

The Effect of Health Education and Mobile Control Application Program on Anemia among Pregnant Women

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Abstract: *Background:* anemia is one of the most widespread nutritional deficiency diseases. An intervention is needed to improve Hb among pregnant women in order to avoid maternal and perinatal complication and deaths. The use of mobile control application has improved the compliance of ferrum tablet consumption. This study aimed to assess the effect of health education and mobile application control on anemia among pregnant women.

Methodology: The design of the research is quasy experimental. The study was conducted in Banten from September to December 2017. Multistage cluster sampling technique was used in this research. The samples were divided into experimental and control groups. The experimental group consists of health education using a module and the mobile application program. The data were analyzed using descriptive and inferential statistics. Wilcoxon sign rank test and independent t-test were used with alpha .05.

Results: There was a significant difference of pregnant women's knowledge ($z = -7.187, p = .005$), pregnant women's perception ($z = -7.054, p = .005$), and pregnant women attitude before and after intervention ($z = -6.35, p = .005$). There was a significant difference of family knowledge ($z = -6.53, p = .005$), family attitude ($z = -4.56, p = .005$), and family support before and after intervention ($z = -7.08, p = .005$). There was a difference of Hb mean between experiment and control group after the intervention ($t = 7.12, p = .005$).

Conclusions: health education and mobile control application program has a positive effect on anemia among pregnant women. An advocacy is required at governmental level after developing a frame of reference for understanding anemia in pregnancy.

Keywords: Anemia, Health Education, Mobile Application, Pregnant Women.

1. INTRODUCTION

Anemia in pregnancy remains a major problem in nearly all developing and developed countries. According to the World Health Organization, prevalence of anemia that exceeds 40% in any population group is an indicator of a public health problem [1]. The prevalence of anemia ranges from 33% to 89% among pregnant women in India². Frequency pregnant women with anemia in Indonesia relatively high at 63.5%³. Majority of the causes of the Maternal Mortality Rate (MMR) [4] was bleeding due to anemia in pregnancy [4]. MMR in Banten Province, Indonesia is still high. Banten Provincial Health Office reported that Banten is the top five national position as the region with the highest MMR.

Anemia in pregnancy has adverse effects on the mother and the fetus. Severe iron deficiency anemia may be presented by complications of pregnancy, such as placenta previa or abruption placenta, operative delivery and post-partum hemorrhage. The untreated of

this condition may lead to severe complications. The reduction in hemoglobin level was associated with prematurity, spontaneous abortions, low birth weight, and fetal death [5].

Anemia is one of the most frequent complications related to pregnancy. Anemia is a decrease in the oxygen-carrying capacity of the blood and is best characterized by a reduction in hemoglobin concentration. The commonest of signs and symptoms of anemia are headache, fatigue, lethargy, paresthesia, and the clinical signs of tachycardia, tachypnea, pallor, glossitis, and cheilitis [5]. Because of the physiologic changes in pregnancy that impact to hematocrit and certain other parameters, such as hemoglobin, reticulocytes, plasma ferritin, and unsaturated iron-binding capacity, diagnosing true anemia, as well as determining the etiology of anemia, is challenging⁶. The most common anemias are iron-deficiency anemia and folate deficiency megaloblastic anemia [5-8].

The absorption of dietary iron and the utilization of endogenous and exogenous iron are also influenced adversely by chronic infection and inflammation due to malaria and multiple helminthic infections [9]. Furthermore, A study found that infections and food

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constraints are probably important causes of anemia in pregnancy [10]. This finding suggests that nutrient deficiencies and illnesses rather than parasitic infestations are primarily the causes of anemia in Ethiopian women [11].

Maternal iron–folic acid (IFA) supplementation is one of the key interventions to reduce anemia in pregnant women [12]. Routine Fe supplementation in pregnancy is a common practice to prevent iron deficiency and anemia [13]. The iron supplementation has a benefit on maternal iron status during pregnancy even more apparent postpartum. This is supported by a study that found all pregnant women who did not take iron supplements had less than “sufficient” iron stores in late pregnancy compared with 43% of supplemented (200 mg Fe/d) women [14].

