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Impact of Micronutrient Supplementation, and Infection on Z Score (A Study on Children Under Five in Coastal Areas)

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ABSTRACT

Infection and a lack of micronutrients are what prevent plants from thriving in toddler. The reason of this find out about was once to analyze infection and micronutrient supplementation on the Z rating of young people with failure to thrive. An experimental with Pretest Posttest Group Design was carried out on sixty-nine children aged 12-23 months who, for two months, were observed to gain less than the 5th percentile of WHO standard weight increment, selected with the aid of consecutive sampling and stay in the coastal area of the city of Semarang. The supplementation intervention was given to three groups in a double-blind manner: 1) Zn sulfate syrup 10 mg; 2) iron syrup 7.5 mg + vitamins B complex; 3) Zn sulfate syrup 10 mg and iron syrup 7.5 mg + vitamins B complex. The research was once carried out for two months. The lookup instrument used a questionnaire, baby scale, infantometer, WHO Antro, nutrisurvey. Statistical test using paired T-test, multi² variate analysis of variance, and dummy variable logistic regression. The Paired T-Test confirmed that there used to be a sizable difference in the Z Score in WHZ in the two supplementation groups (p=0.014). The MANOVA test concurrently for the three groups affected the Z Scores of WAZ, HAZ and WHZ (p=0.001). Post Hoc evaluation determined that the Z score of WHZ in group two used to be one-of-a-kind from team 1 (p=0.001) and group 3 (p=0.011). Micronutrient supplementation influences the Z Score of WHZ in children who fail to thrive. The Dummy Variable Logistic Regression found that the incidence of URI affected WHZ.



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1. Introduction ⁵

Golden period is the First 1000 Days period Life, which starts from the time the child is in the womb until the child is old 2 years. The physical growth and improvement of brain cells is very speedy in this period [1]. Nutrition and health parenting patterns as well as early detection of child growth can forestall failure to thrive. Growth failure can be monitored routinely by way of weighing at the Integrated Service Post

(Posyandu) each and every month, so that even the slightest deviation can be detected quickly [2].

A graphical depiction of a increase curve for kids who trip failure to thrive is no longer elevated in more than one weighing, [3] growth under the third or fifth percentile curve is appropriate with the intercourse and age of their peers, [4] and or changes in a growth curve that passes thru the two main percentile curves at two times observation [4].

The have an impact on of failure to thrive at 1,000 Days period life is irreversible, especially for intelligence development [1]. Impact of failure to thrive in kids can varied, beginning with impaired bodily growth, low patience to a disease, until there is a decline in levels intelligence and emotional development [5]. Research in Southeast Asian Countries shows that children with WAZ index under 80% standard median are at threat of three –five times have nonverbal IQ 89, language skills, gross motor movements, as nicely as interpersonal relationships [6], [7]. Failure to thrive in variety of manifestations have an negative impact on number aspects the life of a nation [6].

Failure to thrive is mostly triggered by using non-organic factors, namely environmental and social factors. The environmental factor in query is the nutritional parenting style the duty of the mom or surrogate mother who functions as a "Gate Keeper". UNICEF in a number of research reviews found it Complementary Food quality made at domestic is low in nutritional vitamins and minerals. recognized as "Hidden hunger" or micronutrient deficiencies [8], [9]. The International Zinc Nutrition Consultative Group estimates the population in the country developing countries which include Indonesia 25% are at risk of experiencing Zn deficiency, caused by way of deficiency in the course of pregnancy, low consumption of micronutrients [10]. Similar findings from studies conducted in various Indonesian provinces indicate that roughly 50% of children under five have inadequate intakes of the micronutrients zinc, iron, and vitamin A [11]. Deficiency of micronutrients can lead to decreased reserves of nutrients that affect weight loss and the immune system [12- 14]. Toddlers who experience deficiencies of macro and micro nutrients, are at risk of decreasing growth rate or linear growth disturbance.

