Original Article

# Optimal timing for introducing enteral nutrition in the neonatal intensive care unit

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**Objective:** To identify the optimal time for introducing enteral nutrition to critically ill neonates. **Methods:** This prospective cohort study included all eligible critically ill neonates who were admitted to a multidisciplinary tertiary neonatal intensive care unit (NICU) between 1st June and 30th November 2013. Nutrient intake and clinical outcomes during NICU stay were recorded. The effect of early (<24 hours after NICU admission) and delayed (≥24 hours) enteral nutrition introduction on clinical outcomes was assessed. **Results:** Energy deficit in critically ill neonates was frequent: 84.7% could not achieve the caloric goal during the NICU stay. Growth retardation was common especially among the preterm: the frequency of neonates whose weight was below the 10th percentile increased significantly from 21.6% on admission to 67.6% at discharge. Compared with delayed enteral nutrition, early enteral nutrition was associated with better median time to starting weight gain (0 vs 6 days, $p$=0.0002), a lower chance of receiving parenteral nutrition (41.7% vs 95.9%, $p$<0.0001), shorter NICU stays (196 vs 288 hours, $p$=0.0001), fewer hours on mechanical ventilation and a lower chance of developing pulmonary infection (37.5% vs 56.0%, $p$=0.005). The accumulated energy deficit to the subjects who were exposed to delayed nutrition could not be compensated by subsequent nutrition. Neonates who underwent mechanical ventilation had suboptimal nutrient delivery: they took longer to gain weight and were more likely to develop respiratory distress and receive parenteral nutrition. **Conclusions:** Early enteral nutrition initiation (<24 hours) is recommended. Neonates with mechanical ventilation should be monitored with particular attention.

**Key Words: neonates, feed introduction, intensive care unit, enteral nutrition, parenteral nutrition**

## INTRODUCTION

Enteral nutrition (EN) is an extremely important auxiliary nutrition support in the neonatal intensive care unit (NICU) but when it should be introduced after admission to the NICU remains controversial. Some practitioners propose that EN should be delayed because it may increase oxygen demand and thereby further compromise hemodynamically unstable patients. Moreover, it is believed by some that early EN associates with a high risk of small bowel necrosis, gastrointestinal ischemia, multi-organ dysfunction,[1,2] and necrotizing enterocolitis (NEC).[3-5] However, others argue that delayed EN associates with an increased risk of infections and metabolic disorders and may hamper the functional adaptation of the immature gastrointestinal tract. It may also increase the need for parenteral nutrition, which promotes gastrointestinal tract dysfunction.[6] Trophic feeding (namely, providing patients with very small volumes of enteral feeds) may help to promote intestinal function and, in the case of infants, intestinal maturation, thereby enhancing feeding tolerance. For these reasons, many hospitals worldwide now administer full or trophic EN as early as possible.[7-9] However, as it was introduced in order to promote intestinal function other than improve calorie intake, whether early EN improves the energy balance of infants or adults compared with later EN remains unclear.

How to define early EN is also unclear. A randomized controlled trial divided the patients into those who received EN early (defined as day 2 after birth) and those who received EN late (defined as day 6 after birth); they found that the two groups did not differ in terms of risk of developing NEC.[10] In a meta-analysis of randomized or quasi-randomized controlled trials, early and delayed progressive EN was defined as within and after 96 hours of birth, respectively.[11] Neither group differed in terms of the incidence of NEC, mortality, or other morbidities. However, it was notable that the meta-analysis cohort only included relatively few very low birth weight infants. The authors also concluded that most of the cohort participants were not typical and there was no further investigation of other important outcomes, including duration from admission to the start of weight gain and the duration of intensive care units stay and hospital stay.

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The ongoing lack of clarity regarding the optimal onset time of EN makes it difficult to identify the best nutritional strategy for critically-ill neonates.[12] The present cohort study explored the impact of different timings of EN initiation on the clinical features, weight change, and clinical outcomes (including the durations of NICU and hospital stays) of critically-ill neonates who were admitted to an NICU. Energy intake and energy balance were also measured to determine whether early EN compensated the energy deficit during the NICU stay better than delayed EN. Whether mechanical ventilation increased the risk of nutrient deficiency was also assessed.

## METHODS

### *Patient selection*

This prospective observational cohort study did not involve any clinical interventions and was approved by the institutional review board of the participating hospital. The parents of all enrolled subjects provided written informed consent.

