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Effect of sand filter clean water intervention on the nutritional status of children aged 6 - 24 months in Makassar

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Abstract:
A study to assess the effect of sand filter clean water intervention on weight and height of children aged 6 - 24 months. Quasi experimental research approach and non-randomized pretest and posttest with control design was used. A total of 32 samples (16 in the intervention group and 16 in the control group) were obtained through non-probability purposive sampling technique. Pretesting for both groups was carried out and sand filter clean water intervention was carried out for the intervention group for two months and posttest for the two groups was carried out after one and two months. Analysis of the data, the findings in the intervention group showed that the mean child's weight of the pretest was 8.45±0.93, the mean child's weight of the first posttest was 8.58±0.98, and the mean child's weight of the second posttest was 8.79 ±1.08 increased after the intervention sand filter clean water. The mean child's weight of the pretest in the control group was 9.02±1.80, also the mean child's weight of the first posttest to the second posttest was 9.68±2.53 to 9.99±2.71 also increased. The findings revealed that the pretest mean child's height of the intervention group was 73.94±4.47, the mean child's height of the first posttest was 75.00±4.29, and the mean of the child's height of the second posttest was 76.08±4.40 improved after the intervention of sand filter clean water. Pretest mean child's height in the control group was 73.61±5.75, also the mean child's height of the first posttest to the second posttest was 75.68±4.61 to 76.66±4.55 also increased. The results showed that the sand filter clean water intervention had an effect on child's weight, p values = .007 and child's height, p values = .001.

Key Word*: slow sand filter system, nutritional status.*

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I. Introduction

Indonesia is ranked fifth in the world for the number of children with malnutrition after China, India, Nigeria and Pakistan. More than a third of children under the age of five in Indonesia are below the average height. Undernutrition in Indonesia is higher than other countries in Southeast Asia, such as Myanmar (35%), Vietnam (23%), and Thailand (16%) [1].

Environmental sanitation and hygiene factors also affect the health and development of children, because children under the age of two are susceptible to various infections and diseases. Low sanitation and environmental hygiene also trigger digestive tract disorders, which makes energy for growth diverted to the body's resistance to infection. A study found that the more often a child suffers from diarrhea, the greater the threat of stunting for him. As a result, the child is threatened with malnutrition, which results in disrupted mental and physical growth, so that his potential cannot develop optimally. Sanitation and environmental hygiene. Sanitation and Hygiene for Perfect Child Development [1].

Clean water is water that is fit for consumption. Clean water is not only clear, odorless, and tasteless, but also must meet health requirements. These health requirements include not containing toxic chemicals or bacterial germs that can interfere with health [2]. In the last decade, an average of 50,000 people died per day from diseases related to unclean water [3].

II. Material And Methods

This Non-Randomized Pretest-Posttest with Control Group Design was adopted for the study. the study was conducted from 12/072021 to 30/09/2020 on 32 children aged 6-24 months (16 in each experimental and control group). Purposive sampling technique was used to collect data. Data was collected in three stages. Before the intervention, both groups were pretested and nursing interventions were carried out sand filter clean

water for the intervention group for two months and posttests from both groups were carried out after one and two months.

Study Design: Non-Randomized Pretest-Posttest with Control Group Design Study
Study Location: The study was conducted at Makassar, Indonesia.
Study Duration: 12 July to 30 September 2020.
Sample size: The research sample was divided into two groups, namely 16 subjects in the intervention group who were given clean water from sand filtered clean water. In addition, the use of bottled drinking water by 16 subjects in the control group. The study was conducted for two months: posttests for both groups were performed after one and two months.

Statistical analysis

Repeated Measures ANOVA and Friedman test were used to determine the difference between weight and height children after the sand filter clean water intervention. Repeated Measures ANOVA is parametric test and Friedman test are non-parametric test designed to analyze the effect of sand filter clean water intervention on children's weight and height gain. The level of $p \leq 0.05$ is considered as the limit value or meaning.

III. Result

Overview of sample characteristics

Table (1) Characteristic of study group according to age and gender n = 32

	Frequency	Percent %
Age		
6-12 Months	16	50
13 – 18 Months	12	37.5
19 – 24 Months	4	12.5
Total	32	100
Gender		
Boy	14	43.7
Woman	18	56.3
Total	32	100

Table (1) showed that, half (50%) of children aged between 6-12 months. Regarding gender, more than half (56.3%) of them are woman.

