

Analysis of Malnutrition Changes in Children from Birth to One Year Old using Two-Compartment Markov Regression Model.

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Abstract: Underweight and malnutrition in the first year of lifetime will have lasting effects on physical and mental growth, reduction of creativity and attenuation of the immune system throughout lifetime. Thus, knowledge of factors that lead to the incidence or improvement of malnutrition in children during the first year of life is so important. The purpose of this study was to examine effective factors, amount and timing of their effect in incidence or improve malnutrition during the first year of life. **Materials and Methods:** In this study, the information is chosen by continuing following up the children in rural areas of Boyer Ahmad city, born in the first half of 1390, resident in the rural areas of Boyer Ahmad city and information related to their health until one year old were collected in a form which was prepared for this purpose. In this study, having a weight-for-age with $-1SD < Z$ standard is considered as malnutrition. In this study, 1463 children from birth to one year old, which are about fifty percent of overall people that were born in desired area, were examined. The WHO Anthro software was used to determine the malnourished children and SPSS21 statistical software for overall data analysis and R statistical software for the calculations related to two-compartment regression model analysis and computational logic of O'Braian (1980) for data analysis were used. **Results:** From the 1463 children who were examined in this study, 247 children (16.9%) were malnourished during the first year of their lifetime which in 109 cases (7.5%), malnutrition was occurred in the first month of lifetime. Among the effective factors on malnutrition, maternal age more than 35 years or less than 18 years, low birth weight, numbers of previous maternal parturitions, twin babies, infant sex, maternal and child illnesses have significant effects on the incidence or improvement of malnutrition. Also, the most significant changes in the incidence or improvement of malnutrition have occurred in the intervals of 0-1 months old, 1-2 months old, 4-5 month old and 9-12 month old. **Conclusion:** The most important factors affecting the incidence of malnutrition are child disease, maternal disease, low birth weight and then: maternal age, twin babies, number of maternal parturitions and infant sex. These findings correspond to similar studies and it is necessary to consider above cases, and to training about low parturition and same attention to girl and boy. Using the two-compartment regression model, odds ratio of effect of independent variables on the incidence or improvement of malnutrition as well as odds ratio of effect of any interval on these changes were estimated.

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1, Introduction

Knowledge of the factors that lead to malnutrition in children during the first year of lifetime has particular importance. Also, awareness of time of effect of each factor during the first year of lifetime and severity of their effect can be used to prevent the incidence of malnutrition and also improvement of malnourished children. Many

factors affect the child health at birth and throughout the life; prenatal factors are such as health, family circumstances, and especially maternal health during pregnancy and parturition. Also, factors such as parental education, household per capita income, number of previous parturition, asked baby, parturition type, maternal and child disease during pregnancy and after that, maternal age at birth,

number of pregnancies, past abortions, baby sex, weight, height, head circumference at the birth and later, can lead to the incidence of malnutrition, diseases and child health problems during his/her life. These factors, reduce the physical and mental growth, reduce creativity and weaken the immune system and also increase the probability of infect to many infectious and non-infectious diseases. While most of them are recognizable, they are easily preventable. The most important indicators of infant health are weight, height, normal head circumference and suitable growth chart based on the health road. The first indication of child health problem is the incidence of malnutrition and delay in normal growth which has a very slow process and in the early stages is not detectable easily by maternal and health care personnel look. Therefore, it can be viewed by using a systematic method. This simple method is called "growth monitoring". Knowledge of factors that lead to malnutrition in children during the first year of lifetime is so important. Also, awareness of effect time of each factor during the first year of lifetime and severity of their effect can be used to prevent the incidence malnutrition and also improvement of malnourished children. According to recent studies, 4.15 percent of children under age of 5 suffer from moderate and severe stunting (Bolourian, 2007) and 10.9 percent (540 thousand) suffer from moderate and severe underweight (montazery, 1381). However, the weight of 82 percent of children under age of 5 is not recorded on growth card regularly and in fact their growth is not monitored (Mohamadzade, 2002). In the Keshavarzi and et al (2001) work, only three variables; baby sex, rank of baby birth and father's job have had significant effect on weight-for-age indicator until one year old. That the father's job variable has had a direct relationship with family's economic situation. In Zeighami et al study (2006) twin, interval between maternal pregnancies, rank of birth and low parental education have been reported as most important factor influencing low birth weight (LBW) newborns. Namkin et al (2008), have been reported that the low birth weight, congenital malformations, birth interval with previous child and father's literacy are the most important factors affecting deaths under one year old. Also, awareness of effect time of each of these factors during the first year of life and its severity can be used to prevent the incidence and also improvement of malnourished children. The purpose of this study is recognition of effective factors and their severity and effect time on the incidence and improvement of malnutrition in children during the first year of lifetime. Above information can determine the attention priorities and planning and cost for children health who make up the future community.

Another purpose of this study was to determine a model that can examine effects of effective variables on changes of incidence or improvement of the malnutrition according to the time which by examining various models, ultimately two-compartment Markov model according to simple estimating of desired coefficients and offering a simple, summary and conceptual results than other models, used in this study.

