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Medico-socio-economic perspective of congenital hydrocephalus patients treatment in dr. Soetomo Academic General hospital, Surabaya, Indonesia

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ABSTRACT

Background: Hydrocephalus is a brain disease that requires prompt treatment. The outcome of hydrocephalus is dependent on early detection and treatment. This study was conducted to analyze the medico-socio-economic perspective on the delayed treatment of hydrocephalus patients, which aimed to advance the practice of neurosurgery in the socio-neurosurgery field, including both preventive and therapeutic aspects.

Method: This was an observational analysis study. The study subjects were all patients with congenital hydrocephalus treated in dr. Soetomo Academic General Hospital between January 2017 and December 2019. The study was carried out on January 2017 to December 2019 at the Inpatient Surgery ward, dr Soetomo Academic General Hospital, neurosurgery outpatient unit, and home visits. Research data consists of both primary and medical record data. Data on patient characteristics were obtained through direct interviews with the sample using prepared questionnaires, medical record data, and radiological data of both patients examined at dr. Soetomo Academic General Hospital and other health services. Bivariate correlation analysis was performed to assess the effect of each risk factor on the incidence of delay in treatment, and multivariate logistic regression analysis was performed to assess the magnitude of the effect of risk factors.

Result: The number of cases was 101 subjects. A total of 101 patients included as research samples were congenital hydrocephalus patients who received the first treatment at dr. Soetomo Academic General Hospital from January 2017 to December 2019. Up to 50 individuals (49.5%) were delayed in treatment. The data analysis with Chi-square did not reveal a statistically significant correlation between delay in treatment and level of parent's education (p=0.0951), delay in treatment and economic status ((p=0.4955). Delays in the treatment of congenital hydrocephalus were statistically significant and correlated with *Posyandu*'s role (p=0.0012), health insurance ownership (p=0.0001), family support (p=0.0130), and professional medical decisions (p=0.0001). Health insurance ownership has the smallest p-value (0.000) and largest wald (16.545) in the multivariate logistic regression analysis calculation using the enter method. The insurance ownership variable has the most significant and largest partial influence on the delay in treating congenital hydrocephalus.

Conclusion: There were 101 patients included, and up to 50 individuals (49.5%) were delayed in treatment. Parents' education level and socioeconomic status were not associated with delayed treatment of congenital hydrocephalus. Delays in managing congenital hydrocephalus were influenced by *Posyandu*'s role, health insurance ownership, family support, and professional medical decisions.

Keywords: Congenital, Hydrocephalus, Medicosocioeconomic, Delay in treatment, Socioneurosurgery.
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INTRODUCTION

Hydrocephalus has become a major public health concern, with an estimated incidence of over 380,000 new cases per year.[1] Hydrocephalus is an active dilatation of the brain's ventricular system caused by impeded passage of cerebrospinal fluid (CSF) from the brain's ventricles to the location of its absorption.[2] The incidence of congenital hydrocephalus is about 0.2-0.5 per 1000 live births. Male infants are more likely than female neonates to develop hydrocephalus. Congenital hydrocephalus is more common in Europeans than in Asians. Low birth weight (LBW) infants are more likely to develop hydrocephalus. Congenital hydrocephalus has a high risk associated with socioeconomic level.[3] Currently, 80% of cases of congenital hydrocephalus can be diagnosed during pregnancy by ultrasound.[4]

Increased CSF pressure in the ventricles leads to compression and atrophy of the periventricular white matter. Increased hydrostatic pressure in the white matter reduces blood flow to the tissues, resulting in local tissue hypoxia,

damage to myelinated neuronal pathways, and, ultimately, irreversible gliosis. Nelson and Rekate concluded that a three-centimeter-thick frontal brain is associated with a lower IQ. IQ in patients with hydrocephalus is affected by age at shunt placement, the severity of hydrocephalus, type of hydrocephalus, shunt function, additional abnormalities sustained, and complications encountered. Additional influences include genetics, social status, and economic background.[5]

After a diagnosis of hydrocephalus is made, treatment can begin immediately without waiting for the rule of ten. Hydrocephalus that is not treated immediately will become severe with long-term neurological problems and affect the child's future.[6,7] Surgery is used to treat pediatric hydrocephalus situations in the vast majority (more than 90%).[8] There has never been any discussion of the prevalence of severe hydrocephalus worldwide or in Indonesia. From 2017 to 2019, according to the pediatric neurosurgery department database at dr. Soetomo Academic General Hospital, as many as 73 hydrocephalus patients, presented with severe or very severe hydrocephalus, with 50 patients experiencing treatment delays.

