EFFECTS OF SUPPLEMENTING COLOS24H GROW PLUS 2+ ON NUTRITIONAL STATUS AND HEALTH OF PRESCHOOL CHILDREN

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ABSTRACT

A controlled intervention study to evaluate the effect of formula supplementation on nutritional status and health of preschool children aged 36-59 months was completed in Ninh Binh province in August 2023 with 110 subjects. The intervention group (55 subjects) used formula supplementation twice daily for 2 months and the control group (55 subjects) used a regular diet. Results showed positive effects comparing the intervention group vs. the control group: Improved average weight: increased 0.18 kg (0.31 ± 0.06 vs. 0.13 ± 0.07 kg) after 1 month; increased 0.43 kg (0.70 ± 0.08 vs. 0.27 ± 0.03 kg) with statistical significance ($p<0.05$) after 2 months. Improved average height after 2 months: increased 0.36 cm (1.44 ± 0.17 vs. 1.08 ± 0.26 cm) with $p<0.05$. Reduced the risk of malnutrition and malnutrition 27.3% (49,1% vs. 21,8%) with $p<0.05$; Reduced underweight malnutrition 9,1% (16,4% vs. 7,3%) with $p<0.05$. Reduced health problems: respiratory infections (3.6%); diarrhoea (1.8%); constipation (5.5%); anorexia (12.7%); difficulty sleeping (14.5%) but not statistically significant ($p>0.05$). Product acceptability was high with 92.8% used full dosage.

Keywords: *micronutrients, formula milk, height, weight, preschool children.*

I. INTRODUCTION

Nutrition for children, especially in rural areas Vietnam is a health issue that affects the stature, height, intelligence and working capacity of Vietnamese people and has received special attention from the Government [1]. One of the solutions to improve children's nutritional status is to use supplemented formula with suitable protein, lipid, carbohydrate and micronutrient ingredients [2]. However, the composition and content of supplementary formula to be balanced and appropriate for different groups are still issues that need more research [3]. Currently on the market there are several milk formulas that may be suitable for nutritional interventions. This study will evaluate the effectiveness of a nutritional product with ingredients and energy consistent with the guidelines on nutritional status and health in preschool children (36-59 months) of the Ministry of Health and the World Health Organization [4].

II. METHODS

Research subjects: preschool children in Ninh Binh province met the criteria for participating in the study. Selection criteria: children aged 36-59 months were not overweight or obese. Exclusion criteria: children with birth defects, mental or motor disabilities or children with chronic diseases; an acute illness; using nutritional supplements; and participating in another research.

Research design: Intervention study with control group.

Time: from March 2023 to Sep 2023.

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Sample size and sample selection: There were 110 eligible children participating in the study divided into 2 groups: control group (55 children) and intervention group (55 children).

Intervention materials: Colos24h Grow Plus 2+ (a nutritional powder formula) produced by NutriCare Nutrition Joint Stock Company; twice daily equivalent to 90 grams of the formula per day including: Energy (440 kcal), Fat (21.6g), Carbohydrates (48.1g), Protein (14.85g). Amino acids include Lysine (1032mg), Leucine (1193mg), Isoleucine (665mg), Valine (788mg), Arginine (53mg), Histidine (340mg), Phenylalanine (564mg), Tyrosine (474mg), Threonine (558mg), Methionine (291mg), Tryptophan (175.5mg), Cystine (154mg), Glutamic acid (2696mg), Aspartic acid (1070mg), Glycine (289mg), Alanine (440mg), Proline (1150mg), Serine (705mg); Fatty acids: DHA (19.8 mg), Colostrum (90.0 mg), IgG (18.0 mg), Soluble fibre (FOS/Inulin, Prebiotics (FOS/Inulin) (2.7g), Postbiotic. Vitamin: Vitamin A (1200IU), Vitamin D3 (168.3IU), Vitamin E (7.49IU), Vitamin K1 (13.2µg), Vitamin C (55.5mg), Vitamin B1 (403µg), Vitamin B2 (844µg), Niacin (6220µg), Acid pantothenic (1749µg), Vitamin B6 (710µg), Folic acid (102µg), Vitamin B12 (1.39µg), Biotin (10.7µg). Minerals: Sodium (235mg), Potassium (410mg), Calcium (528mg), Phosphorus (378mg), Magnesium (58.6mg), Iron (4.54mg), Zinc (6.48mg), Manganese (560µg), Copper (144µg), Iodine (91.8µg), Selenium (5.31µg), Chromium (3.72µg), Molybdenum (17µg).