Indonesia has implemented maternal IFA supplementation as part of ANC programmes for nearly 40 years. A series of Indonesian Demographic and Health Surveys reported the low adherence of women to IFA tablet consumption, in which approximately 20% of women did not consume any IFA tablets during their last pregnancy and only approximately 30% consumed at least ninety tablets [15]. Some factors found related low compliance were negative side-effects disliking the taste of the supplements and forgetfulness [16,17]. Compliance was positively related to Hb concentrations. Some intervention studies have been conducted to improve compliance to medication such as mobile control application [18]. Previous study found that A mobile application for medication adherence increased objectively and subjectively measured adherence in elderly users undergoing rehabilitation [19]. In addition, another study revealed that diabetes device-connected mobile apps can improve glycemic control [20].

Some factors found related adherence to iron and Folic Acid (IFA) supplementation among pregnant women. They are Knowledge of pregnancy-related risks, family particularly husband’s support, and adequate antenatal care (ANC) visits [12]. In addition, a lack of understanding of anemia is a major factor causing low consumption of Fe tablets in pregnant women in Indonesia [19]. Furthermore, a study revealed that the barriers to effective supplementation programs are inadequate supply, inadequate counseling and distribution of iron tablets, difficult access and poor utilization of prenatal health care services, beliefs against consuming medications during pregnancy, and in most countries, fears that taking too much iron may cause too much blood or a big baby,

making delivery more difficult [19]. Furthermore, an adequate frequency of ANC visits, better knowledge of maternal risks and danger signs, and family support significantly increase the likelihood of women to adhere to the IFA supplementation program recommendation.

Health education has an effect to improve knowledge of pregnant women in order to prevent anemia iron deficiency. Previous study indicates positive effect of educational intervention program base on PRECEDE Model and main components (Predisposing, Enabling, Reinforcing factors) in improving of iron deficiency anemia [21]. In addition, there were highly significant increases in the levels of hemoglobin and hematocrite after received health education among children in United Arab Emirates [22].

A study recommend that women of childbearing age should be provided nutritional education regarding food sources of iron, especially prior to becoming pregnant, and taught how food choices can either enhance or interfere with iron absorption [20]. An evidence revealed that close family members could be an opportunity for encouraging compliance with iron supplementation among the women, considering that family members potentially influence health-seeking behaviours of pregnant women [23]. Nutrition and health messages should also be purposefully targeted at other family members.

Forgetfulness is one of the factors related to adherence of Fe tablet consumption and affect on anemia. The application through smartphone will be a reminder for the schedule for the consumption of Fe tablets in women and husbands / families is needed. With this application the women can control protein intake through food. Food consumed by women will be converted using the guidelines from the Indonesian Food Composition Table (*TKPI*), so that women can easily find out the composition of the food and can estimate the type and amount of food that must be consumed. This application can also be used by husband / family as a control medium for pregnant women in the consumption of blood-added tablets and protein consumption. And this application can also be controlled by health workers related to maternal compliance in consuming blood-added tablets. As the evidence recommend that improving women’s knowledge of pregnancy-related risks and involving family members, particularly the husband might improve adherence to IFA supplementation, this study aimed to improve women’s knowledge and also their family on anemia in order to resolve anemia in

pregnancy by providing the health education regarding anemia and mobile control application program.

2. METHODOLOGY

The study design is Quasy Experimental. Multistage cluster sampling technique was used. The study was conducted in Pandeglang Regency, Banten Province Indonesia. It was selected due to the high prevalence of maternal mortality Rate in 2017. Within Pandeglang Regency, Kaduhejo and Bangkonol district were selected due to the high prevalence of anemia in pregnancy. The population in this study was pregnant women in the work area of Kaduhejo Health Centre in amount 630 pregnant women. The sample pregnant women who live with their family with the inclusion criteria: gestational age 13 - 40 weeks, second or more pregnancies, single pregnancy, complete medical record, can communicate verbally and willing to be the subject of research. The inclusion criteria of family members are having a marital or blood relationship, live in one house, be able to communicate verbally, willing to be the subject of research.

Sample were classified into experiment and control group. Simple random sampling was used to get 74 Pregnant women also their family were enrolled into experiment group in Kaduhejo District, while 79 pregnant women also their family were enrolled into control group in Bangkonol District. The experiment group received an intervention while the control group did not receive the intervention. The interventions consist of health education regarding prevention of anemia among pregnant women also their family, and the application of mobile application reminder to iron supplementation. The application was installed on the mobile phone of pregnant women, their family and also the midwife who take care of pregnant women. Both midwife and pregnant women's family could monitor the iron consumption of pregnant women by mobile phone.