The cohort consisted of all critically-ill neonates who were admitted to the NICU of Xinhua Hospital (which is affiliated with School of Medicine, Shanghai Jiao Tong University between 1st June and 30th November, 2013 and who were anticipated to need to stay in NICU 96 hours (hrs) or longer. Patients were excluded who were older than 28 days at the time of NICU admission, who were transferred from other ICUs, who were discharged on a voluntary basis by the parent or guardian, who were receiving end-of-life compassionate care, whose therapy was voluntarily refused by the parent/guardian, and who had inherited metabolic disorders or undefined diseases.

### *Nutrition data collection*

The participating research members were trained to collect the data before the study. Bedside nursing staff recorded the daily parenteral and enteral nutrition intake starting on the day of admission. The daily condition of each patient from the time of NICU admission to discharge from the NICU was collected from observation charts and medical notes. Patients who received at least 24 hrs of nutrient support during their time in the NICU courses were identified and investigators collected the following data: weight (which was measured every 2 days), daily calorie goal (prescribed EN and/or parenteral nutrition (PN)), daily calorie intake (from both EN and PN), calorie intake at discharge (from both EN and PN), enteral calorie intake at discharge, and achievement of calorie goal during the NICU stay (defined as meeting the daily prescribed calorie goal throughout the NICU stay). The prescribed calories and content were determined by nutritionists on the basis of standard age-based formulas and the condition and growth of the infant. EN and PN were initiated and advanced on the basis of Chinese guidelines for newborn nutrition support in neonates, which were established in 2006.[13] These guidelines are based on both clinical practice in China and the Guidelines Committee and Board of Directors of the American Society of Parenteral and Enteral Nutrition (ASPEN).[14] The Chinese guidelines consider EN to be the optimal mode of nutrient support for neonates during their stay in NICU. In our study, TPN was generally indicated when fasting (minimal or no EN) for 3 or more days were anticipated. However, if the infant was malnourished, had a low birth weight, or had hyper metabolism, TPN was indicated when fasting for 1 or more days was anticipated.[15] If patients failed to meet their target EN or PN, the reasons for the interruption or abolishment were recorded. The reason was considered to be feeding intolerance if the infant vomited, exhibited gastric retention, developed diarrhea, or abdominal distension. After all interruptions, nutrient intake was restarted according to the feeding schedule. EN interruption was defined as an episode of EN stoppage for a period exceeding 30 minutes. TPN abandoned was identified as an episode where all or part of the TPN liquid was replaced or wasted for any reason. The frequency of patient's weight below the $10^{th}$ percentile (as determined by comparison with neonates with a comparable gestational age by using the corrected Fenton Growth Curve for growth evaluation were used to describe growth retardation.[16] To ensure the capture of any missing data, the nutrition records at the bedside were examined at the end of each nursing shift and checked against the completed electronic medical record. Related outcomes, namely, duration of mechanical ventilation support and length of NICU stay, were abstracted after enrolment and discharge from the NICU.

### *Statistical analysis*

Categorical variables such as patient characteristics were expressed as number and percentage, while continuous variables were expressed as mean ± standard deviation (SD) if the data were reasonably normally distributed or as median and interquartile range (IQR) if the data displayed a high degree of skew. The patients were divided according to whether EN was initiated within 24 hrs of NICU admission. The resulting two groups were then compared in terms of their demographic and clinical characteristics by Student's t test (continuous variables). Similar test was used to compare the 0-12 hrs and 12-24 hrs groups. All tests of significance were 2-sided. All statistical analyses were conducted with SAS/STAT software (Version 9.1) of the SAS System.

## RESULTS

### *Baseline characteristics of the subjects*

In total, 722 patients were admitted to the NICU during the 6-month enrolment period. All had medical or surgical illnesses. Of the 722 patients, 587 satisfied the inclusion criteria and were enrolled in the study, but 77 patients were later excluded from analysis because of the following reasons: insufficient length of NICU stay (<96 hrs), therapy was refused voluntarily by the parent/guardian, or the patient failed to meet the eligibility criteria after further investigation. Thus, 510 neonates were included in the final analysis. Their clinical characteristics are described in Table 1. The age of the enrolled patients at the time of NICU admission ranged from 0 to 28 days. Most were 1 day old at the time of admission (n=356 patients, 69.8%) and many were premature (n=222 patients, 43.5%), had congenital heart disease (n=180 patients, 35.5%), and received mechanical ventilation (n=162 patients, 31.7%).

