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Assessment and Review of Pneumonia in a Nursing Home

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Abstract: Among residents of nursing homes, pneumonia is the second most common cause of infection associated with the highest mortality rate for any infection. We conducted this study to identify the prevalence of pneumonia in one nursing home in Lebanon and the risk factors that could lead to its development. A cross-sectional retrospective study was carried out. A thorough review of the patients' medical records was done followed by descriptive and logistic regression analysis. Among 225 patients studied, the prevalence of pneumonia was 0.54 episodes per 1000 days of resident care. Having other multiple co-morbidities (OR: 24.513; p=0.014), the use of antibiotics within one to six months prior to pneumonia (OR: 14.14; p=0.041), history of pneumonia (OR: 13.80; p=0.014) and a longer duration of stay at the facility (OR: 1.104; p=0.001) were associated with the development of the disease. Physical therapy and eating independency were protective factors. Conclusion, this study was carried out on patients residing in nursing homes in Lebanon that identified that pneumonia is associated with significant morbidity and mortality. The prevalence found is within the commonly reported range from the literature.

Key words: Long-Term Care Facility · Pneumonia · Prevalence · Risk Factors · Epidemiology · Infection

INTRODUCTION

Nursing homes or nursing facilities refer to residences that provide a wide range of medical and non-medical care and services and are known as long term care facilities (LTCF) [1]. Although there might be a number of non-nursing home facilities considered as LTCFs the terms nursing homes and LTCFs will be used interchangeably throughout the article. The importance of these institutions is highlighted by the increased proportion of elderly population worldwide, with an estimated number of individuals living in nursing facilities to rise from 15 million in 2000 to 27 million in 2050 [2, 3]. Residents of these facilities are particularly susceptible to infections with urinary tract infections as the most common, followed by pneumonia referred to as Nursing Home Acquired Pneumonia (NHAP) [4, 5]. The most recent American Thoracic Society (ATS) and Infectious Diseases Society of America (IDSA) nosocomial pneumonia guidelines illustrated NHAP as a subset of Health care-associated pneumonia (HCAP) to describe patients at risk for harboring multidrug-resistant (MDR) organisms despite their residence in the community [6, 7]. These guidelines were intended to be applied only to HCAP patients evaluated in the hospital setting; therefore it is not clear whether this definition should be applied to patients who remain in a nonhospital environment, such as a nursing home or LTCF.

The incidence of NHAP has ranged from 0.3-2.7 episodes per 1000 days of resident care and may be as high as 250 per 1, 000 persons per year compared to only 20-40 per 1, 000 persons per year of community acquired pneumonia (CAP) among elderly individuals living in the community [8-10].

Several studies investigated the potential risk factors for NHAP and yet some conflicting results were found. Profound disability, bedridden state, urinary incontinence, or deteriorating health status were shown to increase the risk of pneumonia [8]. Another study, found that old age, male gender, difficulty swallowing and inability to take oral medications increase the risk of acquiring the infection, whereas receipt of influenza vaccination was protective [10]. Other factors were also noted including, malnutrition, functional impairment, medications, invasive devices and prolonged antimicrobial exposure [3, 11].

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In Lebanon, care for the elderly is a growing concern. In 2010 the elderly population constituted 8.4% of the Lebanese population and it is estimated to reach over 27% by 2050 [12]. According to the national health statistics, there are 49 LTCFs that provide a total number of 4000 long term care beds. Of these institutions 18% are managed by geriatricians and it is estimated that 1.2% of the Lebanese elderly reside in these facilities (98.8% reside at home) [13]. The prevalence and risk factors of pneumonia in these LTCFs have not been evaluated. In fact, previous studies in Lebanon conducted on CAP focused on bacterial resistance and treatment while excluding patients residing in LTCFs. In addition, the Lebanese Society for Infectious Diseases and Clinical Microbiology developed guidelines for adult CAP for which they also excluded patients residing in LTCFs [14, 15].

The main objectives of this study were: to identify the prevalence of pneumonia in one Lebanese LTCF and to recognize potential risk factors for NHAP. We also aimed to determine the 30 day mortality rate, to describe the treatment regimen, as well as, to examine the appropriateness of the treatment regimen used to treat the pneumonia episode.

MATERIALS AND METHODS

Study Design and Eligibility Criteria: We conducted a cross-sectional, retrospective study in one LTCF in Lebanon. The facility is considered a rehabilitative and restorative center for adults, elderly and patients who require palliative care. Residents are followed closely by full-time geriatricians, nurses, physiotherapists and nutritionists; they are admitted to one of four available units including one dementia and Alzheimer's unit and three other surgical or medical units. Patients discharged between January 2013 and December 2014 were eligible to participate in this study; they were included if they were aged ≥ 18 years and resided more than 48 hours at the center. Patients discharged within 48 hours or less of their admission, presenting for outpatient care such as for physiotherapy sessions or outpatient consultations or those with missing one of the medical forms used for data collection were excluded. An extensive review of the patient's medical records was done by one investigator. The study was conducted in accordance with the Declaration of Helsinki.

