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Original Article

The pulmonary infection risk factors in long-term bedridden patients: a meta-analysis

Zhen Chen[1], Tianshuang Song[1], Yilan Li[1], Ling Luo[1], Ziqiong Li[1], Qinghua Zhao[2]

[1]Department of Infection, [2]Nursing Department, The First Affiliated Hospital of Chongqing Medical University, Chongqing 400016, China

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Abstract: This study aimed to review the pulmonary infection risk factors in long-term bedridden patients. The Cochrane Library, PubMed, EMBASE, Web of Science, CNKI, Wanfang, and the China Biomedical Literature Service System databases were searched to retrieve articles on the clinical risk factors, from database establishment to July 31, 2020. Two researchers independently screened the search results, evaluated the quality of the studies using NOS criteria, and extracted the data. The meta-analysis was performed using RevMan 5.3. A total of 13 articles including 10,182 patients were included. The statistically significant risk factors included age (OR=1.82), diabetes (OR=2.15), hormones (OR=3.14), consciousness disorders (OR=3.83), BMI<18.5 kg/m^2 (OR=1.57), antibiotics (OR=2.21), smoking history (OR=1.68), nasal-feeding (OR=4.64), ventilator use (OR=5.95), invasive operations (OR=5.04), hospitalization times (OR=3.16), and stay-in-bed times (OR=2.69). Therefore, according to the OR values, age, a BMI<18.5 kg/m^2, and smoking history were low risk-factors (2≥OR>1). Diabetes, antibiotics, and stay-in-bed times were medium risk-factors (3≥OR>2). Hormone levels, consciousness disorders, nasal-feeding, ventilator use, invasive operations, and hospitalization times were high risk-factors (OR>3). In conclusion, the low risk-factors (age, BMI, smoking history), the medium risk-factors (diabetes, antibiotics, stay-in-bed length), and especially the high risk-factors (hormones, consciousness disorders, nasal-feeding, ventilator use, invasive operations, hospitalization times) deserve more attention for preventing pulmonary infections in long-term bedridden patients.

Keywords: Long-term bedridden patients, pulmonary infection, risk factors, meta-analysis

Introduction

Long term bedridden refers to a clinical phenomenon in which patients can only maintain their basic physiological needs (diet, excretions, etc.) in bed due to a decline in their daily living abilities caused by various diseases [1]. With the aging of people in China, the total number of elderly people over 60 years old exceeds 200 million, and the number of disabled elderly people now exceeds 33 million [2]. Moreover, the number of long-term bedridden patients has also increased in recent years [3].

Pulmonary infections are a common disease and have a high incidence among the elderly who are bedridden for a long time [4]. According to published data, the incidence of lung infections in the elderly over 65 years old in the United States is about 6.3/1000-16.4/1000. The incidence of pulmonary infections among the elderly in China is about 13.9% [4]. The occurrence of pulmonary infections has been proven to be associated with alcohol abuse, bacterial or viral infections, exposure to air pollution, poor nutrition, aspiration, age, gender, and genetic background [5, 6]. In recent years, being bedridden for a long-term has also been considered to be a risk factor for pulmonary infections [3]. Long-term bedridden patients usually suffer from pulmonary infections with an occult onset, are in a dangerous condition, and have a high disease recurrence rate. Therefore, pulmonary infections caused by being bedridden for a long time can directly affect patients' quality of life and increase the economic burden on their families and on society [7].

At present, studies on the risk factors of pulmonary infection in long-term bedridden patients

are controversial. Therefore, the purpose of this study was to clarify the pulmonary infection risk factors in long-term bedridden patients through a meta-analysis, so as to provide a scientific basis for the prevention of pulmonary infections in long-term bedridden patients.

Materials and methods

Inclusive and exclusive article criteria

Inclusive criteria: ① Long-term bedridden patients (for more than 12 months as defined by the study [8]) and age ≥18 years old. ② Risk factors or predictive factors of secondary pulmonary infections in long-term bedridden patients. ③ Diagnostic criteria refer to the "Guidelines for primary diagnosis and treatment of adult community-acquired pneumonia" formulated by the Chinese Medical Association [9]. ④ The type of study was a case-control study or a cohort study.

Exclusion criteria: ① The full text was not obtained through various channels. ② Duplicate publications. ③ Studies other than case-control and cohort studies. ④ The data could not be extracted from the article.

Search strategy

A series of databases, including CNKI, the Wanfang database, the VIP database, the China Biomedical database, PubMed, Web of Science, The Cochrane Library, EMBASE, CINAHL, and PEDpro, were searched in our study. The key words, including "long term (or long-term) bedridden" "long term (or long-term) bedridden patients", "lung infection", "pulmonary infection", "community acquired pneumonia" or "hypostatic pneumonia", were searched in the above databases. At the same time, the references of the included studies were searched twice. The retrieval period was from the establishment of each database to July 31, 2020.

