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The relationship between psycho-emotional and behavioral disorders and invasive pneumococcal infection with direct impact on children and parents

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ABSTRACT

Background: Invasive infections caused by streptococcus pneumoniae are a significant cause of morbidity and mortality in the pediatric population. Bacterial pneumonia is one of the most common invasive pneumococcal infections, sometimes requiring multiple and prolonged hospitalizations and high costs. In addition to the prolonged clinical course of this pathology, there are long-term negative psycho-behavioral consequences in the absence of proper multidisciplinary management for both children and their parents.

Materials and methods: The aim of this study is to identify the main psycho-emotional and behavioral disorders occurring in patients with invasive pneumococcal infections. The study included a group of 80 pediatric patients, admitted to the Children's Emergency Clinical Hospital "Sf. Ioan" in Galati together with their legal guardians.

Results: The results showed that hospitalized children represent a vulnerable category and are prone to social conditions affecting mental health. The present study revealed that the 2-5 age group was the most affected by the incidence of pneumococcal pneumonia, and those who experienced complications due to the disease required a longer hospitalization period of more than 7 days.

Conclusion: Children with severe or recurrent pneumococcal infections are predisposed to the development of these psycho-emotional disorders, but some preventive measures such as vaccination would considerably change the quality of life of pediatric patients.

Keywords: invasive infections, psycho-behavioral disorders, vaccination, children

INTRODUCTION

Invasive pneumococcal infections are a common pathology encountered in pediatric practice in both outpatient and hospital settings. Streptococcus pneumoniae is a pathogen responsible for the occurrence of invasive infections (community-acquired pneumonia [CAP], acute otitis media, bacteremia, and meningitis), particularly in young pediatric patients. Streptococcus pneumoniae is a gram-positive diplococcus that was first isolated by Louis Pasteur in France in 1881 and comprises more than 100 serotypes pathogenic to humans. In terms of incidence, streptococcus pneumoniae accounts for approximately 27% of cases of CAP worldwide and is one of the leading causes of death of all infectious diseases. However, there are certain predisposing factors that increase the risk of infection in the pediatric population, such as adverse socioeconomic background, institutionalization (children in foster care), community attendance, second-hand smoke, and artificial feeding in the first year of life. In addition to these predisposing factors, there are also risk factors associated with this pathology, namely young age under 2 years, immunosuppressed patients, lack of vaccination, abusive antibiotic therapy in personal history, and splenectomy [1-3].

Nasopharyngeal colonization with streptococcus pneumoniae is a prerequisite for the development of these invasive infections. The rate of colonization peaks at around 2-3 years of age at 50%-80% and then decreases with increasing age to a minimum of 5%-10% in children over 10 years of age [4]. The introduction of pneumococcal conjugate vaccines (PCV) has considerably reduced the incidence of infections with vaccine-coated serotypes, while non-vaccine serotypes have become increasingly common [5]. However, some patients were not receptive to PCV vaccination because it was not included in the mandatory national immunization calendar (for example, Ukraine, Czech Republic, Egypt, Estonia, etc.) resulting in invasive infections with more aggressive serotypes and the need for prolonged or even repeated hospitalization in a short period of time [6-8]. In Romania pneumococcal vaccination was included in the national immunization scheme starting October 2017. Thus, the national childhood pneumococcal immunization program has led to a decrease in the circulation of the serotypes included in the vaccine, but not of the other serotypes causing invasive pneumococcal disease.

Invasive pneumococcal infections have frequently been reported in association with other respiratory co-infections specific to seasonal variations or in the context of pandemics, e.g., COVID-19, making their evolution and prognosis unfavorable for the patient [9]. Thus, the diagnosis of these invasive pneumococcal infections in children, correlated with certain risk factors, comorbidities, lack of vaccination, and association with other bacterial or viral co-infections have led to a prolonged course of the disease with the development of complications. All this had a major psycho-behavioral impact on the pediatric patient and other family members [10].