Numerous factors influence the delay in management. Family income and health insurance ownership are economic issues. Education level, family support, and the community's function in the *Posyandu* (pre-hospital healthcare) are examples of social elements. Medical factors include the decision to postpone action by a medical professional. Therefore, a study was done to determine the influence of medical-socioeconomic factors on the delay in hydrocephalus treatment. This research aimed to advance the practice of neurosurgery in the area of social neurosurgery, which involves both preventive and curative aspects of its practice.

METHODS

This research was an observational analytical study conducted between January 2017 and December 2019 at the inpatient surgery ward and pediatric ward at dr Soetomo Academic General Hospital, neurosurgery outpatient unit and home visits. All patients with congenital hydrocephalus who visited dr. Soetomo Academic General Hospital between January 2017 and December 2019 were included in the study. Particularly for the *Posyandu* (pre-hospital healthcare) participation factor, samples were congenital hydrocephalus patients with normal birth conditions and routine growth-development control at the *Posyandu* and medical professionals.

The variables identified in this study were: the condition of the patient at birth (born with a normal-sized head, born with a large head of unknown degree of hydrocephalus, born with mild or moderate hydrocephalus, born with severe hydrocephalus), delay in treatment, economic aspects (economic status and health insurance ownership), social aspect (education levels of parents, family support, role of *Posyandu*), and medical aspect (decision to delay by a medical professional). Hydrocephalus is classified according to its severity as follows: (1) mild hydrocephalus, (2) moderate hydrocephalus, (3) severe hydrocephalus, and extremely severe hydrocephalus.[1,9] Patients diagnosed at birth with severe hydrocephalus were excluded.

Research data consists of both primary and medical record data. When the patient has been discharged from the hospital, primary data are collected through interviews with the patient's attendants at the hospital, tele-interview or during neurosurgery outpatient unit routine visits.

The data obtained from the research variables will be presented in tabular format. Bivariate correlation analysis was performed to assess the effect of each risk factor on the incidence of delay in treatment, and multivariate logistic regression analysis was performed to assess the magnitude of the effect of risk factors.

RESULT

Sample Characteristics

Data on patient characteristics were obtained through direct interviews with the sample using prepared questionnaires, medical record data, and radiological data of both patients examined at dr. Soetomo Academic General Hospital and other health services. From the collected data, the characteristics of the sample (Table 1), including gender, condition at birth, and severity of hydrocephalus, were determined. A total of 101 patients were included as research samples: congenital hydrocephalus patients who received the first treatment at dr. Soetomo Academic General Hospital from January 2017 to December 2019.

There were more female patients than male patients, with the number of female patients 61 (60.4%), compared to 40 male patients (39.6%). The age of the patients at the time of surgery ranged from newborn to 1.5 years, the most of the group aged 1 month to 6 months, 40 people (39.6%). Samples with normal birth conditions were 34 (33.7%), and those born with hydrocephalus were 67 (66.3%). In patients with normal birth conditions (table 2), as many as 19 (55.9%) did early detection at the *posyandu*, 14 (41.2%) did early detection in the medical professional, and 1 (2.9%) never did early detection (Table 2).

Based on the severity of hydrocephalus during treatment (Table 1), patients with mild and moderate congenital hydrocephalus were 28 (27.7%), and those with severe and very severe hydrocephalus were 73 (72.2%). There were 50 patients (49.5%) who experienced delays and 51 people who did not experience delays (50.5%).

