Influences of Dysphagia on the Prognosis of Chinese Elderly Inpatients: a Prospective Cohort Study

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Abstract

The increasing incidence of dysphagia may pose threats to the health of older patients. The aim of this study was to investigate the adverse influences of dysphagia on the prognosis of older Chinese inpatients. A total of 290 older inpatients with different swallowing functions were involved in this study through group sampling from the geriatric centre of a 3A-level hospital in China. Among them, 125 patients (43.1%) had dysphagia at admission. Based on a cross-sectional investigation, a prospective cohort study was conducted to investigate the incidence of complications, readmission, and death during 6 months of follow-up. A total of 34 patients (11.7%) died, and the remaining 256 patients (88.3%) were investigated concerning their complications. There was a higher prevalence of death among the older patients with dysphagia (15.6% vs 7.9%, $RR = 2.361$). In terms of complications, older patients with dysphagia were more likely to develop malnutrition (29.8% vs 5.9%, $RR = 6.747$) and aspiration pneumonia (34.6% vs 11.2%, $RR = 4.204$). Furthermore, multi-factor analysis demonstrated that dysphagia was an independent predictor of malnutrition and aspiration pneumonia but not an independent predictor of death. In conclusion, dysphagia was proven to be an independent predictor of a poor outcome of Chinese elderly inpatients. Specific clinical management and nursing interventions are recommended to prevent the potential adverse influences of dysphagia.

1. Introduction

With the growth of the older population in China, the incidence of geriatric syndromes that are harmful to health and life safety is continuously increasing, such as pressure sores and dysphagia [1, 2]. For example, by investigating 4038 elderly patients, Leder and Suiter [3] demonstrated that 37.7% of patients over 60 years old have dysphagia.

Dysphagia refers to a disorder of food or liquid transportation from the mouth to the stomach [2, 4, 5]. It can cause various complications, such as aspiration pneumonia, malnutrition, and even asphyxia [6]. In recent years, increasing attention has been given to dysphagia in elderly patients due to the necessity of avoiding these adverse outcomes.

Aspiration pneumonia is reported to be one of the most common complications of dysphagia [7]. For instance, a Singapore follow-up study [8] showed that dysphagia increased the incidence of chest infection. However, other simultaneous factors, such as food reflux from the stomach and saliva containing pathogenic bacteria, may also lead to aspiration pneumonia [9, 10]. Further exploration is needed to determine whether dysphagia is an independent risk factor for aspiration pneumonia.

In terms of nutrition, dysphagia can lead to malnutrition by affecting the normal diet and nutritional intake of patients [11], especially when choking or coughing occurs. Patients with neurological impairment, masticatory weakness, sensory abnormality, or visual impairment may have serious difficulty during feeding. Dysphagia is also related to dehydration, when fluid aspiration occurs in patients with dysphagia and they are unable to drink or avoid doing so out of fear of choking and coughing [11, 12].

Moreover, it was reported that patients with dysphagia at admission had a higher mortality after a 3-month follow-up, and the mortality of stroke patients with dysphagia was 3–5 times higher than those with normal swallowing functions [13, 14]. This is possibly associated with microbial translocation in the oropharynx and reduced systemic resistance [11, 15].

As mentioned above, many cross-sectional/retrospective studies have indicated that dysphagia can increase the risk of aspiration pneumonia, malnutrition, and even death in elderly patients [16, 17]. However, these studies were mainly focused on stroke patients, and prospective cohort studies on the long-term adverse influences of dysphagia are lacking. Therefore, this prospective cohort study aimed to refine the current understanding of the impacts of dysphagia on the prognosis of older Chinese inpatients.

2. Methods

2.1 Subjects

A cross-sectional survey was conducted through convenience sampling of elderly inpatients in four geriatric wards (62 beds in each ward) of a teaching hospital in China from December 2018 to January 2019. Subsequently, a six-month follow-up survey was conducted from June 2019 to July 2019.

Inclusion criteria: inpatients aged 60 and above. The exclusion criteria were as follows: (1) patients in critical condition who needed to be rescued at any time; (2) patients who were forbidden to drink or eat by doctors; (3) patients who were clinically diagnosed with

dementia (middle or late-onset) and could not be evaluated concerning their swallowing function; and (4) patients with serious mental diseases.

2.2 Tools and content

2.2.1 General information

Age, gender, marital status, and education level were investigated.