In these situations, the attention is focused more on the clinical symptoms caused by this pathogen and less on the psycho-emotional and behavioral side effects that target the patient (post-traumatic stress, specific phobia, depressive states, and anxiety). Pneumococcal pneumonia presents a wide range of symptoms that are not necessarily sensitive or specific, which may cause difficulties for the medical specialist and thus delay the diagnosis, the initiation of therapeutic management, and finally the unfavorable prognosis. These psycho-emotional and behavioral disorders can affect both pediatric patients and their parents, thus impacting mental health and quality of life. The onset or existence of an acute or chronic illness has an impact on the whole family, not just the sufferers. Family support can be an important resource for psychological stability and a source of support in the patient's recovery [11]. In the following, we will detail these psycho-emotional and behavioral disorders.

Post-traumatic stress disorder develops after going through an unpleasant even extreme experience associated with helplessness and fear. Following this event, the person continues to have intense feelings related to the moment, nightmares, irritability, insomnia, and avoidance of places or situations that may lead to the memory of the traumatic event [12, 13].

Specific phobia is an enduring and unreasonable fear due to exposure to an object or situation that leads to an immediate reaction, ultimately causing the person to endure intense anxiety or avoid the object or situation. Specific phobias can be classified into several subcategories, but this paper wishes to focus on those phobias caused by certain injuries or invasive medical procedures (needles, surgery, etc.) [14-16]. The pediatric patient, the one who is undergoing certain medical and surgical maneuvers, is particularly targeted here.

Depressive moods occur as a subjective reaction in relation to environmental elements that put the individual in a difficult situation, especially when their aspirations are followed by failure. Depression is considered one of the most common and serious mental disorders and is thus a multidisciplinary problem that affects not only adults but also older children and adolescents [11]. Prevention and careful assessment of these suspected depressive patients is absolutely necessary due to the fact that children and adolescents can mask their symptoms very well and thus remain undiagnosed.

Anxiety is a conditioned response to specific environmental stimuli, a natural emotion that is part of our lives, but when it crosses the threshold of intensity it becomes pathological and is experienced as intense fear, anxiety, or tension [17, 18].

Thus, invasive pneumococcal infections in the pediatric population represent a vast pathology with multiple implications that affect both the patient in question, but also the adults (parents) and medical staff. Therefore, the main objective of this study is to identify the main psycho-emotional and behavioral disorders that may occur in pediatric patients diagnosed with acute CAP caused by streptococcus pneumoniae.

MATERIALS AND METHODS

Patient Selection

The present study is part of a larger study, which included 181 pediatric patients aged 0-14 years, diagnosed with different potentially invasive infections (acquired CAP, acute otitis media, sinusitis) caused by streptococcus pneumoniae, hospitalized at the Children's Emergency Hospital "Sfântul Ioan" in Galati. From the total group of patients, we selected only 80 pediatric patients to participate in this study, diagnosed with different evolving forms of acute pneumonia with streptococcus pneumoniae as an etiologic determinant. As the analysis focused only on CAP, this was the reason why the total number of patients included in the study was 80 children. The other patients were diagnosed with other types of pneumococcal infections with different localizations.

Study Inclusion Criteria

The study inclusion criteria were patients aged 0-14 years and diagnosed with different forms of acute pneumonia with streptococcus pneumoniae as the etiologic agent. The study focused in particular on cases of CAP with streptococcus pneumoniae. The incidence of this pathology was analyzed primarily according to age group, personal pathological history, period of hospitalization, and evolution of cases in terms of complications.

As the study focuses on the psycho-emotional and behavioral phenomena that accompany invasive infections, we have conducted a preliminary assessment in order to exclude all participants who do not meet any mental health-related concerns. We have, therefore, applied the short form of the patient health questionnaire (PHQ-9) [19]. All instructions and scoring issues were maintained from the original source, as such: the 9 items were scored on a Likert scale, from 0 ("not at all") to 3 ("nearly every day"). Participants (or their caregivers) were instructed to describe themselves (or their child, for caregivers of children who were not yet instructed to read), over the past two weeks from the time of the assessment. As previous studies show, out of a total score of 27, scores above 10 exceed a potential cut-off and are able to discriminate between people who experience moderate depression and people who do not experience depression whatsoever [20]. We have, therefore, chosen the PHQ-9 score of 10 as a cut-off to distinguish between children who do and do not experience psycho-emotional symptoms. The 80 participants included provided scores ranging from 10 to 26 (mean [M] = 17.43, standard deviation [SD] = 4.18) and were included in the final assessment.

