

Strengthening growth monitoring among under-5-year children to fight childhood undernutrition in India

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ABSTRACT

Introduction: Growth monitoring of children in India is usually done by Anganwadi workers using weight-for-age growth charts. We wanted to assess the magnitude of various types of undernutrition among under-5 children using multiple growth charts and risk factors of undernutrition. We also wanted to assess if prevalence of undernutrition improves following sensitization of various stakeholders. **Methodology:** This is a single-arm prospective study conducted at a selected urban primary health center area in Puducherry. All the eligible 366 under-5 children and their mothers were included. Data were collected using pretested structured questionnaire. Assessment of nutritional status was done using three types of growth charts. Three home visits were made, at an interval of around 6 months, for monitoring the nutrition status of children. **Results:** The prevalence of undernutrition at baseline was 15.8% (95% CI 12-19.6). The prevalence of underweight, wasting, and stunting were 9.6%, 7.6%, and 7.3%, respectively. Weight-for-age growth chart could identify only 67% with stunting and 50% of children with wasting. The decrease in prevalence of wasting, underweight, and stunting were 63.6%, 44.8%, and 31.5%, respectively, over 1-year follow-up. Nutrition status could improve by prevention of low birth weight, ensuring gaps between births and promotion of breastfeeding and hand hygiene. **Conclusion:** It is important to use multiple growth charts for assessing nutritional status of children, instead of relying only on weight-for-age growth chart. Overreliance on use of weight-for-age growth chart will fail to identify more children with wasting. Under-5 undernutrition status can be decreased following intensive growth monitoring and planning appropriate actions involving various stakeholders.

Keywords: Growth monitoring, India, under-5 children, undernutrition

Introduction

Child growth is taken to be a vital indicator of nutritional status and health of a community. According to the World Health Organization, undernutrition contributes to nearly half of the deaths among under-5-year children worldwide.^[1] The Joint Child Malnutrition Estimates reveals that 151 and 51 million under-5 children worldwide suffered from stunting and wasting, respectively.^[2] India is ranked among the very few countries which have high prevalence of both stunting and wasting.^[3]

The National Family Health Survey (NFHS-4) on malnutrition among under-5 children shows that 38.4% of under-5-year children were stunted, 35.7% were underweight, and 21% were wasted.^[4] Malnutrition affects the physical, mental, and social development of children. It is important to identify the status of malnutrition early so that appropriate remedial measures can be initiated without undue delay.

Growth monitoring of children in India is usually done by the Anganwadi workers under Integrated Child Development Services (ICDS) program. It is known that children suffering from undernutrition constitute a heterogeneous group, as children can be undernourished because of underweight,

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stunting, wasting, or combination of any of these three. The existing mechanism of growth monitoring in India, through ICDS, focuses on monitoring underweight by using weight-for-age growth charts. Weight-for-age growth chart for monitoring underweight is most widely used because of its ease of measurement.^[5] However, underweight cannot distinguish between current or past energy deficits. Keeping in view the limitations of weight-for-age growth charts for monitoring growth of under-5 children, we wanted to assess the prevalence of undernutrition using multiple growth charts and assess the proportion of undernourished children who could be identified using various types of growth charts. We also wanted to assess the proportion of children with wasting and stunting who may be missed in the scenario where only weight-for-age growth chart is used. The secondary objectives were to assess if sharing the study results with various concerned stakeholders (like mothers of under-5 children, respective area Anganwadi workers, and health workers) could decrease prevalence of undernutrition in the community. We also wanted to assess the risk factors of undernutrition in the same population.

Methodology

Study design and study period

It was a single-arm prospective study. The study was carried out between March 2016 and June 2017.

Study setting

The study was conducted at a selected urban health center located at Kuruchikuppam, in the field practice area of Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry, South India. The JIPMER Urban Health Center (JIUHC) is a primary health-care unit providing services to four adjoining wards, namely, Chinnayapuram, Kuruchikuppam, Vaithikuppam, and Vazhaikulam. The center caters to a population of around 8000, providing outpatient services. In addition, it also provides specialist care on selected days of the week which include conduct of antenatal, under-5, adolescent, and non-communicable disease clinic. The center offers routine health check-ups to the children enrolled at the 13 Anganwadi centers located in the area.