2. Material and method

This community-based descriptive analytical study was conducted as longitudinal. Babies that were born during the first half of 1390 and resident in the rural areas of Boyer Ahmad city, were assisted in project until achieving the desired sample size and their health information was recorded from the birth to the first year old in a form that was prepared for that purpose. Children was monitored completely from the birth for one year and in case of appearing the specific disease conditions and other problems, their health changes, nutrition and weight were recorded and examined and the children which were entered the malnutrition state, were examined specifically. Data collection was carried with the active participation of health workers living in target villages that were trained in relation to the subject and objectives of the project and physicians of the health centers and medical students which pass their internships and apprenticeship. Collected data included general information about baby, his/her mother and family and relatively exact times of child changes to healthy status or malnutrition status during the first year of a child's life. This information also included parturition type, maternal and child, maternal age at birth, rank of birth, past abortions, weight, height, head circumference and other health information about mother and child. In this study, infant weighting less than 2500 g is considered as low birth weight (LBW) and having a weight-for-age with $-1SD < Z$ standard as malnutrition. Sample size according to the main purpose of research, study type and by considering the sampling error; $\alpha=0.05$ and the maximum estimation error $d=0.005$ and according to the $p=0.1$ which has been a conservative value of malnutrition in children under age of one year as for the similar studies; the necessary sample size was estimated 1440 people. Due to the possibility of studying children reduction, sample size with additional 5 percent was estimated 1500 people. Finally, 1463 children which were born in the first half of 1390 in rural areas of Boyer Ahmad city were studied from birth to the one year which is fifty percent of overall children who were born in the desired area.

To determine the malnourished children, the WHO Anthro software was used and for general analysis of data, SPSS21 statistical software and for calculations related to the two-compartment regression model analysis and O'Braian computational logic (1980), R software were used. In data analysis using two-compartment regression model, it is assumed that effect of independent variables on changes in the child status from healthy state to malnutrition state as well as changes from malnutrition state to healthy state in the different ranges are the same. All changes in each interval separately the change from healthy state to malnutrition state in a group and change from malnutrition state to healthy state in another group and also, invariance from healthy state to healthy state or malnutrition state to the same state entered in the model at the end of interval associated with independent variables and coefficients of variables effect as well as coefficients of interval effect in changes was estimated.

Using the two-compartment regression model for longitudinal data in this study can be useful, although it has not been used commonly. In this model, independent variables effect on invariance in child health status is ignored that this issue is a disadvantage of this model. However, its conceptual application is simpler than other methods such as cured survival models.

3.Results

General health information of studied children has been as follows: 761 (52%) of children were male; maternal age of children; 132 (9%) were 18 years old or less, 1205 (82%) of children were 19 to 35 years old and the remaining 126 (8.6%) of them were more than 35 years old. The mean and standard deviation of number of parturition was 2.25 and 1.41. 108 cases (7.4%) of these children have had the hospitalization background that the majority of them were related to their birth and the first month of their lifetime. The highest percentage of mothers (65.9%) has had 1-2 parturitions and the most frequent cause of hospitalization of RDS, has been prematurity and pneumonia. About 60.7 % of parturitions were done by natural section and the rest by caesarean section. In total, there were 16 cases (11 per thousand) deaths which all of them had occurred in the first month of lifetime and the majority of them related to the first week of life. Averagely, in this study, mean of baby's weight has been about 500 g less than mean of acceptable weight in our country. The estimated coefficients of the independent variables effect and time intervals on the incidence malnutrition or improvement of children in the two-compartment model are presented in tables 1 and 2.

4.Discussion

As it can be seen (Table 1), more parturition, being a female child, and beginning of complementary foods significantly reduce the chance of improvement of malnourished children. Thus, following cases are proposed to resolve the problem: making culture about identical encounter with the gender of the baby, making culture about reduction of the number of parturitions and attending to the child auxiliary nutrition and breastfeeding. Also, maternal age, maternal disease, more parturition, birth weight, child disease and twin or twain babies significantly have been increased the risk of appearing the malnutrition in healthy children. Therefore, the following cases are proposed to prevent the malnutrition in children: increasing care for women during pregnancy for reducing low birth weight and increasing health care and offering subsidiary services for reducing the maternal and child diseases during pregnancy and after it at least up to the one year old. About effect of intervals on the incidence or improvement of malnutrition, as shown in Table 2, intervals 1, 2, 8 and 9 significantly have been effective in reducing chance of appearing the malnutrition. Therefore, following cases are proposed to prevent malnutrition and improve recovery process in healthy children according to the time: increasing care especially under age of 2 months and 7-12 months, because the most changes in child health have been in these ages, and increasing health care and offering subsidiary services between 4-5 months old for reducing maternal and child diseases and increasing the chance of child health. Intervals 1 (range 0 to one month), 2 (range 1 to 2 months), significantly have been effective in increasing the chance of improvement of malnourished children, intervals 5 (range 4 to 5 months), 8 (range 7 to 9 months) and 9 (range 9 to 12 months) also have been significantly effective in decreasing the chance of improvement of malnourished children. Thus, to enhance the recovery process and prevent malnutrition in healthy children, it is necessary to increase care especially in children under age of 2 months and 7-12 months, because the most changes in child health have been in these ages. Also, increase in health care and supportive services within 4 to 5 months is effective to reduce the chance of maternal and child diseases and the chance of maternal and child health will increase.