Bivariate analysis

Parents' Education Level

There were 101 samples included in the analysis of the effect of parental education level on delays in handling hydrocephalus (Table 3). The samples were grouped into two groups: 9 years of education or more and less than 9 years of education. For patients experiencing treatment delays (50 people), as many as 39 (78%) have parents with an education of 9 years or more, and 11 (22%) have parents with less than 9 years of education. In contrast, among the 51 patients who did not experience treatment delays, 46 (90.2%) had parents with 9 years of education or more, while 5 (9.8%) had parents with less than 9 years of education. The Chi-square test was then conducted to determine the relationship between education level and delay in treating hydrocephalus. The data analysis

did not reveal a statistically significant correlation (p = 0.0951) between the level of parents' education and the delay in treating hydrocephalus.

Role of Posyandu

There were 33 samples included in the analysis of the effect of *posyandu* on the degree of delay in treating hydrocephalus (Table 4). The samples were divided into two groups: those with early detection at the *posyandu* and those with early detection by medical professionals (general practitioners and specialists). Among the 22 patients who experienced delays in treatment, 18 (81.8%) performed early detection at the *posyandu,* and 4 (18.2%) performed early detection in the medical professional. In contrast, among patients who did not experience delays in treatment (11 individuals), 1 individual (9 percent) performed early detection at the *posyandu,* and 10 individuals (90 percent) performed early detection by a medical professional. Then, both groups were evaluated using Chi-square for the delay in hydrocephalus management. Data analysis revealed a statistically significant relationship (p = 0.0012, 95% CI) between early detection of *posyandu* and delay in treating hydrocephalus.

Table 1. Sample Characteristics.

Variable	Characteristic	Total (percentage)
Sex	Male	40 (39,6%)
	Female	61 (60,4%)
	Total	101 (100%)
Condition at birth	Normal head	34 (33,7%)
	Large head	34 (33,7%)
	Mild hydrocephalus	4 (3,96%)
	Moderate hydrocephalus	3 (2,94%)
	Severe hydrocephalus	20 (19,8%)
	Extremely severe hydrocephalus	6 (5,9%)
	Total	101 (100%)
Degree of hydrocephalus at the time of treatment	Mild hydrocephalus	9 (8,9%)
	Moderate hydrocephalus	19 (18,8%)
	Severe hydrocephalus	54 (53,4%)
	Extremely severe hydrocephalus	19 (18,8%)
	Total	101 (100%)
Age at time of treatment	<1 month	37 (36,6%)
	1 month to <6 months	40 (39,6%)
	6 months to < 1 year	17 (16,9%)
	More than 1 year	7 (6,9%)
	Total	101 (100%)
Delay in treatment status	Delay in treatment	50 (49,5%)
	No delay in treatment	51(50,5%)
	Total	101 (100%)
Economic status	Sufficient	43 (42,6%)
	Poor	58 (57,4%)
	Total	101 (100%)
Health insurance ownership	Had health insurance	73 (72,3%)
	Did not have health insurance	28 (27,7%)
	Total	101 (100%)
Education level	9 years of education or more	85 (84,2%)
	less than 9 years of education	16 (15,8%)
	Total	101 (100%)
Family support	Had family support	92 (91,1%)
	Did not have family support	9 (8,9%)
	Total	101 (100%)
Decision to postpone by medical professional	With a decision to postpone by medical professional	12 (11,9%)
	Without a decision to postpone by medical professional	89 (88,1%)
	Total	101 (100%)

Table 2. Variable characteristic of Posyandu's role.

Variable	Characteristic	Total (percentage)
Detection of growth location	*Posyandu*	19 (55,9%)
	Medical professional	14 (41,2%)
	Not visiting *Posyandu* and not visiting medical professional	1 (2,9%)
	Total	34 (100%)

Economic Status

There were 101 samples included in the analysis of the effect of economic status on the delay in the treatment of hydrocephalus (Table 5). The samples were grouped into sufficient and poor economic status. Of the 50 patients who experienced treatment delays, 27 (54%) had sufficient economic status, while 23 (46%) had poor economic status. In contrast, among patients who did not experience treatment delays (51 individuals), 16 (31.4 percent) had sufficient economic status, and 35 (68.6 percent) had poor economic status. Then, both groups were evaluated using Chi-square for the delay in hydrocephalus management. The data analysis revealed no statistically significant relationship (p = 0.4955) between economic factors and treatment delay for hydrocephalus.

