ORIGINAL RESEARCH PAPER

Pediatrics

TO ESTABLISH THE NORMS FOR BODY MASS INDEX(BMI) FOR PRETERM, TERM AND POST TERM NEWBORNS

KEY WORDS: Body Mass Index, Preterm, Ballards Score, Gestation Age ,newborn, Circumference, Growth Curves

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ABSTRACT

Objective(s): To establish the norms for body mass index of preterm, term and post term newborns.

Method(s): Maternal data regarding period of gestation from first day of last menstrual period and Newborn's data regarding sex, gestation age by modified ballard's score, birth weight (by digital weighing machine in grams), length (by infantometer in cm.), head circumference (cm) recorded. Examination was carried out in the special care unit within 24 hours of the delivery at the temperature 29-31°C with good diffuse light .

Observation(s) :). The correlation coefficient between B.M.I. and gestational age is highly significant. From 28 to 40 weeks the rise in B.M.I. is progressive .After 40 weeks B.M.I. decelerates. The results so obtained have been compared with other Indian and foreign authors. Curves for B.M.I. have been constructed with ± 2 S.D. depicting values of different gestational ages

Conclusion(s) There are yet no nationally and internationally acceptable standards of Body mass index. Which is now considered a better index for assessment of growth, so we studied the B.M.I. of Preterm, Term and Post term newborns ,as the Body mass index (B.M.I.) is a simple index of weight for height that is commonly used to classify underweight, normal weight, overweight and obesity in growing children and adults internationally.

INTRODUCTION

Body mass index is a simple index of weight for height that is commonly used to classify underweight, overweight and obesity in growing children and adults. The period of intrauterine growth and development is one of the most vulnerable in the human lifecycle. The weight of an infant at birth is an important indicator of maternal health and nutrition prior to, and during pregnancy, and a powerful predictor of infant growth and survival .

Every year approximately 17 million infants in developing countries are born with low birth weight and those infants who survive have little chance of fully reaching their growth potential. It is generally assumed that the severity of nutrient insufficiency is inversely related to gestational age at birth and birth weight. Moreover, evidence now shows that adults born as low birth weight face an increased risk of chronic diseases including high blood pressure, non-insulin dependent diabetes mellitus, coronary heart disease and stroke in adulthood.

METHODS

The present study was conducted at Govt. Medical College, Kota. The study was carried out during August 17 to July 18. During this period there were >10000 live births, out of this only 2000 live newborn babies were selected on the basis of availability of L. M. P. Mothers certain of their last menstrual period were included in the study. Exclusion criteria were mother not knowing the date of last menstrual period and when there is a discrepancy of >2 wks in assessment of gestation age by LMP and modified ballard's score., multiple births, congenital malformed baby (i.e. cleft lip, cleft palate, tracheoesophageal fistula, urogenital anomalies, congenital hydrocephalus, meningocele and meningomyelocele).

Anthropometry : The following measurements were taken.

(1) Birth weight : Each neonate was weighed with the help of electronic digital weighing machine, weighing up to 10 kg. The birth weight was recorded in grams nearest to 1 gram.

(2) Recumbent length (Crown to heel length) : It was recorded with specially designed infantometer, marked in centimetre and fitted with fixed head board. The infant was placed supine on the table along the side of the scale. The head was held firmly in position against the head board, legs straight with the feet at right angle. The footboard was then brought into firm contact with the infants heel. The reading was recorded in centimeters and recorded to nearest mm.

(3) Head circumference: It was measured by passing a non stretchable tape measure over the most prominent part of the occiput and just above the supraorbital ridges. The measurement was recorded in centimetre to the nearest mm.

Gestational age estimation from the first day of last menstrual period till the date of delivery and is expressed in completed weeks e.g. 34 weeks + 6 days is considered as 34 weeks only.(1)

(1) Preterm - Gestational age less than 37 completed weeks (< 259 days).