Case Definition and Severity Assessment: A patient was considered to have a pneumonia episode based on written diagnosis by a physician or in the presence of tachypnea defined as respiratory rate more than 20 breaths per minute and two of the following symptoms at the same time, anytime during the patient's stay: fever defined as temperature ≥ 37.8 degrees Celsius, cough, increased sputum or productive cough, crackles, wheezes or bronchial breath sounds documented after auscultation and physical exam, hypotension defined as systolic blood pressure (SBP) < 90 mmHg or diastolic blood pressure (DBP) < 60 mmHg, tachycardia defined by a heart rate (HR) of >90 beats per minute, dyspnea identified by shortness of breath or difficulty breathing and new onset delirium or lethargy identified by a new state of drowsiness, confusion or lack of energy [9, 16 & 17]. Each case of pneumonia was followed up at 30 days, 1 year and at patient's discharge to determine the mortality rates. The CRB-65 (Confusion, RR, BP and age), which is the simplified tool of CURB-65 that omits blood urea nitrogen (BUN) levels was used to determine the severity of the case [18, 19]. Patients with a score of 0 or 1 (Mild severity) do not require hospitalization, those with a score of 2 (Moderate) should be considered for hospitalization and those with a score of 3 or 4 (Severe) are at high risk of death and should be urgently hospitalized [20]. An appropriate antibiotic type was considered in accordance with the Canadian Infectious Diseases Society and practice guidelines on the treatment of NHAP in the nursing home setting that recommend the use of an antipneumococcal fluoroquinolones (Levofloxacin or moxifloxacin) alone *or* either amoxicillin/clavulanate or a second- or third-generation cephalosporin in combination with azithromycin [16, 17 & 21]. On the contrary, an antibiotic regimen with broad-spectrum coverage prescribed based on the recommended course of therapy in a hospital setting was considered inadequate. Treatment duration of 7 to 10 days was judged appropriate and a dosing regimen that follows the approved prescribing schedule of the respective antibiotics was regarded as correct too. The appropriateness of the route of administration was not included nor evaluated in the data analysis.

Risk Factors Assessment: Several known or potential risk factors found in the literature were studied along with demographic and social factors and several co-morbidities. Of those, malnourishment was indicated by weight loss of more than 10% of body weight from admission, by receiving hyper caloric formulas or having a body mass index (BMI) < 18.5 (Kg/m^2) [22]. The presence of a tracheal tube, urinary catheter, intravenous line and feeding tube was identified. Immunization against pneumococcus and influenza was reviewed according to recent recommendations [23, 24]. In addition, mechanical ventilation, oxygen therapy, evidence of current or past

respiratory failure and hypoxemia (Oxygen saturation less than 90% by pulse oximetry) were detected. Further characteristics included: history of pneumonia, history of acute aspiration, difficulty swallowing, inability to take oral medications, bedridden, undergoing physiotherapy and hospitalization (When transferred to a hospital for an acute illness and spent at least one night before return to the facility). The use of antibiotics was recognized within one to six months and within more than six months from the occurrence of pneumonia, or from discharge in those who developed the disease and those who did not respectively. The receipt of more than one course of antibiotics in all patients was also identified. Medication history was evaluated from the pharmacy records; the use of poly-pharmacy was considered when a patient was taking five or more medications concomitantly [25] and the following classes of medications were identified: acid suppressive medications, narcotic analgesics, barbiturates, benzodiazepines (BZD) and non-BZD anxiolytics, sedative antihistamines, antidepressants, antipsychotics and corticosteroids [8, 11 & 18].

Functional impairment was assessed with the use of the activities of daily living (ADL-6) score through a baseline assessment of independency in the following activities: bathing, dressing, toileting, transferring, continence and feeding. Patients received 1 point on each of the activities when they were considered independent and that is if they can manage without supervision, direction or personal assistance. Alternatively they received 0 points when they were considered dependent irrespective of the dependency level. Possible scores ranged from 0 to 6 with a score of 5 to 6 indicating high functional independency and scores of 3 to 4 or $\leq$ 2 representing moderate functional impairment and severe impairment respectively [26, 27].

To assess cognitive impairment, we looked at the neurologic and memory examinations done upon admission. Patients with memory problems, confusion, disorientation or known Alzheimer's disease were thus, identified.

Statistical Analysis: All variables were entered into SPSS version 21.0© SPSS Inc. Initially, descriptive analysis was performed; means and standard deviations were calculated for continuous variables and frequencies determined for categorical variables. The prevalence of NHAP was determined by the frequency of patients who developed a pneumonia episode during their stay at the center. The total number of episodes that occurred was used to determine the incidence by 1000 days of resident care. Calculation of percentages based on recorded responses and valid percentages were reported. Bivariate analysis was then performed; relationship between categorical variables whether dichotomous or multinomial qualitative variables were examined using Pearson's Chi square or Fisher's exact tests when appropriate. Comparison of continuous quantitative variables was analyzed using student (Independent) T-test and Mann-Whitney test when normal or abnormal distribution was assumed, respectively. An α level of $\geq$ 5% was used to detect statistical significance. Valid 2-sided p-values were reported. A forward stepwise likelihood ratio logistic regression was then conducted for multivariable analysis to identify variables predictive of NHAP. The dependent variable was pneumonia and variables that showed significant results in the univariate analysis ($p < 0.1$) were considered the independent variables. Collinearity of independent variables was avoided by the use of the variance inflation factor (VIF) with values > 10 indicating serious collinearity. The Hosmere-Lemeshow goodness-of-fit test was used to assess the overall fit of the model and adjusted odds ratios (ORa) were calculated.

RESULTS

Prevalence of NHAP and Patient Demographic Information: A total of 225 patients were studied (Fig. 1) and baseline demographics are shown in Table 1.

The most common disease seen in the total population was hypertension (60.4%) followed by coronary artery disease, heart failure (32%) and diabetes (23.6%). A past medical history of previous or present infections was also usual (20.4%) with the most common infection reported being a urinary tract infection. Of noteworthy was the presence of other co-morbidities in the total patients (62.5%) such as: osteoporosis, rheumatoid arthritis, gastro-intestinal diseases, thyroid problems and ophthalmologic disorders and others. Statistically significant difference in past medical history between both groups is found in Table 1. A total of 28 cases of pneumonia were detected with an incidence rate of 12.4% and an incidence density of 0.54 episodes per 1000 days of resident care.