***Calorie achievements of the subjects during the NICU stay***

Although nutritional intervention was introduced in a timely fashion (the median time from admission to starting nutrient therapy was 24 hrs), the introduction of EN was often quite late: the median time to starting EN was nearly 3 days (67 hrs) and 438 patients (85.9%) did not receive any EN in the first day of admission to the NICU. The critically ill neonates also exhibited growth retardation during their stay in the NICU: the frequency of patients whose weight was below the $10^{th}$ percentile increased from 16.5% on admission to 40% at discharge from the NICU. The growth retardation was higher in the premature infants: 21.6% and 67.6% exhibited growth retardation at admission and discharge, respectively. Calorie deprivation was highly prevalent: more than 80% of the neonates (n=432) did not reach the calorie goal during their NICU stay and only 251 neonates (<50%) totally regained their birth weight. Table 2 shows the distribution of patients who received <60, 60-79, 80-99, and ≥100 kcal/kg per day on average or at discharge. A large number of neonates (n=221, 43.3%) achieved less than 60 kcal/kg per day and only 181 (21.2%) achieved 80-99 kcal/kg per day. At the day of discharge from the NICU, only 128 (25.1%) neonates reached >100 kcal/kg, and most of the rest reached 80-99 kcal/kg (n=214, 42.0%). with the remainder (n=168, 32.8%) achieving <80 kcal/kg.

***Comparison of the patients whose EN was started early or later***

In total, 491 neonates received at least 24 hrs of EN during their stay in NICU. For these patients, nutrition therapy and EN were started at 24 and 67 median hours after NICU admission, respectively, and 438 (85.9%) neonates did not receive EN in the first 24 hrs in the NICU. Compared with the patients who started receiving EN early (<24 hrs), the late-starting (≥24 hrs) patients had a significantly longer period between admission and starting weight gain (median 6 vs 0 day; $p$=0.0002), a longer stay in the NICU (median 288 hrs vs 195.5 hrs, $p$=0.0001), and were more likely to receive parenteral nutrition (95.9 vs 41.7%, $p$<0.001) with abandoned parenteral nutrition ($p$=0.007), and received mechanical ventilation ($p$<0.001) (Table 3). The late-starting patients were also more likely to be younger on admission (median1 vs 6.5 postnatal day, $p$<0.001). The disparity between the two groups in terms of energy deficit started early: during the first 4 days in the NICU, the median energy deficits of the delayed and early groups were 880 and 638 kcal, respectively ($p$=0.008). This difference accelerated over time: during the first 7 days, the median energy deficits of the delayed and early groups were 1138 and 602 kcal, respectively ($p$=0.004). Combining with the clinical outcomes shown above, it seemed that the accumulative energy deficits to the subjects who were exposed to delayed nutrition could not be compensated by subsequent nutrition.

**Table 1.** Clinical characteristics of the cohort

| Characteristic | All patients |
|---|---|
| Age at admission, days, median (IQR) | 0 (0-1) |
| Male, n (%) | 245 (48) |
| Gestational age at admission, n (%) | |
| Term infants (>37 weeks) | 288 (56.5) |
| <34 week preterm infants | 89 (17.5) |
| 34-37 week preterm infants | 135 (26.5) |
| Neonates with CHD, n (%) | 180 (35.3) |
| Neonates admitted to the medical service, n (%) | 306 (60) |
| Neonates admitted to the surgical service, n (%) | 204 (40) |
| Neonates on EN for at least 1 day, n (%) | 491 (96) |
| Days on EN (491 neonates), median (IQR) | 7 (4-11) |
| Neonates on PN for at least 1 day, n (%) | 450 (88) |
| Days on PN (450 neonates), median (IQR) | 7 (5-12) |
| Hours in incubator in NICU, median (IQR) | 144 (0-281) |
| Neonates with pulmonary infection during ICU stay, n (%) | 272 (53.3) |
| Neonates with respiratory distress, apnea, respiratory failure, n (%) | 204 (40) |
| NICU length of stay, hour, median (IQR) | 281 (184-458) |
| Length of stay in hospital, hour, median (IQR) | 333 (232-498) |
| Hours from ICU admission to starting nutrition (all neonates), median (IQR) | 24 (20-31) |
| Hours from ICU admission to starting EN (only patients on EN), median (IQR) | 67 (44-164) |
| Hours on mechanical ventilation in NICU, median (IQR) | 0 (0-44) |
| Daily calorie intake during the NICU stay, kcal/kg/d, mean ± SD | 65.2 ± 18.7 |
| Calorie goal reached during NICU stay, n (%) | 81 (15.9) |
| Calorie intake at discharge, kcal/kg/d, median (IQR) | 75.7 (50.2-103) |
| Enteral calorie intake at discharge, kcal/kg/d, median (IQR) | 86.3 (72.3-103) |

CHD: congenital heart disease; EN: enteral nutrition; IQR: interquartile range; NICU: neonatal intensive care unit; PN: parenteral nutrition; SD: standard deviation.