2.2.2 Health function status

(1) Comorbidity: the Charlson comorbidity index (CCI) was used. It consists of 19 items: diabetes mellitus (diabetic complications), congestive heart failure, peripheral artery disease, chronic lung disease, moderate or severe liver disease, hemiplegia, kidney disease, leukaemia, lymphoma, tumour metastasis and AIDS. Each of the items is weighted according to its impact on mortality [18].

(2) Disease severity: the Acute Physiology and Chronic Health Evaluation II (APACHE II) was used. This tool aims to comprehensively assess acute physiology, age and chronic health status. The final score is the sum of the three subscores. The higher it is, the more serious the disease [19].

(3) Cognitive function: The short portable mental status questionnaire (SPMSQ) was used [20, 21]. It concerns orientation, personal history, recent memory and computational power. The cognitive function level of the subject was assessed according to educational background (primary school, junior high school, senior high school and above). Furthermore, those clinically diagnosed with Alzheimer's disease, or those with severe cognitive impairment written in the electronic medical record and unable to be evaluated by the scale were directly judged as having severe cognitive dysfunction.

(4) Ability of daily living: The Barthel Index (BI) was used [22], which is comprised of 10 items with a total score range of 0-100. It is classified into five levels: self-care (100 points), mild disorder (75–95 points), moderate disorder (50–70 points), severe disorder (25–45 points), and extremely severe disorder (0–20 points).

(5) Swallowing function evaluation: the Kubota water swallow test was used [23]. The time required for patients to swallow 30 ml water taken by mouth was recorded. The test was carried out once to record the shortest time and the occurrence of choking and coughing. This test has been widely used nationwide with good reliability and validity. If the result of this test is positive, the patient would undergo the standardized swallowing assessment. Patients who need gastric tube feeding were directly judged as dysphagia.

Standardized swallowing assessment (SSA): the SSA includes three parts: clinical examination, a 5 ml water swallow test 3 times, and a 60 ml water swallow test [24]. Difficulty swallowing is observed during the test. The final score ranges from 18 to 46. The higher the score is, the more pronounced the dysphagia is. Patients whose score was ≥ 19 were considered to have dysphagia.

In this study, people with a score < 22 were tested again at an interval of 20 minutes. If the two scores were identically 18 or identically ≥ 19 , no more tests were implemented. If one score was > 18 and another score was 18, a third test was implemented after another 20 minutes. If the third score was > 18 , the patient was considered to have dysphagia.

The final determination of dysphagia was based on the positive results of both the Kubota water swallow test and the SSA. Moreover, dysphagia was directly determined if the patient was ordered to use nasogastric tubes by doctors.

2.2.3 Prognosis

Complications (malnutrition and aspiration pneumonia), readmission, and death were investigated.

2.2.3.1 Malnutrition

The Mini Nutritional Assessment Short Form (MNA-SF) was used to assess the nutritional status of the subjects [25]. The simplified MNA-SF scale includes six indexes: decreased food intake (3 months), weight loss (3 months), occurrence of stress or acute disease (3 months), mobility, neuropsychiatric disease, and body mass index (if the body mass index cannot be measured, the calf circumference is measured instead). The total score ranges from 0 to 14. A total score of < 8 indicates malnutrition.

2.2.3.2 Aspiration pneumonia

Aspiration pneumonia was judged according to the doctor's clinical diagnosis. If the type of pneumonia was not indicated in the medical record, it was judged by 2 deputy chief doctors with expertise in elderly respiration. The following indicators were necessary for diagnosis: history of aspiration, chest X-ray showing pulmonary fibrosis (or increased infiltration) or moist rales on chest auscultation, and at least two of three symptoms (fever over 38 °C, number of white blood cells in the blood > 10000/mm³, decreased content of oxygen in the blood [10]).

2.2.3.3 Death

The mortality of all of the patients by the end of the 6-month follow-up was investigated.

2.2.3.4 Readmission

The readmission rate (into hospitals, rehabilitation institutions or therapeutic nursing homes) of the live patients over the 6-month follow-up was investigated.

2.3 Data collection

The baseline data of inpatients were collected by investigators (nurse specialists from the geriatric centre who had been specially trained). Cognitive function and swallowing function were assessed within 24 hours after admission. Other demographic data were provided by the patients or their caregivers. Disease information and biochemical tests were collected from the electronic medical records. The investigators conducted a comprehensive inspection of the questionnaire immediately after collection to check the accuracy and completeness. Reverification was implemented if there was any doubt, error, or missing item. Furthermore, the investigators cross-checked each other. One-third of the questionnaires were randomly checked for accuracy by the authors themselves.

