

## Growth Faltering Among Discharged Babies from Inpatient Newborn Care Facilities: Learnings from Two Districts of Himachal Pradesh

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**Objective:** To determine the burden of early growth faltering and understand the care practices for small and sick babies discharged from newborn units in the district.

**Study design:** Observational and follow-up study.

**Participants:** 512 babies discharged from two Special Newborn Care Units (SNCUs) and four Newborn Stabilization Units (NBSUs) in two districts of Himachal Pradesh.

**Methods:** Anthropometric assessments, interview of mothers and Accredited Social Health Activists (ASHAs) conducted between August, 2018 and March, 2019. Change in weight-for-age z-score ( $\Delta$ WAZ) of  $<-0.67SD$  between birth and assessment was used to define growth faltering.

**Outcomes:** Proportion of growth faltering (or catch-down growth) in small and sick babies discharged from SNCUs and NBSUs, and infant care practices.

**Results:** Growth faltering was observed in a significant proportion of both term (30%) and preterm (52.6%) babies between 1 to 4 months of age. Among babies with growth

faltering ( $n=180$ ), 73.9% received a home visit by ASHA, and only 36.7% received a follow-up visit at a facility. There were 71.3% mothers counselled at discharge (mostly informed about breast feeding). Most (96.7%) mothers did not perceive inadequate weight gain in their babies post-discharge. During home visits, ASHAs weighed 61.6% of the infants with growth faltering. Amongst infants who had growth faltering, only 49.6% of mothers had been provided information about their infant's growth and 57.1% mothers had received breastfeeding counselling.

**Conclusion:** Small and sick newborn infants (both term and preterm babies) discharged from special care newborn units are at increased risk of early growth faltering. Follow-up care provided to these infants is inadequate. There is a need to strengthen both facility-based and home-based follow up of small and sick newborn infants discharged from newborn care facilities.

**Keywords:** Catch-down growth, Growth monitoring, Low birth weight, Preterm.

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While there has been significant decline in neonatal mortality in India over the past few decades, bending the curve further requires greater focus on small and sick babies and addressing failure to thrive in these babies beyond survival [1,2]. Small and sick babies are newborn weighing  $<2500$  g at birth (includes preterm, low-birth-weight (LBW) and small for gestational age (SGA) new-borns) or newborns with any medical/surgical condition [3]. These babies often require inpatient care and have the highest risk of death. Following inpatient care, small and sick survivors remain at increased nutritional and developmental risks; most of the longterm consequences are largely preventable; though, with effective follow up care [2, 4-6].

Cut-offs for defining growth faltering have varied from -0.67 to  $>-2$  weight for age z-score (WAZ) in different studies [7-12]. Globally, growth faltering in pediatric population has

been reported to vary from about 2% to 21% [7,13]. In India, findings from national surveys highlight high prevalence of stunting (20.1%), wasting (31.9%), and underweight (26.7%) in children under six months of age [14]. However, recent

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studies suggest that the cut-off of -0.67 WAZ scores defined as catch-down growth rather than growth faltering should be used to enable early detection of growth deviation, and implementation of interventions which that would prevent children from experiencing greater degrees of growth faltering [7-9,12,15].

Several studies have assessed growth faltering in preterm or LBW babies in India; however, there is a paucity of such data among at-risk neonates discharged from district level Special Newborn Care Units (SNCUs) and Newborn Stabilization Units (NBSUs) [8,16,17]. The current

programmatic dimensions also do not adequately capture the thrive component [12]. Therefore, this study was undertaken in an attempt to fill this gap; to understand the burden of growth faltering (an important metric to assess thrive) in early infancy, and the care practices for small and sick babies.

## METHODS

This was an observational and follow-up study conducted between August, 2018 and May, 2019 in two districts of Himachal Pradesh (HP). Of the 12 districts in the state, two districts (Kangra and Sirmour), which both had a functional SNCU and NBSU, and reported a higher proportion of admissions during the financial year (2017-2018) preceding the study initiation year were included. All functional SNCUs and NBSUs in the selected districts were included. All newborn infants admitted to these facilities between April, 2018 and February, 2019 served as the potential participants for the study.

Infants were included into the study if they had been discharged alive from the identified SNCUs and NBSUs, were residents of the two identified districts, located within 150 kms of the identified facilities, and were aged between 1 and 4 months at the time of data collection.