**Table 2.** Distribution of patients receiving different energy during NICU stay and at discharge

| Calorie intake for all subjects (kcal/kg/day) | <60 | 60-80 | 80-100 | >100 |
|---|---|---|---|---|
| Average daily calorie, n (%) | 221 (43.3) | 181 (35.5) | 83 (16.3) | 25 (4.9) |
| Calorie reached at discharge, n (%) | 23 (4.5) | 145 (28.3) | 214 (42.0) | 128 (25.1) |

When the patients were divided according to whether EN was initiated within 12 hrs of admission, the patients whose EN was started after 12 hrs were more likely to receive parenteral nutrition (93.4%) than the patients whose EN started before 12 hrs (44.4%, $p<0.001$) (Table 3). They also had longer stays in the NICU (median 287 vs 207 hrs, $p=0.0003$) and a longer time from admission until weight gain started (median 6 vs 0 day, $p<0.0001$).

Comparison of the patients who started receiving EN 0-12 hrs after admission to the patients who started receiving EN at the 12-24 hrs time point revealed no significant differences in terms of the length of NICU stay, hospital stay, or the incidence of respiratory diseases (pneumonia, respiratory distress, apnea, and respiratory failure). Therefore, taking into consideration various barriers and the need to provide intervention in clinical practice prudently, the most feasible and safe time to initiate EN maybe within 24 hrs of NICU admission.

***Comparison of patients who did and did not receive mechanical ventilation***

Table 4 shows the comparison of the neonates with (n=162) and without (n=348) mechanical ventilation. Despite receiving the same standard nutrition support, neonates who received mechanical ventilation took more time to start gaining weight (median 9 vs 3 days, $p=0.0005$), had a longer stay both in the NICU (median 463 vs 234 hrs, $p=0.002$) and the hospital (median 436 vs 311 hrs, $p=0.0005$) and a longer time to EN introduction (median151 vs 47.5 hrs, $p=0.0001$). They also tended to have a longer duration of EN interruption (and were more likely to develop respiratory diseases during their stay in the NICU (66.7% vs 27.6%) than the neonates who did not receive mechanical ventilation.

## DISCUSSION

The present study showed that delayed initiation of EN (≥24 hrs) was very common among the critically ill neonates during their ICU stay. It also associated with a higher incidence of pulmonary infection and mechanical ventilation, and longer stays in the NICU and hospital. It also associated with frequent parenteral nutrition administration (95% of the patients in the ≥24 hrs group received parenteral nutrition) and parenteral nutrition waste.

Initially, many researchers believed that it might not be prudent to give early EN to critically ill infants because of a presumed high risk of NEC and other critical diseases. As a result, it became common practice to delay the initiation of feeding in these infants.[17] However, it was then suggested that EN may actually stimulate gastrointestinal hormone secretion and motility, and that delayed EN may disrupt the patterns of microbial colonization and diminish the functional adaptation of the gastrointestinal tract. More and more researchers then found evidence for the potential disadvantages associated with the delayed introduction of progressive EN.[18-21] The prevailing dogma changed and policies that aimed to improve the early introduction of EN began to be adopted.[22-25] In 2013, a systematic review of the effects of early trophic EN in preterm or low weight infants was performed.[26] It included nine randomized or quasi-randomized trials with a total of 754 preterm or low weight infants. It showed that early trophic feeding did not influence feed tolerance, weight gain, NEC, and other important harmful outcomes. Moreover, a prospective study even found that early fasting, namely, the delay of EN introduction increased the incidence of NEC.[27] In the present study, early EN initiation (<24 hrs) seemed to be tolerated well, as shown by the fact that EN interruption did not occur more frequently in the early group than in the delayed group ($p=0.26$). Moreover, delayed EN initiation associated with greater deterioration of the cumulative energy deficit during the entire NICU stay compared with early EN initiation: patients with delayed EN had a median total energy deficit of 1426 kcal, whereas the early EN group had a median total energy deficit of 1026 kcal ($p=0.002$). Considering the energy achieved during the NICU stay, it appears that delayed EN initiation associated with energy deficits at an early stage, which could not be compensated by subsequent nutritional support.