Inclusion criteria

We included a cohort of under-5-year-aged children and their mothers residing in the area catered by the JIUHC.

Sample size and sampling

A cohort of 366 under-5-year children and their mothers were eligible from the selected area. All these children were included in the study.

Study procedure

The eligible children dwelling in the selected JIUHC area were identified from the enumeration register of the health center.

One dedicated staff was trained for data collection, growth monitoring, and counseling of the mothers. Data were collected using a structured pretested data collection pro forma.

After obtaining consent from the mothers, all eligible children were enrolled into the study by doing house-to-house visits. The trained data collector interviewed the mothers using a pretested questionnaire. Anthropometric measurements such as weight and height of children were recorded. Weight was measured using a validated digital weighing machine which was calibrated to the nearest 0.01 kg. The length was measured by placing the child in the supine position with extended legs, aided by the mother, for less than 2-year-old children. Height was measured for children of 2 or more years old, who were made to stand with legs joined together, heads straight, and arms by the side. The crown to foot length/height of all children was measured using a nonstretchable measuring tape rounded to the nearest 1 cm. Body mass index (BMI) was then computed using the Quetlet's index. Growth monitoring to assess the nutritional status was done by plotting the measured values on the WHO weight-for-age, length/height-for-age, and BMI-for-age growth charts.

The trained data collector also counseled the mothers regarding the importance of growth monitoring, nutritional support, and personal hygiene. All the mothers were given a color-coded WHO weight-for-age growth chart for their under-5 children. This chart was shared with the mothers as it was comparatively easy for mothers to plot this chart and as similar growth chart is used in Anganwadis. Mothers were appraised to plot the growth chart on a monthly basis. This sensitization was done in the same setting when baseline data collection was done at the residence of the study participants.

After completing baseline data collection, the results of the collected data were shared with the health center staff. With the active involvement of health center staff, four sensitization meetings were held for mothers of under-5 children. Mothers from four to five adjoining Anganwadi areas were invited to attend this sensitization meeting. In the meeting, the mothers were re-sensitized regarding the importance of growth monitoring, plotting of growth chart, and nutritional counseling. Corresponding area Anganwadi workers were also involved in the sensitization meetings. The list of the undernourished children was also shared with the health workers and respective Anganwadi worker to facilitate appropriate follow-up actions.

Two follow-up visits were conducted at an interval of around 6 months to see the effect of sensitization to mothers and the effect of growth monitoring on the nutritional status of children. During the follow-up visits, the data collectors used multiple WHO growth charts to independently monitor nutrition status of children and also verified whether the mothers were monitoring growth of their children. It was also checked whether the mothers were plotting the same on weight-for-age growth charts.

In total, three home visits were made, at an interval of around 6 months, that is, baseline and two follow-up visits for collecting relevant information. All the children recruited at baseline were follow-up, if their age were below 5 years at the time of follow-up visits. Risk factors for undernutrition were assessed using the baseline data. Children who were overweight and/or obese at baseline were excluded from analysis while assessing for risk for undernutrition.

Analysis

Data entry was performed using EpiData software (v. 3.1 EpiData Association, Odense, Denmark) and analysis was done using EpiData Analysis software and Stata (StataCorp. 2009. *Stata Statistical Software: Release 11*, College Station, TX: StataCorp LP). Prevalence of undernutrition is reported as frequency and proportions. The continuous variables were summarized as mean and standard deviation or median and interquartile range as applicable. The categorical variables were reported as frequency and proportion. Children found to be undernourished by at least one of the following criteria, namely weight-for-age, height/length-for-age, or BMI-for-age were classified as undernutrition. Cross-tabulations were made to find the association between various known risk factors and undernutrition using Chi-square test and a *P* value of less than 0.05 was considered to be statistically significant. Unadjusted prevalence ratios with 95% CI were calculated. Multivariate analysis was done considering the independent variables which had a *P* value of less 0.25 into the model.