A module is used as a tool in providing education about anemia prevention. The module consists of 2 main parts namely module used for pregnant women and family. The module for pregnant women aims to allow the pregnant women to prevent or overcome the occurrence of anemia during pregnancy. This outline consists of the role of the women in the care of pregnancy, the process of pregnancy, nutrition in pregnancy, substances needed during pregnancy, balanced menu settings during pregnancy, and treatment of pregnant women with anemia. The family module aims to enable families to show their support to

pregnant women with anemia. This outline consists of family role, family support principle, information support for pregnant women, support of award for pregnant women, instrumental support for pregnant women, and emotional support for pregnant women. The health education provided to pregnant women in antenatal class. Midwives who have trained to be educator provided health education to pregnant women. There were 3 session of class which the duration was 20 minutes. It was delivered to pregnant women once a week in the pregnancy class. In addition, in the last minute midwives provided education to family member also. The method of health education is client centered.

A mobile application was used to monitor adherence of pregnant women in consuming Fe tablets and high protein foods. Application trials were conducted on 10 pregnant women and families in Cikedal district. At this stage, the researchers conducted a trial with a pre-post design test to see women adherence in the consumption of Fe tablets and foods high in protein. The application trial is carried out for two months from 2 September to 8 November 2016. The results of the pre-post test found that there are limitations in the application where the husband / family cannot see the food which women consumed, further improvements are made, but there is an increase in maternal adherence in the consumption of fe tablets and high-protein foods as well as family support for the reminder of consuming fe tablets and foods that are high in protein. There are no difficulties either midwives, pregnant women, and husbands / families in using this application.

The application was revised 4 times on April 4, 2016 and June 27, 2016, July 24, 2016 and August 8, 2016. Based on the results of the product trial evaluation, assessing deficiencies and preparing a broad scale test. The application consists of the Midwife application, Pregnant women and husband / family application. The revised application was submitted for validation by two experts namely nutritionists and application experts. The content assessed is the ease of use of the application, the appropriateness of content, linguistics, appropriateness of presentation, the appropriateness of cohesiveness. In the application of this application, the researcher gave a midwife socialization about how to use the application on August 21, 2017. The socialization was attended by 8 midwives in charge of the village and 1 midwife coordinating the Public Health Center in Cikedal District. After understanding how to use the application, midwives socialize to pregnant women as a reminder

and control of protein intake. Application is simultaneously installed and disseminated to pregnant women husband / family starting on September 20 until November 2017.

A questionnaire used has been developed by the researcher. It has been analyzed for validity and reliability. Face validity was judged by some experts who related to nutrition, obstetric gynecologist and item development. The questionnaire was used to analyze of knowledge of pregnant women, perception of pregnant women, attitude of pregnant women, family knowledge, family attitude, and family support. The study was approved by the Ministry of Health of Indonesia. All respondents gave informed verbal consent to participate in the study, and there were no refusals.

3. DATA ANALYSIS

Data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to analyze demographic data including age, education levels, ethnic, family member who taking care pregnant women, and family income. In addition, descriptive statistics were used to analyze the characteristics of pregnant women and family related to knowledge, attitude, support, perception, and anemia status. The assumption of normality and homogeneity of variance

of the variables have been conducted before determine the appropriate statistical analysis. Wilcoxon sign rank test has been applied to analyze the difference of knowledge of pregnant women, perception of pregnant women, attitude of pregnant women, family knowledge, family attitude, family support and anemia status before and after intervention. Independent t-test was used to analyze the difference of Hb after intervention between experiment and control group.

4. RESULTS

The results showed that the average of pregnant women's age was 27.8 years, majority of the pregnant women (37.3%) were graduated from junior high school, near all of the pregnant women were sunda ethnic (91.5%), majority of the family who taking care of pregnant women were husband (88.9%), and majority of the respondents had the family income less than IDR 2.164.979 per month.

