ORIGINAL ARTICLE

Bali Medical Journal (*Bali Med J*) 2020, Volume 9, Number 1: 36-40
P-ISSN.2089-1180, E-ISSN.2302-2914

Published by DiscoverSys

Influence of baby massage stimulation on the improvement of nutritional status, IGF-1, and cortisol level on undernourished infant

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ABSTRACT

Aim: This study aims to prove the effect of infant massage stimulation on the improvement of vagal activity and neurological effects (HPA axis) in infants with 6-12 months of nutrition including increased nutritional status, insulin-like growth factor 1 (IGF-1) and decreased cortisol.

Method: The design method used for this study was a quasi-experimental with randomized pre-test and post-test control group design. Samples in this study were infants aged 6-12 with undernutrition status as many as 24 person as an intervention group (infant massage interventions and complementary feeding) and 24 people in the control group (provision of supplementary feeding). Infant massage interventions carried out for 3 months. Data collected included body weight, IGF-1 level, and Cortisol.

Results: Effective infant massage improves nutritional status ($p = 0.035$) / ($p \leq 0.05$), increases IGF-1 levels ($p = 0.002$) or ($p < 0.05$), and decreases cortisol levels ($p = 0.022$) / ($p < 0.05$).

Conclusion: Infant massage stimulation increases body weight, IGF-1 level, and reduces cortisol in undernourished infants aged 6-24 months. It is recommended for every mother to apply baby massage stimulation for alternative treatments to improve the nutritional status of infants who are undernourished.

Keywords: massage, nutritional status, outcome.

Cite This Article: Sudarmi, Sukrama, I.D.M., Sutirtayasa, I.W.P., Weta, I.W., Irianto. 2020. Influence of baby massage stimulation on the improvement of nutritional status, IGF-1, and cortisol level on undernourished infant. *Bali Medical Journal* 9(1): 36-40. DOI:10.15562/bmj.v9i1.1688

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Received: 2019-12-04
Accepted: 2020-01-02
Published: 2020-04-01

INTRODUCTION

Poor nutrition status and malnutrition are still a major public health problem in Indonesia. A good nutritional intake can often not be fulfilled to a child because of family economic factors, education, and the number of person in the families. Some efforts have been made, but nutrition problems have not shown a significant decline.[1]

At the age of 0-2 years is the optimal growth and development period (golden period) so that if there is a disruption in this period, the loss cannot be fulfilled in the next period and will negatively affect the quality of the next generation.[2]

Non-pharmacological treatment is needed to help increase the baby's weight and prevent malnutrition in infants. Baby massage is a part of touch therapy that is carried out on the baby so that it can provide assurance of sustained body contact, maintain a feeling of security in the baby and strengthen the parent's love sensation with the baby.[3]

The main function of baby stimulation massage is to improve the inner relationship of parents and baby, increase breast milk production, develop communication, understand baby cues, and increasing confidence in the mother, increase baby's weight and accelerate the development of the baby's neurological system. It is believed baby massage can reduce pain, stress, depression, anxiety, and cortisol, and increase several immune parameters.[4-5]

Research on infant massage has been carried out so far, especially about the effect of infant massage on infant weight gain.[6] Research that proves or explains the theoretical basis of how beneficial effects of infant massage have not been found is research literature that explains biomolecular change or hormonal outcomes that have benefit from baby massage with the alleged role of the hypothalamus-pituitary-target organ axis (HPA axis) with evidence of how the effectiveness of infant massage increases nutritional status through increase in IGF-1 level as a growth marker, baby massage provides comfortable sensation that might result in reduced adrenal glands glucocorticoid production and lowering cortisol level. The study aims to evaluate effect of baby massage on improving nutritional status, IGF-1, and Cortisol level in undernourished infants under 6-12 months in Mataram City, Lombo, Indonesia.

METHOD

Study design and population

This research was conducted with a quasi-experimental model with randomized pre-test and post-test control design of the experimental group design namely the intervention group and the control group.[7] In the treatment group were infants aged 6 to 12 months who were given massage interventions by the baby's mother and supplementary feeding every day for 12 weeks. Whereas the control group was infants aged 6-12 months who were given supplementary food only, but were not given infant massage interventions. Measurement of infant weight levels, IGF-1, and cortisol level was carried out before and after the intervention.

The study was carried out in the working area of the Mataram City-West Nusa Tenggara Primary Health Center with the inclusion criteria such as undernourished infants aged 6 to 12 months in good health and mothers or families willing to participate in the study. Exclusion criteria in this study were infants with congenital abnormalities and infants with a history of prematurity, and low birth weight. The sample in this study was 48 (24 people in each group). Sampling was carried out using randomization technique around the working area of Primary Health Care Centers in the city of Mataram.

Study protocol

Before the intervention started, the baby's parents who had received informed consent and had agreed to the consent letter following this study had previously conducted infant massage training and counselling for infant feeding techniques for the intervention group, then the control group had previously been given counselling for infant feeding techniques.