Data Analysis and Statistical Analysis

The period studied was between 2015-2017, before the introduction of the PCV in the national immunization scheme. All the data that was collected following the clinical and paraclinical examination of the patient was entered into an Excel spreadsheet and then filtered as necessary. In the study presented in the article, we also used a series of graphical representations to help us visualize and better understand the

results obtained. We also used a line representation to show the evolution of cases by age group.

For the comparison of the daily averages for the two periods analyzed, given that the sample used was quite large, we used the Z-test. We also applied the ANOVA test, which is a parametric test, or the Kruskal-Wallis test, which is a non-parametric test and is applied when one or more of the assumptions of the ANOVA test are violated (normality–the variable is normally distributed in each group, homogeneity of variance–the variance must be approximately identical for all groups).

Clinical data, concerning patients' and parental caregivers' psycho-emotional and behavioral symptoms, was collected in two measurement waves, through a semi-structured interview. SCID-5 is the most frequently used diagnosis instrument for screening and assessment purposes, as far as the DSM-5 criteria are concerned [21, 22].

SCID-5 is designed to assess a wide range of DSM-5 symptoms and disorders, ranging from anxiety (specific phobia included) and depressive disorders to trauma and stressor-related disorders, such as PTSD (post-traumatic stress disorder). As per its initial purpose, SCID-5 can either be used at a disorder level, as a diagnosis tool, or at a symptom level, as a mere screening tool [22]. Usually, the clinician chooses to either assess a diagnosis categorically or dimensionally. A categorical assessment is supposed to establish whether or not a DSM-5 diagnosis is present. A dimensional assessment, on the other hand, focuses on listing the unique symptom configuration for each specific person. Data can be interpreted both quantitatively and qualitatively, depending on the general purpose of the evaluation.

Our general purpose was to evaluate mental health-related symptoms in two measurement waves: before and after psychological counseling. Consequently, we have employed a dimensional assessment of the following DSM-5 disorders: generalized anxiety, specific phobia, major depressive disorder, and post-traumatic stress disorder. We henceforth make the following specifications: as SCID-5 questions (and diagnosis criteria for DSM-5 disorders) are more suitable for adults, we have ensured that, for preadolescents, the parents could complete the protocol and answer the questions from their child's point of view. For children aged 7 and above, the wording of each question was adjusted by the clinician to each child's level of understanding. Questions such as "does this produce distress to you" were worded as such: "does this upset you", "does this make you worried", and "does this make you feel unwell", each target question being tailored to the children's age and understanding of emotional stimuli. The questions addressed to the caregivers remained unaltered from the original protocol. It is important to note that anxiety and depression take various shapes in children, which might differ from those of adults. Children might experience separation anxiety or elective mutism instead of anxiety and disruptive behavior dis-order in place of depressive disorders, as their patterns of emotional regulation usually differ from those of adults, and symptoms such as anhedonia might actually be expressed through anger or frustration. Therefore, where suspicions of anxiety and depression-related symptoms in children could not be confirmed by simply administering the questions related to generalized anxiety or major depressive disorder, the clinician proceeded to ask the following questions: "after the hospitalization, did the child find it troubling to communicate with their peers or with other people outside of the family?" (to assess elective mutism); "after the hospitalization, did the child find it difficult to part from you/to go to school/to spend time with people other than the close family?" (for separation anxiety); "after the hospitalization, did the child become more frustrated, more aggressive, angrier than he was before?" (to assess any potential disruptive behavior).

The initiation of this study was approved by the Ethics Committee of the Children's Emergency Clinical Hospital "Sf. Ioan" in Galati (no.19398/10.11.2020), each patient, in this case, the legal guardians, filling out an informed consent form expressing their participation in this research.

RESULTS

The interviewed group of 80 pediatric patients was followed over 3 years using the information base from the archive of the Children's Emergency Clinical Hospital, "Sf. Ioan" from Galati. The study was a retrospective cohort study, and selected patients were included according to the following criteria: socio-demographic characteristics (sex, means, and age), period of hospitalization, different types of pneumonia, and main types of psycho-emotional and behavioral manifestations. The diagnosis of pneumococcal pneumonia was established by correlating the history of the disease and of the patient, clinical symptoms, radio imaging data, and bacteriological examination of the cultures. Thus, in terms of socio-demographic data (gender and background), the incidence of this pathology was shown in **Figure 1**: (rural-34 cases, urban-46 cases) and (female-44 cases, male-36 cases). The evaluation of the group in terms of the distribution of cases by age group showed the highest incidence in the age group 2-5 years (39 patients), and at the opposite pole was the age group 10-14 years (2 patients). Thus, children aged 2-5 years seem to be the most prone to develop pneumococcal pneumonia due to the fact that they are all un-vaccinated against pneumococcal disease, frequenting communities, poor living conditions, and passive smoking, an aspect confirmed by numerous studies in the literature (**Table 1**).

