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Original Research Article

Influence of infant feeding practices on baby weight by the first birthday vis-à-vis nutrition status: a prospective cohort study

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ABSTRACT

Background: Aim of the study was to examine the under nutrition among infants aged one to twelve months. Also, find out the influence of infant feeding practices on baby weight by the first birthday. This was a prospective cohort study to collect the data by visiting the village health centres.
Methods: This was a prospective cohort study of infants. We enlisted 157 new-born infants by a multi-cluster random sampling method representing the entire Primary Health Centre area. We obtained the written consent of mothers who participate in our study. These babies are followed up by periodic visits for a year. The data compiled, descriptive summary made, analysed with the Kolmogorov Smirnov test, chi-square test to infer statistical significance using SPSS 20.00 Software.
Results: There were 157 babies (n) who met the inclusion criteria, Male 51%, female 49%, Birth order ≤2 are 85%, Gestational age ≥38 weeks are 85%, all the babies gained weight, however, only 73.9% of them weighed more than third percentile growth curve, at the first birthday. Among those babies who weighed less, 6% of babies too low weight, less active, while 20% is thin and active. A significant relationship is seen between the baby weight with feeding practices, Clinical Features, and lactation at a 5% level ($p<0.05$).
Conclusions: The under nutrition has its origin in infancy. In our observation, 26.1% of babies remained undernourished by their first birthday. The main reasons for under nutrition is inadequate to breastfeed, an inherent lack of appetite, and imbalanced feeding practices.

Keywords: Appetite infants, Breast milk, Feeding practices, Under nutrition

INTRODUCTION

We base our assumption on the Null hypothesis- all the 700 babies born in our study area, in a year, weigh a minimum of weight above the third percentile of WHO Infant Growth Chart by their first birthday. Hence, we took a sample of 157 new-born babies and follow them through a year to find out the results. The growth of the baby depends primarily on feeding practices like breast milk, cow milk, formula milk, rice porridge, soft rice, fruits, fruit juices, egg, vegetables, food from animal sources.

The influence of feeding practices is another issue we would want to examine. There may be secondary factors

like birth order, gestational age, baby appetite, and socio-economic status of the family bearing on the baby weight gain.

First: Our study is unique, set in the community, prospective cohort, spread over two years to quantify under nutrition, weight for age by the first birthday. We believe an appropriate nutritional environment is crucial for baby growth and development and if this is diagnosed early, can be managed, irreparable if neglected (Golden hour concept). The babies have a short time to grow but a lifetime to live.

Second: There are only two studies that make simple passing references on infant under nutrition in the first year.[1-2] But there are scholarly articles from China, Philippines, Malaysia, the Middle East, Africa, and Latin America highlighting under nutrition among preschool children. The worldwide study of under nutrition among preschool children is estimated to be 16.2%.[3-9] Perhaps these studies reflect the residual effect of delayed diagnosis.

Third: Our country, does not lag in nutritional studies conducted among the preschool age group. In India under nutrition continues to be an important public health problem with a prevalence of 43%, perhaps the highest-burden in the world.[10-12] The factors like inadequate food, insanitation, indiscriminate disposal of organic waste, infections, illiteracy in family, inadequate water are responsible for this state of condition.

The result is morbidity, mortality in children from infectious diseases, poor physical, mental, and social health, a vicious cycle of worsening the nutrition status.

Our colleagues have studied under nutrition among preschool children in urban areas. In a recent study the prevalence rate of underweight among preschool children (low weight for age), stunting (low height for age), and wasting (low weight for height) was (29.1%), (28.0%) and (28.4%) respectively.[13] This study was a cross-sectional one and just quantified the prevalence.

Fourth: The literature is rich, 2,183 studies between the year 2000 to 2015, focused on the nutrition of preschool children, studies from different parts of the world, and varied.[14] We have made an extensive search for literature on "childhood under nutrition" on Medline.

There are descriptive studies, cross-sectional studies, Field observational studies, Nutritional support studies, and WHO Bulletin. In all these studies the overall conclusion is consistent, clear, and constant that under nutrition continues to be a public health problem.[15-18]

If this state persists longer than 24 months may be irreversible. The long-term consequences of under nutrition may be Lower IQ, Low cognitive development, low productivity. Such children are more prone to infectious diseases. Hence early identification of under nutrition during infancy, prompt correction (Principle of Golden hour management) may prevent irreparable damage in the coming years.

Perhaps highlighting what happens when under nutrition is not detected early enough and the need for focus on infants, family, community concerning nutrition. The nil or paucity of studies among infants (early identification) is one of the most pressing needs of our study to fill the gap in the knowledge. So, we focus on the extent of under nutrition during infancy and the influence of infant feeding practices on baby weight in this study.

