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Original Article

The accuracy of clinical diagnosis for dehydration according to the integrated management of childhood illness

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ABSTRACT

Background Acute diarrheal disease causes over 5 milion deaths worldwide in children under 5 years old, mostly because of failure to detect and treat dehydration properly and immediately.

Objective To determine the validity of clinical diagnosis of dehydration according to Integrated Management of Childhood Illness (IMCI) as a diagnostic test for dehydration in children under five years old.

Methods A prospective observational study was done for clinical diagnosis in dehydration. Children aged 2 months-5 years old with diarrhea and or vomiting who visited the primary health centers in Yogyakarta were enrolled. Clinical diagnosis was made by a trained IMCI nurses. Dehydration was defined as the presence of decreasing consciousness, very sunken eyes, slow reaction when offered a drink, and decreased skin elasticity. Ninety-five percents confidence intervals (CI) were calculated, and the significance was assessed by X^2.

Results There were 148 children aged 2 months to 5 years old enrolled this study. Clinical dehydration used according to IMCI produced sensitivity of 91% (95% CI 83;98), specificity of 82% (95% CI 75;89), positive predictive value (PPV) of 70% (95% CI 58;77), negative predictive value (NPV) of 94% (95% CI 90;98), positive likehood ratio of 5.17 (95% CI 3.37;7.94), and negative likehood ratio of 0.11 (95% CI 0.04;0.27).

Conclusion Clinical diagnosis for dehydration according to IMCI is sufficiently accurate as a diagnostic test for dehydration in children under 5 years old **[Paediatr Indones 2006;46:225-228]**.

Keywords: *clinical diagnosis, dehydration, integrated management of childhood illness*

Diarrheal disease is one of the main causes of mortality in children in de veloping countries. It is estimated that around 5 million children and infants in Latin America, Asia, and Africa died due to diarrhea followed by dehydration every year.[1,2] Dehydration also causes a decrease of blood volume as well as cardiovascular collapse if it is not treated immediately. The main cause of the mortality of diarrhea is dehydration, since it causes loss of electrolytes and fluids.

According to the Indonesian health household survey, the mortality rates of diarrhea in infants and children <5 years old are as follows: 539,000 infants and 61,000 children <5 years (1980); 368,000 infants and 103,082 children <5 years (1986); 268,700 infants and 76,400 children <5 years (1992); 301,000 infants and 39,000 children <5 years (1995); 229,600 infants and 28,700 children <5 years (2001).[3,4]

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Several diagnostic methods have been developed to detect the dehydration. In 1974, Maurice King, determined diagnostic symptoms of dehydration, i.e., a decrease of general appearance, a decrease of skin elasticity, sunken eyes, a concave fontanelle, dryness of the mouth mucous membrane and a weak pulse. In 1980, WHO published a guidebook on the diagnosis of dehydration by general examination which included a reaction when offered to drink, a weak pulse, an abnormal respiratory pattern, a concave fontanelle, and a decrease of skin elasticity, sunken eyes, excessive tear production, and humidity of mucous membranous, excessive urine excretion and systolic blood pressure.[5] In 1985, WHO included diarrhea and frequency of vomiting to the diagnosis of dehydration. Later, WHO again revised the criteria which included general appearance, a reaction when offered to drink, decrease of skin elasticity, sunken eyes, tears and the humidity of the mucous membrane.[6] We conducted this study to determine the validity of clinical diagnosis of dehydration according to Integrated Management of Childhood Illness (IMCI) as a diagnostic test for dehydration in children under five years old.

Methods

An observational study was carried out on all new diarrheae patiens who visited the primary health center in Yogyakarta between October 2004-September 2005. We proposed to attain a minimal of 61 subjects based on formula.[9]

The inclusion criteria of the subjects were all patients aged 2 months to 5 years with diarrhea and the parents agreed to participate in this study. Children with malnutrition were excluded from the study. The gold standard was the body weight gain after 2x24 hours, during recovery period.

We conducted a workshop for 36 nurses from 18 primary health centers before starting this study on how to diagnose dehydrated children with the training materials from IMCI. We counted the Kappa value (k) for the diagnosis of dehydration by using 15 children with diarrhea; they were examined for clinical dehydration signs, i.e., consciousness, thirst, sunken eyes and decrease of skin elasticity by two nurses trained in IMCI course. The clinical diagnosis of dehydration of these 15 children was confirmed by trained nurses, and was further analyzed with its kappa value. Before starting the treatment for diarrhea, all children had to undergo a measurement of their body weight in their current condition without wearing shoes. Further anamnesis and physical examinations were done by trained nurses.