Based on Table 2, it can be concluded that majority of the pregnant women had a low level of knowledge (59.5%) in the experiment group and a low level of knowledge (74.7%) in the control group, majority of pregnant women had a negative perception (60.8%) in the experiment group, and a negative perception (62%) in the control group, and majority of pregnant women had a negative attitude (60.8) in the experiment group and a negative attitude (70.9%) in the control group. In

Table 1: Demographic Characteristics

Characteristics	N	%
Education levels		
Do not have experience in formal school	7	4.6
Elementary school	34	22.2
Junior high school	57	37.3
Senior high school	53	34.6
College	2	1.3
Ethnic		
Jawa	10	6.5
Sunda	140	91.5
Batak	1	.7
Others	2	1.3
Family member who taking care of pregnant women		
Husband	136	88.9
Parents	6	3.9
Parent in-laws	1	.7
Others	10	6.5
Family income		
USD ≥ 152.34 per month	118	77.1
USD < 152.34 per month	35	22.9

Table 2: The Characteristics of Pregnant Women and Family Related to Knowledge, Attitude, Support, Perception, and Anemia Status

Characteristics	Experiment group		Control group	
	Pre test f (%)	Post test f (%)	Pre test f (%)	Post test f (%)
Knowledge of Pregnant Women				
Low level	44 (59.5)	13 (17.6)	59 (74.7)	55 (69.6)
High level	30 (40.5)	61 (82.4)	20 (53.3)	24 (30.4)
Perception of Pregnant Women				
Negative	45 (60.8)	21 (28.4)	49 (62)	46 (58.2)
Positive	29 (39.2)	53 (71.6)	30 (38)	33 (41.8)
Attitude of Pregnant women				
Negative	45 (60.8)	34 (45.9)	56 (70.9)	64 (81)
Positive	29 (39.2)	40 (54.1)	23 (29.1%)	15 (19)
Family knowledge				
Low level	63 (85.1)	21 (28.4)	61 (77.2)	47 (59.5)
High level	11 (14.9)	53 (71.6)	18 (22.8)	32 (40.5)
Family Attitude				
Negative	46 (62.2)	37 (50)	56 (70.9)	44 (53.7)
Positive	28 (37.8)	37 (50)	23 (29.1)	35 (44.3)
Family support				
Negative	55 (74.3)	34 (45.9)	62 (78.5)	62 (78.5)
Positive	19 (25.7)	40 (54.1)	17 (21.5)	17 (21.5)
Anemia status				
Anemia	74 (100)	42 (56.8)	79 (100)	71 (89.9)
Not Anemia	0 (0)	32 (43.2)	0 (0)	8 (10.1)

addition, majority of respondent's family had a low level of knowledge (85.1%) in the experiment group and a low level of knowledge (77.2%) in the control group, majority of the respondent's family had a negative support (74.3%) in the experiment group and had a negative support (78.5%). Furthermore, all of the respondents were anemia (100%) before the intervention.

Based on Table 3, it can be concluded that there was a significant difference of pregnant women's knowledge before and after intervention ($z = -7.187, p = .005$), there was a significant difference of pregnant women's perception before and after intervention ($z = -7.054, p = .005$), there was a significant difference of pregnant women attitude before and after intervention ($z = -6.35, p = .005$). In addition, there was a significant difference of family knowledge before and after intervention ($z = -6.53, p = .005$), there was a significant difference of family attitude before and after intervention ($z = -4.56, p = .005$), and there was a significant difference of family support before and after intervention ($z = -7.08, p = .005$).

Table 4 shows that the mean of Hb in the experiment group (10.82) was higher than control group (9.79). In the other words there was a difference of Hb mean between experiment and control group ($t = 7.12, p = .005$). It showed that the health education and mobile control application program has a positive effect on clinical outcome such hemoglobin among pregnant women.

5. DISCUSSIONS

Anemia is a leading cause of maternal morbidity, mortality and poor birth outcomes in developing countries including Indonesia. Education on anemia and provision of prophylaxis iron supplements during pregnancy are key strategies that are used to reduce the high prevalence of anemia among pregnant women [22].