The Chi-square value for the variable sex is 0.800 and indicates the size of the difference between the observed and expected frequencies for the variable "sex", while the value for the variable origin is 1.8. The p-value of the Chi-square test is 0.371, which tells us that we reject the null hypothesis, i.e., the categories of the variable "sex" are distributed differently. In other words, the result suggests that any observed difference in the "sex" variable could be due to random chance, rather than a significant deviation from the expected distribution. The Chi-square p-value for the origin variable is 0.180, which means that we reject the null hypothesis in this case as well. In conclusion, in the case of the origin variable, any difference that arises is due to random choice and not to deviation from the expected distribution (**Table 2**).

Regardless of the age of the pediatric patient, they were admitted together with a family member (mother or father), which was still a strength in terms of psycho-emotional support for the patient. Because most of the patients in the study group are either part of the age category predisposed to this pathology or are accompanied by certain risk factors or predisposing factors, they had a long evolution of the disease with the appearance of specific complications (acute

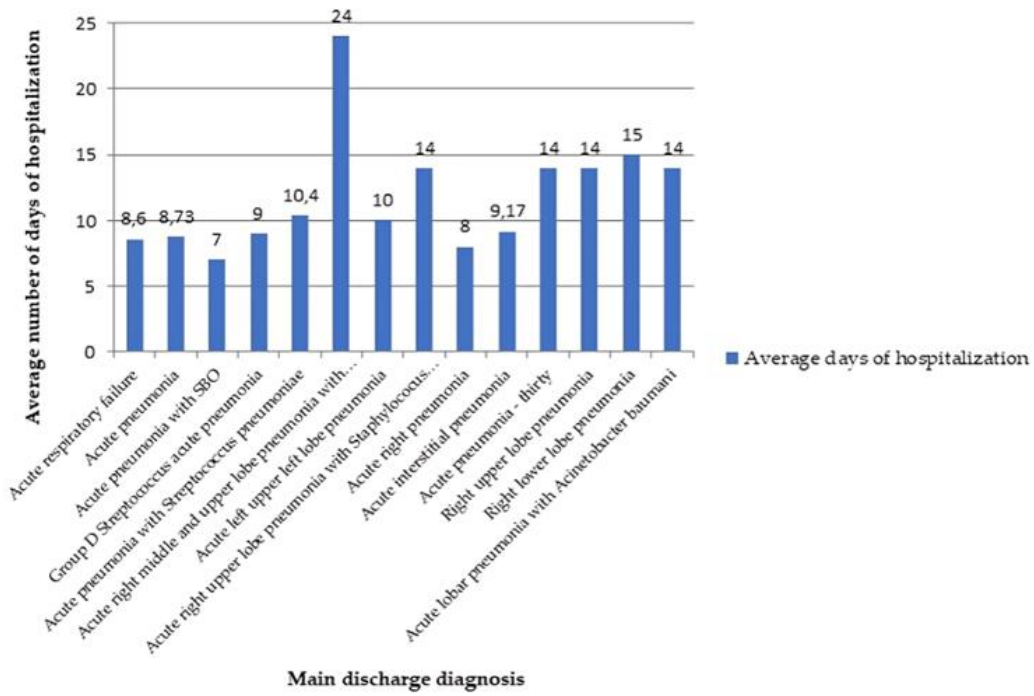

Figure 1. Distribution of mean days of hospitalization for each discharge diagnosis (Source: Authors' own elaboration)

Table 1. Socio-demographic descriptive information

Items		Number of cases
Gender	Female	44
	Male	36
Location	Urban	46
	Rural	34
Age	0-2	29
	2-5	39
	5-10	10
	10-14	2

Table 2. Chi-square test statistics

Sex		Origin
Chi-square	.800[a]	1.800[a]
df	1	1
Asymptotic significance	371	180

Note. [a]0 cells (0.0%) have expected frequencies less than 5 & the minimum expected cell frequency is 40.0

respiratory failure), thus the period of hospitalization was prolonged over 7 days (**Table 3**).