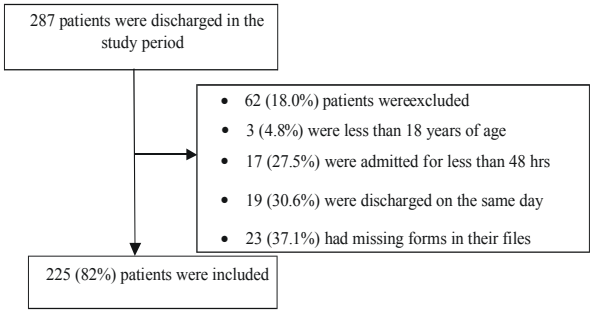

Fig. 1: Patient inclusion procedure

Table 1: Demographic information of patients with and without NHAP

Characteristic		All patients	Patients without Pneumonia	Patients with Pneumonia	P- Value
Number		225 (100.0)	197 (87.6%)	28 (12.4%)	
Age (years)	Mean (SD) [Min-Max]	75.9 (12.5) [19-99]	75.5 (13) [19-99]	78.9 (8.6) [58-91]	0.176
Gender	Male	77 (34.4%)	72 (93.5%)	5 (6.5%)	0.049
	Female	147 (65.6%)	124 (84.4%)	23 (15.6%)	
Marital status	Single	70 (31.7%)	56 (80.0%)	14 (20.0%)	0.08
	Married	113 (51.1%)	103 (91.2%)	10 (8.8%)	
	Widowed	38 (17.2%)	34 (89.5%)	4 (10.5%)	
Admission source	Hospital	115(53.0%)	99 (86.1%)	16 (13.9%)	0.155
	Home	102 (47.0%)	94 (92.2%)	8 (7.8%)	
Alcohol consumption	No consumption	154 (77.0%)	131 (85.1%)	23 (14.9%)	0.424[#]
	On occasions	39 (19.5%)	35 (89.7%)	4 (10.3%)	
	Drinker	7 (3.5%)	7 (100.0%)	0 (0.0%)	
Smoking status	Smoker	41 (19.8%)	35 (85.4%)	6 (14.6%)	0.301
	Ex-smoker	28 (13.5%)	22 (78.6%)	6 (21.4%)	
	Non smoker	138 (66.7%)	123 (89.1%)	15 (10.9%)	
Weight	Mean (SD) [Min-Max]	63.8 (11) [49-95]	64.8 (11.2) [45-95]	58.2 (7.5) [50-77]	0.001
BMI	Mean (SD) [Min-Max]	22.5 (2.8) [17.1-30.1]	22.7 (2.9) [17.1-30.1]	21.3 (1.9) [18.6-27.3]	0.021
BMI Categories	Underweight (< 18.5)	11 (6.4%)	11 (100.0%)	0 (0.0%)	0.237[#]
	Normal (18.5 – 24.9)	138 (79.8%)	114 (82.6%)	24 (17.4%)	
	Overweight (25.0 – 29.9)	23 (13.3%)	22 (95.7%)	1 (4.3%)	
	Obese (≥ 30.0)	1 (0.6%)	1 (100.0%)	0 (0.0%)	
Length of stay	Mean (SD) [Min-Max]	228.9 (506) [5-2779]	102.8 (249.5) [5-2779]	1115.9 (860.3) [22-2691]	<0.0001
Discharge status	Alive	173 (80.8%)	163 (94.2%)	10 (5.8%)	<0.0001
	Dead	41 (19.2%)	23 (56.1%)	18 (43.9%)	
Respiratory Diseases	No	200 (88.9%)	180 (90.0%)	20 (10.0%)	0.01[#]
	Asthma	2 (0.9%)	2 (100.0%)	0 (0.0%)	
	COPD	14 (6.2%)	9 (64.3%)	5 (35.7%)	
	Bronchitis	9 (4.0%)	6 (66.7%)	3 (33.3%)	
Depression	No	211 (93.8%)	188 (89.1%)	23 (10.9%)	0.019[#]
	Yes	14 (6.2%)	9 (64.3%)	5 (35.7%)	
Postoperative orthopedic surgery	No	121 (53.8%)	98 (81.0%)	23 (19.0%)	0.001
	Yes	104 (46.2%)	99 (95.2%)	5 (4.8%)	
Respiratory infection[a]	No	186 (82.7%)	167 (89.8%)	19 (10.2%)	0.035
	Yes	39 (17.3%)	30 (76.9%)	9 (23.1%)	
Presence of other comorbidities	No	84 (37.5%)	80 (95.2%)	4 (4.8%)	0.007
	Yes	140 (62.5%)	116 (82.9%)	24 (17.1%)	

Abbreviations: BMI: body mass index; COPD*:* chronic obstructive pulmonary disease*;* SD: standard deviation, Min: minimum; Max: maximum

[#] Fisher's Exact Test.

[a] Respiratory infections excluding pneumonia

Pneumonia Diagnosis, Symptoms, Severity and Treatment Data: Most of the patients with NHAP (78.6%) were diagnosed according to valid physician documentation, whereas the remaining 21.4% of the patients were considered to have developed a pneumonia episode based on a pre-specified definition and diagnostic approach. While some patients had a history of pneumonia before admission to the center, none of the patients developed more than one episode during their stay at the facility. The associated symptoms, severity of the infection and prescribed antibiotic are shown in Fig. 2 and Table 2 respectively.

When assessing the appropriateness of the treatment regimen according to pre-specified definition, 30.8% of the patients were treated with an inappropriate type of antibiotic, while most of the patients received the appropriate dosing regimen (92.3%) and duration (88.5%).

Risk Factors: Risk factors are presented in Table 3 which shows the statistically significant ones that were studied.

Overall, 45.1% received an antibiotic treatment regimen within more than 6 months; the occurrence of pneumonia was comparable in those who did and didn't (p=0.879). On the other hand those who were prescribed an antibiotic course within one to six months and those who received more than one course of antibiotic during their residence were more likely to express the disease. Patients' immunization records were revised and results are shown in Table 4.