Efforts to overcome deficiencies of micronutrients according to reports International Food Policy Research Institute in the quick time period is by way of supplementation [9]. Numerous studies concerning the supplementation of Zn and iron have been conducted both in single and multiple doses, [15], [16] with or without some micronutrients capable of influencing the Z score [17]. Iranian studies on kids aged 3 to 7 who received multivitamins (vitamins A, C, iron, Zn, Mg, and Lysine), but at a dose of iron 10.5 mg higher than Zn 7.5 mg, did not find any differences in WAZ outcomes. and Upper Arm Circumference between the placebo and intervention groups [18]. The child's growth process will be positively impacted by Zn and iron supplementation if given together with a dose of iron that does not exceed Zn [19].

Zn and iron ¹ play a role in the body's production of protein and energy, and they have an impact on IGF-1, a growth hormone mediator that is crucial for a child's growth process [20]. Zn plays a mediator role in appetite regulation as well. Zn syrup supplementation significantly decreased appetite, according to research from Semarang and Iraq. Children with increased appetites eat more frequently, resulting in better weight gain than children with normal appetites [21], [22].

Vitamin B is one of the vitamins that is beneficial for the growth and development of children, by regulating appetite and body metabolism. Vitamin B generally converts food into energy, breaking down fats, carbohydrates, and proteins. Vitamin B cannot be made by the body and is easily damaged, so it needs supplementation [23].

Micronutrient deficiency can result in lower nutrient reserves, which can affect immune function and weight loss [12- 14]. Therefore, at the beginning of life, especially the first 1000 days of life. Zn, and iron supplementation is needed to prevent micronutrient deficiencies. The findings of several studies indicated that micronutrient (Zn, iron) supplementation had an effect on Zn and ferritin levels, [24], [25] increased the adequacy of nutrients, [26] weight and height, [27], [28] and ultimately had an effect on toddlers' nutritional status [29], [30].

Organic abnormalities that are not due to functional damage to organs are infections due to exposure to germs (viruses, bacteria, etc). Children during toddlers can multiply the infection hundreds of times. Infectious diseases and malnutrition are mutually exclusive contact with one another, infectious diseases will exacerbate malnutrition due to increased loss of nutrients essential nutrients in the body and disruption of intake food [31].

Diarrhea and acute respiratory tract infections are the most common in children. Liquid bowel movements occurring more than three times/day accompanied by vomiting, and fever in ARI cause fewer nutrients to enter the body, causing weight loss [32]. Diarrhea and ARI in Ethiopia, [33] and other infections in Sri Lanka, [31] and incidence of infection in other developing countries, which triggered the habit of not washing hands and the condition of family latrines at risk for growth retardation [34]. There is an internal parasite in the human body, causing disruption of the process of absorption of nutrients by the small intestine mucosa so that the need for nutrients is not fulfilled [35].

2. METHODS

Type of study Quasi-Experimental pre-test and Post-test Group Design. The research will begin in the Bandarharjo Health Centre area, located on the north coast of the city of Semarang, in 2020. The subjects were children aged 12-23 months with weight gain during the two months of observation that was below the 5th percentile of the WHO standard. The number of subjects was 69 with consecutive sampling, then divided into 3 intervention groups as follows: 1) Zn sulfate syrup 10 mg; 2) Iron syrup 7.5 mg + Vitamin B Complex; 3) Zn sulfate syrup + 7.5 mg iron and Vitamin B Complex. Supplementation was given every day for two months, assisted by cadres in a double-blind manner. Subjects were declared to have dropped out if they had not consumed food for at least one week, or changed their address.

The independent variables were the provision of micronutrient supplementation and the incidence of infection (diarrhea, ARI). The dependent variables are WAZ, HAZ, and WHZ. Variables disturb the adequacy of micronutrient (vitamin A, D, folic acid, calcium, Zn, and iron). The research instruments consisted of Zn sulfate syrup, iron syrup + vitamin B Complex, baby scale, infantometer, questionnaire, checklist sheet, WHO Antro, Semi-Quantitative Frequency Food Form, food picture, Nutri survey.