(2) Term - Gestational age from completed 37 to 41 weeks (259 – 293 days).

(3) Post term - Gestation age 42 weeks or more (294 days or more).

Birth weight :Normal birth weight - 2500 to 3999 gm,

:Low birth weight - less than 2500 gm

(a) Very low birth weight - <1500 gm

(b) Extremely low birth weight - 1000 gm

(C) **Appropriate for gestational age -** babies with a birth weight between 10^{th} to 90^{th} percentile for period of their gestation.

(D) **Small for gestational age -** babies will be considered SGA if the birth weight is below the 10^{th} percentile for period of gestation.

(E) **Large for gestational age -** babies will be considered LGA if the birth weight is more than the 90^{th} percentile of their gestational age.[1]

(F) **Body mass index –** Is calculated from the following formula

$$BMI = \frac{\text{Weight (kg.)}}{\text{Ht. or length } (m^2)}$$

According to CDC,[3] a BMI over the 95^{th} percentile indicates "overweight" between 85^{th} and 95^{th} percentile is "risk of overweight" and below the 5^{th} percentile is underweight

OBSERVATION AND DISCUSSION

Most of the workers studying intrauterine growth, have constructed growth curves for that particular geological region and representative population. Within our country the various studies show wide differences in growth curves in different regions and population. But no study is available for the B.M.I. of newborns, which is now considered a better index for assessment of growth, so we studied the B.M.I. of Preterm, Term and Post term newborns, as the Body mass index (B.M.I.) is a simple index of weight for height that is commonly used to classify underweight, normal weight, overweight and obesity in growing children and adults internationally.

In our study the B.M.I. had been found to increases consistently throughout the period of study, from 28 weeks of gestation to 40 weeks.(Table - 1 and Curve - 1).The mean B.M.I. at 28 weeks of age was 7.1 ± 0.6, at 32 weeks 8.8 ± 1.0, at 36 weeks 10.7 ± 1.6 and at 40 weeks it was 11.8 ± 2.2 and at 42 weeks 11.7 ± 2.0 . When these B.M.I. were plotted on graph paper against gestational age, a consistently rising curve was obtained (Curve-3). This curve shows a steady increase in the B.M.I. from 7.1 at 28 weeks to 11.8 at 40 weeks, the increase has been progressive and directly proportional. After 40 weeks the growth in B.M.I. seems to be decelerate from 11.8 to 11.7 at 42 weeks. The increment in B.M.I. is only 0.5 in last 5 weeks up to 42 weeks.

As most other studies were available for weight and length, not for B.M.I. we calculated the value of B.M.I. from the data of mean weight and mean length available from these workers [(Purohit A[2] (1979), Ghosh S[3] (1971), Laxminarayan[4] (1974), Lubchenco[5] (1963)], for comparison with our data (Table-2 and Curve-2) .

It is evident from table 2 that at 28 weeks of G.A. our values are similar to Purohit A[2] et al (1979), but less than the value of other workers. At 32 weeks, our values are near to Ghosh S[3] (1971) and Lubchenco[5] (1963) but B.M.I. value of other workers are higher than us. At 36 weeks all other workers having high value except Laxminarayan[4] (1974) have low value. At 40 weeks our value are much near to Purohit[2] (1979) and Ghosh[3] (1971) but less than Lubchenco[5] (1963). At 42 weeks value of all other workers are higher than our values (Table 2 and Curve -2).