Ethical approval

Approval of Institute Ethics Committee of JIPMER, Puducherry, was obtained before undertaking data collection.

Results

As shown in Figure 1, the prevalence of undernutrition at baseline using multiple growth charts (58 out of 366) was 15.8% (95% CI 12–19.6). The prevalence of underweight, wasting, and stunting was 9.6% (95% CI 6.6–12.6), 7.7% (95% CI 4.9–10.3), and 7.3% (95% CI 4.6–9.9), respectively.

The proportion of children with undernutrition identified using WHO weight-for-age growth chart (underweight or severely underweight) was 60.3% (35 out of total 58). Similarly, the proportion of children with undernutrition who could be identified using BMI-for-age growth chart (wasted or severe wasted) and height-for-age growth chart (stunted or severely stunted) were 48.3% (28 out of 58) and 46.5% (27 out of 58), respectively.

Among the 58 undernourished children, as shown in Figure 1, almost 18 (31%) suffered from both underweight and stunting. Similarly, there were 14 (24%) undernourished children who suffered from both underweight and wasting. Only six (10.3%) undernourished children suffered from both stunting and wasting. Weight-for-age growth chart could identify 67% of the children with stunting and 50% of the children with wasting.

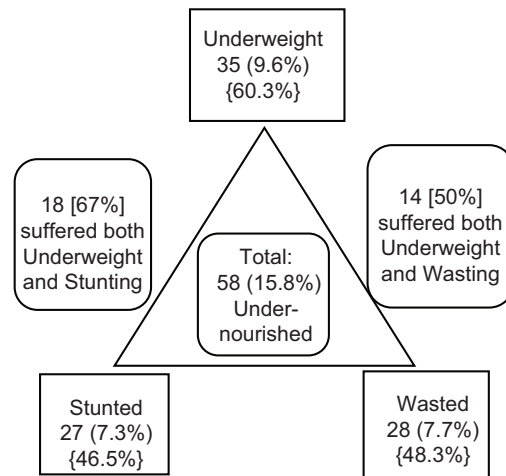


Figure 1: Baseline distribution of undernourished children identified using WHO growth charts in a selected urban area of Puducherry, South India ($n = 366$). Six children suffered from both stunting and wasting, () – this percentage is out of total children, that is, 366; {} – this percentage is out of total undernourished children, that is, 58; [] – this percentage is out of total children with stunting or wasting. If weight-for-age and BMI-for-age growth charts are both used, the additional yield of detecting more children with undernourishment would be $14 \times 100/(35 + 14) = 28.6\%$. If weight-for-age and height-for-age growth charts are both used, the additional yield of detecting more children with undernourishment would be $9 \times 100/(35 + 9) = 20.4\%$. If weight-for-age, BMI-for-age, and height-for-age growth charts are all used, the additional yield of detecting more children with undernourishment would be $(14 + 9) \times 100/(35 + 14 + 9) = 39.7\%$.

This indirectly reflects that weight-for-age growth chart failed to identify 50% and 33% of undernourished children with wasting and stunting, respectively.

During the follow-up period, there was decrease in prevalence of undernutrition from 15.8% (95% CI 12–19.6) at baseline to 7.2% (95% CI 4.5–9.9) at first follow-up. The undernutrition status further dropped to 5.3% (95% CI 2.9–7.7) during second follow-up visit.

Table 1a shows that combined prevalence of underweight and severely underweight at baseline was 9.6%. The combined prevalence of underweight and severely underweight status decreased to 7.3% during the first follow-up and it further dropped to 5.3% at the time of second follow-up visit. There was 44.8% decrease in underweight status over 1-year follow-up period.