This study revealed that majority of pregnant women (59.5%) had a low level of knowledge regarding anemia before the intervention. Women frequently recognize symptoms of anemia, but they do not know the clinical term for anemia. It is contrast with a

Table 3: The Difference of Variable Pre and Post-Test within Experiment Group

Variable	M (SD)	Min-max	z	p
Knowledge of Pregnant Women				
Pre test	10.16 (2.10)	7-16	-7.187	.000
Post test	14.5 (2.64)	9-19		
Perception of Pregnant Women				
Pre test	7.07 (2.02)	4-12	-7.054	.000
Post test	9.39 (2.24)	5-13		
Attitude of Pregnant women				
Pre test	26.89 (3.33)	23-35	-7.313	.000
Post test	3.35 (4.60)	25-44		
Family knowledge				
Pre test	9.39 (2.04)	7-27	-6.359	.000
Post test	12.43 (2.82)	7-18		
Family attitude				
Pre test	19.35 (2.53)	15-25	-4.564	.000
Post test	20.58 (3.16)	15-27		
Family support				
Pre test	36.72 (6.19)	24-51	-7.083	.000
Post test	42.49 (6.71)	30-55		
Hb				
Pre test	9.59 (1.02)	7.0-10.9	-7.284b	.000
Post test	10.8 (.87)	8.6-13.2		

Table 4: The Difference of Hb Post-Test between Experiment and Control Group

	N	M	SD	95% Confidence Interval of the difference		t	p
				Lower	Upper		
Experiment group	74	10.82	.87	.74	1.31	7.124	.005
Control group	79	9.79	.91				

previous study which found that levels of knowledge of anemia were almost universal, which meets the target (95%) [24]. It seems that Indonesia still need to improve knowledge regarding Anemia among pregnant women.

The level of education supports a good level of knowledge. Women with a high school education had substantially fewer children. Thus, education was indirectly associated with a greater frequency of prenatal visits²³. In addition, tertiary level of education and high social class were factors significantly associated with compliance to iron supplementation [24, 25].

It was observed in this report that women with good knowledge of iron supplementation in pregnancy were six times more likely to comply with iron supplementation than those with poor knowledge. It

may therefore imply that educating the women on significance of iron supplementation in pregnancy may improve their compliance to iron supplementation in pregnancy. As the theory revealed that education can affect a person as well as a person's behavior on a lifestyle especially in motivating to behave. Education affects the learning process, the higher a person's education the more easily the person receives information either from others or from the mass media [26].

One indicator of the success of Sustainable Development Goals (SDG's) is food for pregnant women, therefore it is very important that awareness of pregnant women eat nutritious food. Nutrients in food not only contain macronutrients such as carbohydrates, proteins, and fats that produce energy, but also contain micronutrients such as vitamins and minerals as a regulator of the body. While anemia is a condition that

often accompanies malnutrition due to protein and micronutrient energy. The importance of protein consumption for pregnant women is one focus on managing anemia. The level of protein consumption is influenced by maternal behavior in consuming various types of food during pregnancy. One of the health behaviors of pregnant women in consuming high-protein foods is influenced by knowledge, so there is a belief. In changing behavior, it takes a strong intention to be able to change unhealthy behavior into healthy behavior. In the context of anemia, emphasis is needed on the knowledge of pregnant women to be able to change their behavior during pregnancy and after childbirth.

Indonesia has implemented the nine years basic education programs as the national program. They are elementary school, junior high school, and senior high school. The education system provides learning opportunities to every citizens, irrespective to gender, religion, ethnic, social, or economic background. However, this present study found that majority of the pregnant women were graduated from junior high school (37.3%). Hence the knowledge of respondents might be low as a result of low level of education.

The way women view anemia and react to taking iron tablets was difference depend on region, country or ethnic group. This study found that majority of pregnant women (91.5%) were ethnic Sunda. It might be reason that they have a similar point of view regarding anemia. In addition, majority of pregnant women had negative perception and attitude regarding anemia prevention. Attitude refers to a general and enduring positive or negative feeling about some person, object, or issue [27]. Perception is closely related to attitudes. Perception is the process by which organisms interpret and organize sensation to produce a meaningful experience of the world [28].