The estimated sample size was 384 assuming prevalence of growth faltering to be 20%, with a relative precision of 20% with a confidence of 95%. Since, growth faltering data for infants aged between 1 and 4 months was not available, the reported prevalence of wasting, stunting and underweight as 21%, 38% and 36%, respectively in NFHS-4 was considered as the best proxy [1].

For the purpose of the study, change in weight for age  $z$ -score (WAZ) of  $< -0.67SD$  between two time points was defined as growth faltering (catch-down growth) as suggested by recent literature [7-9]. Intergrowth 21st standards were used for WAZ calculation for preterm babies and World Health Organization (WHO) Child growth standards was used for term babies [18,19]. For babies reassessed during the second follow-up visit (beyond 64 weeks postmenstrual age),  $z$ -scores for growth parameters were calculated using WHO child growth standards (using STATA i-growup package).

To ensure optimal recruitment to meet the estimated sample size and ensure geographical representation, planning of the route for data collection was critical, given the difficult terrain of the two districts and the intervening monsoon and winter months during the period of data collection. Data collection was planned block-wise in each district based on feasibility of travelling with each visit to a health block ranging between 3-5 days.

During the visit to the home of the identified infant, relevant demographic, maternal and infant care practice data

were collected from the mother, and the infant's weight was recorded using an electronic scale with a capacity of 20 kg and a sensitivity of 5 g (Crown Scales) by trained study personnel. Birth weight was documented as per facility record. The village ASHAs were also interviewed to collect information on infant care practices followed by her. Pre-designed, pilot tested tools were used to collect data.

Standardization of weight measurement of the infant was carried out using the intergrowth 21<sup>st</sup> protocol during the Facility Based Newborn Care training sessions organized in the state and at Safdarjung Hospital, Delhi [20]. Calibration of the weighing scale was done at least twice a week. The data collected during the home visits were checked for completeness through a two-pronged check at the field site (before ending the home visit sessions) as well as by the supervisors. Amongst the infants enrolled for the study, a reassessment for validation of the growth data was conducted in a subset of 100 babies (between January, 2019 - March, 2019). In addition, periodic monitoring and onsite supervision was done by a team of specialists to ensure quality. Repeat trainings were conducted by the monitoring team, if required.

In addition to the growth assessment of infants, indepth interviews were carried out with 42 mothers/caregivers and 12 ASHAs along with non-formal interactions and group discussions using semi-structured interview guides and qualitative data analyzed using grounded theory approach (data not presented).

Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was taken from the mothers/caregivers interviewed. Administrative approvals were obtained from the state and district authorities before commencement of the study.

*Statistical analysis:* All statistical analyses was conducted using *STATA* version 16.1 (Stata Corp). Proportion (with 95% CI) of babies with growth faltering was estimated between birth, assessment, and reassessment. Comparisons were made between subgroups stratified by gender, birth weight and gestational age using chi-square test. Multivariate logistic regression analysis was performed considering growth faltering as dependent variable and gestational age (preterm vs term) as independent variable; covariates adjusted in the regression analysis included gender, birth order, age on assessment, mother's age, antenatal illness, number of indications for hospitalization, post discharge illness and number of follow-up visits. A probability of 5% ( $P < 0.05$ ) was considered statistically significant.

## RESULTS

There were 2841 babies admitted to the SNCUs and

NBSUs identified for the study in the two districts of Kangra and Sirmour between April, 2018 and February, 2019. Of these 879 infants were eligible for inclusion in the study. The study enrolled 518 infants whose parents gave consent. Six babies without birth weight record were later excluded and hence 512 infants were included for analysis. **Table I** provides the baseline characteristics of the study participants. The infants at enrolment had a mean (SD) age of 74.8 (26.5) days. The mean (SD) gestational age at birth was 37.4 (2.1) weeks with a mean (SD) birth weight of 2.6 (0.6) kg.

At birth, average (SD) weight of term and preterm babies was 2.8 (0.4) kg and 2.1 (0.6) kg, respectively. At the time of assessment, the average (SD) weight was 4.9 (1.1) kg and 3.7 (1.3) kg, and the median (IQR) weight gain during the period was 2 (1.4, 2.6) kg and 1.5 (0.8, 2.3) kg in term and preterm babies, respectively. In the validation cohort reassessed at a mean (SD) age of 116.7 (15.4) days, the median (IQR) weight gain between assessment and reassessment was 1.2 (0.7, 1.7) kg and 1.5 (1.0, 2.1) kg in term and preterm babies (**Table II**).