The mean (9.48) and median (8.50) are relatively close, suggesting that we have a somewhat symmetric distribution of hospitalization days. The standard deviation of 3.656 and variance of 13.366 suggest that while most hospitalization durations are close to the mean, there is some variability in the data.

Respiratory failure was the most frequently encountered complication in patients with pneumococcal pneumonia, which required a more careful and complex therapeutic approach, some of them even requiring hospitalization in the intensive care unit. We statistically analyzed the relationship between the number of days of hospitalization and the principal diagnosis of pneumonia. After testing for normality, using the Shapiro-Wilk test for which the following result was obtained, as shown in **Table 4**.

Table 3. Mean (or median) and measure of variability for hospitalization days (statistics: hospitalization days)

Variable	Value
N valid	80
Missing	0
Mean	9.480
Median	8.500
Standard deviation	3.656
Variance	13.366

FooterWillBeHere

Table 4. Result of the Shapiro-Wilk test for the variable hospitalization days

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Hospitalization days	.214	80	.000	.860	80	.000

Note. [a]Lilliefors significance correction

From the results obtained for the Shapiro-Wilk test, it can be concluded that our series is not normally distributed between groups, i.e., the data are not normally distributed. In this case, we continue with a non-parametric Kruskal-Wallis test to show whether there is a relationship between the number of days of hospitalization and the main diagnosis at discharge (**Table 5**).

The test results indicate that there are no statistically significant differences between the groups (p-value = 0.208). Therefore, we cannot reject the null hypothesis, which suggests that the distribution of hospitalization days is approximately similar between the main diagnosis categories at discharge, meaning that for any diagnosis category, the number of days is approximately equal. This can also be seen in **Figure 1**, which shows the mean number of days of hospitalization by each diagnosis. In the analysis of the patients diagnosed with acute respiratory diseases in **Table 6**, the following diagnostic categories and corresponding number of cases were identified.

Table 5. Results of the Kruskal-Wallis test for the variable hospitalization days (asymptomatic significances are displayed & the significance level is .05)

Null hypothesis	Test	Significance	Decision
The distribution of hospitalization days is the same across categories of principal discharge diagnosis	Independent samples Kruskal-Wallis test	.208	Retain the null hypothesis

Table 6. Types of pneumonia by number of patients

Diagnostics	N
Acute respiratory failure	25
Acute pneumonia	11
Acute pneumonia with SBO	1
Group D streptococcus acute pneumonia	1
Acute pneumonia with streptococcus pneumoniae	5
Acute right middle and upper lobe pneumonia with streptococcus pneumoniae	1
Acute left upper left lobe pneumonia	1
Acute right upper lobe pneumonia with staphylococcus aureus	1
Acute right pneumonia	1
Acute interstitial pneumonia	29
Acute pneumonia–thirty	1
Right upper lobe pneumonia	1
Right lower lobe pneumonia	1
Acute lobar pneumonia with acinetobacter baumani	1
Total	**80**

Note. N: Number of patients

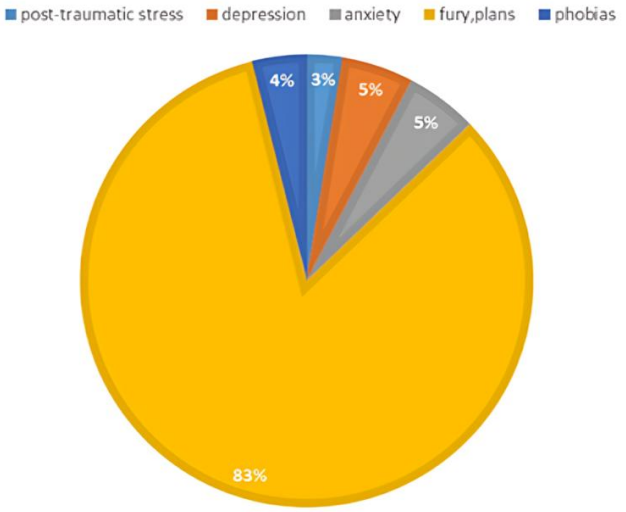

Figure 2. Incidence of psycho-emotional and behavioral disorders (Source: Authors' own elaboration)