The study of Purohit[2] et al (1979) was conducted in Jaipur city (north west India) on 500 live newborns 39 years back, in a similar hospital, which also caters to large number of maternity cases of Jaipur district. The B.M.I. value of Purohit et al is much similar to our values as their study included the cases which represent the large population of the Jaipur district, similar to our study in socio-cultural, maternal education, regional, religion & cast. Ghosh[3] et al (1971)did their study in Delhi (north Indian) on newborns. No post natal confirmation of G.A. was made. The B.M.I. value of Ghosh et al also corroborates with our values as their study included the cases which represent the large population of the Delhi, similar to our study in socio-cultural, maternal education, regional, religion & cast factor. Laxminarayan[4] et al (1974) did their study in Madras (south India), on 1001 live born babies born to apparently normal mothers. They assessed G.A. from mothers 1st day of L.M.P. and confirmed it with neurological examination of baby. The B.M.I. value of Laxminarayan et al also corroborates with our values and their study included the cases which represent the large population of the south India, though different from our study in socio-cultural, maternal education, regional, religion, cast, & environmental factors. The study of Lubchenco[5] et al (1963) was conducted at Denver (United states). It is a hospital study, including extramural low birth weight newborns referred from outside. In comparison to Indian studies, their study reflects that in United states B.M.I. is higher at all gestational ages and it might be due to higher maternal education, high per capita income, ethnic and racial differences.

Graph-2 shows comparative B.M.I. value concluded from work done by different workers on weight & length parameters. As it is evident from our study that growth follows a definite linear pattern (Curve -3) and the same is also expected in case of 2 S.D. value but in actual values some fluctuation occurs in linear growth in earlier weeks of gestation, this could be due to availability of lesser no. of cases in preterm. To improve this discrepancy we smoothened the values by dividing the data in 3 groups (33% each) according to gestational age and then calculated the single S.D. value for each group separately and then measured the - 2 S.D. & + 2 S.D. value for each group from this S.D. values and prepare a graph of B.M.I. ± 2 S.D. smooth values (Table – 3 ,4 & Curve - 4).

CONCLUSION

There are yet no nationally and internationally acceptable standards of B.M.I. of newborns, so we are at disadvantage to discuss the variables critically. As standards of growth in form of weight and length are available nationally and internationally we have compared our data with theirs after calculating the B.M.I. from their mean values at different gestational ages wherever available.

TABLE – 1
Mean B.M.I. and standard deviation of Preterm, Term and Post term newborns

Gestational age (weeks)	No. of cases	Mean B.M.I.	S.D.
28	4	7.1	0.3
29	6	8	0.4
30	6	8.3	0.3
31	10	8.6	0.6
32	11	8.8	0.5
33	24	9.4	0.7
34	41	9.6	0.5
35	73	10.2	0.8
36	97	10.7	0.8
37	304	11.2	0.9
38	434	11.6	1
39	451	11.7	1.1
40	421	11.8	1.1
41	97	11.7	1.1
42	21	11.7	1

Correlation coefficient (r) = 0.975 (P value < 0.001)

TABLE – 2 Shows Mean B.M.I. at different gestational ages reported by various authors.

Gestational age (weeks)	Present study	Purohit (1979)	Ghosh (1971)	Laxmi Narayan (1974)	Lubchenco (1963)
28	7.1	6.9	7.9	7.6	8.3
29	8	8	7.1	7.9	8.5
30	8.3	8.3	7.7	8.5	9
31	8.6	8.2	8.9	8.6	9.3
32	8.8	9.4	8.4	9.4	9.1
33	9.4	9.9	9.5	11.2	9.7
34	9.6	10	10.2	9.9	11.1
35	10.2	10.3	10.4	11	11.3
36	10.7	11.1	11	10.4	12.2
37	11.2	11.5	11.6	11.2	12.5
38	11.6	12.2	11.8	11.2	13.8
39	11.7	11.8	11.9	11.3	13.1
40	11.8	12	12	11.4	13.2
41	11.7	12	12	11.5	13.4
42	11.7	12.3	12.2	12.1	13.3

TABLE – 3 Shows ± 2 Standard deviations from Mean B.M.I. (Actual values) of Preterm, Term and Post term newborns

