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# TWINS: ITALIAN STANDARDS FOR WEIGHT, LENGTH AND HEAD-SIZE AT BIRTH

*I. Cortinovis, A. Bossi, S. Milani*

Institute of Medical Statistics and Biometry, University of Milan, Milano, Italy

Abstract: *Neonatal norms for weight, length and head-size of twins are presented, based on 575 reference neonates delivered, after low-risk, uncomplicated pregnancy, between 1973 and 1981 in nine hospitals of North, Central and South Italy, and included in a multicentre survey of perinatal preventive medicine. These norms are compared to those (previously published) for singletons, based upon 16336 reference babies born in the same period and included in the same survey.*

*In twins, modal gestation's length is 3 weeks shorter and the percentage (43%) of preterm births is four times higher than in singletons. Pregnancy at risk does not seem to exert prominent effects on somatic growth of twins. The largest differences in body size between singletons and twins appeared to be the overlapping between singletons' 50th centile and twins' 90th centile (for weight), and the small positive difference between singletons' and twins' head circumference (2 cm) and length (3 cm). These results may suggest that the intrauterine limitations that are typical of twin pregnancies tend to depress weight gain more than bone growth.*

*For these reasons, the assessment of body size of twins by standards based on singletons leads to overestimate, chiefly in the case of full-term pregnancies, the proportion of babies below the reference limits which are generally accepted as warning limits. The use of neonatal standards based on twins could improve the evaluation of fetal growth and body size at birth.*

Key words: *Twins; Neonatal standard; Birth weight; Birth length; Head circumference.*

## Introduction

Intrauterine and neonatal growth standards are widely recognized as fundamental to a good obstetric management of pregnancies: literature presents a large variety of standards on data collected from mono or multicentre studies and suitable for monitoring fetal development and assessing the stage of maturity of neonates in different human populations. The large majority of these studies, however, concern singleton pregnancies: the available standards for twins date back to Sixties or early Seventies (Naeye et al. 1966, Wilson 1974), or refer to populations with unusually high proportion of twin births (Nnatu and Kayode 1983, Fakeye 1986) and, as to Italy, are lacking at all.

This paper presents neonatal standards for weight, length and head-size of twins, based on 575 Italian neonates born between 1973 and 1981. These norms are compared to those for singletons, based on 16336 reference babies born in the same period and included in the same survey (Bossi and Milani 1986, 1987).

## Subjects and Methods

### *Target population and selected sample*

Weight, length and head-size at birth were recorded in the "neonatal data" section of an ad-hoc questionnaire of an obstetric-pediatric multicentre survey, one of the goals of which was the definition of cross-sectional standards for Italian neonates. The survey was supported by CNR, the National Research Council (Target project: Preventive

Medicine and Rehabilitation, subproject SP1). Design of the survey, methods adopted to collect information, and data description have been presented in detail elsewhere (Bertulessi et al. 1983). It sufficies to say here that the nine hospitals in which data have been collected were placed so as to supply information on health conditions and care of mothers and babies in regions of Italy which largely differ in social or demographic features and life habits, as thoroughly discussed in previous papers (Milani et al. 1986).

Out of some 46.000 pregnancies surveyed, there were 465 twin pregnancies which yielded 932 neonates. The percentage of twin-births (1.97%) is twice the value (0.9%) reported in the same time period for Italy (ISTAT records). This finding might be ascribed to the special role of some hospitals (mainly Milan and Naples) in which the survey was carried out (*Table 1*).