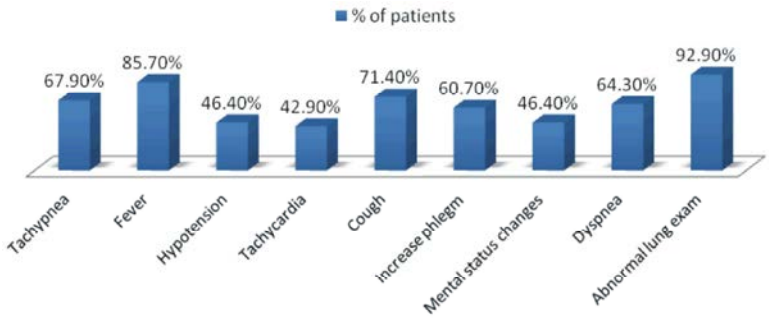

Fig. 2: Pneumonia episode associated symptoms

Table 2: NHAP severity and treatment regimen

Antibiotic regimen		Patients with Pneumonia
Diagnosis	Physician documentation	22 (78.6%)
	Diagnostic symptoms	6 (21.4%)
Time of pneumonia from admission	Mean (SD) [Min-Max]	840 (752.6) [22-2594]
Recent hospitalization	Yes	9 (32.1%)
Place of treatment	Successfully at the center	17 (60.7%)
	Center then transferred to a hospital	7 (25.0%)
	Initially transferred to a hospital	4 (14.3%)
Sputum culture taken	Yes	1 (3.6%)
CRB 65 Score	Mean (SD) [Min-Max]	2.4 (1) [1-4]
Pneumonia severity	Mild episode	6 (21.4%)
	Moderate episode	9 (32.1%)
	Severe episode	13 (46.4%)
Mortality within 30 days	No	24 (85.7%)
	Yes	2 (7.1%)
	Discharged before one month	2 (7.1%)
Mortality within one year	No	8 (28.6%)
	Yes	14 (50.0%)
	Discharged before one year	6 (21.4%)
Antibiotic type	Amoxicillin-clavulanic acid	2 (7.1%)
	Third generation cephalosporin	2 (7.1%)
	Levofloxacin	12 (42.9%)
	Moxifloxacin	3 (10.7%)
	Azithromycin	1 (3.6%)
	Ertapenem	1(3.6%)
	Piperacillin/Tazobactam	1 (3.6%)
	Combination beta lactam and macrolide	1 (3.6%)
	Other combinations	3 (0.7%)
	Not started at the center	2 (7.1%)
Duration of treatment	Mean (SD) [Min-Max]	8.6 (2) [5-14]

Abbreviations: CRB-65: confusion, respiratory rate, blood pressure; SD: standard deviation; Min: minimum; Max: maximum

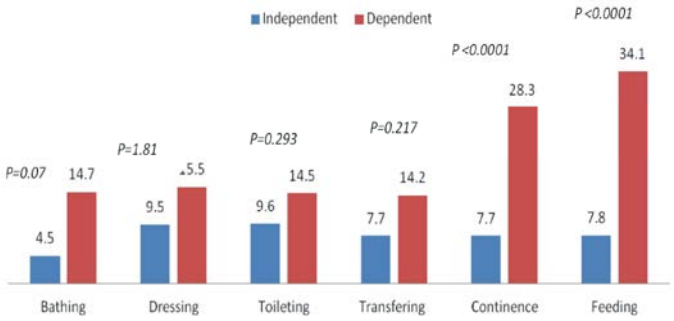

Fig. 3: Development of NHAP between independent and dependent patients in the different ADL

Table 3: Statistically significant NHAP risk factors

Characteristic		All patients N (%)	Without Pneumonia	With Pneumonia	
Number		225 (100.0%)	197 (87.6%)	28 (12.4%)	P- Value
Intravenous line	No	185 (82.6%)	169 (91.4%)	16 (8.6%)	0.001[#]
	Yes	39 (17.4%)	27 (69.2%)	12 (30.8%)	
Oxygen therapy	No	193 (86.2%)	174 (90.2%)	19 (9.8%)	0.006[#]
	Yes	31 (13.8%)	22 (71.0%)	9 (29.0%)	
History of previous pneumonia	No	199 (89.2%)	179 (89.9%)	20 (10.1%)	0.004[#]
	Yes	24 (10.8%)	16 (66.7%)	8 (33.3%)	
Acute aspiration	No	221 (98.7%)	195 (88.2%)	26 (11.8%)	0.042[#]
	Yes	3 (1.3%)	1 (33.3%)	2 (66.7%)	
Antibiotic use within 1 to 6 months	No	184 (83.3%)	165 (89.7%)	19 (10.3%)	0.029[#]
	Yes	37 (16.7%)	28 (75.7%)	9 (24.3%)	
More than one course of antibiotic	No	205 (91.5%)	184 (89.8%)	21 (10.2%)	0.004[#]
	Yes	19 (8.5%)	12 (63.2%)	7 (36.8%)	
Hypoxemia shown by pulse oximetry	No	195 (87.1%)	176 (90.3%)	19 (9.7%)	0.004[#]
	Yes	29 (12.9%)	20 (69.0%)	9 (31.0%)	
Difficulty swallowing	No	203 (90.6%)	181 (89.2%)	22 (10.8%)	0.032[#]
	Yes	21 (9.4%)	15 (71.4%)	6 (28.6%)	
Inability of taking oral medicine	No	218 (97.3%)	193 (88.5%)	25 (11.5%)	0.027[#]
	Yes	6 (2.7%)	3 (50.0%)	3 (50.0%)	
Undergoing physiotherapy	No	86 (39.4%)	67 (77.9%)	19 (22.1%)	0.001
	Yes	138 (61.6%)	129 (93.5%)	9 (6.5%)	