The combined prevalence of wasting and severely wasting was 7.7%, 5.8%, and 2.8% at baseline, first follow-up, and second follow-up visits, respectively, as shown in Table 1b. The decrease in wasting or severely wasting was 63.6% over 1-year follow-up period. Overweight and/or obesity was found in seven (1.9%) children at baseline. There was no significant change in the combined prevalence of overweight and obesity status over the follow-up period.

Table 1c shows that the combined prevalence of stunting and severe stunting was 7.3%, 5.7%, and 5% at baseline, first

follow-up, and second follow-up, respectively. There was 31.5% decrease in stunting and/or severely stunting over 1-year follow-up period.

Table 2 shows association of various sociodemographic factor and undernutrition among the children. None of the factors represented in the table were found significantly associated with undernutrition. One out of four children [PR: 1.55

(95% CI 0.28–8.64)] who had experienced death of parent had undernutrition. Similarly, two out of three children [PR: 4.23 (95% CI 1.83–9.77)] who had experienced death of sibling were undernourished.

Table 3 shows association of environmental and personal hygiene factors with undernutrition. Environmental factors considered were not found significant. Among the factors related to personal hygiene, children having poor hand hygiene (presence of dirt under their nails) and lesser frequency of head bath had significantly higher risk of undernutrition.

Among the factors related to “maternal and child health” factors as represented in Table 4, children having higher birth weight (>3 kg) had lesser risk of suffering from undernutrition and children with low birth weight (<2.5 kg) had more risk of suffering from undernutrition as compared to children weighing between 2.5 kg and 3 kg at birth. None of the factors considered under “knowledge and practice of mothers” were found significant.

Table 5 illustrates multivariable logistic regression analysis for factors associated with undernutrition among the under-5 children residing in urban area of Puducherry. For the regression analysis, the factors like “birth weight,” “number of under-5 children in same family,” “hand hygiene (presence of dirt in nails of children),” “continuing breastfeeding among those aged below 2 years,” and “frequency of head bath” were considered for building model. Children with higher birth weight (>3 kg) had less risk of suffering from undernutrition.

Table 1: Trend of nutrition status among under-5-year children as per various WHO growth charts in a selected urban area of Puducherry, South India

Nutrition status	Baseline (%)		First follow-up (%)		Second follow-up (%)	
a. As per WHO Weight-for-Age growth chart						
Normal	331	90.4	306	92.7	304	94.7
Underweight	30	8.2	20	6.1	14	4.4
Severely underweight	5	1.4	4	1.2	3	0.9
b. As per WHO BMI-for-Age growth chart						
Normal	331	90.4	303	91.8	304	94.7
Wasted	27	7.4	19	5.8	9	2.8
Severely wasted	1	0.3	0	0	0	0
Overweight	3	0.8	7	2.1	7	2.2
Obese	4	1.1	1	0.3	1	0.3
c. As per WHO Height-for-Age growth chart						
Normal	339	92.8	311	94.2	305	95.0
Stunted	21	5.7	16	4.8	13	4.1
Severely stunted	6	1.6	3	0.9	3	0.9
Total	366		330*		321*	

*Loss to follow-up as some had left the area and some had crossed age of 5 years. WHO: World Health Organization; BMI: Body mass index

Table 2: Association of sociodemographic factors and undernutrition among under-5-year children in a selected urban area of Puducherry, South India