Univariate Analysis

Table (2) Comparison of the nutritional status of children in the intervention group of sand filtered clean water and bottled drinking water in the control group n = 32

	Pre		Post 1		Post 2	
Intervention Group	n	%	n	%	n	%
Weight indicator						
Malnutrition	2	12.5	1	6.3	1	6.3
Good Nutrition	14	87.5	15	93.8	15	93.8
More Nutrition	0	0.0	0	0.0	0	0.0
Total	16	100	16	100	16	100
Height indicator						
Short	0	0.0	0	0.0	0	0.0
Normal	15	93.8	15	93.8	15	93.8
Tall	1	6.3	1	6.3	1	6.3
Total	16	100	16	100	16	100
	Pre		Post 1		Post 2	
Control Group	n	%	n	%	n	%
Weight indicator						
Malnutrition	5	31.3	3	18.8	4	25.0
Good Nutrition	10	62.5	11	68.8	10	62.5
More Nutrition	1	6.3	2	12.5	2	12.5
Total	16	100	16	100	16	100
Height indicator						
Short	3	18.8	2	12.5	2	12.5
Normal	13	81.3	13	81.3	13	81.3
Tall	0	0.0	1	6.3	1	6.3
Total	16	100	16	100	16	100

Table (2) shows that, in the intervention group there was a 6.2% decrease in poor nutritional status and an increase in 6.3% in good nutrition. There was no change in the height indicator. In the control group there was a 12.5% decrease in poor nutritional status in the first posttest and again increased 6.2% in the second posttest. And an increase in 6.3% in good nutrition in the first posttest and down again 6.3% in the second posttest. There was an increase in the child's height by 6.3%.

Bivariate Analysis

Table (3) Comparison of weight score pretest, 1st posttest and 2nd posttest in the intervention group and the control group

	Intervention group (n=16)				Repeated Measures ANOVA, p-values	Control group (n=16)				Friedman test, p-value
	Mean	SD (±)	Min	Max		Mean	SD (±)	Min	Max	
Pretest	8.45	0.93	7.00	10.10	0.007*	9.02	1.80	6.20	13.80	0.002*
1st posttest	8.58	0.98	7.10	10.00		9.68	2.53	6.70	15.20	
2nd posttest	8.79	1.08	7.10	10.50		9.99	2.71	6.80	16.00	

*=Significant,
Pretest = measurement before intervention
1st posttest = measurement in the first month after intervention
2nd posttest = measurement in the second month after intervention

The results in Table (3) revealed there are differences between the intervention group (Repeated Measures ANOVA, p=.007<.05) so it can be concluded that there is an effect of giving sand filter clean water to the child's weight. Likewise, in the control group (Freidman test, p=.002<.05), it can be concluded that there is an effect of giving bottled water on child's weight.

Table (4) Comparison of height score pretest, 1st posttest and 2nd posttest in the intervention group and the control group

	Intervention group (n=16)				Repeated Measures ANOVA, p-values	Control group (n=16)				Repeated Measures ANOVA, p-values
	Mean	SD (±)	Min	Max		Mean	SD (±)	Min	Max	
Pretest	73.94	4.47	67.80	82.00	0.001*	73.61	5.75	65.00	83.20	0.002*
1st posttest	75.00	4.29	69.00	83.00		75.68	4.61	67.50	83.20	
2nd posttest	76.08	4.40	69.10	84.00		76.66	4.55	67.60	84.00	

*=Significant,
Pretest = measurement before intervention
1st posttest = measurement in the first month after intervention
2nd posttest = measurement in the second month after intervention

The results in Table (4) revealed there are differences between the intervention group (Repeated Measures ANOVA, p=.001<.05) so it can be concluded that there is an effect of giving sand filter clean water to the child's height. Likewise, in the control group (Repeated Measures ANOVA, p=.002<.05), it can be concluded that there is an effect of giving bottled water on child's height.