Growth faltering (catch-down growth) was observed in 30% of 396 term babies, and 52.6% of 116 of preterm infants. **Fig. 1** depicts the magnitude of growth faltering at the ages of assessment stratified by gestation. Growth faltering was also noted in 38% of the validation cohort who were reassessed. Although the difference in growth faltering among the term and preterm babies was statistically significant ( $P < 0.001$ ), regression analysis observed that gestation could only explain about 8% of the variability in growth (**Web Table I**).

When the mother's perception of growth faltering was assessed, 96.7% of the mothers did not perceive inadequate

**Table I Baseline Characteristics of Included Babies Discharged From Inpatient Care Facilities in Two Districts of Himachal Pradesh, 2018-19 (N=512)**

Characteristics	Value
<i>Maternal characteristics</i>	
Household members <sup>a</sup>	6.7 (2.6)
Annual household income, INR <sup>b</sup>	1.8 Lakhs (10,000, 3 Lakhs)
Maternal age, y <sup>a</sup>	26.1 (4)
Maternal education status	
Higher senior secondary or graduate	305 (9.5)
Secondary or Senior secondary	136 (0.7)
Primary or literate (can read or write)	63 (12.3)
Illiterate	8 (1.5)
Maternal antenatal illness	131 (25.6)
Antenatal visits <sup>a</sup>	3.7 (1.2)
<i>Neonatal characteristics</i>	
Male	276 (53.9)
Low birth weight (<2500 g)	169 (33.0)
Preterm (<37 wk)	116 (22.7)
Birth order	1.6 (0.7)
Birth interval ≤24 mo <sup>a</sup>	72 (14.1)
Facility birth	500 (97.7)
<i>Hospitalization related characteristics<sup>c</sup></i>	
Inborn admissions, (n=490)	358 (73.1)
Indications for hospitalization, (n=504)	1 (1, 2)
Age at admission, d (n=507) <sup>b</sup>	2 (0, 4)
Duration of hospital stay, d (n=506) <sup>b</sup>	3 (0, 6)

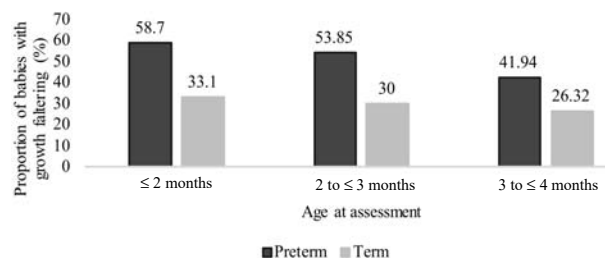
Values in no. (%), <sup>a</sup>mean (SD) or <sup>b</sup>median (IQR). <sup>c</sup>Denominator varies for different variables based on data available from the facility records.

weight gain in their infants. Around one-fourth (26%) of the mothers reported that their infants had not been visited by an ASHA post-discharge at home. Further, 66.4% of the infants had not been taken for follow-up visits

**Table II Growth Parameters (for weight) of Small and/or Sick Babies From Birth to Assessment and Re-assessment**

Growth parameters	Birth <sup>b</sup>			Initial Assessment (1st home visit)			Reassessment (2nd home visit)		
	Total (n=512)	Preterm <sup>c</sup> (n=116)	Term (n=396)	Total (n=512)	Preterm <sup>c</sup> (n=116)	Term (n=396)	Total (n=100)	Preterm <sup>c</sup> (n=22)	Term (n=78)
Age, d	37.4 (2.1)	34.4 (1.8)	38.3 (1.1)	74.8 (26.5)	72.5 (27.9)	75.5 (26.1)	116.7 (15.4)	116.5 (16.9)	116.8 (15.0)
	wk	wk	wk						
Weight, kg <sup>a</sup>	2.6 (0.6)	2.1 (0.6)	2.8 (0.4)	4.6 (1.2)	3.7 (1.3)	4.9 (1.1)	5.65 (0.95)	5.17 (0.99)	5.78 (0.90)
Weight for age z-score <sup>a</sup>	-1.0 (-1.7 to -0.3)	-0.5 (-1.41 to 0.4)	-1.1 (-1.7 to -0.4)	-1.3 (-2.1 to -0.5)	-1.4 (-2.6 to -0.4)	-1.2 (-2.1 to -0.5)	-1.10 (-1.85 to -0.23)	-0.65 (-1.58 to 0.05)	-1.20 (-1.90 to -0.31)
ΔWeight, kg <sup>a</sup>	-	-	-	2.0 (1.2 to 2.6)	1.5 (0.8 to 2.3)	2.0 (1.4 to 2.6)	1.33 (0.82 to 1.84)	1.52 (0.95 to 2.13)	1.20 (0.71 to 1.68)
ΔWeight for age z-score <sup>a</sup>	-	-	-	-0.3 (-0.9 to -0.4)	-0.7 (-1.65 to -0.1)	0.1 (-0.8 to 0.45)	0.16 (-0.20 to 0.67)	0.05 (-0.37 to 0.90)	0.22 (-0.17 to 0.60)