For the follow-up survey, the relevant data were collected by the investigators face to face when patients participated in the health education classes organized by the ward or returned for further consultation. The patients who could not be followed up as scheduled were investigated through telephone. Fourteen nurse specialists were each responsible following up 25–30 patients.

The data of the inpatients who died in the hospital were collected through electronic medical records, whereas the data of those who died elsewhere were collected through their relatives or friends.

2.4 Investigation procedures

The investigation procedures are shown in Fig. 1.

2.5 Statistical analysis

All of the data were input and managed through Excel 2016 and analysed using SPSS 18.0. Based on the type and distribution of the data, different methods were used for the statistical descriptions and statistical inferences.

Frequency and percentage were calculated for descriptions of counting data, and percentile spacing was calculated for descriptions of skewed data. For statistical inferences, the chi-square test was used for counting data, and binary logistic stepwise regression analysis was used for multivariate analysis. A two-tailed *p* value of < 0.05 indicated a statistically significant difference.

2.6 Ethical considerations

This study was approved by the clinical trial and biomedical ethics committee of the hospital and was conducted in accordance with the principles of the Declaration of Helsinki. Initially, the investigators carefully introduced the relevant information to the subjects. The subjects participated voluntarily and signed a written informed consent form. Moreover, because of traditional Chinese culture, family members tended to be reluctant to talk about deceased relatives. The investigators were required to demonstrate full respect and collect only the minimum required information.

3. Results

3.1 General information of the elderly patients

A total of 290 elderly patients were successfully followed up for 6 months. Among them, 34 elderly patients died, accounting for 11.7%, and 125 had dysphagia, accounting for 43.1%. The features of the 290 elderly patients were as follows: aged ≥ 80 years (66.2%), male (70.3%), receiving public health care (68.6%), having a spouse (70.3%), living with a spouse (60.7%), monthly income of 3,000 yuan and above (79.3%), and having a middle school education or above (87.2%). Their general information is shown in Table 1. Furthermore, the age, CCI, APACHE II, and BI of the 290 elderly inpatients were nonnormally distributed (Table S1).

Table 1
General information of the elderly inpatients involved in this study (n = 290)

Items		n	%	Items		n	%
Age (years old)	< 70	47	16.2	Marriage	Married	204	70.3
	70 ~ 80	51	17.6		Unmarried	86	29.7
	≥ 80	192	66.2	Educational level	Primary school and below	37	12.8
Gender	Male	204	70.3		Middle school	134	46.2
	Female	86	29.7		University and above	119	41.0

Table S1
Non-normal distribution of the relevant measurement data of the elderly inpatients (n = 290)

Items	P25	P50	P75
Age	74	82	86
CCI	1.00	2.00	3.00
APACHE II	7.00	11.00	14.00
BI	50	80	100

3.2 Univariate analysis of the incidence of dysphagia

A chi-square test based on the cross-sectional investigation at admission was performed. The incidence of dysphagia was higher among the elderly patients who had the following characteristics (Table 2): advanced age ($p < 0.001$), dementia ($p < 0.001$), stroke ($p = 0.001$), Parkinson's disease ($p = 0.001$), dental masticatory disorder ($p < 0.05$), obstructive pulmonary disease ($p < 0.001$), a history of aspiration pneumonia ($p < 0.05$), a relatively high CCI score ($p < 0.001$), a relatively high APACHE II score ($p < 0.001$), daily life dysfunction ($p < 0.001$), and cognitive dysfunction ($p < 0.001$).

Table 2
Univariate analysis of the incidence of dysphagia in the elderly inpatients (n = 290)