Evaluation method: comparing nutrition status according to WHO 2006 standards [5] and some health indicators before and after intervention, between the control group and the intervention group.

Data analysis and processing: *Data were entered using* MS.Excel 2016 software and analysed using WHO Anthro 3.2.2 and SPSS 20.0 software.

Research ethics: The study was approved by the IRB of the Institute of Health Research and Technology and followed good clinical practice.

III. RESULTS

A total of 110 preschool children participated in the study.

Table 1. *Characteristics of the two groups before intervention*

Index	Control group (n = 55)	Intervention group (n = 55)	Total (n = 110)	p
Boy (%)	49.1%	49.1%	49.1%	(a)
Age (months)	57.34 ± 3.28	57.22 ± 3.44	57.27 ± 3.36	>0.05 (b)
Weight (kg)	14.77 ± 1.61	14.72 ± 1.59	14.74 ± 1.52	>0.05 (b)
Height (cm)	103.47 ± 4.23	103.42 ± 4.21	103.44 ± 4.14	>0.05 (b)
BMI (kg/m^2)	14.15 ± 1.20	13.82 ± 1.22	14.08 ± 1.18	>0.05 (b)
WAZ (Z-score)	-1.27 ± 0.89	-1.27 ± 0.94	-1.27 ± 0.86	>0.05 (b)
HAZ (Z-score)	-1.04 ± 0.93	-1.04 ± 0.88	-1.21 ± 0.87	>0.05 (b)
BAZ (Z-score)	-0.77 ± 0.95	-0.75 ± 0.67	-0.76 ± 0.67	>0.05 (b)

[a] *Chi-squared test,* [b] *T-test.*

Table 1 shows that there were no statistically significant differences (p>0.05) between the intervention group and the control group in terms of the proportion of boys, average age, height, weight, body mass index (BMI), and Z-score of the indicators: weight/age (WAZ), height/age (HAZ), and BMI/age (BAZ) before the intervention (T0).

Table 2. *Intervention effectiveness on weight*

Time	Control group (n= 55)	Intervention group (n= 55)	p[(b)]
T0	14,77 ± 1.60	14.72 ± 1.64	p>0.05
T1	14.90 ± 1.67	15.03 ± 1.58	p<0.05
T2	15.04 ± 1.63	15.42 ± 1.72	p<0.05
T1-T0	0.13 ± 0.07	0.31 ± 0.06	p<0.05
T2-T0	0.27 ± 0.03	0.70 ± 0.08	p<0.05

Data were presented as X̄±SD; [(b)] *T- test.*

Table 2 shows that after 1 month of intervention (T1) the intervention group's average weight was higher control group 0.18 kg (0.31 ± 0.06 vs. 0.13 ± 0.07 kg) with statistical significance (p<0.05). After 2 months, the difference in gain weight between the two groups was 0.43 kg (0.70 ± 0.08 vs. 0.27 ± 0.03 kg) with statistical significance (p<0.05).

Table 3. *Effectiveness of intervention on height*

Time	Control group (n = 55)	Intervention group (n = 55)	p [(b)]
T0	103.47 ± 4.23	103.42 ± 4.21	p>0.05
T1	103.97 ± 4.30	104.18 ± 3.75	p>0.05
T2	104.55 ± 4.49	104.86 ± 4.38	p<0.05
T1-T0	0.50 ± 0.07	0.76 ± 0.46	p>0.05
T2-T0	1.08 ± 0.26	1.44 ± 0.17	p<0.05

Data were presented as X̄±SD; [(b)] *T-test.*

Table 3 shows that the height increased in the intervention group was higher than the control group immediately after 1 month of intervention (T1) but not statistically significant (p>0.05). After two months (T2), the average height of the intervention group (104.86 cm) was significantly higher than the control group (104.55 cm). The difference between the intervention group and the control group was 0.36 cm (1.44 ± 0.17 vs. 1.08 ± 0.26 cm) with statistical significance (p<0.05).