IV. Discussion

Nutritional status in children is usually evaluated by assessing the physical growth rate (through anthropometric measurements) or micronutrient status (clinical signs of deficiency or blood tests). Various standard methods are available for the assessment of nutritional status. There are direct and indirect causes of malnutrition in children. The two direct causes of malnutrition are insufficient food intake and disease, which interact in a complex manner and manifest as chronic malnutrition (stunting) or in acute situations as wasting. Many indirect factors contribute to nutritional status, such as food security, child-rearing practices, maternal education, access to health services and clean water, hygiene and sanitation conditions [4].

An integral role in health is the provision of clean water, disposal of human waste and personal hygiene has long been recognized [5]. One of the targets of Millennium Development Goal 7 (MDG 7) is to reduce by half the proportion of people who do not have access to safe drinking water and basic sanitation. Activities

related to this objective aim to improve access to drinking water and better sanitation. However, the possible health and nutritional benefits of meeting the MDG 7 targets for clean water and sanitation are rarely discussed [4].

Poor access to clean water and personal hygiene (WASH) was associated with 6.6% of the global burden of disease and disability, and 2.4 million deaths each year from diarrhea, malnutrition and its consequences [6]. Most of the burden of this disease is experienced by children in low-income countries. Several authors have claimed that poor WASH conditions account for as much as 50% of maternal and child underweight, primarily through the well-described synergy between diarrheal disease and malnutrition, where one increases vulnerability to the other [7]. On the other hand, the Lancet Maternal and Child Nutrition Series estimates that a personal hygiene and sanitation intervention implemented with 99% coverage will reduce the incidence of diarrhea by 30%, which in turn will reduce the prevalence of stunting by 2.4% at 36 months of age [8].

The association between improved water supply and sanitation and better growth outcomes in children has been reported from cross-sectional, case-control, and prospective studies. Using samples from eight countries, [9] estimated that improved sanitation was associated with an increase of 0.06-0.65 height/age. Better water sources were associated with smaller benefits to height that were only seen when sanitation was also improved. In a longitudinal cohort design, Peruvian children at the age of 2 years with the worst water sources, reservoirs, and sanitation conditions were 1.0 cm shorter than children with the best conditions [10]. Similarly, Bangladeshi children under 4 years of age living in households with better water quality, better toilets, and hand washing facilities had height/age 0.54 (95% CI: 0.06–1, 01) is greater than children who do not live in these conditions [11].

Other studies have also reported better growth outcomes in children from households with better water supply, sanitation, or both in different countries [12]. In a large prospective cohort study in Sudan, the risk of stunting was lowest in children from households with water and sanitation (multivariate RR = 0.79, 95% CI: 0.69-0.90).31 Among children who were stunted at baseline, those from households that had water and sanitation had a 17% greater chance of recovering from stunting than their peers from households without both facilities. The effects of water quality and sanitation on child growth are complex and may involve interactions between the two factors. The synergistic effect of water and sanitation on growth was reported among children in Lesotho in a prospective study [5] and in the Esrey study described above, [9] but similar synergies were not found in Sudan [13]. This inconsistent finding can be explained by differences in the hygienic conditions of the child's physical environment and personal hygiene practices.

In a study of the functional consequences of mild to moderate malnutrition in rural central Mexico (WASH) strongly and significantly associated growth (height, weight, and height-to-weight) in children aged 6 and 30 months, when socioeconomic status, household size, and food intake were controlled for in statistical analysis [14]. Two recent studies further support the role of WASH in child stunting; in a recent cross-sectional study, poor household hygiene was associated with lower height/age regardless of infant feeding practices, neonatal morbidity, household feeding.

Experimental evidence is needed to check the causality of these observations. However, a recent non-randomized experimental design showed that in a food insecure region of Ethiopia, children aged 6–36 months from the WASH intervention area obtained 0.33 more Z-scores in the mean height/age over a period of time. 5 years ($p = 0.02$) versus children of the three comparisons. villages that did not receive any additional intervention; all regions receive the government's Productive Safety Net Program [15]. WASH interventions are comprehensive, including the provision of protected water, sanitation education, practice of washing hands with soap, construction of sanitation facilities, house hygiene, construction of separate cages for animals, and maintaining clean water. In the same study, areas allocated to receive nutrition education or health education without WASH showed no effect on children's growth.

V. Conclusion

1. There is a significant effect of providing clean water from a sand filter on the weight gain of children aged 6-24 month.
2. There is a significant effect of providing clean water from a sand filter on the height gain of children aged 6-24 month

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