Literature screening and data extraction

Using the author, year of publication, and article title metadata, Endnote software was used for duplicate checking. The article screening was conducted by two researchers in strict accordance with the inclusion and exclusion criteria. When there were different opinions, a decision was made by a third researcher. Referring to the Joanna Briggs Institute (JBI) Reviewer's Manual (2008), the extracted information included: ① basic information of the article, such as author, country and year, ② basic information of study, the sample size, the types of included studies, the risk factors involved, etc.

Literature quality evaluation

According to the Newcastle Ottawa scale 13.3 (NOS 13.3), two researchers independently evaluated the quality of the articles. The evaluation mainly involved three parts, including the study population selection, the comparability between groups, and the exposure factors, with a total possible score of 9 points. An article with a total score higher than 6 points was considered to be a high-quality study. In the process of evaluation, if there were different opinions, they would be solved through mutual discussion or by consultation with the third researcher.

Data analysis

RevMan 5.3 software was used for the meta-analysis. χ^2 tests were used to measure the heterogeneity. I^2<50% and P>0.1 indicated no heterogeneity among the studies, and the fixed effect model was used for the analysis. I^2≥50% and P≤0.1 indicated heterogeneity among the studies, and a sensitivity analysis was used to determine the source of the heterogeneity. We removed the selected articles one by one to calculate the overall association results. If it still could not be eliminated, the random effects model was selected. At the same time, the potential publication bias of each article was evaluated using the Begg rank correlation test. P>0.05 indicated that there was no publication bias. The comprehensive effect of the count data was expressed using the two odd ratio (OR) and 95% CI.

Results

Literature search results

A total of 7,067 articles were obtained, including 3,260 in Chinese and 3,807 in English (**Figure 1**). Among the above articles, 1321 duplicate articles and 5,222 irrelevant articles were excluded, and 511 articles were deleted after further reading. Finally, 13 papers [4,

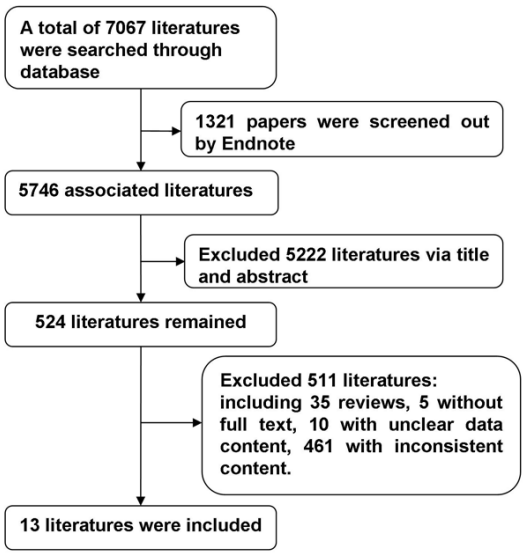

Figure 1. Flow chart for the literature screening process.

10-21] were included, including 11 in Chinese [10-20] and 2 in English [4, 21].

Basic characteristics and quality evaluation of the included articles

Among the 13 included articles, 12 were case-control studies [4, 10-20], and 1 was a cohort study [21], involving a total of 10,182 patients. The quality score of all the included articles was equal to or more than 7 (≥7 points), so the article quality met the requirements. The basic characteristics and quality evaluation findings of the included articles are shown in **Table 1**.

Age acted as a risk factor for pulmonary infection (≥80 years old)

Five studies [4, 12, 15, 16, 18] were included to report the effect of age ≥80 years on pulmonary infections in long-term bedridden patients. The incidence of pulmonary infection was 46.80% in patients ≥80 years old and 27.88% in patients <80 years old. There was no heterogeneity among the studies (χ^2=3.89, P=0.42, I^2=0%) (**Figure 2**), so the fixed effect model was used for our analysis. The results showed that risk of pulmonary infection in patients ≥80 years old was significantly higher compared to the risk in patients <80 years old [OR=1.82, 95% CI (1.55-2.14), P<0.00001] (**Figure 2**; **Table 2**).

Diabetes mellitus is a risk factor for pulmonary infections

Five studies [11, 12, 17-19] were included in this study to clarify the effect of diabetes on pulmonary infection sin long-term bedridden patients. The incidence of pulmonary infection was 31.71% in diabetic patients and 19.11% in non-diabetic patients. There was no heterogeneity among the studies (χ^2=1.80, P=0.77, I^2=0%), so the fixed effect model was used for the analysis. The results indicated that diabetes mellitus is a risk factor for pulmonary infection in long-term bedridden patients [OR= 2.15, 95% CI (1.49-3.11), P<0.0001] (**Figure 3**; **Table 2**).

Application of hormones could induce risk of pulmonary infection

Three studies [4, 10, 13] included in this study showed that the incidence of pulmonary infections was 32.07% in patients administered steroids and 12.38% in patients without not administered steroids. There was heterogeneity among these studies (χ^2=8.64, P=0.01, I^2=77%). After removing the studies of Chen *et al.* [10], there was no heterogeneity among these studies (χ^2=0.79, P=0.38, I^2=0%) using a sensitivity analysis, so the fixed effect model was used for the analysis. The results showed that hormone application is a risk factor for pulmonary infections in long-term bedridden patients, with a significant difference [OR=3.14, 95% CI (2.60-3.80), P<0.00001] (**Figure 4**; **Table 2**).

