

Assessment of the reference values of intrauterine growth with particular to ponderal index for our region

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Abstract

Introduction: Ponderal index (PI) is well known growth parameter from birth onwards but there are no reference values from 25 weeks till birth. Therefore, incorporation of a combination of weight and length may be a useful parameter to assess the growth. **Aims and Objectives:** To set standards of ponderal indices for local population and to identify high risk vs low risk and growth difference between male and female babies. **Materials and Methods:** This is prospective observational study done in NIMS, Jaipur from Jan. 2015 –June 2016 with 503 institutional births fulfilling the inclusion criteria of singleton born intramural births with confirmed gestational ages between 25 to 43 weeks. These babies were then tabulated according to their gestational age and sex. The mean PI, standard deviation of PI were calculated and their curves were drawn. **Results:** Out of 503 neonates studied, 272 (54.08%) were females and 231 (45.92%) were males. The minimum PI was seen at 28 weeks (1.98±0.10) with a gradual increase along with gestational ages. The maximum PI was at 42 weeks (2.65±0.28). No significant difference was seen in males and females. Growth velocity was maximum in earlier weeks. Sharp fluctuation in growth was seen around 30 to 33 weeks. **Conclusion:** Classification of neonates with the help of such growth curves is inexpensive and does not require advanced knowledge. These values for PI cannot be used as standards rather used as reference values for our region for further research.

Key Words: Intrauterine Growth, Gestational age, Growth charts, Ponderal Index, Reference Values

Introduction

Gestational age and birth weight are important factors of growth, development and survival of the child [1]. Growth of fetus is dependent on maternal, placental, and genetic factors. Morbidity and mortality in newborns are directly correlated with gestational age and weight.

The anthropometric measures of length, birth weight and certain circumferences in addition to period of gestation are expected to provide the building blocks for the desired index [2]. Ponderal index (PI) has been mentioned as growth parameter from birth onwards. But it is irony that there are no

standards for its measurement in babies in whom the growth is fastest during the intrauterine life. Therefore, we decided to layout a “reference” standard of PI as a growth parameter from 25 weeks of gestation till 43 weeks for our rural population and also to identify any difference in values of PI according to sex.

Aims and Objectives

1. To set standards of ponderal indices for local population.
2. To identify babies having low, appropriate or high ponderal index so as to assign a label of high risk vs low risk for future follow up.
3. To identify difference between male and female growth.

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Materials and Methods

Study Design: Prospective observational study.

Setting: Neonatal Intensive Care Unit and postnatal wards in National Institute of Medical Sciences & Research Centre, Shobha Nagar, Jaipur offering all levels of neonatal care.

Period: Jan. 2015 – June 2016

After obtaining clearance from Institutional Ethical Committee and informed consent from the parent/guardian of every patient who are parts of this study.

Study sample: 503 institutional births fulfilling the inclusion criteria

Inclusion Criteria

- Singleton born intramural births between the gestational ages of 28 weeks to 43 weeks.
- Only babies in whom the mothers gestational age was definitely known.

Exclusion Criteria

- All extramural births
- Mothers not knowing their date of LMP or 1st trimester dating scan
- Multiple births
- Gross discrepancy of ≥ 2 weeks in the assessment of gestational age by LMP and modified Ballard's score.
- Congenital malformed baby

Results

Out of 503 mothers 52.29% belongs to age group of 21-25 years, 30.42% belongs to age group of 26-30 years, 10.74% and 6.16% in age groups of 31-35 and < 20 year respectively.

In this study sample 78.73% didn't have any significant medical conditions, 18.89% mothers had anemia, 1.19% asthma, 0.8% had hypothyroidism and 0.4% epilepsy.

Most of our study population comprised of the rural class i.e. 95% of the total population whereas 5% belonged to the urban class. Out of 503 mothers 433 belonged to socio-economic class IV and V(86.6%). (B.G. Prasad, May 2011). Rest 70 were in class I and II. During delivery 55.07% mothers didn't have any complication whatsoever, while 14.51% had fetal distress followed by 8.55% previous LSCS and cephalo pelvic disproportion 3.38%.

Out of 503 neonates studied, 272 (54.08%) were females and 231 (45.92%) were males.

Among all neonates 36.98% newborns were preterm (<37 weeks), 54.27% were term (37-40 weeks) and 8.75% were post term newborns.