The result of examination was written on a special form. After that, all subjects followed the course of treatment based on the IMCI, then they were measured again for their body weight within 2x24 hours after treatment to be taken as the gold standard. The nurses who measured the children's body weight and dehydration signs after therapy were blinded to the results of the first examinations.

The overall data was collected on the integrated form for every subject and after that it was entered and analyzed. The following statistics were then calculated: sensitivity, specificity, the predictive values, and the likelihood ratios. [11,12]

Results

There were 148 children who visited the primary health center that fulfilled the inclusion criteria. The subjects characteristics are shown in **Table 1.**

Of 148 children with dehydration according to the gold standard, 84 patients (56.3%) met the crite-

TABLE 1. CHARACTERISTICS OF THE PATIENTS

Variable	Total (n=148)	%
Age		
2–12 months	93	63.1
1–5 years	55	36.9
Gender		
Male	65	41.5
Female	83	58.5
Diarrhea frequency		
=2 times/day	83	56
>8 times/day	65	44
Vomiting frequency		
=2 times/day	84	57
>2 times/day	64	43
Diarrhea duration		
1–2 days	92	60
3–4 days	55	39.4
5–6 days	1	0.6

ria of dehydration according to IMCI. The diagnostic properties are presented in **Table 2**.

Table 2. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (PLR), and negative likelihood ratio (NLR) of dehydration examination according to IMCI

	Percentage (95% CI)
Sensitivity	91 (83–98)
Specificity	82 (75–89)
PPV	70 (58–77)
NPV	94 (90–98)
PLR	5.17 (3.37–7.94)
NLR	0.11 (0.04–0.27)
Prevalence	32 (24–38)

Discussion

The agreement between the two nurses who involved in this study showed a Kappa value of 0.75. It means that the dehydration examination done by the two observers was acceptable for the research.[13]

Based on IMCI, the sensitivity of this study was 91% (95% CI 0.35;0.98). It can be assumed that the test had a detection capability of 91% on the dehydration group and only 9% were undetected since the result had a false negative. Furthermore, the examination for dehydration performed according to IMCI produced the specificity of 82% (95% CI 0.75;0.89), which means that the test had a capability detection of about 82% in the non-dehydration group, and only 18% of the dehydration cases were missdiagnosed due to a false positive result.

Based on the sensitivity and the specificity of the study, the dehydration criteria of IMCI produced a positive predictive value of 70% (95% CI 0.58%;0.77) and a negative predictive value of 94% (95% CI 0.90;0.98). If the physician treated the patients based on clinical dehydration symptoms, the probability of children having dehydration was about 80% (suitably with its prevalence condition). If the examination of dehydration done according to the IMCI showed a positive result, the probability of the children having a dehydration symptoms changed to be 70%. If the examination showed a negative result, the probability of the children not having dehydration symptoms was 94%.

The dehydration examination of IMCI had a good positive likelihood ratio of 5.17 (95% CI 0.04;0.27). The prevalence found in this research was 32%, so the determination by the odds value strated with changing its probability, using odds ratio formula=probability/(1–probability), so the pre-test odds=32%/(1-32%)=0.47.

The pre-test odds furthermore changed to be post-test odds by multiplying these odds with the likelihood ratio, post test odds=0.47x5.17=2.4. The return to post-test probability was used with the probability formula=odds/(odds+1), so the post test probability=2.4/(1+2.4)=0.705=70.5%. The positive likelihood ratio of 5.17, showed that the examination had a moderate changing pattern from the pre-test probability of about 32% to the post test probability of about 70%, so the examination seems to be very useful.

A similar research previously done by Sachdev *et al*,[14] showed the dehydration examination done according to IMCI had a sensitivity of 99%. The differences of the results is due to the fact that we used analysis for the kappa value in training with IMCI materials before the research started. The age of their subjects was 1 month–5 years, while ours 2 months–5 years old.

We concluded that the clinical diagnosis of dehydration according to IMCI is sufficiently accurate as a diagnostic test for dehydration in children under five years old.

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