Consciousness disorders are a risk factor for pulmonary infections

Eight studies [4, 10, 11, 13, 15, 16, 19, 20] were included in this study that explored the effect of consciousness disorders on pulmonary infections in long-term bedridden patients. The incidence of pulmonary infection was 51.94% in patients with consciousness disorder and 29.17% in patients without consciousness disorder. There was heterogeneity among the above studies (χ^2=32.27, P<0.001, I^2=78%). After removing the studies of Jiao *et al.* [4], there was no heterogeneity among the studies (χ^2=5.66, P=0.46, I^2=0%) by sensitivity analysis. Therefore, the fixed effect model was used for analysis. Our findings showed that f consciousness disorders are a risk factor for pul-

Table 1. Basic characteristics and quality evaluation of the included articles

Included studies	Year	Study type	Infection	Non infection	Risk factors	NOS score
Chen et al. [10]	2016	Case control	22	138	③④	8
Zheng et al. [11]	2019	Case control	27	94	②④⑦⑩	8
Chen et al. [12]	2014	Case control	17	101	①②⑩	8
Sun et al. [13]	2019	Case control	145	46	③④⑥⑩	7
Xu et al. [14]	2019	Case control	150	150	⑥	7
Ni et al. [15]	2015	Case control	78	308	①④⑤⑦⑩	8
Yang et al. [16]	2017	Case control	103	100	①④⑦	8
Chen et al. [17]	2013	Case control	70	192	②⑦⑧⑨	8
Chen et al. [18]	2019	Case control	18	108	①②⑩	8
Niu et al. [19]	2015	Case control	73	227	②④⑦⑧⑨	8
Liu et al. [20]	2018	Case control	41	119	④	8
Ishida et al. [21]	2015	Cohort study	131	400	⑧	8
Jiao et al. [4]	2019	Case control	566	6758	①③④⑤⑦⑨	8

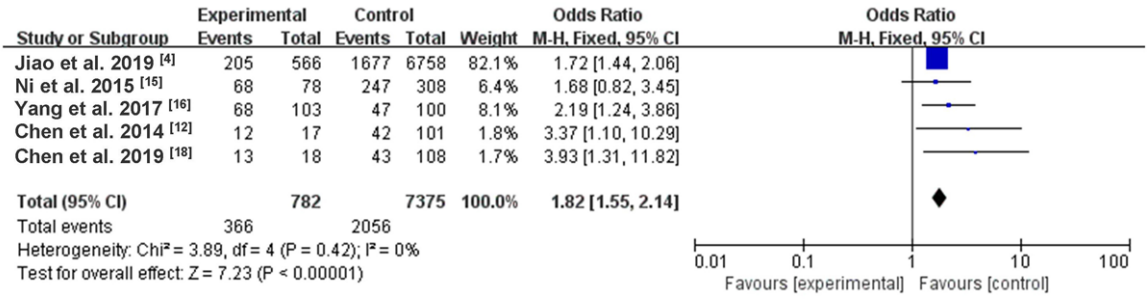

Figure 2. The effect of age ≥80 years on pulmonary infections in long-term bedridden patients.

Table 2. A summary of the OR and 95% CI values of the different risk factors for pulmonary infections in long-term bedridden patients

Risk factor	OR	95% CI	P
Age ≥80 years	1.82	1.55-2.14	<0.01
Diabetes mellitus	2.15	1.49-3.11	<0.01
Hormones application	3.14	2.60-3.80	<0.01
Consciousness disorders	3.83	2.91-5.03	<0.01
BMI<18.5 kg/m^2	1.57	1.24-1.98	<0.01
Antibiotics use	2.21	1.49-3.27	<0.01
Smoking history	1.68	1.43-1.98	<0.01
Nasal feeding	4.64	1.60-13.44	<0.01
Ventilator administration	5.95	2.02-17.53	<0.01
Invasive operation	5.04	3.21-7.90	<0.01
Hospital stay ≥30 days	3.16	1.26-7.92	<0.05
Time in bed	2.69	1.69-4.29	<0.01

monary infections in long-term bedridden patients, with a statistically significant difference [OR=3.83, 95% CI (2.91-5.03), *P*<0.00001] (**Figure 5**; **Table 2**).

BMI was identified as a risk factor for pulmonary infections (<18.5 kg/m^2)

Two studies [4, 15] included in this study suggested that BMI<18.5 kg/m^2 had an effect on pulmonary infections in long-term bedridden patients. The incidence of pulmonary infections was 15.99% in patients with BMI<18.5 kg/m^2 and 9.29% in patients with BMI≥18.5 kg/m^2. There was no heterogeneity among the studies (χ^2=0.51, *P*=0.47, I^2=0%), and the fixed effect model was used for the analysis. The results showed that a BMI<18.5 kg/m^2 is a risk factor for pulmonary infection in long-term bedridden patients [OR=1.57, 95% CI (1.24-1.98), *P*< 0.001] (**Figure 6**; **Table 2**).