Health insurance ownership

The analysis of the effect of health insurance ownership on the delay in the treatment of hydrocephalus includes 101 samples (Table 6), divided into those who had health insurance (yes) and those who did not have health insurance (no). Of the 50 patients who experienced delays in treatment, 27 people (54%) had health insurance, and 23 people (46%) did not. In contrast, among the 51 patients who did not experience delays in treatment,

Table 3. Analysis of the parent's education level on the delay in treatment of congenital hydrocephalus.

Level of education	Delay in treatment	
	Yes	No
9 years of education or more	39 (78%)	46 (90,2%)
less than 9 years of education	11 (22%)	5 (9,8%)
Total (n=101)	50 (100%)	51 (100%)

Table 4. Analysis of Posyandu's role in the delay in treatment of congenital hydrocephalus.

	Delay in treatment	
	Yes	No
Posyandu	18(81,8%)	1 (9%)
Medical professional	4 (18,2%)	10 (90%)
Total (n=33)	22 (100%)	11(100%)

Table 5. Analysis of economic status on the delay in treatment of congenital hydrocephalus.

Economic status	Delay in treatment	
	Yes	No
Sufficient	27 (54%)	16 (31,4%)
Poor	23 (46%)	35 (68,6%)
Total (n=101)	50 (100%)	51(100%)

Table 6. Analysis of health insurance ownership on the delay in treatment of congenital hydrocephalus.

Health insurance ownership	Delay in treatment	
	Yes	No
Had health insurance	27 (54%)	46 (90,2%)
Did not have health insurance	23 (46%)	5 (9,8%)
Total (n=101)	50 (100%)	51 (100%)

Table 7. Analysis of family support on the delay in treatment of congenital hydrocephalus.

Family support	Delay in treatment	
	Yes	No
Had family support	42 (84%)	50 (98%)
Did not have family support	8 (16%)	1 (2%)
Total (n=101)	50 (100%)	51 (51%)

Table 8. Analysis of the decision to postpone by a medical professional the delay in treatment of congenital hydrocephalus.

The decision to postpone by a medical professional	Delay in treatment	
	Yes	No
With the decision to postpone by a medical professional	12 (24%)	0 (0%)
Without the decision to postpone by a medical professional	38 (76%)	51 (100%)
Total (n=101)	50 (100%)	51 (50,5%)

46 (90.2%) had health insurance, while 5 (9.8%) did not. Then, both groups were evaluated using Chi-square for the delay in hydrocephalus management. The results of data analysis revealed a statistically significant relationship (p = 0.0001) between health insurance ownership and delays in treating hydrocephalus.

Family support

The analysis of the effect of family support in the treatment of hydrocephalus on the delay in treating hydrocephalus included 101 samples (Table 7). The samples were divided into family support (yes) and those without (no). Of the 50 patients who experienced treatment delays, 42 (84%) had family support, while 8 (16%) did not. In contrast, among the 51 patients who did not experience treatment delays, 50 (98%) had family support, and 1 (2%) did not. Then, both groups were evaluated using Chi-square for the delay in hydrocephalus management. The data analysis revealed a statistically significant relationship (p=0.0130, 95% CI) between family support and delay in treating hydrocephalus.

Treatment by a medical professional

There were 101 samples included in the analysis of the effect of a decision to delay treatment by a medical professional in the treatment of hydrocephalus on the delay in handling hydrocephalus (Table 8). The samples were divided into two groups: those in which medical professionals decided to postpone treatment (yes) and those in which no such decision was made (no) (none). Of the 50 patients who experienced treatment delays, 12 (24%) had the decision to delay treatment made by a medical professional, while 38 (76 %) did not. On the other hand, none of the 51 patients (100%) who did not experience treatment delays had their treatment delayed by a medical professional. Then, both groups were evaluated by Chi-square for the delay in hydrocephalus management. Data analysis revealed a statistically significant relationship (p=0.0001, 95% CI) between a medical professional's decision to delay treatment and the delay in handling hydrocephalus.

Multivariate Analysis

Several independent variables tested for correlation with the dependent variable, the delay in hydrocephalus treatment, were included in the multivariate logistic regression analysis calculation using the enter method (table 9).