[#] Fisher's exact test

Table 4: Vaccination status of studied population

Characteristic		All patients N (%)	Patients without Pneumonia	Patients with Pneumonia	P- Value
Number		225 (100.0%)	197 (87.6%)	28 (12.4%)	
Influenza vaccine received[a]	No	91 (41.4%)	74 (81.3%)	17 (18.7%)	0.034
	Yes	22 (10.0%)	19 (86.4%)	3 (13.6%)	
	Not applicable	107 (48.6%)	100 (93.5%)	7 (6.5%)	
Pneumococcal vaccine[b]	Unknown	221 (98.2%)	194 (87.8%)	27 (12.2%)	0.415[#]
	Yes	4 (1.8%)	3 (75.0%)	1 (25.0%)	

[a]Influenza vaccine received in the fall through spring season in previous year. For patients who were admitted and discharged at other time we considered this variable not applicable

[b]Pneumococcal vaccine received at any time during the patient's stay. For patients with missing immunization history or lack of evidence of vaccination, we considered this variable as unknown.

[#] Fisher's Exact Test

Most of the patients were dependent in all the assessed ADLs. In fact, 80.1% of the patients were dependent in bathing, 52.5% in dressing, 62% in toileting and 76.5% in transferring, while they were less dependent in continence and in feeding (24% and 18.6% respectively). There was no significant difference in those who were dependent and independent in their ADLs in the development of pneumonia, except in continence and feeding (Fig. 3).

Cases had a significantly lower ADL score and were more likely to have severe functional impairment (Table 5). Patients with cognitive impairment were insignificantly more probable to develop NHAP (p = 0.131).

Medication history showed that 58.4% of the patients were taking five or more concomitant medications, however there was no difference in the disease development in both groups (p=0.134). Some of the most commonly used medications were acid suppressive therapies (81.8%) with omeprazole and esomeprazole being the most prescribed (52.2% and 23.4% respectively), followed by antidepressants (34.1%) with citalopram being the most frequent (57.5%), then anxiolytics (31.7%) with bromazepam as the most prevalent one (31%) and the non-benzodiazepine tranquilizers (21.1%). The use of narcotic analgesics was seen in 22.2% of the patients with the most frequent agents including codeine in combination with paracetamol and tramadol; morphine was rarely used. Only 10.2% of the patients were reported to have used antihistamines with hydroxyzine as the most widespread agent (60.9%). There was no significant difference between both groups in most of the studied drugs except with anxiolytics, antidepressants

Table 5: Functional and cognitive assessment in patients with or without pneumonia

ADL		All patients N (%)	Without Pneumonia	With Pneumonia	
Number		225 (100.0%)	197 (87.6%)	28 (12.4%)	P- Value
ADL -6 Score	Mean (SD) [Min-Max]	2.86 (1.8)[0-6]	3.0 (1.7)[0-6]	1.8 (1.8)[0-6]	0.001[#]
Functional impairment	High independency	41 (18.6%)	39 (95.1%)	2 (4.9%)	0.04
	Moderate impairment	85 (38.5%)	77 (90.6%)	8 (9.4%)	
	Severe functional impairment	95 (43.0%)	77 (81.1%)	18 (18.9%)	
Cognitive impairment	None	159 (72.6%)	142 (89.3%)	17 (10.7%)	0.144[#]
	Known memory problem	13 (5.9%)	9 (69.2%)	4 (30.8%)	
	Known confusion/disorientation	25 (11.4%)	22 (80.0%)	3 (12.0%)	
	Known Alzheimer disease	19 (8.7%)	16 (84.2%)	3 (15.8%)	
	More than one	3 (1.4%)	2 (66.7%)	1 (33.3%)	
Overall cognitive impairment	No	159 (72.6%)	142 (89.3%)	17 (10.7%)	0.131
	Yes[a]	60 (27.4%)	49 (81.7%)	11 (18.3%)	

Abbreviations: ADL: activities of daily living; SD: standard deviation; Min: minimum; Max: maximum.

[a] Cognitive impairment is considered if any known memory problem, confusion, disorientation or Alzheimer disease present

[#] Fisher's Exact Test.

Table 6: Multivariable analysis for the predictors of NHAP

Independent variables in logistic regression model	OR_a	95% CI	P- Value
Length of stay	1.104	1.002- 1.006	0.001
Other multiple co-morbidities	24.513	1.892 - 317.622	0.014
History of pneumonia	13.805	1.684 - 113.146	0.014
Antibiotic use within 1 to 6 months	14.143	1.515 - 132.040	0.041
Physical therapy	0.149	0.028 - 0.783	0.025
Feeding independency	0.028	0.004 - 0.222	0.001

Abbreviations: CI: confidence interval; NHAP: nursing home associated pneumonia; OR_a: adjusted odds ratio

and antipsychotics. In fact 23.9% of the patients receiving anxiolytics developed NHAP compared to only 7.2% of those who haven't ($p<0.0001$), as well as 20.5% of those taking antidepressants compared to 8.6% in the other group ($p=0.011$) and 36.4% versus 8.4% respectively receiving antipsychotics or not ($p<0.0001$).

Multivariable Analysis: Age and gender adjusted multivariable analysis followed the univariate analysis for all patients included in this study. The Omnibus Tests of Model Coefficients was found significant (<0.0001). The Hosmere-Lemeshow goodness-of-fit test was used to assess the overall fit of the model, it was found to be non significant (0.380). Results of significant variables in the equation are presented in Table 6. Age and gender were found to be insignificant.