The use of antibiotics is a risk factor for pulmonary infections

Two studies [13, 14] suggested that the use of antibiotics has an impact on pulmonary infections in long-term bedridden patients. The incidence of pulmonary infections in patients with

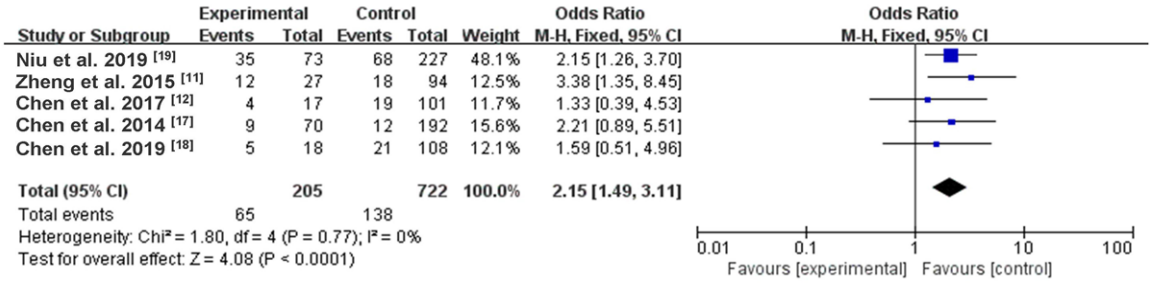

Figure 3. The effect of diabetes on pulmonary infections in long-term bedridden patients.

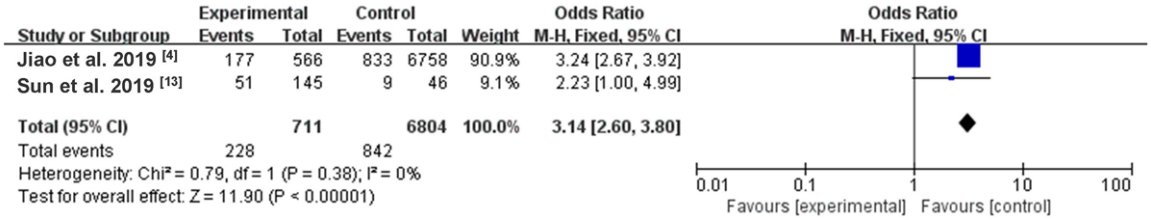

Figure 4. The effect of hormone use on pulmonary infections in long-term bedridden patients.

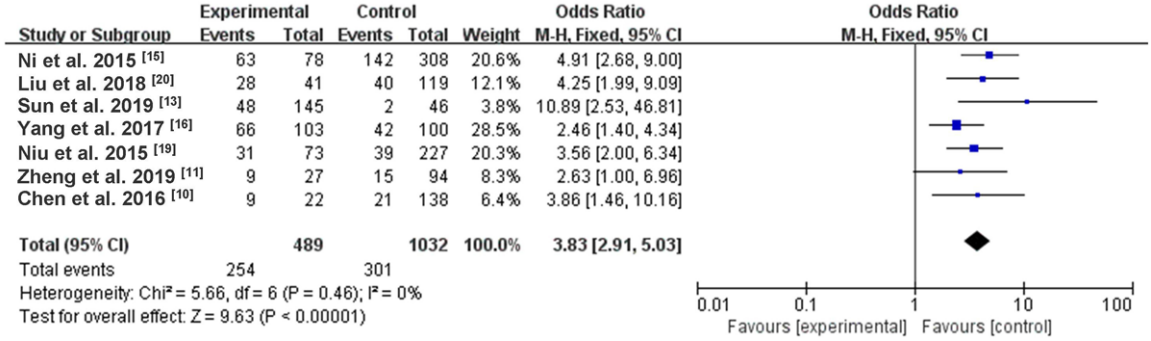

Figure 5. The effect of consciousness disorders on pulmonary infections in long-term bedridden patients.

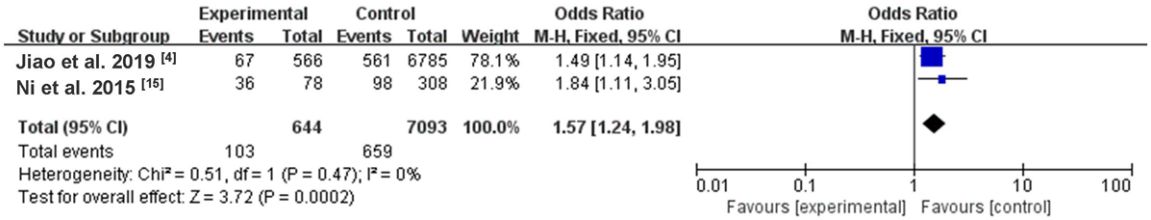

Figure 6. The effect of a BMI<18.5 kg/m^2 on pulmonary infections in long-term bedridden patients.

antibiotics was 50.17%, and the incidence in the control group was 35.71%. There was no heterogeneity among the studies (χ^2=0.00, P=0.95, I^2=0%), and the fixed effect model was used for the analysis. The results showed that the use of antibiotics is a risk factor for pulmonary infection in long-term bedridden patients, with a significant difference [OR=2.21, 95% CI (1.49-3.27), P<0.0001] (**Figure 7**; **Table 2**).