*Table 1.* **Number of twins and percentage (in parentheses) of twins on total number of neonates, in the 9 centres participating in the survey**

| CENTRE | | TWINS | |
|---|---|---|---|
| TRIESTE | (Instituto Burlo Garofalo) | 157 | (1.48) |
| MILAN | (Clinica L. Mangiagalli) | 333 | (2.64) |
| PARMA | (Ospedali Riuniti) | 82 | (1.25) |
| ROME | (Policlinico A. Gemelli) | 108 | (1.49) |
| NAPLES | (Il Policlinico) | 126 | (3.56) |
| BARI | (Policlinico) | 100 | (2.30) |
| MANTOVA | (Istituti Ospedalieri C. Poma) | 12 | (0.73) |
| BELLANO | (Ospedale Civile) | 8 | (3.05) |
| MORBEGNO | (Ospedale Civile) | 6 | (1.13) |
| TOTAL | | 932 | (1.97) |

The reference babies for the standards were liveborn twins without detectable congenital anomalies; further their mothers did not have any of the risk factors identified on the questionnaire and which seem to impair fetal growth (Bossi and Milani 1986). Risk factors taken into account concern maternal history (uterine fibroids, uterine surgery, renal diseases, hypertension), previous pregnancies (spontaneous abortions, stillbirths, neonates weighing 2.5 kg or less), present pregnancy (urinary infections, lues, jaundice, diabetes, tuberculosis, asthma, endocrine and heart diseases, hypertension, eclamptic strokes, epilepsy, vaginal bleeding, placental abruptio, isoimmunization, intrauterine transfusion, smoking 10 cigarettes or more).

### *Variables*

All measures were taken within one hour of delivery, as a part of routine care. Body weitht (BW) was recorded to the nearest 10 g. Crown-heel length (CHL) was measured with the neonate flat on its back and both legs extended in a measuring device containing a built-in centimetre rule; head-size (HC) was measured by a tape at the largest occipito-frontal circumference. Length and head-size values were recorded to the nearest centimetre. The measuring error, including both "within-neonatologist" and "between-neonatologists" components, was less than 2% (in terms of CV%). Gestational age (GA) was expressed as completed weeks counting from the first day of the last menstrual period. The estimate of gestational age was considered reliable if the date of beginning of the last menstrual period was recorded accurately, the period was normal with respect to flow, duration and expected date, and menstrual cycles preceding preg ‚ancy were regular within 28 days ± 5.

*Statistical Analysis*

The effects of sex and pregnancy at risk on neonatal body size of twins were estimated by a proper linear model, after adjustment for the effect of gestational age (Searle 1976).

The prefixed centiles of the empirical distributions were computed by nonparametric method (Conover 1971): this makes no distributional assumption, and hence is a more general and safe method to adopt (Solberg 1981), although its efficiency is somewhat lower, chiefly for extreme centiles (Healy 1974). The estimates of centiles were then smoothed (Healy et al. 1988), so as to reduce random variability and elicit the shape of the relationship of traits to gestational age.

## Results

The analysis was carried out on 807 babies (411 girls and 396 boys) out of 932, 87 stillbirths and neonatal deaths (i.e. deaths occurred in the first month of postnatal life), 32 neonates with congenital anomalies and 6 neonates without reliable gestational age having been excluded. *Figure 1* reports the frequency distribution for gestational age in girls and boys. In both sexes, gestation's length is less than 37 weeks for some 43% of twins, and the maximum frequency of births occurs on the 37th week.