Table 4. *Intervention effectiveness on some health indicators*

Index	Before intervention		After intervention		p[(c)]
	Control group	Intervention group	Control group	Intervention group	
Risk of underweight malnutrition	49.1%	49.1%	47.3%	21.8%	p<0.05
Malnutrition	14.5%	16.4%	14.5%	7.3%	p<0.05
Respiratory infection	10.9%	12.7%	7.3%	3.6%	p>0.05
Diarrhoea	5.5%	5.5%	3.6%	1.8%	p>0.05
Constipation	12.7%	10.9%	9.1%	5.5%	p>0.05
Anorexic	23.6%	23.6%	18.2%	12.7%	p>0.05
Difficulty sleeping	23.6%	20.0%	21.8%	14.5%	p>0.05

[(c)]: *Fisher's exact - test, Bootstrap 1000 samples.*

Table 4 shows that before the intervention, the intervention group and the control group had not much differences in term of respiratory infections, diarrhoea, constipation, anorexia, and difficulty sleeping. After intervention, the nutrition status was improved: Reduced the risk of malnutrition and malnutrition 27.3% (49,1% vs. 21,8%); Reduced underweight malnutrition 9,1% (16,4% vs. 7,3%) with statistical significance (p<0.05). The intervention group tended to improve more than the control group in terms of respiratory infections (3.6% vs. 7.3%); diarrhoea (1.8% vs. 3.6%); constipation (5.5% vs. 9.1%); anorexia (12.7% vs. 18.2%), difficulty sleeping (14.5% vs. 21.8%); but these differences were not statistically significant.
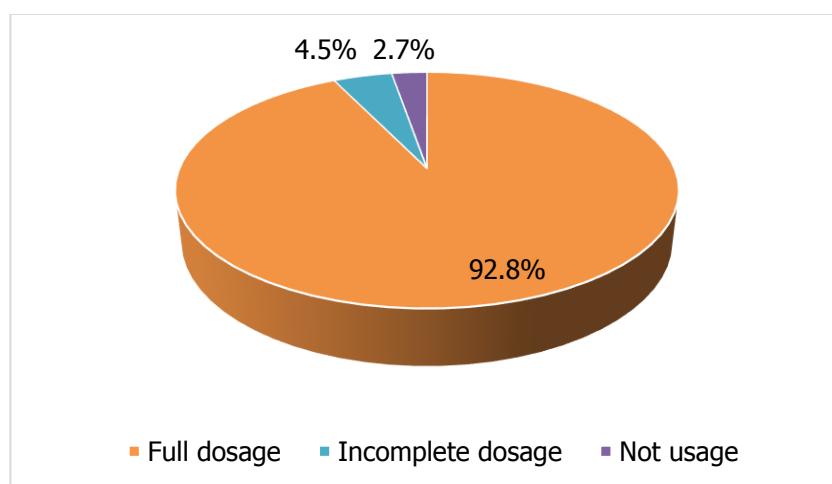
Figure 1. *Product acceptability rate*

Figure 1 shows that the rate of children drinking milk was 97.3%, of which the rate of drinking a full portion of milk was 92.8%, the rate of not drinking half the amount of milk was 4.5%. The rate of not drinking milk due to different reasons such as missing school or being sick was 2.7%. Besides those, research results also showed that nausea, vomiting, and reactions to milk rarely occur. The milk supplement program was supported by families, schools, and health centres.

IV. DISCUSSION

Research results showed that supplementing nutritional powder formula had positive effects in the intervention group versus the control group: The average weight gain was 0.43 kg higher (0.70 ± 0.08 vs. 0.27 ± 0.03 kg) ; The average height gain was 0.36 cm higher (1.44 ± 0.17 vs. 1.08 ± 0.26 cm); Reduced the risk of malnutrition and malnutrition 27.3%; Reduced underweight malnutrition 9,1% with statistical significance (p<0.05); This can be explained that the intervention group was lacking nutrition in their diet, supplemented milk had promptly provided energy (440 kcal/day) and nutrients such as protein (14.85 g), fat (21.6 g), carbohydrate (48.1 g) reasonable content, meeting about 20-40% of the needs of children at this age. The formula also supplemented 28 vitamins and minerals with appropriate amounts to support absorption, metabolism to provide important contribution