Data represented as mean (SD) or <sup>a</sup>median (IQR). <sup>b</sup>post-conceptional age in weeks. <sup>c</sup>Weight z-scores estimated using corrected age for preterm babies. Intergrowth and WHO standards used for z-score estimation. ΔWeight-for-age z-score is calculated.



**Fig. 1** Proportion of babies with growth faltering by gestation and age at assessment.

to the health facility by the family (**Table III**). Among the infants who reported having had visits by ASHA ( $n=379$ ), infant weight had been taken in 64.6%, breastfeeding and weight-gain related counselling had been provided in 62.5% and 55.4% respectively, and 1.6% were counselled for follow-up visits to the facility (**Table III**). Similar trends were seen in babies with and without growth faltering (weight measured in 61.6% and 66.3%, counselled for breastfeeding in 57.1% and 65.4%, counselled for weight-gain in 49.6% and 58.5%, and counselled for follow-up visits in 3.0% and 0.8%, respectively).

When assessed for mother's preparedness for follow-up care of their infants at time of discharge from the health facility, 71.3% mothers reported that counselling had been provided at the time of discharge, but many a time mother was not the primary recipient of the counselling. It was reported that the counselling was largely limited to breastfeeding the infant till six months.

Of the 193 ASHAs interviewed from the same districts, 78.7% reported to have received information about discharged babies through phone calls or visits made to the family; however, 18.2% were unaware about babies having received inpatient care. Unlike what was reported by mothers, 95.8% of the ASHAs reported that the infants are weighed during home-visits for identification of small babies (**Table III**). The post-discharge visit by ASHAs were largely limited to updating Mother-Child Protection (MCP) card and informing about immunization.

## DISCUSSION

The present study identified a high prevalence of early growth faltering in newborn infants discharged from newborn care units in the districts of Himachal Pradesh. Follow-up home visits by ASHAs or at the facility did not lead to an early detection of growth faltering among these babies with majority of mothers being unable to perceive inadequate weight gain in their infant. During follow-up visits at home, while ASHAs recorded weight, they did not provide any information to the mothers about the infant's growth, nor were they counselled about feeding or referral to a facility in case growth failure was detected.

**Table III** Infant Care Practices Post-discharge of Small and Sick Babies as Reported by Mothers and ASHAs

Infant care practices as reported by the mothers during interview ( $n=512$ )	
Follow up visits to the facilities by caregiver/	
mother	172 (33.6)
Follow up visit by ASHAs at home	379 (74.0)
Interval between discharge and 1 <sup>st</sup> ASHAs visit <sup>a</sup> , d	3 (1, 7)
Information provided to mothers by ASHAs ( $n=379$ )	
Breast feeding	237 (62.5)
Weight gain	210 (55.4)
Danger sign identification	29 (7.7)
Facility follow-up	6 (1.6)
Infant wt measured	245 (64.6)
No. of mothers provided information during home follow-up visits by ASHAs ( $n=193$ )	
Exclusive breastfeeding	187 (96.9)
Hand hygiene	172 (89.1)
Keep baby warm	152 (78.8)
Immunization	140 (72.5)
Cord care	68 (35.2)
Danger sign identification	40 (20.7)
Complementary feeding	35 (18.1)
Change in weight	78 (40.4)
Follow up care	13 (6.7)
No. of infants monitored for weight gain during home follow-up visits by ASHAs ( $n=193$ )	
Weight taken and plotted on growth chart	61 (31.6)
Only weight recorded	122 (63.2)
No weight recorded	10 (5.2)

Data represented as no. (%) or <sup>a</sup>median (IQR).