Smoking history is a risk factor for pulmonary infections

Six studies [4, 11, 15-17, 19] were included here to investigate the effect of smoking his-

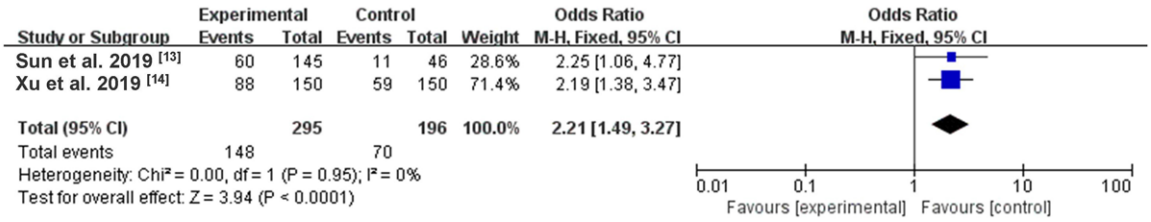

Figure 7. The effect of antibiotics on pulmonary infections in long-term bedridden patients.

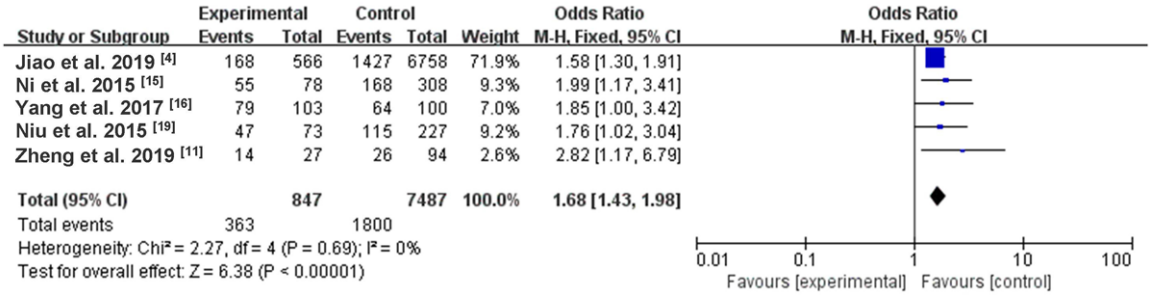

Figure 8. The effect of smoking history on pulmonary infections in long-term bedridden patients.

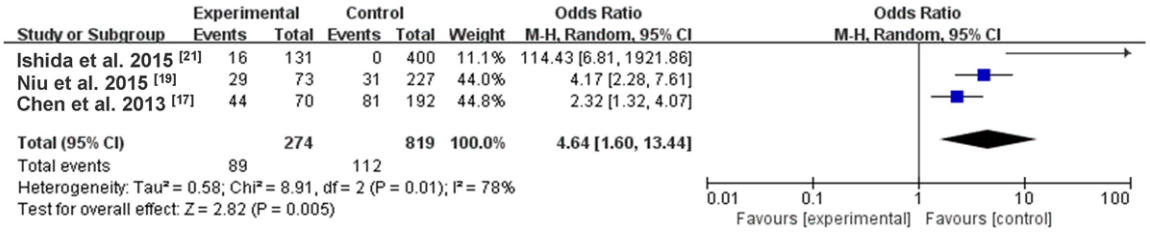

Figure 9. The effect of nasal feeding on pulmonary infections in long-term bedridden patients.

tory on pulmonary infections among long-term bedridden patients. The incidence of pulmonary infections was 42.86% in patients with a smoking history and 24.04% in patients without a smoking history. There was heterogeneity among the above studies (χ^2=15.83, P=0.007, I^2=68%). Using a sensitivity analysis, and after removing the study of Chen *et al.* [17], there was no heterogeneity among the studies (χ^2=2.27, P=0.69, I^2=0%). The results showed that smoking history is a risk factor for pulmonary infection in long-term bedridden patients, and the difference was statistically significant [OR=1.68, 95% CI (1.43-1.98), P<0.00001] (**Figure 8**; **Table 2**).

Nasal feeding is a risk factor for pulmonary infection

According to our analysis of three articles [17, 19, 21], the incidence of pulmonary infections in patients with nasal feeding was 32.48%, and the incidence in patients without nasal feeding was 13.68%. There was heterogeneity among the studies (χ^2=8.91, P=0.01, I^2=78%). Our sensitivity analysis showed that the heterogeneity didn't change significantly, so a random effects model was used for the analysis. Our data showed that nasal feeding is a risk factor for pulmonary infection in long-term bedridden patients, with a significant difference [OR=4.64, 95% CI (1.60-13.44), P<0.01] (**Figure 9**; **Table 2**).