Most importantly, the present study showed that early introduction of EN (within 24 hrs) was beneficial for critically ill infants admitted to the NICU. This issue has not been assessed fully previously. In addition, the 0-12 hrs and 12-24 hrs groups did not differ significantly in terms of most associated outcomes shown in our study, such as similar incidences of pulmonary infection and respiratory distress (including apnea and respiratory failure). However, it should be noted that these two groups only contained 54 and 18 neonates, respectively. Further research with higher numbers may be needed to validate the results of these analyses. Nevertheless, given various barriers that complicate nutrient introduction in the early hours after admission and the need to provide intervention in clinical practice prudently, the most feasible and safe time to initiate enteral nutrition maybe within 24 hrs of NICU admission.

Identifying eligible patients who are at high risk of EN deprivation will allow targeted interventions and optimize EN delivery during critical illness. A study by Coss-Bu suggested that the increased risks for the critically-ill neonates who undergo mechanical ventilation might relate to the fact that their growth arrests during their acute illnesses.[28] In addition, a study that estimated the energy requirements of mechanically ventilated children found that they tended toward hyper metabolism and were at a high risk of underfeeding.[29] The present study revealed similar outcomes: despite receiving the same standard nutrition support for neonates, the patients with mechanical ventilation exhibited less weight gain and had longer stays in both the NICU and the hospital. Moreover, the median day of EN introduction in the mechanically ventilated patients was delayed to 6 days (151 hrs) in non-ventilated neonates, the median day of EN introduction was 2 days (47.5 hrs). The neonates with mechanical ventilation also had a significantly longer duration of EN interruption after EN was initiated during their stay in the NICU. Thus, neonates who require mechanical ventilation should undergo close clinical monitoring and their nutrition should be adjusted frequently and carefully to ensure their energy needs are met. Further studies on this issue are warranted.

Since both under-feeding and over-feeding in the ICU have negative impacts on patient recovery from serious

**Table 3.** Comparison of neonates with early and delayed EN initiation

| Hours from admission to start EN | EN initiation within 12 hours (2a) | | *p* | EN initiation within 24 hours (2b) | | *p* |
|---|---|---|---|---|---|---|
| | YES (54) | NO (456) | | YES (72) | NO (438) | |
| Age at NICU admission, day, median (IQR) | 8 (4-18) | 0 (0-0) | <0.0001 | 5.5 (1.5-18.0) | 0 (0-0) | <0.0001 |
| Preterm infants, n (%) | 18 (33.3) | 206 (45.2) | 0.514 | 20 (27.8) | 204 (46.6) | 0.162 |
| Patients with CHD, n (%) | 12 (22.2) | 168 (36.8) | 0.386 | 18 (25.0) | 162 (36.9) | 0.421 |
| Days from admission to start weight gain, median (IQR) | 0 (0-0) | 6 (3-10) | <0.0001 | 0 (0-3) | 6 (3-10) | 0.0002 |
| PN administered, n (%) | 24 (44.4) | 426 (93.4) | <0.0001 | 33 (41.6) | 421 (95.9) | <0.0001 |
| Hours from admission to start nutrition, median (IQR) | 2 (1-2) | 25 (22.0-33.5) | <0.0001 | 2 (1.0-8.5) | 25 (22-34) | <0.0001 |
| Duration of EN interruption, median (IQR) | 0 (0-6) | 0 (0-6) | 0.634 | 3 (0-10.5) | 0 (0-6) | 0.223 |
| Episode of EN interruption, median (IQR) | 0 (0-2) | 0 (0.0-1.5) | 0.808 | 1 (0-2) | 0 (0-1) | 0.265 |
| Episode of PN abandon, median (IQR) | 0 (0-0) | 1 (0-3) | 0.007 | 0 (0-0) | 1 (0-3) | 0.003 |
| NICU length of stay, hours, median (IQR) | 207 (142-265) | 287 (186-458) | 0.0003 | 195 (129-405) | 288 (194-457) | 0.0001 |
| Length of hospital stay, hours, median (IQR) | 265 (142-640) | 337 (232-487) | 0.407 | 276 (163-667) | 338 (233-476) | 0.457 |
| Hours on mechanical ventilation in NICU, median (IQR) | 0 (0-0) | 0 (0-52) | 0.036 | 0 (0-0) | 0 (0-46.5) | <0.0001 |
| Hours on incubator in NICU, median (IQR) | 144 (0-262) | 142 (0-281) | 0.931 | 104 (0-234) | 150 (0-281) | 0.465 |
| Pulmonary infection, n (%) | 20 (37.0) | 252 (55.5) | 0.014 | 27 (37.5) | 245 (56.1) | 0.005 |
| Respiratory distress, apnea, failure, n (%) | 18 (33.3) | 186 (40.8) | 0.666 | 24 (33.33) | 180 (41.10) | 0.213 |
| Daily calorie intake, kcal/kg/d, mean ± SD | 83.9 ± 18.0 | 62.9 ± 17.2 | 0.004 | 76.7 ± 20.9 | 63.3 ± 17.4 | 0.042 |
| Calorie intake at discharge, kcal/kg/d, median (IQR) | 90.4 (77.7-99.5) | 74.4 (53.3-95.2) | 0.242 | 86.3 (73.5-101) | 73.5 (53.0-94.1) | 0.228 |
| Enteral calorie intake at discharge, kcal/kg/d, median (IQR) | 97 (82-100) | 87 (73-101) | 0.343 | 93.8 (73-101) | 87.5 (73.4-99.8) | 0.913 |