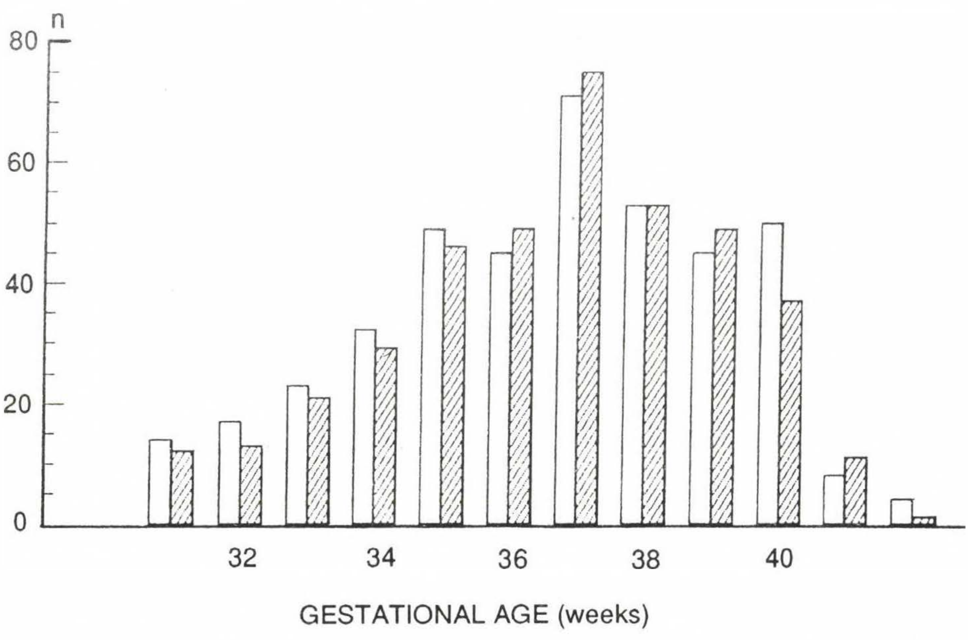


*Fig. 1:* Distribution of gestational age in girls (empty columns) and boys (dashed columns)