to improvement nutritional status. The content of these micronutrients met approximate 50% of the child's needs and was balanced with each other. The nutrients were provided per day included DHA (19.8 mg), lysin (1032 mg), leucin (1193 mg), isoleucine (665 mg), valine (788 mg), arginine (553 mg), histidine (340 mg), phenylalanine (564 mg), tyrosine (474 mg), threonine (558 mg), methionine (291 mg) and other vitamins and minerals. Those were supplemented in appropriate amounts to support absorption and metabolism, contribute to improving nutritional status, child's height and weight [6].

There were tends to increase resistance, immune system and reduce respiratory infections, diarrhoea, constipation, anorexia, and difficulty sleeping; but the small sample size and short research time were not enough to conclude statistical significance. The explanation for this improvement was the additional proteins, lipids, vitamins, and minerals, especially the additional antibodies contained in colostrum (90.0 mg) had contributed to creating new blood vessels, synthesizing collagen, producing carnitine, helping to absorb maximum nutrients, producing enzymes, antibodies, and hormones. As a result, those promoted the body increase resistance and metabolic processes and then to increase the body development, increase immunity and digestion, support children eat and sleep better. Vitamins A, D, B, C, iron, zinc, copper, iodine, and selenium also participated in enhancing cell development, affecting height, weight, digestive system, and immunity. Antioxidant micronutrients of the formular played an important role in building, strengthening, and repairing the immune system, increasing resistance, enhancing digestion, and reducing anorexia

[7]. The role of DHA, Vitamin D and other micronutrients participated in nerve system operation reducing stimulation and difficulty sleeping. Soluble fibre (FOS/Inulin) was very good at preventing constipation. Vitamin C and B1, B2 helped children to eat better, increased absorption and metabolism, and affect muscle and bone mass. Other micronutrients also participated in the biosynthesis of hormones and enzymes, and participated in cell building such as B12 and folic, which participated in the production of red blood cells and nerve cells [8]. The addition of 28 micronutrients in this formula complements each other and could had superior effects compared to fortifying one or a few micronutrients. Those had impacts on the digestive, immune, metabolic, and nervous systems, promoting growth and improving health. In addition, lysine (1147 mg) was an important component of many proteins such as enzymes, antibodies and hormones, helping the body increase resistance and greatly participate in metabolic processes, helping children's digestion [9] .

High usability: The rate of usage was 97.3%, of which the rate of drinking enough milk was 92.8% twice daily for 2 months. The milk supplement program was supported by families, schools, and health centres. These results may be consistent with the hypothesis that the milk formula was suitable for usage and absorption with suitable energy, fat, protein with 18 amino acids and 28 vitamins and minerals, adding DHA, colostrum, and soluble fibre (FOS/Inulin).

Limitations of the study: due to the sample size design with the main goal of assessing nutritional status and the study period of two months, the statistical significance of some health indicators could not be fully assessed.

V. CONCLUSION

Supplementing nutritional powder formula (Colos24h Grow Plus 2+) in preschool children had positive effects; comparing the outcomes of the intervention group versus the control group showed:

-Improved average weight: increased 0.18 kg (0.31 ± 0.06 vs. 0.13 ± 0.07 kg) after 1 month; increased 0.43 kg (0.70 ± 0.08 vs. 0.27 ± 0.03 kg) with statistical significance ($p<0.05$) after 2 months.

-Improved average height: increased 0.36 cm (1.44 ± 0.17 cm vs. 1.08 ± 0.26 cm) with statistical significance ($p<0.05$) after 2 months.

-Reduced the risk of malnutrition and malnutrition 27.3% (49,1% vs. 21,8%); and reduced underweight malnutrition 9,1% (16,4% vs. 7,3%) with statistical significance ($p<0.05$).

-Reduced health problems: respiratory infections (3.6%); diarrhoea (1.8%); constipation (5.5%); anorexia (12.7%); and difficulty sleeping (14.5%) but not enough data for test or statistically significant ($p>0.05$).

-Product acceptability was high with 92.8% used full dosage twice daily. The nutritional supplement program was supported by families, schools, and health centres.

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