Items		Total		Normal swallow (n = 165)		Dysphagia (n = 125)		χ^2	p	OR value	95% CI	
		n	%	n	%	n	%				Lower limit	Upper limit
Age	< 70	47	16.2	38	80.9	9	19.1	21.960	0.000			
	70~80	51	17.6	36	70.6	15	29.4					
	≥ 80	192	66.2	91	47.4	101	52.6					
Gender	Male	202	69.7	113	55.4	91	44.6		0.426			
	Female	88	30.3	52	60.5	34	39.5					
Stroke	×	238	82.1	146	61.3	92	38.7	10.708	0.001	2.756	1.470	4.985
	√	52	17.9	19	36.5	33	63.5					
Alzheimer's disease	×	261	90.0	159	60.9	102	39.1	17.224	0.000	5.975	2.361	14.430
	√	29	10.0	6	20.7	23	79.3					
Parkinson's disease	×	268	92.4	160	59.7	108	40.3	11.333	0.001	5.037	1.822	12.710
	√	22	7.6	5	22.7	17	77.3					
Other central nervous degeneration disease	×	282	97.2	163	57.8	119	42.2		0.079			
	√	8	2.8	2	25.0	6	75.0					
Neuromuscular disease	×	284	97.9	161	56.7	123	43.3		0.702			
	√	6	2.1	4	66.7	2	33.3					
Dental masticatory disorder	×	280	96.6	163	58.2	117	41.8	5.749	0.017	5.573	1.332	26.34
	√	10	3.4	2	20.0	8	80.0					
Oropharyngeal tumors	×	289	99.7	164	56.7	125	43.3		1.000			
	√	1	.3	1	100.0	0	0.0					
Head and neck injury	×	286	98.6	164	57.3	122	42.7		0.318			
	√	4	1.4	1	25.0	3	75.0					
Head and neck tumors	×	288	99.3	164	56.9	124	43.1		1.000			
	√	2	.7	1	50.0	1	50.0					
Gastroesophageal reflux	×	287	99.0	163	56.8	124	43.2		1.000			
	√	3	1.0	2	66.7	1	33.3					
Esophageal cancer*	×	287	99.0	165	57.5	122	42.5		0.079			
	√	3	1.0	0	0.0	3	100.0					
Other esophageal diseases	×	289	99.7	164	56.7	125	43.3		1.000			
	√	1	.3	1	100.0	0	0.0					
Chronic obstructive pulmonary disease	×	229	79.0	143	62.4	86	37.6	13.668	0.000	2.948	1.612	5.228
	√	61	21.0	22	36.1	39	63.9					

Respiratory failure	×	285	98.3	164	57.5	121	42.5					
	√	5	1.7	1	20.0	4	80.0	0.169				
History of aspiration pneumonia	×	283	97.6	164	58.0	119	42.0					
	√	7	2.4	1	14.3	6	85.7	5.311	0.021	8.269	1.328	95.460
Coronary heart disease	×	229	79.0	126	55.0	103	45.0	0.212				
	√	61	21.0	39	63.9	22	36.1					
Diabetes	×	192	66.2	112	58.3	80	41.7					
	√	98	33.8	53	54.1	45	45.9	0.532				
CCI	0 point	60	20.7	48	80.0	12	20.0					
	1–2 points	137	47.2	80	58.4	57	41.6					
	≥ 3 points	93	32.1	37	39.8	56	60.2	24.290	0.000			
APACHE II	≤ 11 points	165	56.9	111	67.3	54	32.7					
	> 11 points	125	43.1	54	43.2	71	56.8	16.805	0.000	2.703	1.686	4.345
Ability of daily living	Total dependence	41	14.1	10	24.2	31	75.6	36.710	0.000			
	Obvious dependence	20	6.9	5	25.0	15	75.0					
	Severe dependence	45	15.5	25	55.6	20	44.4					
	Moderate dependence	42	14.5	25	59.5	17	40.5					
	Mild dependence	142	49.0	100	70.4	42	29.6					
Cognitive impairment	Severe	38	13.1	6	15.8	32	84.2	45.26	0.000			
	Moderate	32	11.0	16	50.0	16	50.0					
	Mild	21	7.2	6	28.6	15	71.4					
	Normal	199	68.6	137	68.8	62	31.2					

3.3 Analysis of the effect of dysphagia on death

A total of 290 elderly inpatients were followed up for 6 months, and 34 of them died (11.7%). Elderly patients with dysphagia were found to have a higher mortality risk than those with normal swallowing function (RR = 2.361, 95% CI = 1.132–4.925, Table 3). However, according to the logistic regression analysis, dysphagia was not an independent predictor of death.