Characteristics	Total (n=359*), (%)	Undernourished frequency (%)	PR (95% CI)	P
Age (years)				
<1	55 (15.3)	8 (14.5)	1	
1-2	68 (18.9)	12 (17.6)	1.21 (0.53-2.75)	0.64
2-3	74 (20.6)	14 (18.9)	1.30 (0.58-2.88)	0.51
3-4	83 (23.1)	10 (12.0)	0.82 (0.34-1.96)	0.67
4-5	79 (22.0)	14 (17.7)	1.21 (0.54-2.70)	0.62
Gender				
Male	199 (55.4)	31 (15.6)	1	
Female	160 (44.6)	27 (16.9)	1.08 (0.67-1.73)	0.74
Socioeconomic status (BG Prasad classification)				
Lower and lower middle	150 (41.78)	26 (17.33)	1.19 (0.68-2.09)	0.53
Middle	92 (25.63)	15 (16.3)	1.12 (0.59-2.12)	0.72
Upper middle and upper	117 (32.59)	17 (14.53)	1	
Type of house				
Katcha and semi pucca	69 (19.22)	15	1.46 (0.86-2.48)	0.15
Pucca	290 (80.8)	43 (14.8)	1	
Family type				
Nuclear	249 (69.4)	43 (17.3)	1	
Joint	110 (30.6)	15 (13.6)	0.78 (0.45-1.35)	0.38
No of under-5 children in family				
1	241 (67.1)	33 (13.7)	1	
2 or more**	118 (32.9)	25 (21.2)	1.54 (0.96-2.47)	0.06

*There were 7 overweight and obese children at baseline, those children have been excluded from analysis; **115 of 118 families had 2 children. PR: Prevalence ratio; CI: Confidence interval

Table 3: Association of environmental and personal hygiene factors with undernutrition among under-5-year children in a selected urban area of Puducherry, South India

Characteristics	Total (n=359), (%)	Undernourished frequency (%)	PR (95% CI)	P
Environmental factors				
Overcrowding				
Yes	88 (24.5)	15 (17.1)	1	
No	271 (75.5)	43 (15.9)	0.93 (0.54-1.59)	0.794
Ventilation				
Good	181 (50.4)	24 (13.3)	1	
Average	178 (49.6)	34 (19.1)	1.44 (0.90-2.32)	0.13
Source of drinking water				
Municipality	234 (65.2)	41 (17.5)	1	
Buying cans or reverse osmosis	125 (34.8)	17 (14.0)	0.79 (0.46-1.30)	0.34
Presence of latrine				
Yes	341 (95.0)	56 (16.4)	1	
No	18 (5.0)	2 (11.1)	0.67 (0.18-2.55)	0.56
Parent smoking*				
Yes	282 (78.55)	47 (16.67)	1	
No	77 (21.45)	11 (14.29)	0.85 (0.46-1.57)	0.61
Personal hygiene factors				
Hand washing after toilet				
With soap/rubs	211 (58.8)	36 (17.1)	1.1 (0.63-1.74)	0.78
With only water	148 (41.2)	22 (15.5)	1	
Bath frequency				
Daily	344 (95.8)	57 (16.6)	2.48 (0.36-16.75)	0.35
Alternate days	15 (4.2)	1 (6.7)	1	
Head bath				
Daily/Alternate days	162 (45.13)	19 (11.73)	1	
One or two days in week	197 (54.87)	39 (19.80)	1.68 (1.01-2.80)	0.04
Hand hygiene (presence of dirt under nail)				
Good	86 (24.0)	20 (23.3)	1.67 (1.02-2.71)	0.03
Bad	273 (76.0)	38 (13.9)	1	

*Among the parents of under-5 children who were smoking, nine were involved in indoor smoking. PR: Prevalence ratio; CI: Confidence interval

Discussion

Nutritional status

This community-based household survey using multiple anthropometric indices reported the prevalence of 15.8% of under nutrition among under-5 children in urban setting. In this study, an additional 40% of the undernutrition were identified through alternative anthropometric indices, namely, BMI-for-age and length/height-for-age as compared to the conventional approach of using only weight-for-age. The prevalence of undernutrition was lesser in the present study as compared to various other studies conducted in other parts of urban India.^[6-11] This could be attributed to better socioeconomic status of people and better availability and accessibility of health-care services in the area.