DISCUSSION

This is an epidemiological study conducted to assess the prevalence of pneumonia at a nursing home in Lebanon and in the Middle East. We have found an incidence rate of which appears to be lower than that reported in most published studies. This suggests that some cases had possibly not been included but also could be explained by the fact that we included all patients admitted to the nursing home rather than limiting the population to the elderly. This has been previously documented in a study that showed that elderly patients had twice the incidence of nursing pneumonia as younger patients [28]. On the other hand, all patients were diagnosed clinically by physical examination and associated symptoms because a chest radiograph was not available on site. As such some cases of respiratory infections could be erroneously diagnosed as pneumonia and could have influenced the results by falsely increasing the incidence rate. Nevertheless despite taking the above mentioned points into consideration, the incidence rate found is within the overall range of 0.3 to 2.5 episodes per 1, 000 patient-days found from previous studies [8].

In our study, the presence of other multiple co-morbidities was the most important risk factor associated independently with the development of NHAP. We looked at other multiple co-morbidities as the presence of one, two or more additional medical or psychiatric conditions than the ones we studied and may or may not directly interact with each other within the same individual. The Charlson co-morbidity index (CCI) assesses co-morbidity level by taking into account both the number and severity of 19 pre-defined co-morbid conditions. It is the most widely used scoring system for

co-morbidities used by researchers and clinicians but was not calculated in our present study since it is extensively used to assess the risk of the thirty days or one year mortality rates following NHAP which was not the objective of our study [29]. Nevertheless, previous studies have identified that NHAP affects the elderly population with multiple co-morbidities; Nakagawa *et al*. [31] detected that patients with NHAP had significantly more co-morbid conditions and higher scores of the CCI than those with CAP, in addition to the fact that a score of more or equal to 3 was associated with higher mortality. Our results are also consistent with previous studies that established that pneumonia in residents of nursing homes compared to CAP occurred more in patients with higher CCI score and co-morbid underlying diseases that predispose them to site-specific infections of which the exact mechanisms involved have not been fully established [30, 31]. These findings suggest that further studies should be done by examining and including further diseases and comparing them between both groups because hidden medical conditions could influence the study model and could independently influence the development of NHAP.

Consistent with our results, antibiotic treatment during one to six months preceding the onset of NHAP has been frequently reported to be a risk factor [32, 33]. It may also reflect an individual susceptibility to infections. Previous antibiotic therapy may select bacteria colonizing the upper respiratory tract and repeated aspirations can therefore lead to the development of lung infections [11]. Rothan-Tondeur *et al.* [34] reported that, 54.1% of cases and 26.8% of controls had received antibiotics during the previous month and was significantly associated with the further development of pneumonia. These figures also emphasize that antibiotic prescription is frequent in such patients and suggest the persistence of certain factors predisposing to pulmonary infection; they may be relatively or completely inaccessible to prevention or treatment. Finally, repeated aspiration of oropharyngeal flora modified by drugs or poor oral hygiene is frequently observed in geriatric populations and most often contributes to the development of pneumonia [35]. In our study, we found similar results where patients who received antibiotics within one to six months were independently and significantly at higher odds of acquiring pneumonia. In addition, patients who received multiple courses were also significantly at higher risk of developing NHAP however it was not detected to independently affect the disease in the multivariable analysis.

History of pneumonia was significantly associated with the development of NHAP in both univariate and multivariable analysis. In one study, history of pneumonia acquired at a geriatric hospital was found as one of the most important independent risk factors [34]. Eighty-one cases of pneumonia were followed in LTCFs; 35 (43%) experienced at least one recurrence of pneumonia over a period of 1 year [36].

As for the length of stay, we found that a longer stay at the facility is slightly but significantly independently associated with pneumonia. Even though previous studies did not address or identify this as a factor that could increase the risk of developing an episode, the incidence of pneumonia appears to increase in long-term units defined as an average stay at the facility 880 days compared to elderly patients admitted to short-term units [34]. These results could be related to the fact that a longer stay at the facility favors the transmission of infections to residents.

Patients with pneumonia were found to be more dependent in their ADLs indicated by a statistically significant lower score. Our results are very similar to those of a recent study where patients with NHAP had a mean score of 1.4 [SD 2.0 (0.6–2.1)] compared to a score of 3.3 [SD 2.5 (2.9–3.6)] for those with no NHAP symptoms ($p<0.001$) [37]. In another study, up to 70% of patients were partially or totally dependent, where poor functional autonomy had considerable effect on pneumonia severity and mortality [38]. Also, data by El-Solh *et al*. [32] showed that worse functional status according to the ADL score greatly increased the likelihood of infection with drug-resistant bacteria. Individuals with severe functional impairment and urinary and fecal incontinence and eating dependency were associated with an increased risk of pneumonia. However, eating dependency was the only significant item of dependency correlated in the multivariable analysis with the development of NHAP in the present study where patients who were independent in their eating habits were less likely to develop pneumonia. These results are also consistent with the results of a previous study which revealed that global dependency was not identified as a risk factor, but after analysis of the various components of dependency, only the criterion of eating dependency was revealed to be significant [39]. In fact, the presence of eating dependency generally reflects a high overall level of dependency [40]. Feeding by another person may not fully respect the patient's rate and capacity of swallowing, as well as, it can predispose to malnutrition and therefore, nutritional status and eating dependency are interrelated

and may reflect multiple deficiencies predisposing to NHAP. While the above cited studies revealed that eating dependency is a risk factor, we found that eating independency was protective; this further strengthens an association with pneumonia.

Another factor that was shown to be less likely associated with NHAP was physical therapy, which is vital toward restoring or maintaining physical and mental function. At the center, policies and procedures covering infection control aspects of physical therapy including cleaning and disinfecting of hydrotherapy tanks and equipments, hand hygiene indications and cleaning of exercise equipment are well developed which help in reducing the risk of bacterial cross contamination. In addition, the most common indication of physiotherapy was for the rehabilitation and restoration of physical function after undergoing orthopedic surgery. These patients were found to have a lower mean age than that of the total population and seem to have less co-morbidities. As such these patients were overall healthier influencing a lower likelihood of developing pneumonia.