The long periods of hospitalization had a negative impact on both the patient and the caregiver, leading to the development of psycho-emotional and behavioral disorders that could have been prevented by certain prophylactic measures (e.g., vaccination). On the other hand, prolonged hospitalization entails high hospitalization costs and dropping out of school for a certain period. All these patients and their relatives (parents) benefited from psychological counseling to provide them with support throughout the hospitalization period in the correct management of this situation and because some of them started to present certain psycho-emotional disorders affecting their mental health (specific phobia of needles and medical maneuvers, anxiety and even mild depression).

As the focus of the present research was to highlight whether children and parents experience mental health-related symptoms (and not disorders) after exposure to invasive procedures, the trained clinician did not attempt to come up with a specific diagnosis for any of the participants. Instead, they have sought to underline whether anxiety, depression, phobia, or PTSD-specific tendencies were present, as such: any positive answer to a symptom-related question was marked with a "1". If symptoms were absent, the question was coded with a "0". We have applied for the same interview before and after the psychological counseling sessions. Therefore, four individual general scores were then calculated for each of the disorders, as such: two overall scores summing the coding for all of the questions for every child (one from the pre-counseling assessment and one from the post-counseling assessment), and two overall scores, summing the coding for all of the questions, for every adult (one from the pre-counseling assessment and one from the post-counseling assessment). The data were interpreted qualitatively: first and foremost, we checked for the presence of mental health-related symptoms for each of the patients and their caregivers (an overall score greater than 1 in the pre-counseling assessment indicates the presence of at least one mental health-related symptom); then, for each patient and caregiver, we have examined the two overall scores and we have looked for potential increases or decreases from the pre-procedure assessment to the post-procedure assessment, in order to monitor the effects of the intervention.

The patients and their caregivers underwent psychological counseling sessions, which consisted of cognitive restructuring techniques. Patients and their caregivers were advised to recall their experience with hospital-invasive procedures (parents were asked to recall events from the perspective of their children if they were unable to speak) and to employ techniques such as cognitive reframing, in changing their perspectives to a more functional alternative.

In **Figure 2** we can observe the incidence of psycho-emotional disorders identified in pediatric patients during hospitalization. The graph below shows that the majority of patients suffer from anger and crying disorders, while the remaining disorders have a much lower prevalence (**Figure 2**).

In children under 5 years of age, it was more difficult to accurately assess the psycho-emotional disorder and this is due to age because the assessment was made only from the parents' reports. They stated that their children showed more frequent crying, anger, and tantrums, especially after certain medical maneuvers, after the visit of medical staff or other strangers. So stealing, crying, and tantrums are in the first place and this is due to the younger age, and at the opposite pole is post-traumatic stress.

DISCUSSION

Over the years, this topic of acute CAP caused by streptococcus pneumoniae in pediatric age has been intensively discussed in numerous specialized studies. This topic has presented interest from several points of view such as the extreme ages most affected, predisposing factors, pneumococcal vaccination, the geographical distribution of

pneumococcal serotypes, the occurrence of complications, and their multifactorial impact on the quality of life of patients [23-26].

Thus the present study aimed to bring to the foreground some particularities of pneumococcal pneumonia in the pediatric population in a South-Eastern geographical area of Europe, where this aspect has been less discussed by medical specialists. Attention was focused on the following aspects, namely prolonged hospitalization, occurrence of complications, personal history of multiple hospitalizations, and low compliance to treatment that had a negative impact on the patient's mental health. In terms of socio-demographic distribution, most of the patients were from urban areas (46 cases) in favor of the female sex. One explanation for this fact is that our newly diagnosed patients who come from urban areas could possibly be the more frequent exposure to crowded places, and air pollution or those from urban areas are either under or even undiagnosed some of them due to more limited access to primary health care. The female incidence in our case is in discordance with data from the literature, where many studies have confirmed the incidence of this type of infection more frequently in males. A retrospective analysis conducted between 2018-2021 in Luzhou, China on 12,546 cases analyzed the main bacterial and viral agents identified in terms of gender in relation to age group, revealed that the higher incidence of streptococcus pneumoniae was found in males [27].