METHODS

This was a study conducted in the northern part of Karnataka state, India. This study comprised of 157 new-born infants, followed up till they complete their first birthday. We obtained an ethical clearance letter to conduct the study (USMKLE/EC 41 Dated 20th Feb 2018) and study made from February 2018 to April 2020. The study plan details were informed to the participant mothers in their local language and written consent obtained from them. The mother to be living in the study area, willing to participate, willing for follow up of baby, the baby to be healthy, no chronic ailments, and no congenital diseases are eligibility criteria. The mother from the outside study area is excluded.

A sample of 157 infants drawn out of 700 new-borns distributed in 5 clusters among 52 village health workers, selected by multiple random sample method so that each worker to have three babies for follow up. The sample size needed for the study is 111 babies, but we recruited extra to make up for migration, missing for follow up, and refusals. (Sample size Formula:$n=2+(SD/d)^2$ $(Zalpha+Zbeta)^2$ Where SD=6.99, d=7.87 Z=1% Alpha error = 1.96 Z=95% Power=1.682 N=111 and to minimize error we can take up to 150 . There are two teams of trained persons, one team to visit, interview, do anthropometric measurements and collect the data as per protocol, another team with a checklist, to make the supervisory visit, scrutinize the data, and fill missing data. We use Salter Baby weighing Machine in our study.

The study tool consisted of a validated questionnaire to collect demographic data, prenatal, postnatal data anthropometric data infant feeding practices, and baby appetite data. The baseline visit was when the baby is two months old, to collect demographic data, the first visit when the baby is five or six months old, to know more about breastfeeding data, and the second visit when the baby is one year old to know more about supplementary foods. During the visit, we enquire about complementary feeds, how they prepare, how often they feed, how the baby feeds.

The rating is given to each mother based on exclusive breastfeeding, complementary feed, the timing of weaning foods, frequency, variety, and sources of food.

We observe the vegetables, fruits, ready to make infant foods available to mothers. We offer eatables like biscuits/lollipops/soft food/banana to babies and observe how they pick up and eat to sense the appetite. The baby feeding practices, food quality, quantity, food items are summarized in Infant feeding practices, how the baby looks, plays, feeds are summarized under clinical features, Breastfeeding adequate or not summarized under lactation. All this information is compiled and used for analysis. Before analysis, the normality of numerical data is tested by the Kolmogorov Smirnov test. For skewed variables, the non-parametric test i.e. Wilcoxon matched pairs test is applied to find the effect of observation from baseline (BL) to the last visit. The chi-square test for independence is performed to assess the association between the independent variables and the final baby weight. The statistical significance was set at a 5% level of significance. The data was compiled and analysed using SPSS Software 20 version.

Outcome: The baby weight by the first birthday above WHO Baby Growth Chart 3rd percentile, and details of infant feeding practices like Breastfeeding, complementary feeds, weaning feeds, their composition, fruits, and vegetables, when they introduce, frequency, quantity quality, variety and find relation if any between the baby weight with feeding practices.

RESULTS

There were 157 babies (n) who met the inclusion criteria, male 51%, female 49%, birth order ≤2 are 85%, gestational age ≥38 weeks are 85%, all the babies gained weight, however, only 73.9% of them weighed above the third percentile WHO Growth Curve, at the first birthday. Among those babies who weighed less (26%) are low weight, thin, irritable and less active. The demographic details are summarized in Table 1 and 2.

The mothers showing good baby feeding practice 42.7%, satisfactory 38.2%, and a rest 19% average rating. We also conducted the Kolmogorov Smirnov test for Normality of numerical data, the Wilcoxon test to know improvement in baby weight between visits, and the Chi-Square correlation ranking test between the baby weight to independent variables like birth order, social status, gestational age, clinical features, and lactation.

The findings are summarized in Table 3. After the second visit, a significant relationship was observed between the baby weight with clinical features, feeding practices, and lactation at a 5% level ($p<0.05$) (Table 3).

Table 1: Distribution of study respondents by different characteristics.

Demographic data	No. of respondents	% of respondents
Sex		
Male	80	50.9
Female	77	49.1
Mother age (yrs)		
<20	17	10.8
21-25	87	55.4
26-30	41	26.1
31 above	12	7.7
Pregnancy status		
Gravida1	68	43.3
G2	65	41.4
G3	16	10.2
G4	6	3.8
G5	2	1.3
Socio economic status		
Lower class	20	12.7
Middle class	55	35
Upper middle class	69	43.9
Higher class	13	8.4
Gestational age		
34 and below	6	3.8
35-37	18	11.5
38-40	121	77.1
41 above	12	7.6
Birth weight		
<2 kg	24	15.3

Continued.

Demographic data	No. of respondents	% of respondents
2.1-2.4 kg	24	15.3
2.5 to 3 kg	89	56.7
3.1 kg and above	20	12.7
Weaning		
6-7 months	3	1.9
7.1 to 8 months	154	98.1
Total	157	100

Table 2: Distribution of children by clinical features and weight in 1st birthday.