The statistical test known as the paired T-test was used to compare WAZ, HAZ, and WHZ before and after the intervention. To ascertain the effect of supplementation and the level of sufficiency micronutrient on the Z Score, Multivariate analysis of variance to simultaneously decide they have an effect on of the three supplementation groups on the Z score. To ascertain the effect of infection incidence on the Z score, dummy logistic regression was used.

3. RESULTS

The survey results found that the working region of the Bandarharjo Health Center is a location with a very densely populated residential environment, with houses that are very shut to each other, very narrow roads, shut to the Java Sea, and there are even several homes if the ROB (tide) season does now not occur.

habitable. Access to fish for human consumption is very easy. Most of them are of middle to lower socioeconomic levels.

The sex of the subjects who skilled failure to thrive from the three intervention groups was often > 50% male, the mean age of the subjects used to be 16.86 – 19.67 months, the subjects' birth weight used to be generally ≥ 2500 gr, and their body length born \geq forty-eight cm. Most parents' education is equal to high school with middle to lower socioeconomic levels. Most of the mothers as housewives

Table 1. Subject Distribution Based on Subject Characteristics

Characteristic	Suppl Z sulfate 10 mg		Supp Iron + Vit B Complex		Suppl Zn & Iron +Vit B Complex		p value
	f	%	f	%	f	%	
Age (month)							
12 – 18	16	72,7	10	38,5	07	60,3	0,007*
19 - 23	06	27,3	16	61,5	17	39,7	
Birth Weight (g)							
< 2500	01	95,4	02	92,3	00	00,0	0,457*
≥ 2500	21	04,6	24	07,7	24	100,0	
Length of birth (cm)							
< 47	00	00,0	00	00,0	00	00,0	0,525*
≥ 47	22	100,0	26	100,0	24	100,0	
Sex							
Men	14	63,6	09	34,6	13	54,2	0,173**
Woman	08	36,4	17	65,4	11	5,8	
Father's Education (year)							
Basic ≤ 9	07	31,8	09	34,6	04	16,7	0,590*
Continued > 9	15	68,2	17	65,4	20	83,3	
Mother's Education (year)							
Basic ≤ 9	07	31,8	07	26,9	07	29,2	0,416*
Continued > 9	15	68,2	19	73,1	17	70,8	
Father's Job							
Government employees	01	04,6	00	00,0	00	00,0	0,153**
Laborer	14	63,6	18	69,2	22	91,7	
Self employed	07	31,8	08	30,8	02	08,3	
Mother's Work							
Work	09	40,9	06	23,1	07	29,2	0,236**
housewife	13	59,1	20	76,9	17	70,8	

*One Way Anova

** Kruskal-Wallis

The mean WAZ, HAZ, and WHZ were normal (<-2 SD) before and after the study. Paired t-test found that WAZ and HAZ did not differ in all intervention groups, but WHZ differed significantly ($p < 0.05$). Multivariate Analysis of Variance depicts that micronutrient supplementation simultaneously affects WAZ, HAZ, and WHZ. The Post Hoc determined only the WHZ, which differed between group 2 and groups 1 and 3.

