patients with abnormal SDQ or WST were associated with malnutrition and higher rate of aspiration pneumonia. Moreover, about 90% of patients who had abnormal WST also had oxygen desaturation during the swallowing tests which suggests the evidence of significant aspiration. Pre-existing neurological diseases and malnutrition were independently associated with impaired swallowing after adjusted by age.

Symptoms suggestive of swallowing problems are variable such as inability to initiate swallowing, choking, coughing, drooling, hoarseness of voice, nasal regurgitation during swallowing, and repeatedly swallow to clear food from the pharynx.² Some of these symptoms are non-specific and might lead to under-recognition of swallowing problems particularly in hospitalized patients who had other primary diagnosis to be focused on. This study showed that patients with swallowing problems detected by SDQ or WST were significantly older than those with normal swallowing tests and those with age over 70 years had increase chance of having impaired swallowing for 2.3-3.3 times. Physiological changes such as slow swallow reflexes, weakened and lower endurance of the muscles involved in the swallowing process, a decrease in saliva, taste, and smell acuity in the elderly make dysphagia occurs more common than the younger age and may deteriorate during the acute illness.¹⁵ Our study showed that patients with neurological disorders had approximately 3 times more likely to have dysphagia. The result was similar to the other study showing that dementia and cerebrovascular diseases were at a higher risk of developing swallowing problems than other diseases.^{12, 13} Also, the neurological conditions of these patients probably worsened during acute illness and uncovered their dysphagia.

Dysphagia screening tests including SDQ and WST were performed in all patients in this study. Nowadays, various protocols of water swallow tests to detect dysphagia has been reported. The systematic review and meta-analysis revealed that progressive challenges in a volume of WST had high pooled sensitivity and specificity of 86% (95%CI 76-93) and 65% (95%CI 57-73), respectively by using either videofluoroscopy (VFSS) or fiberoptic endoscopic evaluation of swallowing (FEES) as a gold standard.¹² This study showed that the last 50-ml water swallow could detect as high as 55% while 5-mL water swallow could detect 45% of all patients with failed WST. However, it is more secure to swallow 3 sips of 5-ml water before taking a last 50-ml sip because the test can promptly be terminated whenever the abnormal result is shown.¹² This study also demonstrated the advantage of using a decline in oxygen saturation during the WST as one of the parameters to suggest the evidence of aspiration. About 90% of patients who had abnormal WST had oxygen desaturation and the desaturation in this study only occurred in patients with abnormal WST. More than 90% of patients who

could not swallow 5 ml of water or could not finish 50 ml of water within 1 minute had the only desaturation observed without any other physical change. Therefore, the desaturation might help us detect a silent aspiration.

The prevalence of either having abnormal swallowing questionnaires or abnormal WST in patients with acute illness who were allowed to have an oral diet in this study was comparable to other studies (25.3-30.7%).^{4,16} Although dysphagia screening tools were different between these studies, all of the reported tools have a good relationship with an established imaging study such as the FEES and VFSS as the gold standard. The prevalence of having abnormal WST (29%) was higher than abnormal SDQ (15.3%) in this study. These findings might be explained as the SDQ is used to evaluate the swallowing problem during the past month while WST is used to evaluate the current swallowing problem. The patients with underlying neurological conditions were independently associated with abnormal WST but not abnormal SDQ. Patients might have no or compensated swallowing problems before the admission and dysphagia just uncovered or decompensated with acute illness. So, WST could detect more patients with impaired swallowing during hospitalization than the SDQ. The previous study defined abnormal SDQ as a score equal or more than 11 with a sensitivity of 80.5%, and specificity of 81.3% using FEES as a gold standard test.⁹ The other study showed slightly lower sensitivity (79.7%) and specificity (73%) of SDQ compared to FEES at a cut-off score of 12.5.¹⁰ The SDQ score of 11 was used as a cut-off point in this study although it has been reported in the out-patient setting.^{9,10} When both SDQ and WST were used in this study, nearly all the patients with SDQ score > 11 had impaired swallowing detected by WST. We further performed the ROC curve between SDQ score and abnormal WST and demonstrated the optimal SDQ score of ≥ 3 to predict abnormal WST with a high sensitivity and specificity. The patients who had abnormal SDQ with this lower cut-off were associated with a high incidence of aspiration pneumonia during follow-up period. This finding suggests that SDQ with the cut-off at 3 can be used for dysphagia screening in acute illness-hospitalized patients and should be managed as the patients with abnormal WST.

The SGA and NAF class B and C representing moderate-to-severe malnutrition were significantly associated with patients with impaired swallowing, whereas patients without swallowing problems detected more likely had normal-to-mild malnutrition. The result was consistent with the previous study using geriatric nutritional risk index and another study using mini nutritional assessment as nutritional assessment tools.^{5,7} NAF demonstrated the higher prevalence of moderate to severe degree of malnutrition than SGA in this study might be from the highly-detailed scoring about comorbidities, food accessibility and patients' symptoms of NAF. As our study has displayed a significant association between malnutrition and impaired swallowing function, dysphagia screening test(s) are recommended in malnourished patients.