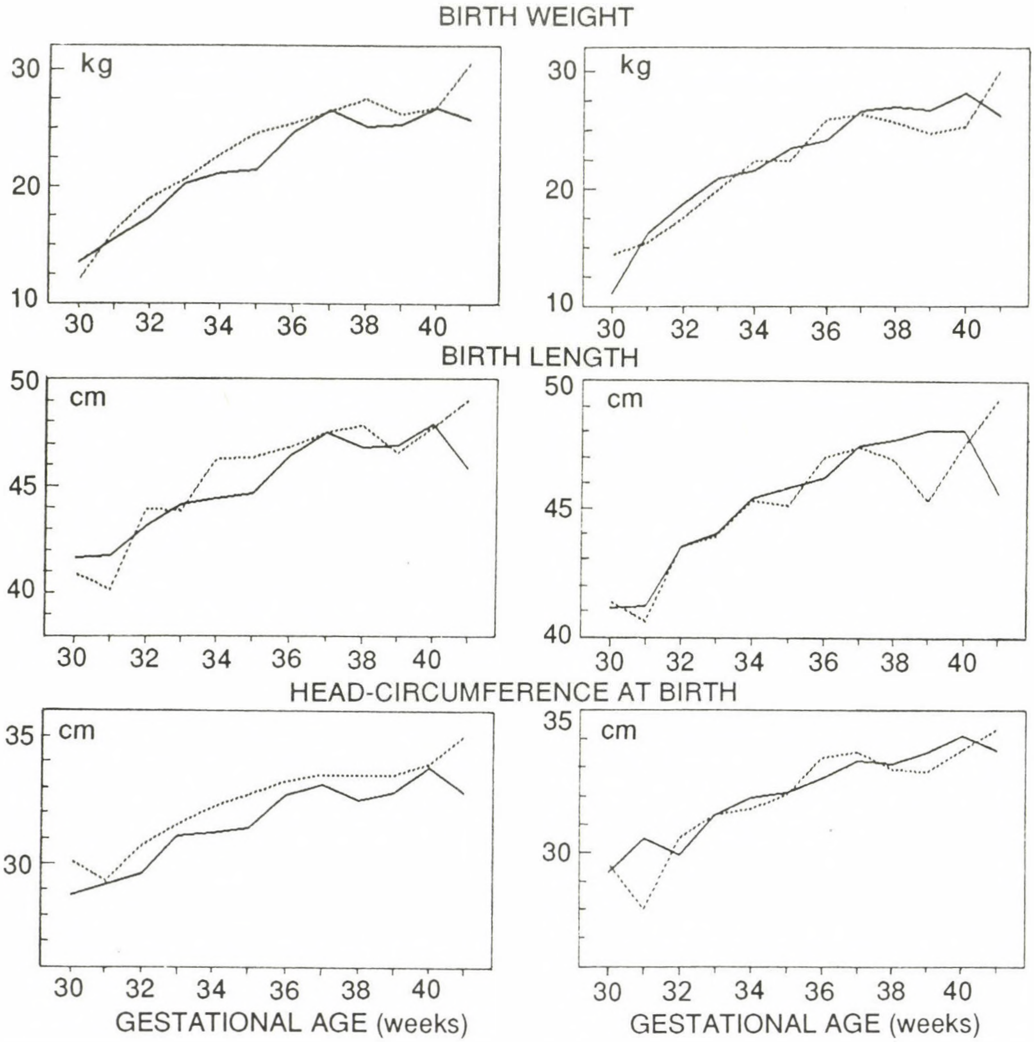


*Fig. 2:* Mean values of morphometric traits in girls (solid line) and boys (dashed line) on the left, and in reference (solid line) and at risk (dashed line) groups on the right

The sample was made up of 575 reference neonates, and 232 neonates whose mothers have at least one of the risk factors mentioned above. Results of the analysis of variance show that, at birth, boys have body weight and head-circumference significantly larger than girls, but not length. Actually, in the range 32–39 weeks of gestation, the median differences range from 0.1 to 1.2 cm for length, from 0.4 to 0.7 cm for head-size and from 80 to 200 g for weight. Pregnancy at risk does not appear to exert large effects on somatic growth of twins, though there may be differences between reference and at-risk groups in the shape of the relationship of all traits to gestational age (*Fig. 2*). It is worth noting that the unexplained between-pregnancies variability (BW: 480 g; CHL: 3.1 cm;

HC: 1.7 cm) it is 1.3–1.5 times the unexplained within-pregnancy variability (BW: 330 g; CHL: 2.4 cm; HC: 1.3 cm). On the basis of the above findings, it seemed tr be sensible to compute neonatal standards for twins separately for reference girls (303) and boy' (272).

Neonatal norms for twins in *Table 2* are expressed as selected centiles (5, 10, 50, 90 and 95) of the distribution of body weight, crown-heel length and head circumference, between 32 and 41 weeks of gestation.

*Table 2.* **Centiles of the distribution of body weight (g), length (cm) and head-size (cm) at birth, by Gestational Age (GA)**