Comparison of growth charts

Use of weight-for-age growth chart could identify maximum proportion (60%) of undernourished children as compared to using other types of growth charts in unison. This finding also shows that in the scenario where only weight-for-age growth chart is used for detecting undernutrition, almost 40% of undernourished children may go undetected. Thus, it is important for primary care providers to use the other types of growth charts like BMI-for-age growth

chart and height-for-age growth chart along with weight-for-age growth chart for detecting undernutrition optimally. Similar recommendations were given by another study from India, reinstating the additional yield obtained by using multiple growth charts.^[12]

The present study shows that the weight-for-age growth chart could identify 50% of undernourished children with wasting and 67% of undernourished children with stunting. This finding indirectly reflect that – in the scenario where only weight-for-age growth chart is used to assess undernutrition status in the community, it is expected that more children with wasting (50%; 14 out of 28 children with wasting) would go unidentified as compared to stunting (33%; 9 out of 27 who were stunted). It is important to pay attention to early identification of children with wasting, as the risk of infection among children is more consistently associated with wasting as compared to other forms of undernutrition.^[13]

Trends in nutritional status during follow-up period

There was significant drop in prevalence of undernutrition status over the follow-up periods as compared to the baseline.

The decrease in “wasting or severe wasting,” in the present study, was 63.6% over 1-year follow-up period, whereas the same for

Table 4: Association of “maternal and child health” and “knowledge and practice” factors with undernutrition among under-5 children in a selected urban area of Puducherry, South India

Characteristics	Total (n=359), (%)	Undernourished frequency (%)	PR (95% CI)	P
Maternal and child health factors				
Mode of delivery				
Normal	230 (64.1)	37 (16.1)	1	
LSCS	129 (35.9)	21 (16.3)	1.01 (0.61-1.65)	0.96
Birth weight (kg)				
<2.5	32 (8.9)	12 (37.5)	1.72 (1-2.98)	0.05
2.5-3	138 (38.4)	30 (21.7)	1	
>3	189 (52.6)	16 (8.5)	0.38 (0.22-0.68)	0.00
Time of initiation of breastfeeding				
<1	193 (53.8)	38 (19.7)	1	
>1	166 (46.2)	20 (12.1)	0.61 (0.37-1.00)	0.05
Continuing breastfeeding (children aged <2 years, n=123)				
Yes	75* (60.98)	9 (12)	1	
No	48 (39.02)	11 (22.92)	1.9 (0.85-4.26)	0.10
Morbidity status of children				
Yes	149 (41.50)	20 (13.42)	1	
No	210 (58.50)	38 (18.10)	0.74 (0.45-1.22)	0.24
Knowledge and practice				
Ever heard about growth card				
Yes	135 (37.6)	18 (13.3)	1	
No	224 (62.4)	40 (17.9)	1.34 (0.80-2.23)	0.25
Knew the use of growth card				
Yes	116 (32.3)	15 (12.9)	1	
No	243 (67.7)	43 (17.7)	1.37 (0.79-2.35)	0.25
Knew how to plot a growth card				
Yes	40 (11.1)	5 (12.5)	1	
No	319 (88.9)	53 (16.6)	1.33 (0.56-3.12)	0.51
Availing Anganwadi services				
Yes	173 (48.2)	26 (13.0)	1	
No	186 (51.8)	32 (17.2)	1.14 (0.71-1.83)	0.57

*Out of the 75 children who were continuing to breast feed at baseline, 22 were aged <6 months, 26 were aged between 6 months and 1 year, 27 were aged between 1 and 2 years. LSCS: Lower segment Cesarean section

Table 5: Multivariable logistic regression analysis for factors associated with undernutrition among under-5-year children in a selected urban area of Puducherry, South India

Characteristics	Total (n=359)*, (%)	Undernourished frequency (%)	Adjusted prevalence ratio (95% CI)	P
Birth weight (kg)				
<2.5	32 (8.9)	12 (37.5)	2.04 (0.88-4.71)	0.09
2.5-3	138 (38.4)	30 (21.7)	1	
>3	189 (52.6)	16 (8.5)	0.34 (0.11-0.99)	0.05
No. of under-5 children in family				
1	241 (67.1)	33 (13.7)	1	
2 or more	118 (32.9)	25 (21.2)	1.27 (0.57-2.79)	0.54
Hand hygiene				
Good	86 (24.0)	20 (23.3)	1.48 (0.52-4.21)	0.74
Bad	273 (76.0)	38 (13.9)	1	
Continuing breastfeeding among those aged below 2 years				
Yes	75* (60.98)	9 (12)	1	
No	48 (39.02)	11 (22.92)	1.84 (0.83-4.07)	0.13
Frequency of head bath				
Daily/Alternate days	162 (45.13)	19 (11.73)	1	
Once in week	197 (54.87)	39 (19.80)	1.2 (0.56-2.53)	0.64