- Chronic maternal disease or any obstetrical complication known to hinder fetal growth, history of smoking, alcohol consumption or drug abuse, hypertension, diabetes mellitus

Assessment of Gestational Age

Last menstrual period (LMP) -By Naegele's formula, i.e. addition of 9 months and 7 days to the first day of LMP or 1st trimester dating scan.

New ballardscore:The New Ballard's Criteria which serves as a semi-gold standard for assessment of gestational age.

Anthropometric measurement: Methods of measurements of weight, crown to heel length and head circumference were taken as per "Handbook of physical measures" by Hall JG et al, Oxford University press 1995[18].

All babies fulfilling the inclusion criteria were classified according to local curves in our setting into Small for Gestational Age (SGA), Appropriate for Gestational age (AGA) and Large for Gestational Age (LGA) babies according to their gestational ages. Examination of newborn was done at birth for weight and length.

Ponderal index (PI) = Birth weight (in kgs) x 100/Crown-heel length³ (in metres)

These babies were then tabulated according to their gestational age and sex. The mean PI, standard deviation of PI were calculated and their curves were drawn.

Figure-1 shows proportion of cases in each gestational week (25 to 43). The largest section was formed by the 38 (16.79%) and 39 weeks (17.69%) while the extremes accounted for the smallest portions, namely 0.2% by 25, 0.2% 26 and 1.19 % by 27,1.99% by 28, 2.39% by 29,2.58% by 42 weeks and 0.6% by 43 weeks.

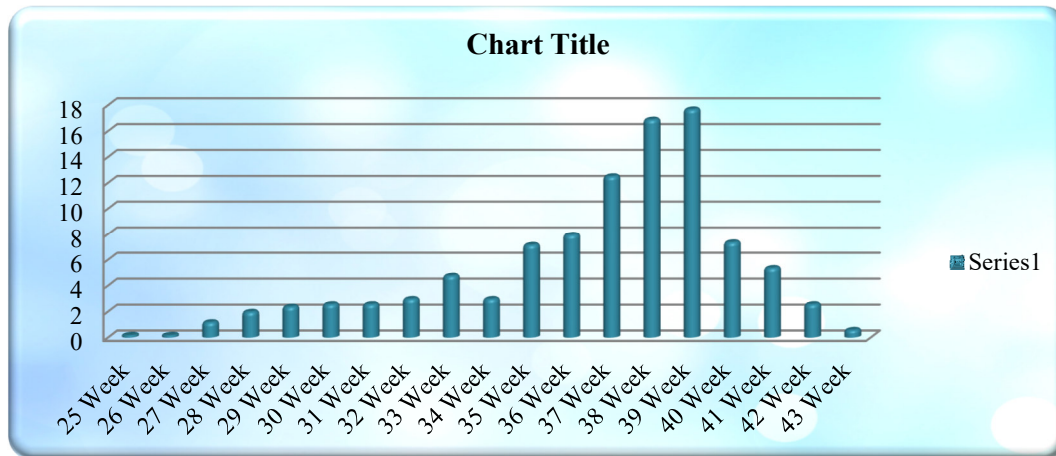


Figure-1: Break-up of the study sample in each gestational age

Table No. 1 shows the mean PI with standard deviation at various gestational ages. The minimum PI at 28 weeks of gestational age (1.98 ± 0.10) with a gradual increase in PI with corresponding gestational ages. The maximum PI was at 42 weeks of gestational (2.65 ± 0.28).

Table-1: Mean PI and standard deviation of newborns in each gestation age.