In the implementation process every day the intervention group did a baby massage by the baby's mother and was given additional food one times daily, and the control group was only given additional food one times daily. Monitoring is carried out every day by researchers and assisted by cadres and midwives in the study area. The supplementary food used in this study is a standard additional biscuit for infant distributed by Ministry of Health as a national program to reduce under nutrition of infant. Total energy of supplementary food is 180 kcal, with fat content 6 gram, protein 3 gram, carbohydrates 29 gram, fibers 2 grams, sugar 8 gram, and 120 mg of sodium.

Blood sample collection and analysis

Blood sampling was done 2 times, before the intervention and after the intervention in each group. Blood sampling is performed by a health analyst and storage of baby blood serum is stored in the freezer of the Mataram Biomedical Hospital laboratory with a temperature of – 40° celcius until laboratory assay was done. Examination of IGF-1 levels, and cortisol level using the ELISA method, it was conducted at the Biochemistry Laboratory of Universitas Udayana.

Data analysis

Data analysis was presented descriptively in a comparison table of two groups, infant massage stimulation intervention and control. Differences in changes in IFf-1 levels and cortisol level of undernourished infants, before and after treatment, in the two groups evaluated using paired sample t-test and independent t-test. All data considered significant if $p<0.05$. Data were analysed using SPSS 25.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

The study was conducted in the working area of the Mataram City Primary Health Care Center, West Nusa Tenggara. All 48 infants with undernourished aged 6-12 months who met the inclusion and exclusion criteria, all participant complete the follow up until end of the study period. Respondents were randomly divided into two groups, the intervention

Table 1 **Nutritional Status**

Nutritional Status	Intervention Group		Mean differences	Control Group		Mean Differences
	Before	After		Before	After	
Average	-2.087	-1.897	0.190	-2.46	-1.83	0,63
Min	-4.46	-3.71		-3.00	-3.50	0,50
Max	-0.95	-0.81		-1.73	0.29	1,44
Std, Deviation	0.934	0.793		0.36	0.89	-
Normality test	0.090	0.138	0.416	0.200	0.200	-
Paired t-test	0.027*			0.426		
Independent t-test	0.035*					

*Significant ($p<0.05$)

Table 2 IGF-1 level before and after intervention

IGF-1 parameter	Intervention Group		Mean differences	Control Group		Mean differences
	Before	After		Before	After	
Average	1.377	2.573	1.19	1.74	4.29	2.55
Min	0.02	0.83		0.36	0.81	
Max	4.41	6.19		3.97	5.71	
Std. Deviation	1.01	1.07		0.86	1.21	
Normality test	0.007	0.001	0.189	0.061	0.004	0.127
Wilcoxon/Paired t-test	0.003*			<0.00*		
Independent t-test	0.002*					

*Significant (p<0.05)

Table 3 Cortisol level before and after intervention

Cortisol Parameter	Intervention Group		Mean differences	Control Group		Mean differences
	Before	After		Before	After	
Average	8.33	7.29	-1.03	7.85	7.54	-0.31
Min	5.69	5.04		5.62	5.22	
Max	9.81	9.41		9.97	9.47	
Std. Deviation	1.15	1.54		1.04	1.49	
Normality test	0.135	0.008	0.438	0.679	0.003	0.151
Wilcoxon/Paired t-test	0.021*					0.581
Independent t-test	0.022*					

group given baby massage therapy and supplementary feeding and the control group was only given supplementary food for 3 months, each consisting of 24 respondents.

Nutritional Status

In Table 1, shows that the average value of Z-Score weight by age in the previous intervention group was -2.503 and thereafter to -1.887 there was an increase in Z-Score of 0.606, from the results of statistical analysis using paired t test showed a significant increase in p<0.001 (p<0.05), whereas in the previous control group it was -2.46 and at the end of the study it was -1.83 an increase of 0.63. (the difference is 0.03) also showed a significant increase p=0.001 (p<0.05)

Based on statistical analysis test shows that there is a significant difference (p=0.035) of the nutritional status of infants based on weight index between the intervention group and the control group. Thus it can be concluded that infant massage is effective in increasing the nutritional status of infants.

IGF-1 level

The average IGF value in the intervention group before intervention group was 1.377 and after that it became 2.573 there was an increase in the average IGF-1 value of 1.19, from the results of statistical analysis using paired t test showed a significant increase p=0.003 (p <0.05), whereas in the previous control group was 1.74 and thereafter 4.29 an increase of 2.55 showed a significant increase p<0.001 (p<0.05) (Table 2). Intervention and controls group comparison showed significant differences in average IGF-1 levels (p=0.002) or (p<0.05) which indicated that infant massage increased IGF-1 levels in infants with nutritional status aged 6-12 month.