	No. of respondents	% of respondents
Clinical features		
Poor	32	20.4
Good	125	79.6
Baby weight at 1st birthday		
≤7 kg	10	5.7
7.1-7.4 kg	14	9.6
7.5-7.9	16	10.1
8.0-9 kg	80	51
≥9.1 kg	37	23.6
Height		
60-65cms	17	10.8
66-70 cms	118	75.2
71-77 cms	22	14
Lactation		
Nil	2	1.2
Inadequate	69	44
Good	86	54.8
Total	157	100

Table 3: Association between weight gain from baseline to second visit with other factors by chi-square test.

Factors	≤3kg (%)	3-6kgs (%)	≥6.1kgs (%)	Total	χ^2	P value
Mother married life						
1-2 years	10.34	70.69	18.97	58	7.294	0.121
3-4 years	16.67	45.83	37.5	24		
≥4 years	20	62.67	17.33	75		
Gravida						
Gravida 1	8.82	69.12	22.06	68	9.025	0.172
Gravida 2	21.54	53.85	24.62	65		
Gravida 3	25	62.5	12.5	16		
Gravida 4	12.5	87.5	0	8		
Socio economic status						
Lower class	5	50	45	20	30.996	0.0001*
Middle class	12.73	52.73	34.55	55		
Upper middle class	24.64	68.12	7.25	69		
Higher class	0	100	0	13		
Mode of delivery						
Normal	15.63	64.58	19.79	96	0.282	0.868
Caesarian	16.39	60.66	22.95	61		
Gestational age						
<37weeks	23.08	69.23	7.69	13	4.564	0.335
37-39	20.59	57.35	22.06	68		
40-41	10.53	67.11	22.37	76		
Fruits						

Continued.

Factors	≤3kg (%)	3-6kgs (%)	≥6.1kgs (%)	Total	χ^2	P value
No	18.46	60	21.54	130	4.275	0.118
Yes	3.7	77.78	18.52	27		
Vegetables						
No	15.44	66.18	18.38	136	5.08	0.079
Yes	19.05	42.86	38.1	21		
Pulses						
No	16.9	64.08	19.01	142	3.984	0.136
Yes	6.67	53.33	40	15		
Clinical features						
No	16.13	80.65	3.23	31	7.714	0.0210*
Yes	15.87	58.73	25.4	126		
Lactation						
Poor	20	76.67	3.33	60	18.317	0.0001*
Plenty	13.4	54.64	31.96	97		
Baby feeding practices						
Average	23.33	76.67	0	30	46.438	0.0001*
Satisfactory	26.67	68.33	5	60		
Good	2.99	52.24	44.78	67		
Total	15.92	63.06	21.02	157		

*p<0.05 indicates significant association

DISCUSSION

Our study is a community based prospective cohort, meaning we visit village sub-centres to collect data. The mothers are all registered for antenatal care, received Iron, Folic acid, nutrition supplements, all are institutional deliveries, neonatal physiological jaundice the commonest symptom in the new-born, few babies had mild difficulty in breathing, and babies received timely immunizations. Because of adequate community health care, women workers present, we had easy access for mothers and their infants. The baseline visit was to establish rapport, enlisting participants as per protocol, collecting demographic, prenatal, natal, and postnatal data. The sample size of 157 babies is an adequate representative of the area.

The mothers are in the age group of 18 years to 35 years, all can read and write, belong to all income groups, and most of them housewife with farm work. One-third of these women had, either low body weight suffered from anemia, pregnancy-induced hypertension, or preterm delivery. All these features have been summarized in Table 1.

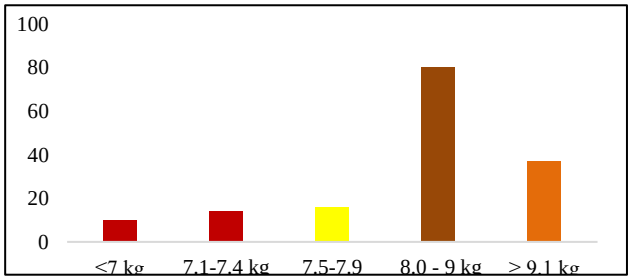

Figure 1: Final outcome distribution of the babies (n=157) weight by their first birthday.

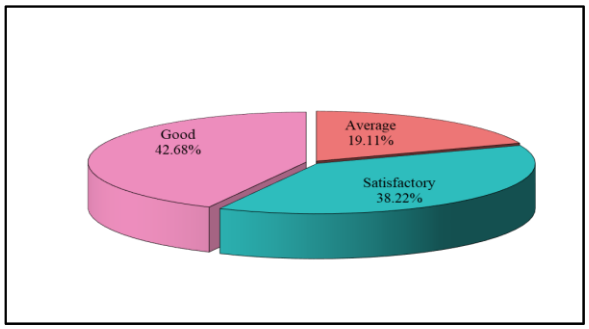

Figure 2: Distribution of mothers as per rating based on baby feeding practices.