This study has several limitations. First, other diagnostic tests such as VFSS or FEES to evaluate the diagnostic accuracy of SDQ and WST were not performed. Swallowing studies including VFSS, FEES, pharyngeal manometry, and esophageal manometry not only provide a definitive diagnosis of swallowing disorders but also provide mechanistic insight and guide the treatment. Second, whether there is a progression or improvement of dysphagia is not known as we did not reevaluate the swallowing problem before discharge from the hospital. Reevaluation of swallowing function when acute illness improves to select an appropriate route of feeding and plan home program to prevent aspiration in patients with abnormal swallowing is suggested.

In conclusion, dysphagia is an underrecognized problem in hospitalized patients. This problem was associated with underlying neurological diseases, malnutrition, the current diagnosis, and readmission due to pneumonia. Swallowing screening tests including SDQ and WST are useful in hospitalized patients with acute illnesses to determine abnormal swallowing and the risk of aspiration.

Declarations

Author contributions

Conceptualization, T.P., N.L., and S.G.; investigation, N.A.; resources, T.P., and S.G.; data curation, N.A., T.P., N.L., and S.G.; writing draft, N.A.; review and editing, N.A., T.P., N.L., and S.G.; supervision, T.P., N.L., and S.G. All authors have revised the manuscript and approved the final version.

Competing interests

All authors have no competing interests as defined by Nature Research, or other interests that might be perceived to influence the results and/or discussion reported in this paper.

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Tables

Table 1. The demographic characteristics, clinical features and nutritional status comparing between patients with abnormal SDQ/WST and patients with normal SDQ/WST

	SDQ		WST	
	Abnormal	Normal	Abnormal	Normal
	N=20	N=111	N=38	N=93
Males, n(%)	11 (55%)	50 (45%)	19 (50%)	42 (45.2%)
Age, years	66 ± 22*	56 ± 21*	66 ± 20*	54 ± 20*
BMI (kg/m ²)	21 ± 4	23 ± 5	21 ± 4	23 ± 5
Underlying diseases				
Hypertension	9 (45%)	38 (34.2%)	18 (47.4%)	29 (31.2%)
Dyslipidemia	4 (20%)	33 (29.7%)	13 (34.2%)	24 (25.8%)
Diabetes mellitus	4 (20%)	28 (25.2%)	9 (23.7%)	23 (24.7%)
Neurological disorders	9 (45%)*	17 (15.3%)	13 (34.2%)*	13 (14.0%)
Cancer	6 (30%)	14 (12.6%)	10 (26.3%)*	10 (10.8%)
Chronic lung and airway diseases	4 (20%)	10 (9.0%)	6 (15.8%)	8 (8.6%)
Current diagnosis of pneumonia	7 (35%)*	10 (9%)	11 (28.9%)*	6 (6.5%)
Current diagnosis of aspiration pneumonia	5 (25%)*	2 (1.8%)	7 (18.4%)*	0 (0%)
Malnutrition				
SGA B and C	17 (85%)*	36 (32.4%)	26 (68.4%)*	27 (29%)
NAF B and C	18 (90%)*	54 (48.6%)	32 (84.2%)*	40 (43%)
Median length of stay (days, IQR)	9.5 (7-18)*	6 (3-11)	9 (5-15)*	5 (3-10)
Readmission rate				
30-day	2 (10.5%)	9 (9.3%)	3 (9.1%)	8 (9.6%)
Long-term	6 (33.3%)	14 (16.5%)	9 (31%)	11 (14.9%)
Mortality rate				
30-day	1 (5%)	1 (1%)	1 (2.9%)	1 (1.2%)
Long-term	2 (11.1%)	9 (10.6%)	2 (6.9%)	9 (12.2%)

*p <0.05 abnormal SDQ vs. normal SDQ; abnormal WST vs. normal WST

Table 2. Factors associated with abnormal SDQ and abnormal WST

Variables	SDQ				WST			
	Unadjusted OR	p-value	Adjusted OR	p-value	Unadjusted OR	p-value	Adjusted OR	p-value
	(95% CI)		(95% CI)		(95% CI)		(95% CI)	
Age >70 years	3.30 (1.24-8.75)	0.02	1.82 (0.53-6.30)	0.34	2.33 (1.06-5.13)	0.04	1.12 (0.42-2.99)	0.82
Male gender	1.49 (0.57-3.88)	0.41	2.54 (0.77-8.38)	0.13	1.21 (0.57-2.59)	0.62	1.66 (0.67-4.06)	0.27
Body mass index (BMI)	0.90 (0.78-1.03)	0.11			0.92 (0.83-1.01)	0.09		
Comorbidities								
Diabetes mellitus	0.74 (0.23-2.40)	0.62			0.95 (0.39-2.29)	0.90		
Neurological disorders	4.52 (1.63-12.56)	0.004	3.46 (0.96-12.4)	0.07	3.20 (1.31-7.80)	0.01	2.96 (1.03-8.47)	0.04
Cardiovascular diseases	1.46 (0.37-5.71)	0.05		0.57	1.75 (0.58-5.31)	0.03		0.22
Cancer	2.97 (0.98-9.00)	0.15	1.54 (0.35-6.80)		2.96 (1.12-7.86)	0.23	2.15 (0.63-7.40)	
Chronic lung & airway disease	2.53 (0.71-9.03)	0.34			1.99 (0.64-6.19)	0.17		
None	0.37 (0.05-2.94)				0.34 (0.07-1.59)			
Current diagnosis of pneumonia	5.44 (1.77-16.76)	0.003	3.75 (0.90-15.7)	0.07	5.91 (2.00-17.47)	0.001	5.29 (1.47-19.0)	0.01
Nutritional status								
SGA class B and C	11.8 (3.25-42.89)	<0.001	9.88 (2.36-41.4)	0.002	5.30 (2.34-12.00)	<0.001	4.14 (1.67-10.3)	0.002