Cortisol level

The average cortisol value in the previous intervention group was 8.33 and after that it became 7.29 there was a decrease in the average cortisol value of 1.03, from the statistical analysis using the Wilcoxon test showed a significant decrease in p = 0.021 (p<0.05), whereas in the previous control group was 8.333 and after 7.29 there was a decrease of 0.31 and showed a non-significant reduction (p> 0.05). Using the Mann Whitney test, p=0.022 (p<0.05), this shows that between the intervention group and the control group showed significant differences in cortisol (Table 3).

DISCUSSION

The nutritional status of infants is important. Nutritional deficiencies in the golden age can be

Published by DiscoverSys | *Bali Med J* 2020; 9(1): 36-40 | doi: 10.15562/bmj.v9i1.1688

an irreversible, therefore emerging treatment to improve nutritional status is needed. Increasing the nutritional status of infants is done by improving nutritional patterns and stimulating the hormonal system the role of the HPA-axis. Improved nutritional status is strongly influenced by the intake of improved nutritional patterns. Adequate nutrition is a major factor in improving nutritional status in infants.[8,9]

The findings in this study indicate that infant massage is effective adjuvant treatment in increasing the nutritional status of infants with poor nutritional status. Infant massage in this study is carried out directly by the baby's own mother every day, this proves that when the baby massage is done at the time of observation increases positive interactions between mother and baby thereby increasing the mother's response to the baby's hunger and makes it easy to breastfeed immediately and provide food and drink to the baby. Several studies have proven that this baby massage improves the response between mother and baby.[4] Another study concluded that applying massage therapy has a positive effect on the physical, physiological, and premature neonatal behaviour, in addition to increasing body weight it also reduces length of stay in hospital.[10]

Insulin-like growth factor (IGF-1) plays an essential role in growth and development, as well as regulation and overall cell metabolism in the human body. IGF-1 is mainly produced by the liver under stimulation of growth hormone and has a systemic growth effect.[11,12] Increase in circulating IGF-1 concentrations and weight gain can be influenced by energy and protein intake. Energy intake and average daily intake, which is given to babies in accordance with what is needed can increase body weight.[13]

The findings in this study shows there are significant differences in IGF-1 levels between the intervention and control groups which indicate that infant massage increases IGF-1 levels. Moderate pressure massage stimulates the vagal nerve (one of 12 cranial nerves in the brain) which causes increased vagal activity and in turn increases gastric motility (movement of the gastrointestinal tract) and release of insulin (food absorption hormone) and IGF-1 which play an important role in stimulating growth.[14] IGF-I secretion and insulin are stimulated by food intake and are inhibited by fasting, the main biological similarity between these systems. This review covers the metabolic effect of IGF-I liver on carbohydrate and fat metabolism and its possible impact on body fat accumulation.[15]

Increases in vagal activity, gastric movements, insulin and IGF-1 after moderate pressure massage are potential fundamental mechanisms.[16] Insulin-like growth factors (IGF-1) play an important role in growth and development, and regulation and cell metabolism as a whole in the human body.[16] massage stimulation acts as a kinesthetic stimulus that activates the hypothalamus-pituitary target organ axis to release cortisol. The hypothalamus will reduce the production of corticotropin-releasing factor (CRH) as a result the production of the hormone adrenocorticotropin (ACTH) by the anterior pituitary decreases.

In this study the results of the average analysis of cortisol in the intervention and control groups showed a significant difference indicating that infant massage can reduce cortisol levels in undernourished infants aged 6-12 months.

The results of this study are similar to previous studies that moderate pressure massage also causes an increase in vagal activity and a decrease in cortisol levels. Functional magnetic resonance imaging data have suggested that pressure massage is being represented in several brain regions including the amygdala, hypothalamus, and anterior pituitary, all areas involved in the regulation of stress and emotions.[6]

During this study, after we are delivering infant massage and supplementary feeding for infants with under nutritional status aged 6-12 months for 3 months we found differences in the nutritional status of infants undergoing massage (intervention group) and supplementary food only group (control group). We found differences in nutritional status, differences in IGF-1 levels and differences in cortisol levels. From some of the most recent literature and research results we can provide an explanation of the pathophysiological mechanisms of infant massage that can affect HPA-axis through vagal activity which affects the mechanism of food absorption so that it can increase IGF-1, increase the ability of glucocorticoid receptor-binding capacity so that the adrenal glands will reduce glucocorticoid production and cause weight gain (improved nutritional status).

CONCLUSION

Infant massage stimulation increases body weight, IGF-1 level, and reduces cortisol in undernourished infants aged 6-24 months. It is recommended for every mother to apply baby massage stimulation for alternative treatments to improve the nutritional status of infants who are undernourished.

CONFLICT OF INTEREST

The author declares no conflict of interests related to the material presented in this article.

ETHICAL ASPECT

All respondents in this study had signed informed consent. This study has been approved by Ethical Committee of the Faculty of Medicine, Universitas Udayana/Sanglah General Hospital, Denpasar with reference number 935/UN 14.2.2.VII.14/LP/2019.

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