The use of ventilators was more likely to cause lung infections

Three related studies [4, 17, 19] showed that the incidence of pulmonary infection in patients using ventilators was 26.09%, and the incidence in the control group was 6.31%. There was heterogeneity among the studies (χ^2=

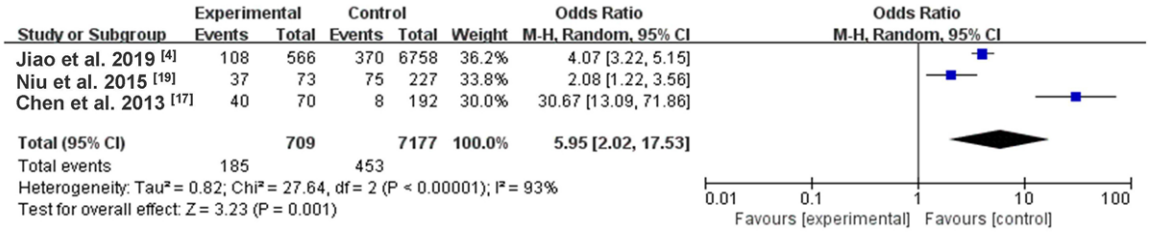

Figure 10. The effect of ventilator use on pulmonary infections in long-term bedridden patients.

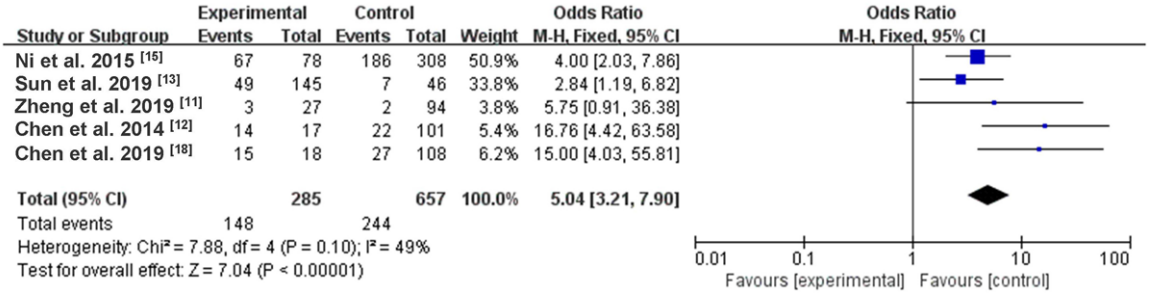

Figure 11. The effect of invasive procedures on pulmonary infections in long-term bedridden patients.

27.64, P<0.00001, I^2=93%). Our sensitivity analysis showed that the heterogeneity did not change significantly, so the random effects model was used for the analysis. The analysis showed that long-term bedridden patients using ventilators were more likely to suffer from pulmonary infections [OR=5.95, 95% CI (2.02-17.53), P<0.01] (**Figure 10**; **Table 2**).

Invasive procedures could cause lung infection

Five studies [11-13, 15, 18] involving invasive operations showed that incidence of pulmonary infections in patients undergoing invasive operations was 51.93%, and the incidence in patients undergoing non-invasive operation was 37.14%. There was no heterogeneity among the studies (χ^2=7.88, P=0.10, I^2=49%). The results showed that invasive operation is a risk factor for pulmonary infections in long-term bedridden patients, and the difference was statistically significant [OR=5.04, 95% CI (3.21-7.90), P<0.00001] (**Figure 11**; **Table 2**).

Hospital stay duration is a risk factor for pulmonary infection (≥30 days)

Three studies [13, 15, 19] were included to explore the effect of the length of hospital stay on pulmonary infections in long-term bedridden patients. Here, a hospital stay longer than 30 days was assigned as the cutoff value in this study. The incidence of pulmonary infections in patients with hospital stays more than 30 days was 54.91%, which was 33.73% in the control group. There was heterogeneity among the studies (χ^2=10.65, P=0.005, I^2=81%). Our sensitivity analysis showed that there was no significant change in heterogeneity, so the random effects model was used for the analysis. The results showed that a hospital stay ≥30 days is a risk factor for pulmonary infections in long-term bedridden patients, and the difference was statistically significant [OR=3.16, 95% CI (1.26-7.92), P<0.05] (**Figure 12**; **Table 2**).