CHD: chronic heart disease; EN: enteral nutrition; IQR: interquartile range; NICU: neonatal intensive care unit; PN: parenteral nutrition; SD: standard deviation.

illness, patients in the ICU must be treated on an individual basis with nutrient prescriptions, clinical monitoring, and repeated adjustment as necessary.[30] For this reason, many multidisciplinary ICU have nutrition support teams (NSTs) that apply standard clinical and professional nutrition guidelines. NSTs collaborate with the ICU team in the daily application of bedside therapy and seek to provide optimal nutrition support, thereby increasing EN and reducing the reliance on parenteral nutrition.[31,32] The present study promotes this model of NST-directed nutrient delivery for critically-ill neonates during their stay in the NICU.

### *Limitations*

One limitation was that this was a single-center study. Although our multidisciplinary tertiary NICU is representative of these NICUs in China, this study may have problems that are specific for our institution, including nutrient delivery methods, nutrient prescription, and NST management. Another possible limitation was the failure to include all NICU patients due to the imposition of inclusion and exclusion criteria, which may limit the generalizability of our study results to other NICU populations. Moreover, since this was an observational study, it was not possible to determine whether the subjects were in a hyper metabolic or hypo metabolic state. Furthermore well-designed studies that measure energy expenditure are warranted.

## AUTHOR DISCLOSURES

None of the authors have a conflict of interest.

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Original Article

# Optimal timing for introducing enteral nutrition in the neonatal intensive care unit

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# 重症监护室的危重新生儿行肠内营养的最佳时机

**目的：**确定危重新生儿行肠内营养（enteral nutrition，EN）的最佳时间。**方法：**本研究为前瞻性队列研究，观察时间为 2013 年 6 月 1 日至 2013 年 11 月 30 日。纳入对象是进入新生儿重症监护室（NICU）接受治疗且日龄为 1-28 天的所有危重新生儿。记录这部分患儿在 NICU 期间营养摄入情况和临床结局相关指标，评价早期 EN（入监护室 24 hrs 内）和延迟开始的 EN（大于 24 hrs）对患儿临床结局的影响。**结果：**热卡摄入不足在危重症新生儿中很普遍：84.7%的患儿住 NICU 期间热卡摄入无法达到推荐摄入量。生长迟缓在患儿住 NICU 期间普遍存在，尤其是早产儿：低于同日龄体重第 10 百分位的患儿入院时的比例为 21.6%，出院时增加到 67.6%。入院 24 hrs 内开始 EN 相比延迟开始 EN，可以缩短入院后体重持续下降时间（0 d vs 6 d, $p$=0.0002），减少肠外营养使用率（41.7% vs 95.9%，$p$<0.0001）和肺炎发生率（37.5% vs 56%，$p$=0.005），缩短住 NICU 时间（195.5 hrs vs 288 hrs，$p$=0.0001）和呼吸机使用时间，并且增加患儿住 NICU 期间平均每天能量摄入量。使用机械通气患儿与非机械通气患儿相比：入院后体重持续下降时间长，呼吸窘迫发生率和肠外营养使用率高。**结论：**危重新生儿需尽早开始 EN 支持治疗，推荐入 NICU 后 24 hrs 内进行，机械通气新生儿住 NICU 期间营养摄入情况应引起重视。

**关键词：新生儿、喂养介绍、新生儿重症监护室、肠内营养、肠外营养**