Previous studies for evaluating growth faltering globally and in India report varied estimates depending on the cut-offs used, birth weight, gestation, and timing of follow-up [7,8,10,13,16]. A previous study [9], involving healthy term infants reported a high proportion of babies with catch down growth (decrease in Z-score >0.67) during the two-year follow-up period with highest (27%) at 3.5 months from birth, which is comparable to the current study observations [9]. Likewise, growth faltering has been documented in very low birth weight neonates till one year of age (underweight, stunting, and wasting: 41%, 32%, and 27%) with Z-score of weight at 3 months identified as a significant risk factor for malnutrition at one year [10]. Another group reported follow-up weight gain and other key parameters among babies discharged from SNCUs for up to 6 weeks [17]. The current study is one of the first studies reporting growth faltering in these vulnerable babies up to 4 months [17]. With variations in the anthropometric criteria used, and lack of consensus on the most appropriate standard for monitoring growth in young infants, comparisons across studies is challenging [11,12]. To define growth faltering, we used WAZ score,

#### WHAT IS ALREADY KNOWN?

- Early growth faltering has been reported (around 20 to 60%) in India, although mostly in low birthweight babies; limited studies assess the status of small and sick babies discharged from newborn care facilities and the follow up care provided both at the facility and at home.

#### WHAT THIS STUDY ADDS?

- We observed growth faltering in a significant proportion of both term (30%) and preterm (52.6%) babies discharged from Special Newborn Care Units (SNCUs) and Newborn Stabilization Units (NBSUs). The potential gaps and opportunities in the follow up of these at-risk infants are highlighted.

which has been suggested as a good predictor of mortality among young infants and operationally suitable for community level assessment of at-risk infants [12,15].

A recent study [17] conducted across four states in India reported majority (97%) of babies discharged from SNCUs were followed up at the recommended time points up to 6 weeks after birth [17]. However, previous national surveys indicated irregular home-based newborn care (HBNC) services provided by ASHAs across several states including follow-up of sick newborns discharged from inpatient facilities [17, 21,22]. Likewise, the quality of services provided in the community in terms of growth monitoring/nutritional counselling have been sub-optimal, with inadequate supportive supervision and overburdening of health workers highlighted as major gaps [22-24]. Variations in self-reported and field performance of ASHAs in providing HBNC have also been reported previously [23]. Similar gaps in follow-up care provided by ASHAs or through facility visits were observed in the present study. One of the challenges for follow-up visits to SNCUs identified in the current study was the distance from these facilities, the district's hilly geographical terrain, and minimally functional NBSUs closer to home.

Growth faltering not picked by ASHAs during follow-up visits, weight not recorded in a large proportion of babies, limited number of mothers counselled, and limited number of follow-up visits made to the facility reiterate the need for strengthening follow-up care post-discharge in the community. Likewise, better preparedness of mothers/caregivers at discharge can strengthen care-seeking and newborn care practices at home. Global and national studies have demonstrated the role of community health workers in improving the child health programs and strategic actions, which at different levels of care can enable early childhood thrive [24-26].

Towards planning and prioritizing intervention strategies, various individual, household, and community level risk factors have been explored; however, causes for early growth faltering remain inadequately understood [27]. The present study attempted to explore some of the

risk factors. Inability of mothers to perceive growth faltering (as documented in the study) warrants for a greater system strengthening or accountability through adequate follow-up of babies by ASHAs at home and linkage to facilities.

The strength of this study is that the infant care practices were triangulated by information provided by mothers and ASHAs. The main study limitation was the lack of standardization of birth weight measurement. The study was also not sufficiently powered to ascertain associated risk factors.

To conclude, there are limited studies in India that report growth failure in early infancy among small and sick babies discharged from SNCUs and NBSUs. The high proportion of growth faltering in these infants reiterates the need for growth monitoring of all at risk babies discharged from inpatient health facilities and strengthened HBNC in the community. Further research can help explore growth patterns and associated factors during early infancy in this vulnerable population critical to prevention of growth faltering.

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**Note:** Additional matter related to this article is available with the web version at [www.indianpediatrics.net](http://www.indianpediatrics.net)

**Contributors:** SR, HC, RDG, RMP, RG, and JJ: involved in the conceptualization of the study; SR, HC, RDG, RMP, RG along with late Dr MK Bhan: provided overall guidance across different steps involved in the study; MS: facilitated the study in the state of HP, JJ, MN, along with the research team were involved in the overall study conduct and data collection process

with inputs provided by SR, HC, RDG, JJ and RJ compiled and analyzed the data, drafted the manuscript with technical inputs from SR, HC, RDG, RMP, RG, and MS in analysis and finalizing the manuscript. All the authors have reviewed and approved the final version of the manuscript.

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