Table 3
Effect of dysphagia on the mortality of the elderly patients (n = 290)

Death	Total		Normal swallow		Dysphagia		χ^2	<i>p</i>	RR value	95% CI	
	n	%	n	%	n	%				Lower limit	Upper limit
×	256	88.3	152	92.1	104	83.2					
√	34	11.7	13	7.9	21	16.8	5.469	0.019	2.361	1.132	4.925

3.4 Analysis of the effect of dysphagia on complications

Over the 6-month follow-up, among the 256 elderly patients (Table 4), 40 developed malnutrition (MNA-SF < 8), accounting for 15.6%, and 53 developed aspiration pneumonia, accounting for 20.7%. Logistics regression analysis of malnutrition and aspiration pneumonia in the elderly inpatients is shown in Table 5.

Table 4
The incidence of malnutrition and aspiration pneumonia in the elderly inpatients (n = 256)

Items	Total		Normal swallow		Dysphagia		χ^2	<i>p</i>	RR value	95% CI	
	n	%	n	%	n	%				Lower limit	Upper limit
Normal	216	84.4	143	94.1	73	70.2	26.725	0.001	6.747	3.050	14.952
Malnutrition	40	15.6	9	5.9	31	29.8					
Normal	203	79.3	135	88.8	68	65.4	20.651	0.001	4.204	2.203	8.023
Aspiration pneumonia	53	20.7	17	11.2	36	34.6					

Table 5
Logistics regression analysis of malnutrition and aspiration pneumonia in the elderly inpatients (n = 256)

Items		B	S.E	Wals	Sig.	Exp (B)	95% CI	
							Lower limit	Upper limit
malnutrition	Disease severity	-.974	.383	6.455	.011	.378	.178	.800
	Dysphagia	-1.752	.412	18.099	.000	.173	.077	.389
	Constant	4.165	.685	37.008	.000	64.390		
aspiration pneumonia	Age	.626	.295	4.500	.034	1.871	1.049	3.337
	Dysphagia	1.027	.353	8.482	.004	2.793	1.399	5.576
	Alzheimer's disease	1.842	.505	13.279	.000	6.309	2.343	16.990
	Constant	-3.726	.815	20.897	.000	.024		

3.4.1 Malnutrition

The incidence of malnutrition in elderly patients with dysphagia was higher than that in those with normal swallowing function (RR = 6.747, 95% CI = 3.050-14.952, Table 4). Factors influencing malnutrition screened out through univariate analysis ($p < 0.05$) included age, dysphagia, dementia, dental masticatory disorder, ability of daily living, and disease severity. Based on these factors, multivariate analysis was performed through stepwise regression, and dysphagia was found to be an independent risk factor of malnutrition (RR = 0.173, 95% CI = 0.077-0.389, Table 5).

3.4.2 Aspiration pneumonia

The incidence of aspiration pneumonia was higher in patients with dysphagia than in those with normal swallowing function (RR = 4.204, 95% CI = 2.203-8.023, Table 4). Factors influencing aspiration pneumonia screened out through univariate analysis ($p < 0.05$) included age, dysphagia, Alzheimer's disease, chronic obstructive pulmonary disease, disease severity, comorbidity, and ability of daily living. Based on these factors, multivariate analysis was performed through stepwise regression, and dysphagia was found to be an independent risk factor of aspiration pneumonia (RR = 2.793, 95% CI = 1.399-5.576, Table 5).

3.5 Analysis of the effect of dysphagia on readmission

Among the 256 elderly inpatients who survived to the end of follow-up, 86 were re-admitted, accounting for 33.6%. There was no significant difference in the readmission rate between elderly patients with dysphagia and those with normal swallowing function ($p > 0.05$, Table S2).

Table S2
Effect of dysphagia on the readmission rate of the elderly patients (n = 256)

Readmission	Total		Normal swallow		Dysphagia		χ^2	P	RR value	95% CI	
	n	%	n	%	n	%				Lower limit	Upper limit
×	170	66.4	97	63.8	73	70.2	1.125	0.289	1.214	0.852	1.756
√	86	33.6	55	36.2	31	29.8					

4. Discussion

4.1 Dysphagia and death

According to the literature, it is generally accepted that dysphagia is one of the indicators of disease severity in older patients, but it may not be a direct risk factor of mortality [11]. In this study, it was found that the mortality of older patients with dysphagia after 6 months was higher than that of patients with normal swallowing function (RR = 2.361, 95% CI = 1.132–4.925, Table 3), but dysphagia was not an independent predictor of death. These results are consistent with previous studies [11].