In India, mothers prefer just 2 babies unless there is a preference for the boy baby. But as the birth order goes up the baby gains less weight. Since the deliveries are conducted in the institutions, babies are put to breastfeeding immediately. In the first 6 months, the babies are breastfed. Two mothers have no breast milk, few retracted nipples, and a fairly good number of mothers who felt breast milk is inadequate (Table 2).

This feeling made these mothers add cow's milk feed to the babies. Cows milk has been used for feeding babies traditionally over a long time. This is not new.[19] The baby when irritable, cries more often are indications that the baby had inadequate breastfeed and mothers tend to add the cow milk.

There are no observations of mothers taking up formula milk for feed. The health care professionals, community based health care workers do educate mothers not to feed Cows' Milk to infants as a National policy. The practice of feeding Cows' milk using a Nifty feeding cup or Paladai (a Tamil word) or bowl and spoon is quite common. All the

mothers breastfed their babies and some supplemented with cow milk.

Then when the baby can sit about or teeth erupt, traditionally a time to add solid foods. This is when the baby is seven months old. The mothers start with liquid rice powder porridge one ounce twice daily. As the baby grows, they add soft rice or soft roti, Sweet soft desert-like Shira, Salty Version like Uppit. Few mothers take additional efforts to prepare "Nutri Powder", using multigrain and cook tasty porridge. Few mothers do feed Banana/Apple to babies. These are some of the commonest easy to make weaning foods for babies feed in our study area. It appears there is some delay in introducing complementary foods to babies and most of these foods are cereal-based, less or no protein, lentil/ vegetable/oil/ animal foods.

The mothers are fully aware of balanced food, the importance of vegetables, fruits, egg, Lentils, oil, Ghee in baby foods. During this time mothers continued to breastfeed. It appears mothers are unable to cook complementary foods from diverse sources. These feeds fall short of lentils, fruits, and vegetables. The rating of Feeding practices is shown in Figure 2.

There is one another observation during our second visit to babies. When we offer some eatables, some babies refuse to pick up, do not show interest in eating, maybe these babies do not have a good appetite (Table 2). With full immunization coverage, timely child care there is not many episodes of respiratory infections/intestinal infections during our observation. No baby was admitted for intensive care.

In this scenario all babies have put on admirable weight may be due to inherent growth character (Figure 2). Some babies, for various reasons, could not reach the useful desired weight mark by the first birthday.

The Wilcoxon test was used to observe progress between visits. Chi-square test for independence applied to establish an association between various independent factors with the baby weight at the first birthday.

We have associated the various factors like birth order, gestational age, socio-economic status, clinical features, and lactation with the baby weight between visits. Table 3 summarize these findings. There is a statistically significant association between these factors on weight gain poor clinical features, inadequate breast milk, Poor infant feeding practices, associated with more chance for under nutrition. These facts are statistically significant (p value <0.05).

The period of 1st year in an infant is crucial for growth and development. The babies are endowed with natural growth instincts. By any chance the growth instinct is not supplemented with adequate nutrients the damage would be difficult to mend. That is why marking growth chart, timely nutrients, assuring adequate weight gain can be considered as Golden hour management of under nutrition (Early diagnosis and Prompt treatment).[20]

Now let us make "U" turn and find out what happens when babies are introduced complementary feeds very early at four months, especially animal origin, and fed more often. There are scholarly articles on this aspect also highlighting the corollary overweight and obesity.[21]

In a given study situation, limited resources, we have put in efforts to make this body of knowledge useful for child care professionals. The period of infancy is unique, timely wholesome food most essential for the comprehensive growth and development of the baby. That is how under nutrition has its origin in infancy, factors like birth order, gestational age, clinical features, and lactation process influence baby weight gain. The immunization program has gained momentum and benefitted babies, while infant feeding has lagged. The imaginative baby weaning feeds may mitigate under nutrition at the right time.[22]

We continue to have 20% of babies who can be marked low weight for age, who are otherwise healthy, active but do not eat well, to be influenced by fetal programming? The study of under nutrition among infancy is fascinating as well challenging. Then a few words about Foetal programming, Barker hypothesis, in utero life and its influence on health and diseases of baby, but our resources are limited.[23]

CONCLUSION

We were able to achieve our objectives. In our observation, 26.1% of babies remained undernourished by their first birthday. The main reasons are the inherent lack of appetite, inadequate breast milk, and incorrect feeding practices. The situation can be mitigated by timely imaginative interventions.

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