Table 9. **Multivariate logistic regression analysis.**

Independent variables	B	Wald	P value	Exp (B)	95% CI. for Exp (B)	
					Lower	Upper
Economic status	-0,178	0,104	0,748	0,837	0,284	2,468
Level of education	1,445	4,194	0,041	4,243	1,064	16,919
Health insurance ownership	2,495	16,545	0,000	6,174	2,671	28,686
The decision to postpone by a medical professional	22.195	0,000	0,998	4,356	0,000	.
Family support	2,749	5,329	0,021	15,631	1,515	161,334

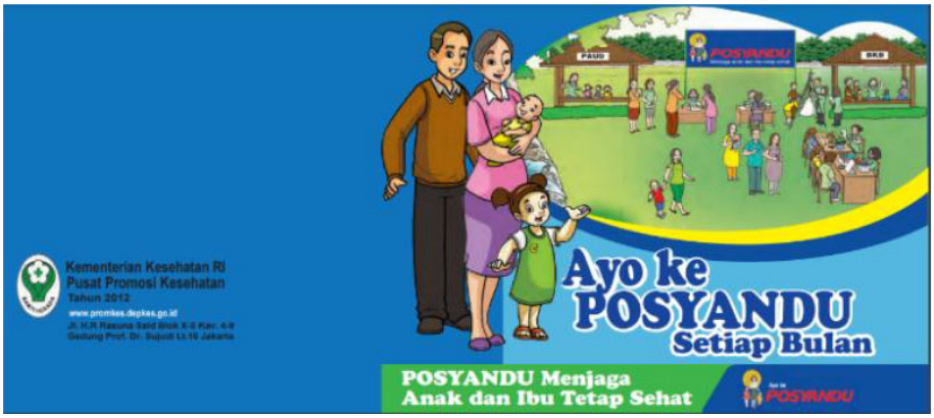

Figure 1. Posyandu handbook: a guide for *posyandu* village health workers to use when conducting *posyandu* activities. This book does not mention head circumference measurement as an early detection method for hydrocephalus.

Figure 2. *Maternal and child health (MCH) book. This book is always brought by the community when they come to the posyandu as a medical history record, starting from pregnancy until the age of 5 years.*

Table 9 shows the combined effects of independent variables on the dependent variable using binary logistic analysis with the enter method. According to the analysis results (Table 9), there are three variables with a p-value of 0.05: education level, health insurance ownership, and family support. This indicates that adding these risk factors has a statistically significant impact on the delay in treating hydrocephalus.

According to the multivariate logistic regression test results, health insurance ownership appears to have the largest wald statistic (16,545). This indicates that the variable of health insurance ownership has the largest partial effect on delays in the treatment of congenital hydrocephalus, with an Exp B or odds ratio of 6.174, indicating that patients without health insurance have a risk of delayed treatment that is six times greater than those with health insurance.

DISCUSSION

Parents' Education Level

There was no correlation between parents' education level and delay in treating congenital hydrocephalus. No prior study has examined how education level affects the delay in treating congenital hydrocephalus. Information about congenital hydrocephalus is not included in the formal education curriculum up to the junior high school level; however, parents typically obtain this information through informal education, such as face-to-face interactions with health professionals. In addition, the level of formal education itself is influenced by numerous variables. Therefore, the lack of information, particularly health information that the layperson should know, is not a significant guarantee.

Posyandu's Role

Posyandu, as pre-hospital healthcare of the Indonesian health system, is expected to play a role in the early detection of community-based health issues using simple instruments. Volunteers from the community are trained to handle personal health issues and regular *posyandu* services to engage the community in health care. The idea is that having community health workers as part of the community would make it much easier to deliver health programs because they are closer to them than public health officials.

Posyandu's performance in routine hydrocephalus patient evaluations is suboptimal, which delays the treatment of hydrocephalus. Infants and children should routinely have their head circumference measured as part of their physical examination.[10] However, this head circumference measurement has not been a concern and is not included as a routine evaluation component in the village health officer's manual for *posyandu* activities. Posyandu activities concentrate more on immunization, adequate nutrition, and family planning.