Time in bed is a risk factor for pulmonary infections

Five studies [4, 12, 13, 18, 19] included in this study showed that incidence of pulmonary infection in patients with long bed rest was 71.30%, and the incidence in the control group was 45.64%. There was heterogeneity among the studies (χ^2=11.42, P=0.010, I^2=74%). According to our sensitivity analysis, the cause of the heterogeneity was related to the length of the stay in bed. After removing the studies of Jiao *et al*. (15 days) [4] and Sun *et al.* (20 days) [13], there was no heterogeneity among the studies (χ^2=0.05, P=0.98, I^2=0%). The results showed that long-term bedrest is a risk factor

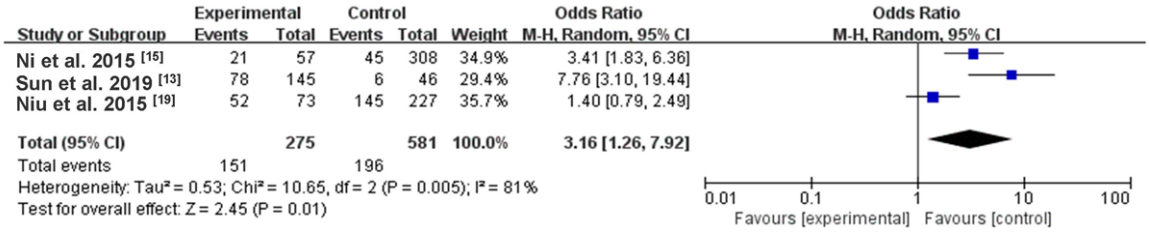

Figure 12. The effect of the length of hospital stay on pulmonary infections in long-term bedridden patients.

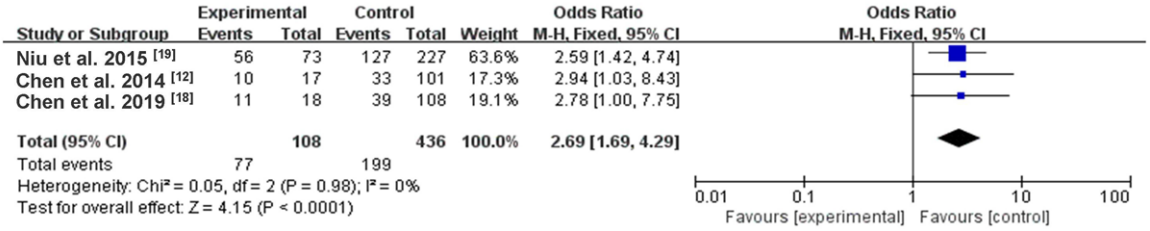

Figure 13. The effect of length of stay in bed on pulmonary infections in long-term bedridden patients.

for pulmonary infections in long-term bedridden patients, and the difference was statistically significant [OR=2.69, 95% CI (1.69-4.29), *P*<0.0001] (**Figure 13**; **Table 2**).

Discussion

Pulmonary infections have high incidence and mortality rates worldwide. Pulmonary infections are the main cause of multiple organ failure and are also considered to be the most common cause of death among elderly hospitalized patients [22]. Identifying the risk factors for secondary pulmonary infections in long-term bedridden patients and carrying out intervention measures in advance can reduce the incidence of the disease, improve patients' quality of life and reduce social and economic burdens. Compared with the previous studies focusing on the risk factors of pulmonary infections in long-term bedridden patients, this study mainly discussed the related risk factors more comprehensively. In the above included 13 papers [4, 10-21], all the patients involved showed a bedridden time longer than 12 months. Therefore, 12 months was defined as "long-term bedridden" in this study. Our findings also showed that length of hospital stay is a risk factor for pulmonary infections. Therefore, this study can effectively supplement the deficiencies of the existing related studies and provide a more comprehensive basis for clinical practice.

Previous studies [9, 23] have shown that the elderly are a high-risk population for pulmonary infection. The results also showed that age is an independent risk factor for pulmonary infections in long-term bedridden patients. With the increase of age, the respiratory system function, the immunity, and the immune defense functions of elderly patients are decreased, and their resistance to bacterial invasion is decreased. At the same time, the functions of the alveoli and the bronchus are weakened, and the function of the cilia clearance is decreased. Therefore, elderly patients are more prone to pulmonary infections [24, 25]. Nutrition is the basis of normal immune function, and a BMI<18.5 kg/m^2 indicates malnutrition. Malnutrition can lead to a decreased immunity and a decreased resistance to pathogens [26, 27]. Phung *et al.* [28] also showed that the risk of pulmonary infection in patients with BMI<18.5 kg/m was 80%, which is higher than we found in our study. According to the earlier studies [13, 15, 19], a hospital stay longer than 30 days is a risk factor for many diseases among patients, and a prolonged hospital stay can increase the risk of iatrogenic infections [29]. Therefore, it is very important to keep the ward environment clean, open windows to provide ventilation, and air disinfection to prevent pulmonary infections.