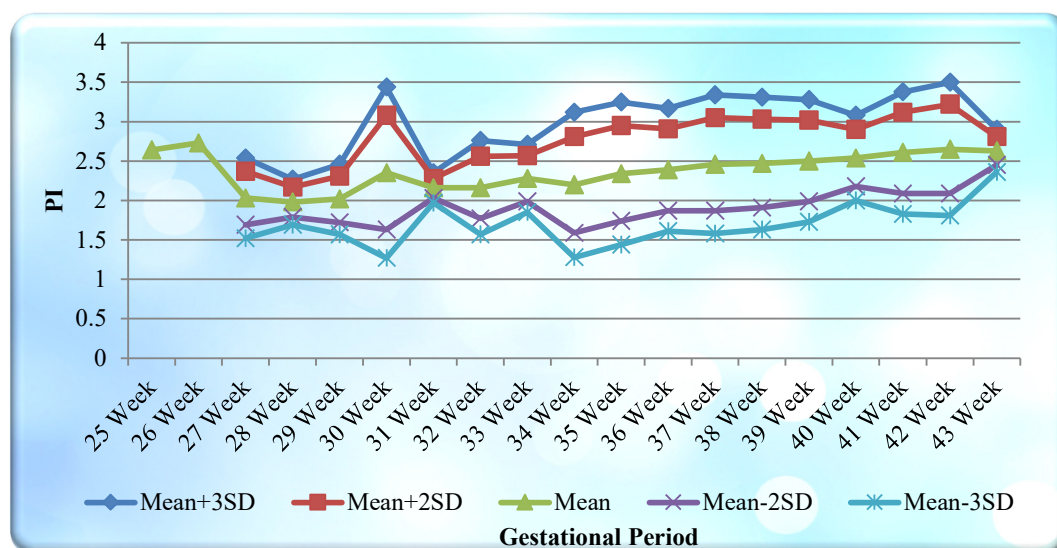
GA (weeks)	N	Mean PI	Std. Deviation
26	1	2.73	
27	6	2.03	0.06
28	10	1.98	0.10
29	12	2.02	0.15
30	13	2.35	0.36
31	13	2.16	0.17
32	15	2.16	0.20
33	24	2.28	0.34
34	15	2.2	0.31
35	36	2.34	0.30
36	40	2.39	0.26
37	63	2.46	0.29
38	85	2.47	0.28
39	89	2.50	0.26
40	37	2.54	0.18
41	27	2.61	0.26
42	13	2.65	0.28
43	3	2.63	0.09

Table No. 2 shows progressive rise in PI of both males and females from 28 weeks to 41 weeks from 1.99 to 2.58 and 1.96 to 2.64 respectively. No significant difference in PI is seen in males and females.

Table-2: Mean PI of male and female newborns in each gestation age

GA	n (male)	Mean PI(male)	n (female)	Mean PI(female)
25			1	2.64
26	1	1.98		
27	3	2.00	3	2.05
28	7	1.99	3	1.96
29	7	2.3	5	2.07
30	6	2.46	7	2.26
31	6	2.16	7	2.16
32	7	2.11	8	2.21
33	8	2.34	16	2.25
34	5	2.18	10	2.21
35	19	2.34	17	2.35
36	18	2.39	22	2.39
37	27	2.44	36	2.46
38	39	2.47	46	2.46
39	40	2.51	49	2.50
40	17	2.55	20	2.50
41	12	2.58	15	2.64
42	7	2.60	6	2.72
43	2	2.63	1	2.64
Total	231	2.41	272	2.42

Figure-2 showing ± 2 & 3 standard deviation from mean PI of newborns in each gestation age. It is observed that the growth velocity is maximum in earlier weeks i.e. preterm groups between 28 to 36 weeks followed by a slowing in growth velocity in term and post term neonates. Sharp fluctuation in growth is seen around 30 to 33 weeks.

**Figure-2: ± 2 & 3 standard deviation from mean PI of newborns in each gestation age**

Discussion

The study was designed to lay down the reference values of intrauterine growth with particular reference to PI for our region and population. The ponderal index was calculated by the following formula;

Table 3 shows comparison of PI found in other studies with our study. There is a paucity of Indian published data whereas there are few foreign studies from developed countries for comparison.

Table-3: Comparison of mean PI values of other studies with those obtained in the present study:

GA in weeks	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Present study	1.98	2.02	2.35	2.16	2.16	2.28	2.20	2.34	2.39	2.43	2.47	2.50	2.54	2.59	2.63
Lubchencoetal[5]	2.16	2.19	2.23	2.24	2.10	2.17	2.46	2.42	2.56	2.62	2.65	2.67	2.67	2.68	2.67
Purohit A 1977[6]	1.86	2.11	2.10	1.98	2.22	2.28	2.27	2.28	2.41	2.43	2.56	2.41	2.45	2.44	2.51
Premalakshminarayan et al,1974[12]	2.04	2.09	2.20	2.16	2.27	2.84	2.23	2.45	2.21	2.35	2.29	2.29	2.24	2.27	2.35
Fok et al, 2003[4]	2.14	1.99	2.17	2.10	2.31	2.30	2.37	2.39	2.50	2.54	2.56	2.55	2.55	2.59	2.56
M amita (2010) [13]	1.90	2.11	2.07	2.07	2.20	2.24	2.30	2.38	2.39	2.56	2.54	2.52	2.57	2.42	2.48
GandhiD(2014)	1.87	1.90	2.10	2.14	2.13	2.37	2.33	2.22	2.39	2.56	2.56	2.48	2.52	2.60	2.36
Singhal S(2014)	1.90	2.11	2.07	2.07	2.20	2.24	2.30	2.38	2.39	2.56	2.54	2.52	2.57	2.42	2.48
Yadav R, (2016) [14]	1.81	2.29	2.24	2.16	2.09	2.33	2.27	2.26	2.57	2.63	2.56	2.50	2.56	2.58	2.40
Saroja H et al[7]	1.96	1.98	2.23	2.17	2.21	2.30	2.25	2.35	2.43	2.44	2.49	2.53	2.55	2.62	2.62
DominRoje et al[15]	2.23	2.32	2.33	2.42	2.42	2.43	2.48	2.52	2.62	2.64	2.71	2.74	2.75	2.75	2.75

As can be seen the values obtained in the present study are consistently lower than the values obtained in the other studies conducted outside India due to racial, environmental, maternal and socioeconomic variations, while they show a close relation with those that were conducted in India.

Though ponderal indices were not done in other studies we have calculated it using their data of gestational age specific weight and length and then compared the results with our study. Comparing among the literature from abroad the mean values are higher for the more recent studies (Olufemi et al [3]; Fok TK et al [4]) when compared to the older ones like those given by Lubchenco et al [5] even though the background remains similar. This could be due to the larger sample sizes or better estimation of gestational ages but also could be due to the changing anthropometric values over the years as expected with rise in health standards and antenatal care. Our values fall in the higher range when compared to the study done by Purohit A et al in Rajasthan. This can be due to the fact that study was done at a tertiary referral center of the state [6]. The closest match is between the present study with Saroja H et al [7].

Our reference results for birth weight, birth length for term infants 37-42 weeks gestation are very similar to the corresponding WHO [8,9] growth reference data increasing the validity of our data. Centers for Disease Control and Prevention CDC [10,11] being a developed world study have higher values at birth.

Limitations of the study: The major limitation of this study is the small size of the sample population & exclusion of condition like gestational diabetes and pregnancy induced hypertension was not always possible. The nutritional statuses of the mother and the socio-economic condition of the family which may again affect the growth of the fetus have not been taken into account.

Birth weight and length increases steadily but with variable velocities so it's difficult to comment upon what affects PI and hence the fluctuation. However we need a study with a larger sample size and inclusion of all maternal factors to establish a fact behind this fluctuation.

Conclusion

The utility of growth curves in classifying the newborns at birth has been attempted. Classification of neonates with the help of such growth curves is found to be inexpensive and accurate and does not require advanced knowledge. As our values at term are similar to that of WHO, we can conclude that the values of initial weeks should be relevant, since we do not have standards to compare.

These values for preterm PI cannot be used as standards but can be used as reference values for our region for further research and use in our hospital setting to assign the babies as high risk and low risk neonates for the future reference and follow-up.

Contribution by different author Dr. Virendra Kumar Gupta: Drafted the manuscript, Dr. Jagdish Prasad Agrawal: Analyse the datas and literature search, Dr. Shagun Gupta: Intellectual input in final drafting, Dr. Swati Agrawal and Dr. PreetiGusain: collected and analyses the data, Dr. Alok Purohit: Concept and design the study.

What these studies add to existing knowledge? - PI is an important parameter as a growth of neonates but reference values were not established yet for different age group in intrauterine life. We want to generate fetal parameters to lay down reference values for the same.

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Abbreviations

PI: Ponderal Index, **LMP:** Last Menstrual Period, **SGA:** Small for Gastational Age, **AGA:** Apprtpropritate for Gastational age, **LGA:** Large for Gastational Age, **LSCS:** Lower segment Cesarian section, **CDC:** enters for Disease Control and Prevention, **WHO:** World Health Organizatin.

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