Our findings were different in some of the aspects to a previous prospective multicenter study that identified older age, male gender, swallowing difficulty and inability to take oral medication as independent risk factors; we found that patients who developed pneumonia were insignificantly older compared to those who did not and in general the mean age in both groups was much lower than the mean age reported in that study with 78.9 and 75.5 compared to 85.8 and 83.5 years respectively [8]. Furthermore, the mean age of our population was lower than the age of residents in such units in other countries; in Italy, it is 81 years [40] in Canada 89 years [41] and in Germany 83 years [42]. In Norwegian LTCFs more than 78% of residents are aged ≥81 years [43]. For this reason the morbidity associated with NHAP among the residents studied may be lower than indicated in the literature. Of note is that the study setting is considered a nursing home but also a rehabilitative, restorative center where 46.2% of the patients were admitted for post orthopedic surgery for rehabilitation purposes and have a younger mean age. Also, we found that females were slightly more at risk to develop pneumonia compared to males as opposite to the cited study, but gender was later found to non-significantly affect NHAP in the multivariable analysis. These results could be confounded by other factors. In fact, most of the males were undergoing physiotherapy; this could have affected the results as our model revealed that physiotherapy is a protective factor and this can show that males have a lower risk of acquiring the disease. On the other hand, most females had a longer duration of stay at the facility and so can influence the results towards finding that females are more at risk to develop pneumonia. In all cases, gender remains a factor of debate in the literature that warrants further investigation. Swallowing difficulty and inability to take oral medication were significant in the univariate analysis but not in the multivariable analysis, the small number of individuals who met these criteria in our study could explain this.

According to an earlier report, malnutrition and recent weight loss have been significantly associated with the development of pneumonia [22]. In our data set, both weight and BMI (Which could represent malnutrition), were associated with the development of pneumonia, however, malnutrition was found to be insignificant. This actually could be the result of inadequate identification of malnourished patients since in the elderly, recent weight is not always known and assessment for weight loss is difficult.

Among the risk factors of NHAP, researchers also mention the excessive use of sedatives. In our study population, the use of anxiolytics, antidepressants and antipsychotics was associated with the development of NHAP. These medications have sedating or anticholinergic side effects that may increase the risk of aspiration, which is considered a major risk factor of pneumonia [11]. Results from previous studies are conflicting; Loeb *et al*. [10] considered the use of both minor (Anxiolytics) and major tranquilizers (Antipsychotics) in their analysis; they did not identify these medications as independent predictors of pneumonia. However, a previous retrospective case control study, found that patients with pneumonia were more likely using major tranquilizers [44]. Similarly, a prospective case-control study that focused on modifiable factors was able to identify that receipt of tranquilizers (Anxiolytics and antipsychotics) is an independent risk factor however there was no association between antidepressant use and pneumonia [11]. Contrary, a study undertaken to identify possible signals of iatrogenic illness in the elderly found that hospitalization for aspiration pneumonia was three times as likely to occur in the ninety-day period following or preceding a hospitalization for depression [45] leading to the hypothesis that antidepressant drugs may increase the risk of aspiration pneumonia. Since this study did not measure exposure to antidepressants or attempt to control for patient factors that may change over time, the findings of another study refuted this prior hypothesis mentioning

that previous results may have been confounded by co-morbidity measures [46]. A recent study was prematurely discontinued because of the associated side effects with atypical antipsychotic in nursing home residents including pneumonia [47]. While not specific to patients residing in nursing homes, a recent study conducted on elderly patients found that current use of antipsychotics was associated with an almost 60% increase in the risk of pneumonia [ORa 1.6, (CI 1.3-2.1)], with the greatest increase in risk found for atypical antipsychotics [48].

The rate of vaccination against influenza and pneumococcal diseases is much lower than that reported elsewhere [37, 38]. Those who received the flu vaccine in the previous year had a lower risk of acquiring pneumonia, comparable with many previous published studies as influenza virus has been known to be a causative agent in the development of pneumonia [11, 19]. The efficacy of pneumococcal vaccine in the elderly population has been the subject of considerable debate as a result of the lack of prospective, randomized controlled trials [49]. Despite this limitation, latest guidelines including the 2010 CDC guidelines, recommend that all residents of LTCF's should receive annually the influenza vaccine and that all adults age 65 years and older should receive the pneumococcal vaccine because the vaccine is safe, inexpensive and cost effective [23, 24].

An association has also been found between certain specific co-morbid conditions and the development of pneumonia, such as history of respiratory diseases including asthma or COPD and chronic lung disease, respiratory infections and depression which were also studied previously and conflicting data exists in the literature that warrant further investigations [8, 10 & 37].

Hypoxemia was also predominant in patients with pneumonia. Pulse oximetry may assist in differentiating pneumonia from other infectious processes in febrile patients residing in long-term care facilities [50]. This was carried out in the study center and supported by the latest guidelines. Furthermore, the oxygen saturation value was missing in some of the patients evaluated and we decided not to report it; this may have affected its significance in a multivariable model. In fact, hypoxemia is considered one of the important indicators in the pneumonia prognosis index of acute severity and short-term mortality for patients with CAP, which included residents with LTCF-acquired pneumonia [51]. This index has been further validated in nursing home populations [52].