This study is provided a suitable model for analysis of growth data in which a significant percentage of people didn't change their status. Although from proposing the cured model has passed more than half a century, but the complexity of these models and lack of proper software, has been limited use of these models. In this study, two-compartment

Table 1 - Estimated coefficients of the independent variables in the two compartment markov regression model in malnutrition changes of malnutritional status (1) the normal state (0) in the whole intervals.

Changes	Malnutrition(1)→ Normal(0)					Normal(0)→ Malnutrition(1)				
	B	Sig	OR	*Lo	*Up	B	Sig	OR	*Lo	*Up
Estimated Parameters→										
Maternal age	.036	.944	1.037	.376	2.857	1.348	.031	3.849	.888	16.423
Mothers disease	.164	.580	1.179	.658	2.110	.635	.002	1.886	1.271	2.801
Deliveries kind	.260	.566	1.296	.535	3.142	.260	.566	1.296	.535	3.142
Previous abortion	.461	.515	1.586	.395	6.368	.461	.515	1.586	.666	4.327
Number of delivery	-.771	0.02	.462	.159	1.348	.530	.063	1.69	.159	1.348
Kind of gestation	-.367	.478	.693	.252	1.907	.251	.478	1.286	1.066	1.550
Baby gender	-2.15	.000	.116	.063	.214	.230	.778	1.258	.939	1.687
Birth weight	0.461	.0.392	1.58	0.396	6.36	4.957	.000	142.14	66.91	301.95
Diseases of children	.0.260	.330	1.29	1.333	2.836	.665	.001	1.945	1.333	2.836
Twin	1.546	.257	4.691	.324	67.843	1.458	.032	4.299	.789	23.452
Complementary foods	.941	.031	2.563	.953	6.897	.941	.062	2.563	.953	6.897

- 95% Confidence Interval

Table 2 - Estimated coefficients of the time intervals in the two compartment markov regression model in malnutrition changes

Changes →	Malnutrition(1)→ Normal(0)					Normal(0)→ Malnutrition(1)				
	B	Sig	OR	*Lo	*Up	B	Sig	OR	*Lo	*Up
Estimated Parameters										
Time Interval month										
Interval 0-1	-.200	.011	.819	.574	1.169	.209	.152	1.232	.926	1.639
Interval 1-2	.250	.271	1.285	.822	2.007	.132	.454	1.141	.808	1.612
Interval 2-3	-.048	.737	.953	.719	1.263	-.091	.517	.913	.695	1.201
Interval 3-4	-.255	.258	.775	.497	1.206	.582	.007	1.790	1.176	2.726
Interval 4-5	-.082	.673	.921	.630	1.347	-.071	.705	.932	.645	1.345
Interval 5-6	.147	.015	1.158	.814	1.649	-.335	.129	.715	.464	1.103
Interval 6-7	.289	.039	1.335	1.015	1.757	.099	.464	1.104	.847	1.440
Interval 7-9	2.856	.000	17.383	10.524	28.715	2.773	.095	16.011	9.624	26.636
Interval 9-12	.265	.037	1.304	.971	1.750	-.208	.018	.812	.575	1.148

- 95% Confidence Interval

Markov regression model was used to examine effective factors on changes of child status from healthy state to malnutrition and inverse and also determine the effect of intervals on appearing these changes. From 11 independent variables that had the greatest effect in this study, child disease and maternal age more than 35 years or less than 18 years, low birth weight, number of parturitions and maternal disease causes significant changes in the incidence or improvement malnutrition in children under age of one year. Other variables had no significant effect on these changes. These results adapt with Keshavarz (2001), Namkin (2008), Zeighami (2005) and Imanieh (2010) works. In present study, weight indicator for children under age of one year in rural areas of Boyer Ahmad city significantly was lower in compared by standard growth curve for all ages under one year in monthly interval. In Bolourian study (2005) also noted that the weight-for-age indicator for 10.5 percent of children has been under the third percentile of nation growth curve. Infants with low birth weight are estimated about 15.6 percent. These finding correspond to finding of these studies: Mohamad zade (2002) and Mullah Mohamadi (2002), which have reported this index about 13.9 percent and 11.8 percent, respectively, although the time interval between present study and these studies indicates worse health conditions in the study area.

Inordinate difference of weight indicators for age toward the national standards is significant and needs more discussion. The most important factors affecting the incidence or improvement malnutrition in children under age of one year included: low birth weight and child disease in the first months of lifetime; and then factors: baby sex, maternal age, the number of parturition of mother and maternal disease. These results were reported similar in all studies and were so. So pay more attention to the supportive measurements of the mother and child during pregnancy, parturition and at least up to one year old are most important priorities of health care of area. Also, making culture in pay attention to the children without considering their gender is necessary.

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