On the level of delay in treating

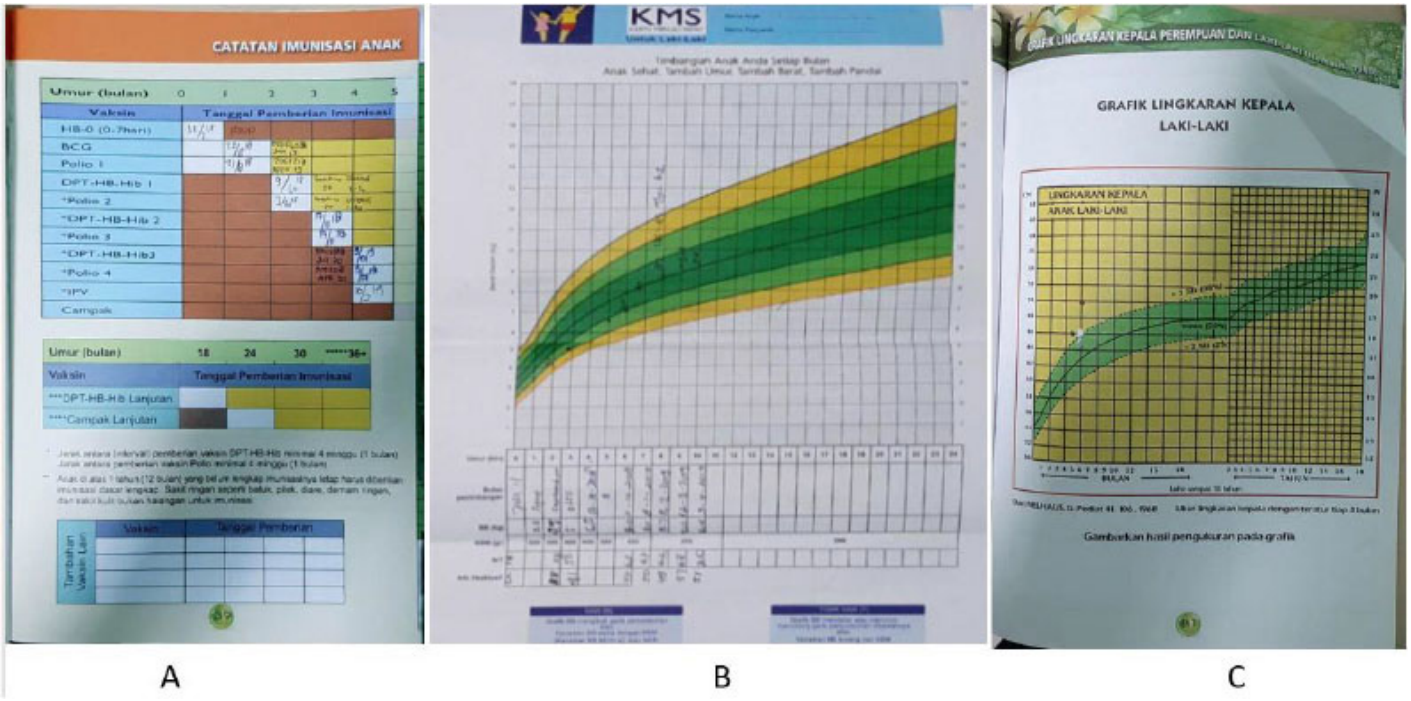

Figure 3. *MCH handbook from one sample of a patient born with a normal head regularly visits the posyandu. The immunization record (A), the weight record (B), and the head circumference record (C).*

congenital hydrocephalus, a correlation test was conducted between samples obtained from *posyandu* and non-*posyandu* (pediatrician and neurosurgeon). The correlation test revealed a significant relationship between the two variables. Treatment delay is uncommon compared to routine evaluations conducted by medical professionals (pediatrician and neurosurgeon).

When collecting data, it was discovered that none of the samples had measured their head circumference at the *posyandu*. The circumference of an infant's head is a straightforward method for detecting hydrocephalus. Late detection can cause a delay in the treatment of hydrocephalus.