Previous study revealed that half of women in all countries consider the symptoms of anemia to be a health concern that requires action and half do not [19]. Those women who visit prenatal health services are often familiar with oral iron supplements, but commonly do not know why they are prescribed. Contrary to the belief that women stop taking iron tablets mainly due to negative side effects. Women of reproductive age may not consider themselves at-risk, hence they may not seek antenatal care, including iron supplementation. It is considered that distance to health centers is also a problem for rural population. It may reflect the inadequacy of health services to provide for antenatal needs. Furthermore, awareness might be an important step that is expected to influence change, cognizant of

the fact that not all knowledge. Health care worker especially midwife should concern on a physical well-being of pregnant women with the alleviation of symptoms of anemia, particularly fatigue, a better appetite, increased appreciation of benefits for the fetus, and subsequent increased demand for prevention and treatment of iron deficiency.

Health education is a planned opportunity to learn about health, and make changes voluntarily in behavior. This program can also include providing information, exploring values and attitudes, making health decisions, and learning the skills that allow for behavior change. Health education interventions are felt to be very appropriate in the development of this anemia prevention model because in theory health education can change, foster, or develop positive behavior [29]. The result showed that health education and mobile control application program has improved knowledge, attitude, perception among pregnant women and knowledge, attitude, and support among family. It is supported by a study which revealed that there was a significant change in the knowledge and attitude of women who received health education about anemia [29,30]. Women who were exposed to nutrition education had much better understanding about causes, symptoms and the means of prevention of anemia. Another study found that maternal education is important in reducing the risk of anemia and iron deficiency [31]. In addition, Education-based intervention using small group discussions was effective in empowering adolescent girls to prevent Iron deficiency anemia [32]. Efforts must be made to educate women and enhance their level of economic status so that the prevalence of anemia can be reduced substantially.

Social influences model also shows that health behaviors and adherence to drug therapy in patients are encouraged and increased by bystander support such as family members and friends [33]. Thus, this study include family member who taking care pregnant women to increase their knowledge, attitude, and support in order to reduce anemia. Parto azam showed that an educational intervention on the knowledge and practice of the students and their mothers can effectively prevent iron deficiency anemia [34]. Midwife and nurses should involve family member to give support and taking care of pregnant women in order to prevent anemia in pregnancy. A kind of health policy related this issue is needed.

Social support refers to emotional, informational, or material resources provided by others and perceived

by the recipient as positive or helpful [35,36]. Although both the quality of available resources (functional measurements) and the number of social network connections (structural measurements) have been associated with positive health outcomes, in this study we focus exclusively on the former concept [37].

Family support was instrumental (helping with housework, presents for the baby and mother, cooking, money, rides) and emotional (company, advice). Mothers and mothers-in-law were the first to provide advice to the inexperienced mother to-be, to tell her about the processes that take place during pregnancy and thereafter, and to offer their help with meal preparation, laundry, and household chores. Some respondents also mentioned that their mother or mother-in-law planned to remain with them for a few weeks after delivery.

The results found that there is an effect of health education and mobile control application program on the improvement of knowledge level, perception, attitude, and support among pregnant women and their family. This improvement was associated with an increase in Hemoglobin among pregnant women. This present study found there is a difference of Hb between experiment and control group.

This study presents the difference of Hb mean between experiment and control group which indicate health education and mobile control application program has a positive effect on clinical outcome such hemoglobin among pregnant women. The health education is effective to change knowledge, attitude, and practice. It is supported by a previous study which found that nutritional educational and counseling during pregnancy can reduce the risk of anemia, increase gestational weight gain and improve birth [36]. In addition, educational package resulted in 50% effectiveness in preventing infection with soil transmitted helminthes among Chinese schoolchildren [38]. The reduction in the rate of infection was associated with an increase in knowledge and improved hygiene practice [39].

6. LIMITATION AND STRENGTH

Husband / family cannot see the food which women consumed by using that mobile application control. A simple random sampling would enhance the validity and addressed as the strength of the study.

7. CONCLUSIONS

This present study revealed that involving family members as the target to receive health education

brings the positive effects. An advocacy is required at governmental level after developing a frame of reference for understanding anemia in pregnancy. We suggest that health educators involve family in pregnant women's education, which may prove advantageous in decreasing the disease prevalence. A health education and mobile control application program is needed to be applied in the clinical setting.

ACKNOWLEDGEMENT

This study acknowledge Faculty of Public Health Andalas University and Faculty of Health Science Nasional University for their support.

CONFLICT OF INTEREST

There is no conflict of interest to conduct this study.

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