Table 2. Changes in Z score during the study

Z score	Suppl Z sulfate 10 mg		Supp Iron + Vit B Complex		Suppl Zn & Iron +Vit B Complex		p value
	Mean	SD	Mean	SD	Mean	SD	
WAZ							
Pre	-0,86	±1,23	-1,12	±1,06	-1,15	±1,09	
Post	-0,68	±1,24	-0,83	±1,27	-1,34	±1,17	
p-value	0,792*		0,077*		0,306*		
HAZ							
Pre	-0,16	±1,61	-1,33	±1,16	-0,37	±1,47	
Post	-0,10	±1,84	-1,25	±1,40	-0,38	±1,53	
p-value	0,578*		0,820*		0,104*		
WHZ							
Pre	-0,86	±1,13	-0,59	±1,09	-1,41	±1,11	0,011**
Post	-0,89	±1,07	-0,19	±1,30	-1,34	±1,15	
p-value	0,791*		0,014*		0,390*		

*Paired T-Test

** Multivariate Analysis of Variance

the study's final findings showed that malnutrition levels ranged from 9.1-20.8% and that stunting and wasting affected 8.3–13.6% of participants. All supplementation groups were able to reduce underweight, stunting, and wasting by 4-8%.

Table 3. Changes in nutritional status based on supplementation

Z Score	Suppl Z sulfate 10 mg				Supp Iron + Vit B Complex				Suppl Zn & Iron +Vit B Complex			
	Awal		Akhir		Awal		Akhir		Awal		Akhir	
	f	%	f	%	f	%	f	%	f	%	f	%
WAZ												
Severely underweight	0	00,0	1	4,5	0	00,0	0	00,0	1	4,2	2	8,4
Underweight	4	18,2	3	13,6	3	11,5	1	3,9	3	12,5	2	8,3
Normal	18	81,8	18	81,8	23	88,5	25	96,1	20	83,3	20	83,3
HAZ												
Severely stunted	0	0	0	0	2	7,7	2	7,7	0	0	0	0
Stunted	3	13,6	3	13,6	5	19,2	3	11,5	3	12,5	2	8,3
Normal	19	86,4	19	86,4	19	73,1	21	80,8	21	87,5	22	91,7
WHZ												
Severely wasted	0	0	1	4,6	0	00,0	0	00,0	2	8,3	3	12,5
wasted	4	18,2	3	13,6	2	7,7	0	00,0	4	16,7	2	8,3
normal	18	81,8	18	81,8	24	92,3	26	100,0	18	75,0	19	79,2

Micronutrients are elements that are needed through the human physique and that characteristic as regulators of more than a few body metabolic processes, influencing the growth and formation of new cells [36]. The nutritional vitamins analysed are those related to growth, specifically vitamin C, folic acid, vitamin A, D, whilst the minerals analysed, were calcium, zinc, and iron [36].

The results of the recall found that sources of vitamins and minerals that support the growth process come from animal foods (milkfish, snakehead fish, eggs, chicken liver), as well as vegetable ingredients (spinach, papaya, pear, melon, tofu, tempeh). The average adequacy levels of nutrition A, vitamin C, calcium, Zn, and Fe have been true for all intervention groups, while folic acid and vitamin D had been categorised as severe to moderate deficits, barring for the 7.5 mg iron + vitamin B complex group, which was once labelled as having mild deficits.

Canonical tests found that zinc, iron, calcium, and vitamins A and D simultaneously affected WAZ, HAZ, and WHZ. The canonical correlation shows a strong relationship between micronutrients and the Z score.

Table 4. Average Level of Adequacy of Subjects' Micronutrients During Intervention

Adequacy level of nutrients	Suppl Z sulfate 10		Suppl Iron + Vit B Complex		Suppl Zn & Iron +Vit B Complex		P Value	Canon Correlation
	Mean	SD	Mean	SD	Mean	SD		
Adequacy level of vitamin A	221,75	± 36,80	83,30	± 12,98	95,57	± 15,16	0,001*	0,50
Adequacy level of folic acid	64,51	± 16,92	134,60	± 33,42	72,66	± 16,03		0,21
Adequacy level of calcium	154,60	± 42,72	161,68	± 33,05	172,37	± 39,47		0,84
Adequacy level of vitamin D	66,78	± 18,29	68,44	± 15,99	72,48	± 14,75		0,61
Adequacy level of Zn	201,30	± 45,93	212,12	± 48,78	241,65	± 36,92		0,93
Adequacy level of iron	161,82	± 28,44	177,29	± 42,24	188,88	± 39,49		0,85

*Canonical Test

Acute respiratory tract infections (ARI) and diarrhea are common infections in children under five. Due to increased catabolic processes, poor nutritional intake from decreased appetite, and impaired nutrient absorption, both of these diseases result in weight loss [32].