*Out of the 75 children who were continuing to breast feed at baseline, 22 were aged less than 6 months, 26 were aged between 6 months to 1 year, 27 were aged between 1 to 2 years. CI: Confidence interval

“underweight or severe underweight” and “stunting and severely stunted” were 45% and 31.5%, respectively. This shows that

children with wasting may be responding early to interventions as compared to other forms of undernutrition.

Keeping these findings in mind, it may be useful for primary care providers to use at least two WHO growth charts, that is, weight-for-age growth chart (as it detects most proportion of undernourished children) and BMI-for-age growth chart (for timely detection of wasting which is more serious form of undernutrition).

Factors associated with undernutrition

The favorable sociodemographic factors for lesser prevalence of undernutrition in the present study could be due to the fact that most of the study population belonged to middle and higher socioeconomic status; four out of five children stayed in pucca house, almost all families had one or two under-5-year children, most of the children stayed with their parents, and few had unfortunately lost their siblings. Moreover, most of the houses were not overcrowded and had latrines, which indicates better housing and sanitation environment. Birth weight was normal for more than 9 out of 10 deliveries.

The study unfolded few areas that need further improvement such as early initiation of breastfeeding (where almost half of the children were not initiated on breastfeeding within an hour of birth) and continuing breastfeeding for at least 2 years (for almost 2 out of 5 children had discontinued breastfeeding prior to 2 years). There was scope for improvement pertaining to knowledge and plotting of growth chart among mothers. Availing services from Anganwadi also needed improvement. The personal hygiene domain also needed some improvement as almost one in two children did not practice recommended hand washing practice following toilet and three out of four children had dirt under their nails.

In our study, the risk of undernutrition increased with increased number of under-5 children in the family; this could be due to lack of focused time of mother toward individual child care, including inadequate attention to child nutrition.

Strengths

This was a community-based study involving all the eligible children in the service area. All the eligible children were prospectively followed up during the study period. Standardized WHO growth charts were used for monitoring growth of children. Results of the study were shared with all the stakeholders like mothers, Anganwadi workers, field staff of JIUHC, and medical officer for facilitating follow-up actions.

Limitations

The findings of the present study may not be generalizable to whole of Puducherry as it was carried out in a selected urban primary health center area. The low sample size dealt in the present study may have failed to pick up significant associations.

Conclusion

Every one in six children suffered from undernutrition. Undernutrition continues to be a greater issue as compared to overweight or obesity. More children suffered from underweight as compared to stunting, wasting, and overweight/obesity. More undernourished children with wasting are likely to be missed as compared to those with stunting, in the scenario where only weight-for-age growth chart is used for growth monitoring. Use of multiple growth charts needs to be used for ensuring optimal detection of undernourished children. It is important to strengthen early detection of wasting as children with wasting respond early to nutrition interventions. Ensuring growth monitoring and sharing the results with appropriate stakeholders can decrease undernutrition status in the community. Similarly, exercises need to be undertaken routinely by all family physicians or primary care providers to bring down undernutrition status in primary care settings. It may be important to incorporate monitoring nutrition status of all under-5 children using multiple growth charts through ASHA workers and Anganwadi workers by incorporating this activity as their routine field activity for improving the quality of nutrition status surveillance or at least monitor nutrition status while doing enumeration of population on a yearly basis. This will help in identification and planning necessary follow-up action for children who may need attention.

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Conflicts of interest

There are no conflicts of interest.

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