Smoking can lead to chronic inflammation in lung parenchyma, airway and pulmonary ves-

sels, stimulate secretions to the inflammatory factors, reduce airway obstructions, and seriously affect human lung health [30]. An earlier study reported that [31] the risk of pulmonary infection increased by 6%-10% for every 1 mmol/L increase in blood glucose. Liu *et al.* [32] thought that the risk of social acquired pulmonary infection in patients with diabetes mellitus would be 40%. Elevated blood glucose in diabetic patients can reduce the oxygen carrying capacity of red blood cells, weaken the phagocytosis and bactericidal ability of granulocytes, monocytes, and macrophages, and increase the risk of infection [33]. Therefore, it is necessary to monitor the blood glucose of patients to control it below 11.1 mmol/L [34]. With an increase in patients' bedridden times, the muscle strength is significantly reduced, the self-turning ability is degraded, and the thoracic mobility is reduced, which promotes the blood deposition at the bottom of the lungs and becomes a high-quality culture medium for bacteria, so it is more prone to pulmonary infections [35]. Therefore, after patients are bedridden for a long-term, the patients are discharged from the hospital and must turn over frequently to prevent pulmonary infections.

Two previous studies [36, 37] reported that aspiration due to epiglottis insufficiency and cough reflex decrease are the main causes of pulmonary infections in bedridden patients. In patients with consciousness disorders [38], if the body's physiological reflexes, especially the swallowing reflex and the cough reflex, decrease or disappear, this results in the accumulation of secretions and aspiration materials in the respiratory tract. These ultimately cause bacterial reproduction and an increase the incidence of pulmonary infections. Long-term bedridden patients often need invasive operations, such as endotracheal intubations, sputum suction, and ventilators, due to serious underlying diseases, however, which often destroy the normal barrier function of the respiratory tract, then inducing iatrogenic pulmonary infections. Our results are consistent with the research results of Lyons *et al.* [39]. The more invasive procedures the patients undergo, the higher the probability of a pulmonary infection.

Long-term bedridden patients often have complex underlying diseases and need to receive a large number of hormones and antibiotics to relieve their clinical symptoms and control the disease. A study by Jiang *et al.* [40] suggested that the long-term use of hormones and antibiotics can damage the body's immunity, leading to dysbacteriosis, double infections, and bacteria breeding in the lungs. A study of Wen *et al.* [41] also showed that the long-term use of antibiotics and hormone drugs will increase the risk of pulmonary infection. A previous study [42] confirmed that the use of hormones is positively correlated with the risk of pulmonary infections. The American Association of Infectious Diseases and the Thoracic Society [43] recommended that the duration of antibiotic treatment should be 7 days, because long-term antibiotic treatment does not show a better effect. Therefore, in the treatment of long-term bedridden patients, the administration of hormones and antibiotics must be done cautiously.

Moreover, treatment should be carried out according to the risk factors, which were divided into three levels, including high risk factors, medium risk factors and low risk factors. In this study, age, BMI, and smoking history were low risk-factors ($2 \geq OR > 1$), and diabetes, antibiotics, and stay-in-bed length were medium risk-factors ($3 \geq OR > 2$), and hormones, consciousness disorders, nasal-feeding, ventilator use, invasive operations, and hospitalization times were high risk-factors ($OR > 3$). Clinically, the clinicians can adjust the treatment strategy according to the risk factors associated with long-term bedridden patients.

Actually, there are few studies on the risk factors of secondary pulmonary infections in long-term bedridden patients abroad, so the articles that we were able to include in this study were limited. Therefore, this study also has some limitations. First, due to the limitations of language and the retrieval strategy, the retrieval may not be comprehensive. Secondarily, there are differences in the evaluation or measurement of the risk factors in different studies, and few studies involving some risk factors, which may cause a deviation of the results in this study. Third, the number of articles related to the risk factors in this study was fewer than 10, so there may be publication bias. Therefore, it is suggested that more high-quality, multi-center, large sample prospective studies should be carried out to provide an early warning and prevent the occurrence of pulmonary infections in long-term bedridden patients.

In conclusion, age ≥80 years old, a BMI<18.5 kg/m^2, and a smoking history are the low risk-factors for pulmonary infections in long-term bedridden patients. Diabetes mellitus, antibiotics, and stay-in-bed length are the medium risk-factors for pulmonary infections in long-term bedridden patients, and hormones, consciousness disorders, nasal-feeding, ventilator use, invasive operations, and hospitalization times are the high risk-factors for pulmonary infections in long-term bedridden patients. Therefore, nurses should identify the high-risk patients early on and provide targeted interventions and health education to prevent the occurrence of pulmonary infections in long-term bedridden patients.

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Disclosure of conflict of interest

None.

Address correspondence to: Dr. Ziqiong Li, Department of Infection, The First Affiliated Hospital of Chongqing Medical University, No. 1 Youyi Road, Yuanjiagang, Yuzhong District, Chongqing 400016, China. Tel: +86-23-89012887; Fax: +86-23-89012428; E-mail: 2359479720@qq.com; Qinghua Zhao, Nursing Department, The First Affiliated Hospital of Chongqing Medical University, No. 1 Youyi Road, Yuanjiagang, Yuzhong District, Chongqing 400016, China. Tel: +86-23-89012887; Fax: +86-23-89012428; E-mail: liziqiong420@163.com

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