As regards the distribution of the incidence of acute pneumonia caused by streptococcus pneumoniae in the present work, we observed that the age group between 2-5 years was the most affected (39 cases) by this pathology. One explanation would be that this is the preferred age for the beginning of attendance at day-care centers. This aspect is reported in numerous articles that have had pneumococcal pneumonia as their main topic [28].

Another aspect followed in this study was the period of hospitalization of these patients diagnosed with pneumococcal pneumonia. Due to the fact that some of the patients presented complications, namely acute respiratory failure requiring more complex treatment, some of them stayed in the intensive care unit, and the hospitalization period was longer than 7 days in these cases.

Coreland the most exposed age group, the presence of certain predisposing risk factors (frequenting collectivities, air pollution, personal history of respiratory infections in the past), and prolonged hospitalization all influenced the mental health of these patients in a negative way. Thus, the main psycho-emotional and behavioral disorders identified in this study were anger, manifested by crying in about 60 patients, followed by phobia towards invasive or non-invasive medical maneuvers. Over the years there have been numerous studies investigating certain psycho-emotional and behavioral disorders in children in the context of different medical pathologies. For example, a study conducted in Sweden among children and young people aged 7-18 years had as its main objective to highlight whether pain of different etiologies precedes mental health states or vice versa. The conclusion of the study was that patients who are presented with pain had an increased risk of developing certain mental health conditions, compared with a very low risk of developing pain after mental health conditions [29].

Another study conducted in two pediatric hematology outpatient clinics in patients diagnosed with thalassemia aged 10-18 years had its main aim to identify patients with depression and anxiety. These two disorders were found in patients who required invasive medical maneuvers, namely repeated blood transfusions [30].

From the point of view of the patient's relatives, the situation was misperceived and misunderstood due to the fact that 28 of the patients were already treated at home with antibiotics, but without favorable results, or even with worsening of symptoms, which amplified their feelings of helplessness, failure, and disappointment, leading to the appearance of evident psycho-emotional disorders. Moreover, most of the parents (relatives) hospitalized after the psychological analysis stated that during hospitalization they experienced feelings of fear, anxiety, and even some depressive states. As for pediatric patients, they experience a phobia towards certain invasive medical procedures. In conclusion, the quality of life of both pediatric patients and their relatives has been affected.

To optimize the diagnosis and a favorable prognosis of this invasive infection, it is absolutely necessary to have collaboration between a multidisciplinary team (pediatrician, family physician, laboratory physician, radiologist, psychologist, and psychiatrist) and the patient himself/herself.

On the other hand, vaccination represents an effective alternative in combating these pneumococcal infections, especially at pediatric age, and implicitly by decreasing antibiotic resistance. O'Brien et al. conducted a review in 2013 in the United Kingdom highlighting the importance of vaccination and decreasing the prevalence of invasive pneumococcal diseases and antibiotic dependence. Thus pneumococcal vaccination has a direct impact on this bacterial agent streptococcus pneumoniae [31, 32].

The prognosis of pediatric invasive infections with streptococcus pneumoniae depends on several factors: predisposing risk factors, associated or pre-existing pathologies, young age, aggressiveness of the serotype, vaccination status, and mental health status of the patient. Thus, the treatment of pneumococcal infections sometimes requires multidisciplinary medical involvement depending on the severity and possible complications, i.e., family doctor, pediatrician, pulmonologist, radiologist, radiologist, psychologist, and even psychiatrist.

This study also comes with some limitations, such as the fact that patients could not be followed over a longer period of time, as some did not return for routine check-ups to assess their health. Another limitation of this research is the small number of patients included in the study.

CONCLUSION

Thus, children aged between 2-5 represent the category most affected by these pneumococcal infections with multiple implications both on the part of prolonged hospitalization in case of complications but also on the part of mental health through the occurrence of various psycho-emotional disorders.

Attention should also be paid to possible psycho-emotional and behavioral disorders that should not be neglected, as they can have a negative impact on the patient's quality of life by affecting mental health. However certain

preventive measures to combat these infections can have multiple advantages and benefits for the pediatric population.

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AI statement: The authors stated that the scientific content, analysis and final editing are entirely the author's own. No AI or GenAI tools were used during the preparation of the article.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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