The relationship between dysphagia and death can be analysed through the following two points. First, older inpatients with dysphagia generally have a higher incidence of major diseases, such as stroke, Alzheimer's disease and Parkinson's disease, as suggested by a previous cross-sectional investigation. These diseases can independently affect the mortality of older patients [26–29]. In addition, elderly inpatients with dysphagia have a higher incidence of other complications, such as malnutrition and aspiration pneumonia. Malnutrition can lead to decreased health function and independently affect the rehabilitation and prognosis of elderly patients [30]. Aspiration pneumonia is also an independent predictor of death in elderly patients [2, 31].

In conclusion, dysphagia can be considered an indirect risk factor for death in older patients. It may be a concurrent symptom of independent predictors of death and may give rise to other independent predictors of death.

4.2 Dysphagia and malnutrition/aspiration pneumonia

In this study, the incidence of malnutrition in elderly patients with dysphagia was higher than that in those with normal swallowing function (RR = 6.747, 95% CI = 3.050–14.952, Table 4), and dysphagia was an independent predictor of malnutrition (RR = 0.173, 95% CI = 0.077–0.389, Table 5). This may be because older patients with dysphagia have less food intake to avoid choking and aspiration. In addition, since general nutrition interventions cannot effectively improve the nutritional status of older patients with dysphagia, comprehensive nutrition interventions and rehabilitation are needed [32, 33]. However, caregivers tend to lack the relevant knowledge and fail to reasonably adjust the eating patterns of older patients after discharge, thus leading to further development of malnutrition [34, 35].

Furthermore, the incidence of aspiration pneumonia in older patients with dysphagia was higher than in those without dysphagia (RR = 4.204, 95% CI = 2.203–8.023, Table 4). Our result is consistent with a previous meta-analysis [36]. The RR value in the current study was lower than in the meta-analysis [36], possibly because of the exclusion of acute stroke patients and critical patients in the current study.

Many studies have been conducted to explore the relationship between dysphagia and aspiration pneumonia. For example, Scannapieco *et al.* [37–40] proposed several possible mechanisms, including oral bacteria being inhaled into the lung tissue, respiratory pathogens surviving in the diseased oral cavity and being inhaled into the lung tissue, dysfunction of the nonspecific host defence mechanism, and cytokines derived from periodontitis affecting the respiratory epithelial cells.

4.3 Guidance for nursing interventions

Considering the adverse influences of dysphagia, specific nursing interventions are highly recommended [41–43]. Desirable intervention measures include (1) oral care (such as gargles and electric toothbrushing), (2) monitoring of nutritional status, (3) management of eating (such as the quality of food and food intake), (4) training of swallowing function, (5) management of artificial airways (such as nasogastric tubes), and (6) psychological nursing concerning the patient's anxiety, fear, and dependence.

4.4 Limitations

This study has certain limitations that should be addressed in future studies. (1) The subjects involved in this study were from only one geriatric centre. Multi-centre studies are desired in the future. (2) The follow-up duration of this study was 6 months, which should be further extended. (3) The specific time of death was not collected. (4) In this study, the identification of dysphagia was based on observational assessment. More objective and rigorous methods, such as fibrous endoscopy, should be used in future studies.

5. Conclusion

In conclusion, this study demonstrates that dysphagia is an independent predictor of malnutrition and aspiration pneumonia in older Chinese patients. Furthermore, the evaluation and management of dysphagia and relevant complications should be taken seriously in elderly patients, and effective nursing interventions should be applied to improve their prognosis.

6. Declarations

Ethics approval and consent to participate

This study was approved by the clinical trial and biomedical ethics committee of the hospital and was conducted in accordance with the principles of the Declaration of Helsinki. Initially, the investigators carefully introduced the relevant information to the subjects. The subjects participated voluntarily and signed a written informed consent form. Moreover, because of traditional Chinese culture, family members tended to be reluctant to talk about deceased relatives. The investigators were required to demonstrate full respect and collect only the minimum required information.

Consent for publication

Not applicable.

Availability of data and material

The datasets generated and/or analysed during the current study are available in the Baidu network disk https://pan.baidu.com/s/14kA8eWE9itqaL4637O_QfA. And the extraction code is 97q2.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

ZM and YZ contributed equally to this study. They completed the main study design data analysis and wrote the main manuscript text. XS and ZY prepared figures and helped complete data analysis. QC is the corresponding author, and guided and helped complete the whole article. All authors read and approved the final manuscript.

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Conflict of interest statement

The authors declare no conflict of interest.

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Figures

Figure 1

investigation procedures

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