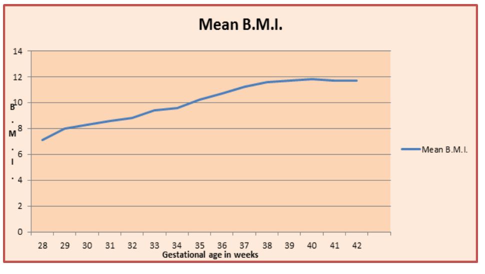
Gestational age (weeks)	B.M.I. - 2 S.D.	B.M.I. Mean	B.M.I. + 2 S.D.
28	6.5	7.1	7.7
29	7.2	8	8.8
30	7.7	8.3	8.9
31	7.4	8.6	9.8
32	7.8	8.8	9.8
33	8	9.4	10.8
34	8.6	9.6	10.6

35	8.6	10.2	11.8
36	9.1	10.7	12.3
37	9.4	11.2	13
38	9.6	11.6	13.6
39	9.5	11.7	13.9
40	9.6	11.8	14
41	9.5	11.7	13.9

TABLE – 4 Shows ± 2 Standard deviations from Mean B.M.I. (Smooth values) of Preterm, Term and Post term newborns

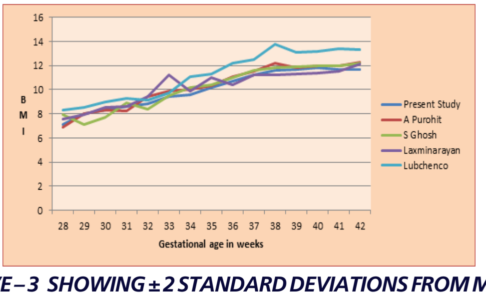
Gestational age (weeks)	B.M.I. - 2 S.D.	B.M.I. Mean	B.M.I. + 2 S.D.
28	5.7	7.1	8.5
29	6.6	8	9.4
30	6.9	8.3	9.7
31	7.2	8.6	10
32	7.4	8.8	10.2
33	7.4	9.4	11.4
34	7.6	9.6	11.6
35	8.2	10.2	12.2
36	8.7	10.7	12.7
37	9.2	11.2	13.2
38	9.6	11.6	13.6
39	9.7	11.7	13.7
40	9.8	11.8	13.8
41	9.7	11.7	13.7
42	9.7	11.7	13.7

CURVE 1 MEAN B.M.I. OF PRETERM, TERM AND POST TERM NEWBORNS

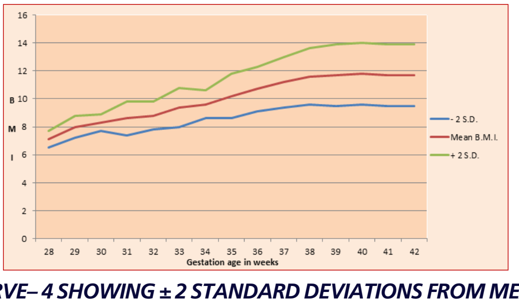


X - axis :- Gestational age in weeks Y - axis :- B.M.I.

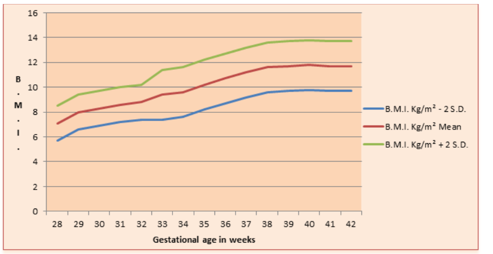
CURVE 2 SHOWS COMPARISON OF MEAN B.M.I. AT DIFFERENT GESTATIONAL AGES REPORTED BY VARIOUS AUTHORS.]



CURVE – 3 SHOWING ± 2 STANDARD DEVIATIONS FROM MEAN B.M.I. (ACTUAL VALUES) OF PRETERM, TERM AND POST TERM NEWBORNS



CURVE– 4 SHOWING ± 2 STANDARD DEVIATIONS FROM MEAN B.M.I. (SMOOTH VALUES) OF PRETERM, TERM AND POST TERM NEWBORNS



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