A child with ARI and diarrhea experiences a negative energy balance, which has an impact on hyper catabolism and reduces nutrient intake, leading to weight loss [32]. Providing good food and immunization, as well as maintaining environmental sanitation, are factors preventing the occurrence of ARI [36].

The three supplementation groups all experienced a decline in the prevalence of ARI at the conclusion of the study (Figure 1). The prevalence of diarrhea in group 1 remained the same at the end of the study, whereas it decreased in groups 2 and 3 (Figure 2)

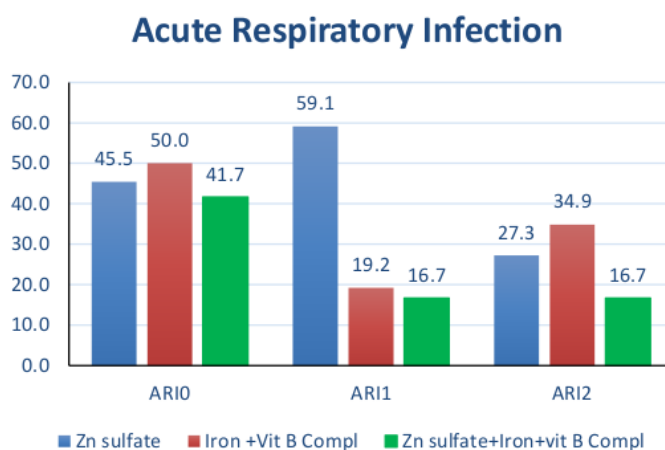


Figure 1. ARI Subject Description

Test Mc. Nemar found no discernible difference ($p > 0.05$). The three intervention groups tended to decrease

in the percentage of ARI incidents, especially the Zn sulfate + iron group. Test Regressed Dummy Variable indicates the incidence of ARI affecting Score WHZ ($p = 0,039$), but not for WAZ, HAZ ($p > 0,05$). Children who experience URI in 1 episode reduces Z Score WHZ 0,626 SD

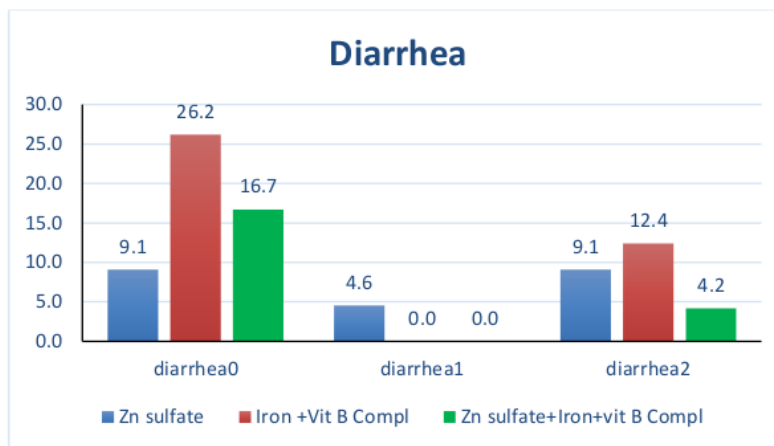


Figure 2. Diarrhea Subject Description

4. DISCUSSION

The paired t-test found a significant difference in the WHZ Z score before and after 2 months of intervention only in the 7.5 mg iron supplementation group + vitamin B complex. The increase in body weight and length in this group was higher than in the other groups.