Economic Status

The contribution of economic status to the provision of health services has been discussed in several studies. Education, income, financial incapacitated[11], and cultural background influence socioeconomic status.[12–14] According to the correlation test results, there is no relationship between economic status and the delay in treating congenital hydrocephalus. This suggests that the sample's low economic status prevents patients with congenital hydrocephalus from receiving prompt treatment. The availability of payments for health services by other parties, such as subsidized insurance or insurance contribution assistance, is another factor that can influence it.

Ownership of Health Insurance

Currently, every resident of Indonesia must be registered as an insurance participant. The health insurance system adopted by the national health insurance includes the participation of the poor as participants who receive contribution assistance (PBI), allowing the poor to continue receiving standard health services. However, there are still residents who have not enrolled in the national health insurance program or other insurance.

This study's samples were divided into two categories: those with health insurance and those without. According to the correlation test results, there was a correlation between the status of health insurance ownership and the delay in treating hydrocephalus. Patients with health insurance are less likely to experience treatment delays than patients without health insurance. This highlights the significance of health insurance against disease morbidity, particularly hydrocephalus.

Family Support

The patient's parents or guardians represent decision-making for pediatric patients. Occasionally, the decision-making process involves the patient's parents or guardians and other family members, such as grandmothers. According to the results of the correlation test, family support has a significant impact on the delay in the treatment of hydrocephalus.

The patient's family mentioned several factors in response to the survey results, including the need for approval from other family members, such as the patient's grandmother or grandfather, protracted discussions between family members, and the reasons for the concern of certain family members regarding the proposed medical action.

The decision to postpone by a medical professional

This study's results determined a significant correlation between the decision to delay by a medical professional and the ensuing delay in treating congenital hydrocephalus. According to the collected data, there are some considerations for a medical professional to delay. These factors can be categorized into three groups: the need for additional diagnostics before the procedure, the medical condition of a

patient judged ineligible for surgery, and the differences in timing considerations between disciplines.

Multivariate statistical analysis

According to the test results, three variables affect the delay in treating hydrocephalus: parent's education level, health insurance ownership, and family support. The role of the Posyandu in the delay in treating hydrocephalus was excluded from the logistic regression test because the data sample was distinct from those of the other variables. Two variables were found to have no significant effect when run simultaneously with other variables.

Variables that affect the delay in hydrocephalus treatment have their probability power (Exp B/odds ratio). Based on the value of Exp B, a patient who does not have health insurance has a 6,174 times greater risk of experiencing delays in treatment hydrocephalus. Congenital hydrocephalus patients with inadequately educated parents or parents who have not completed at least junior high school have a 2.852-fold increased risk of treatment delays. In contrast, the greatest risk is in patients who do not get family support, which is 15,631 times. Regarding the significance of the effect of the independent variable on the dependent variable, it was determined that health insurance ownership was the most influential factor in the delay in the treatment of congenital hydrocephalus. This highlights the significance of an individual's participation in health insurance.

CONCLUSION

One hundred one patients were included as research samples, including congenital hydrocephalus patients who received the first treatment at dr. Soetomo Academic General Hospital from January 2017 to December 2019. Up to 50 individuals (49.5%) were delayed in treatment. Parents' education level and socioeconomic status were not associated with delayed treatment of congenital hydrocephalus. Delays in managing congenital hydrocephalus were influenced by Posyandu's role, health insurance ownership, family support, and professional medical decisions.

RECOMMENDATION

1. Researchers believe it is essential to develop socio-neurosurgery, which focuses on social issues in neurosurgical cases by considering the influence of various social factors on hydrocephalic treatment
2. Research on the medico-socioeconomics of congenital hydrocephalus needs to be conducted with more samples and across multiple centers.
3. Posyandu quality must be improved for early detection of congenital hydrocephalus.

DECLARATIONS

Ethics Approval and Consent to participate

This study has undergone an ethical test by the ethics committee of dr. Soetomo Academic General Hospital with the ethical number 0088/ III/VII/2020. Informed consent from all participants included in this study has been obtained.

Conflicts of interest

The authors have no conflicts of interest that should be known to readers related to this document.

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Author Contribution

All authors contributed to conducting the research and publishing the manuscript.

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