Lastly we also identified the presence of oxygen therapy, intravenous catheters and acute aspiration as potential but not independent risk factors for the development of pneumonia according to multivariable analysis. Rothan-Tondeur *et al.* [34] reported that oxygen therapy was the most important independent factor associated with NHAP. Even though oxygen therapy may be a marker of debility and predisposing pulmonary disease, it could emerge as a risk factor because it transmits infections directly to the patient via humidified air. Intravenous catheters can also predispose individuals to infective diseases. Acute aspiration was found to be slightly significant; we found only three patients with documented acute aspiration because of the retrospective nature of our study and two of them were associated with pneumonia. Aspiration is found to be the major contributor to pneumonia in residents of nursing home in previous reports [11]. Strategies directed at preventing aspiration may be useful in preventing pneumonia in elderly nursing home residents; they deserve further study and include: altering the consistency of the diet, the positioning of residents especially during feeding, the frequency and timing of meals, dental care and oral hygiene. In addition to the above, the risk of NHAP is evident among residents fed by gastric tubes, those with tracheotomy tubes and bladder catheters. Although our study did not achieve similar results, but the use of more invasive medical procedures among nursing home residents may be important in the incidence of NHAP [1, 34].

The NHAP mortality rate described in the literature varies depending on the place of treatment. In a LTCF the 14 days mortality for patients with pneumonia was 23% and the long term mortality was 74% at 1 year and 82% at 2 years [11]. We obtained an overall lower rate of 7.1% at 30 days, yet within the reported rate of 7%–19% for patients who received treatment at the facility [53] and 50% at one year. This slight difference compared with cited studies could be explained by taking into consideration three factors: first that we did not look into patients who were transferred into the hospital, second the difference in geographic variation of pathogens, virulence and antibiotic resistances of other cited studies and third because of the fact that we included adult residents of 18 years or older rather than limiting our population to the elderly. This later point is further supported by a study in Germany that showed that a younger subject group of less than 65 years displayed two times lower mortality than those 65 or over [54].

Our data set found that most of the patients had a severe pneumonia episode as classified by the CRB-65 score, yet few patients were immediately transferred to the hospital for the acute management [55]. Some patients were later transferred after receiving initial treatment at the

center and accordingly comparative numbers between those with a severe episode and those who were eventually treated at the hospital was found. In fact, our findings are in keeping with the results that indicate that 63%–78% of NHAP episodes were treated in the nursing home [8-10]. Usually, there is a great variation in the organization of care within nursing homes and the physicians' decision to hospitalize residents who have suspected pneumonia remains inextensively studied.

Consistent with prior data, more than one fourth of the patients did not present with either dyspnea, or cough and some had no fever, suggesting that patients with NHAP often lack the typical symptoms of pneumonia [38].

Treatment appropriateness was seen in most patients in our study. The most common cause of treatment inadequacy was the use of b-lactams or macrolides as monotherapy; this was comparable to a recent study conducted by Ayaz *et al*. [56] which reported that 3.3 %, 2.2% and 2.7% of the patients who started treatment at the nursing home before admission to the emergency department had started treatment with either a amoxicillin-clavulanic acid, cephalosporins or macrolides monotherapy respectively. Some patients were treated according to the treatment at a hospital setting with broad spectrum antibiotics to target MDR organisms. The microbial etiology is still debated in the literature with few studies confirming the hypothesis of a nosocomial pattern in elderly patients with NHAP [30, 41]. Accurate dosing and duration of treatment was seen in most patients, as it is important for avoidance of potential side effects and increasing the spread of MDR organisms.

Our study has a notable strength; it is the first descriptive and epidemiological study conducted in Lebanon and the Middle East to determine the prevalence of pneumonia and the associated risk factors in adults in a long term care facility. These results can give some preliminary information and present the opportunity for further research to be conducted on that subject. However, several limitations must be acknowledged. First, this was a study conducted on patients admitted to a single private facility in an urban area. Patient selection bias might have influenced the present study, because our study center specializes in rehabilitation and physical therapy after orthopedic surgery as well as geriatric medicine that might have influenced the low incidence rate of NHAP. In addition, patients admitted to the center are either covered by medical insurance or are self payers; therefore some of our findings might not apply to other public or private institutions that provide care for patients having different demographic and medical characteristics. Second, this was a retrospective study, therefore even though we conducted a thorough review of the patients' medical records, some information with regards to the medical history, symptoms, medications and progress throughout their stay might be missing and as such, some cases of pneumonia could have been missed. In addition, suspected cases of pneumonia were not definitively diagnosed as recommended based on pulse oximetry and chest radiography [52]. Third, the study lacked a severity scoring system other than CRB-65 because of the lack of laboratory data, whereas several useful tools for the assessment of pneumonia severity in NHAP patients were reported. Fourth, we included a relatively low number of patients compared to the number of elderly patients residing in LTCFs reported by the national health statistics in Lebanon [15]. Fifth, the study neither provided information on the likely pathogens or etiology associated with NHAP, nor on the predictive factors of mortality. That is because a microbiological examination was not conducted and they were not the objectives of this study, despite the fact that these are emerging areas of research and debate in the literature to further look into NHAP as a distinct and separate entity of respiratory infections. Last but not least, we did not calculate the CCI score that could have given a better insight into the co-morbidity score that is associated with pneumonia; it could have been compared with other related studies and also could have been used to examine initial data of predictive mortality factors.

CONCLUSIONS

In Lebanon, information on NHAP is lacking; it appears that NHAP is not looked at as a distinct respiratory disease and is so far diagnosed and treated the same as CAP. Further studies are needed to discuss the current epidemiological situation in LTCFs nationally to be able at first to identify the microbial etiology so that health care practitioners would recognize NHAP as an entity separate from CAP. Despite being a retrospective study with a small number of patients, this study points that NHAP is associated with significant morbidity and mortality in patients residing in nursing homes in Lebanon and measures for its prevention should be further elaborated. Future prospective can help delineate clear guidelines on the diagnosis, treatment location and optimum antimicrobial agents and regimen for the treatment of NHAP in patients treated at the nursing home or at the hospital.

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