The Manova test (Multivariate Analysis of Variance) showed that simultaneous supplementation of Zn sulfate 10 mg, iron 7.5 mg + vitamin B complex, and Zn sulfate 10 mg and iron 7.5 mg + vitamin B complex affected significant differences in WAZ, HAZ, and WHZ ($p=0.001$). A significant difference was primarily found in WHZ ($p=0.001$) between groups supplemented with iron 7.5 mg + vitamin B complex with Zn sulfate 10 mg + elemental iron 7.5 mg with vitamin B complex ($p=0.011$). This is because the WHZ delta in the 7.5 mg iron + B complex vitamin group was higher (0.40 SD) than the 10 mg Zn sulfate + iron group (0.07 SD).

Iron affects the ribonucleic reductase enzyme, which plays a role in the synthesis of ATP and proteins, which affect tissue growth for the growth process [23].

Iron syrup supplementation, besides containing iron, also contains complex B vitamins, such as Thiamin (B1), Riboflavin (B2), Niacin (B3), Pantothenic Acid (B5), Pyridoxine (B7) which function for the growth and development of body tissue function, helps metabolize energy, protein, carbohydrates, and fatty acids, and influences growth hormone. [36] Kunaryati found that giving taburia powder containing 12 vitamins (Vitamins A, B Complex, C, D, E, K) and 4 minerals (I, Zn, Fe, Se) impacted the Z Score of the WHZ index [25], [37].

The canonical test shows that the adequacy level of vitamin A, folic acid, vitamin C, vitamin D, calcium, Zn, and iron affect the Z Score WAZ, HAZ, and WHZ ($p=0.001$). Zn adequacy level had the most substantial effect (0.93), then calcium (0.87), iron (0.85), Vitamin C (0.84), Vitamin D (0.61), vitamin A (0.50). The level of folic acid adequacy does not affect the Z Score WAZ, HAZ, WHZ (-0.21). Vitamins A, C, and D function for cell differentiation, collagen formation, and bone formation. Apart from providing

elements for bone formation, the minerals calcium, Zn, and iron also stimulate their growth by influencing the hormone IGF-1 as an endocrine hormone mediator, thus maximizing skeletal and muscular maturation which impacts body weight and length. Vitamins A, C, Zn, and iron also play a role in the body's immunity to suppress the incidence of infection [38].

4.1 Impact of Infection Events ON Z Score

Mc test results. Nemar found no significant difference in the incidence of ARI and diarrhea before and after the study, but Dummy Logistics showed that ARI affected the Z Score of WHZ. This can happen because the level of Zn and Vitamin A adequacy of the subjects in the four intervention groups is relatively good, so the body's resistance to infection, especially ARRI, increases.

Zn and iron have a fundamental role in the specific and non-specific immune system, which plays a role in forming T and B cells for antibodies. There is a positive correlation between infection and nutritional status [39]. The content of iron-binding proteins (transferrin and lactoferrin) can prevent infection by separating iron from microorganisms. The condition of iron nutritional anemia is at risk of experiencing a more significant infection [39], [40].

Research in Aceh found a relationship between the incidence of ARI and the Z Score of WHZ. Children infected with ARI have a risk of 3.47 times experiencing poor nutritional status compared to children who are not currently infected with ARI [41].

5. CONCLUSION

Most children who experience failure to thrive, aged 16-19 months, are male, and intrauterine development is good, so the cause of failure to thrive is the result of poor nutritional upbringing. Micronutrient supplementation only affected WHZ. The iron + vitamin B complex supplementation group was better than the other groups. Significantly the level of adequacy of vitamins A, D, folic acid, calcium, Zn, and iron plays a role in WHZ and the incidence of ARI.

6. RECOMMENDATION

POSYANDU cadres must correctly understand proper feeding for children so that if a child with nutritional status problems is found during weighing, they can advise mothers of toddlers. Children still need to be given micronutrient supplementation routinely, especially in the first 1000 days of life. Both of these recommendations can be carried out by the health office and the scientific community (institutions, universities).

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