Figures

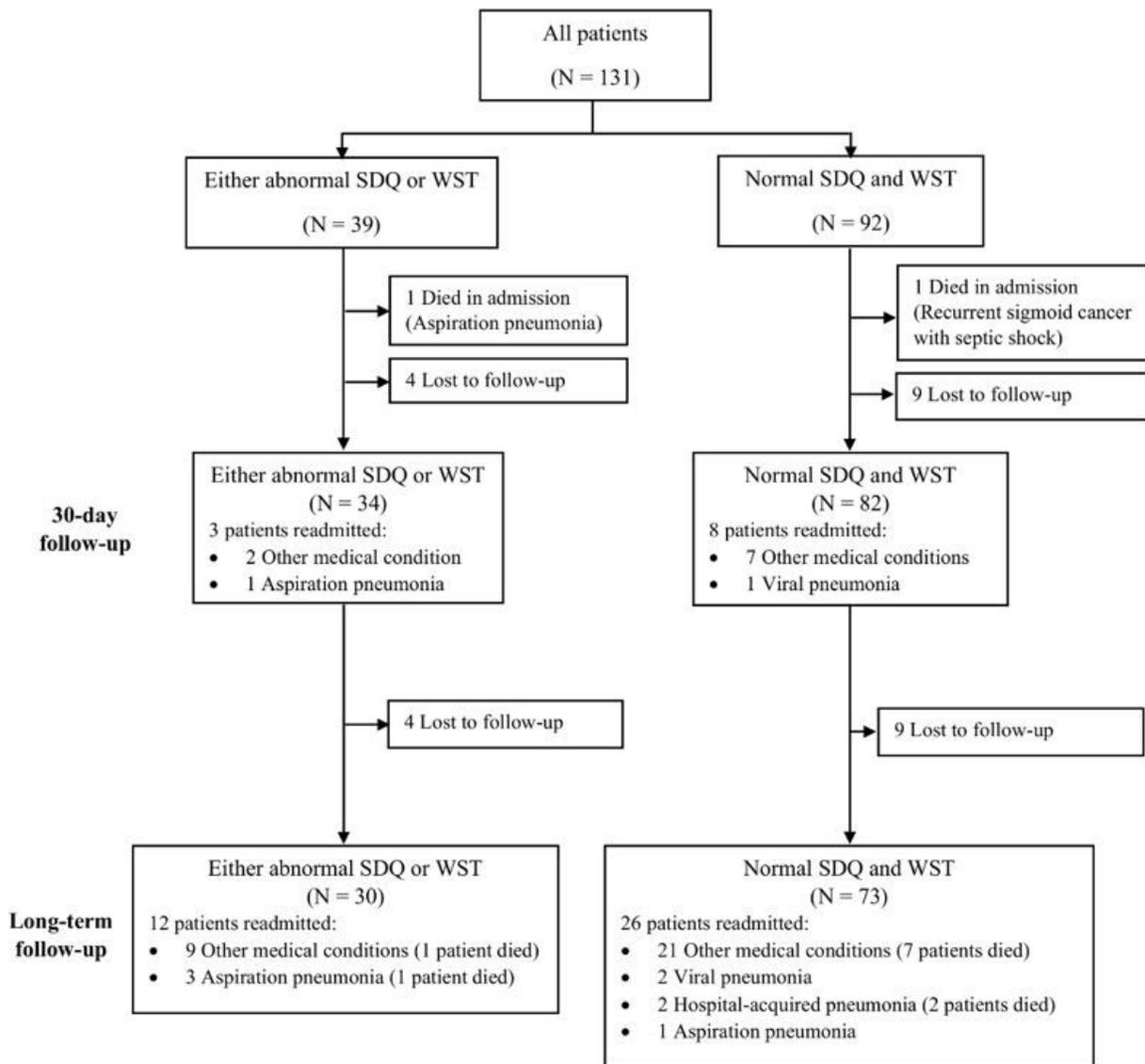


Figure 1

The follow-up data of all enrolled patients.