| GA (wks) | CENTILES GIRLS No | 5 | 10 | 50 | 90 | 95 | CENTILES BOYS No | 5 | 10 | 50 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Body Weight* | | | | | | | | | | | | |
| 32 | 12 | 1199 | 1297 | 1813 | 2309 | 2393 | 11 | 1057 | 1247 | 1894 | 2353 | 2423 |
| 33 | 17 | 1360 | 1468 | 1985 | 2487 | 2585 | 19 | 1262 | 1444 | 2082 | 2561 | 2642 |
| 34 | 18 | 1510 | 1628 | 2147 | 2654 | 2765 | 17 | 1455 | 1629 | 2259 | 2758 | 2849 |
| 35 | 34 | 1645 | 1773 | 2293 | 2806 | 2930 | 32 | 1633 | 1799 | 2420 | 2940 | 3042 |
| 36 | 36 | 1760 | 1899 | 2420 | 2939 | 3076 | 32 | 1792 | 1950 | 2563 | 3103 | 3215 |
| 37 | 46 | 1853 | 2002 | 2524 | 3048 | 3199 | 45 | 1927 | 2078 | 2682 | 3243 | 3365 |
| 38 | 45 | 1918 | 2077 | 2600 | 3130 | 3294 | 34 | 2036 | 2178 | 2774 | 3355 | 3488 |
| 39 | 35 | 1951 | 2121 | 2645 | 3181 | 3358 | 31 | 2112 | 2247 | 2834 | 3436 | 3579 |
| 40 | 38 | 1949 | 2129 | 2655 | 3196 | 3386 | 32 | 2153 | 2280 | 2859 | 3481 | 3635 |
| *Crown-Heel Length* | | | | | | | | | | | | |
| 32 | 11 | 37.2 | 38.7 | 43.3 | 46.7 | 47.4 | 8 | 39.0 | 39.9 | 43.4 | 46.2 | 46.7 |
| 33 | 17 | 38.6 | 39.9 | 44.1 | 47.3 | 48.0 | 15 | 40.4 | 41.3 | 44.6 | 47.1 | 47.6 |
| 34 | 18 | 39.9 | 41.1 | 44.9 | 47.9 | 48.6 | 14 | 41.7 | 42.6 | 45.6 | 48.1 | 48.5 |
| 35 | 28 | 41.1 | 42.2 | 45.6 | 48.5 | 49.2 | 31 | 42.8 | 43.7 | 46.6 | 48.9 | 49.4 |
| 36 | 35 | 42.2 | 43.2 | 46.3 | 49.1 | 49.8 | 32 | 43.7 | 44.5 | 47.4 | 49.7 | 50.2 |
| 37 | 44 | 43.0 | 43.9 | 46.8 | 49.6 | 50.4 | 42 | 44.2 | 45.1 | 47.9 | 50.3 | 50.8 |
| 38 | 45 | 43.6 | 44.5 | 47.1 | 50.0 | 50.9 | 33 | 44.5 | 45.5 | 48.3 | 50.7 | 51.3 |
| 39 | 33 | 44.0 | 44.7 | 47.3 | 50.2 | 51.2 | 30 | 44.5 | 45.5 | 48.4 | 50.9 | 51.6 |
| 40 | 37 | 44.0 | 44.8 | 47.3 | 50.3 | 51.4 | 32 | 44.1 | 45.1 | 48.2 | 50.8 | 51.6 |
| *Head Circumference* | | | | | | | | | | | | |
| 32 | 11 | 26.8 | 27.6 | 30.0 | 31.9 | 32.4 | 10 | 27.9 | 28.6 | 30.7 | 32.6 | 33.1 |
| 33 | 16 | 27.8 | 28.5 | 30.9 | 32.8 | 33.3 | 15 | 28.9 | 29.5 | 31.5 | 33.4 | 34.0 |
| 34 | 18 | 28.6 | 29.3 | 31.6 | 33.5 | 33.9 | 16 | 29.7 | 30.3 | 32.2 | 34.1 | 34.7 |
| 35 | 31 | 29.2 | 29.9 | 32.1 | 34.0 | 34.4 | 30 | 30.3 | 30.9 | 32.7 | 34.6 | 35.2 |
| 36 | 33 | 29.7 | 30.3 | 32.5 | 34.3 | 34.8 | 32 | 30.7 | 31.3 | 33.0 | 34.9 | 35.6 |
| 37 | 45 | 30.1 | 30.7 | 32.8 | 34.5 | 35.0 | 42 | 31.1 | 31.6 | 33.3 | 35.2 | 35.8 |
| 38 | 45 | 30.4 | 31.0 | 33.0 | 34.7 | 35.2 | 33 | 31.4 | 31.9 | 33.5 | 35.4 | 36.1 |
| 39 | 33 | 30.7 | 31.3 | 33.2 | 34.9 | 35.4 | 30 | 31.7 | 32.2 | 33.6 | 35.5 | 36.2 |
| 40 | 36 | 31.0 | 31.5 | 33.4 | 35.1 | 35.6 | 32 | 32.0 | 32.4 | 33.8 | 35.7 | 36.5 |

In girls, body weight increases from 1.8 to 2.7 kg (50%) between the 32nd and the 40th gestation week, in the same period length and head-size increase from 43.3 to 47.3 cm and from 30.0 to 33.4 cm (i.e. some 10%), respectively. In boys, body weight increases from 1.9 to 2.9 kg (50%), whereas length and head-size increase from 43.4 to 48.2 and from 30.7 to 33.8 cm (10%), respectively. For all traits, most of the gain occurs in the range 32–37 weeks, and between-babies (within gestation's week) variability is very large: the range between centiles 5 and 95 is some 1.5 greater than the median growth between the 32nd and the 40th week of gestation.

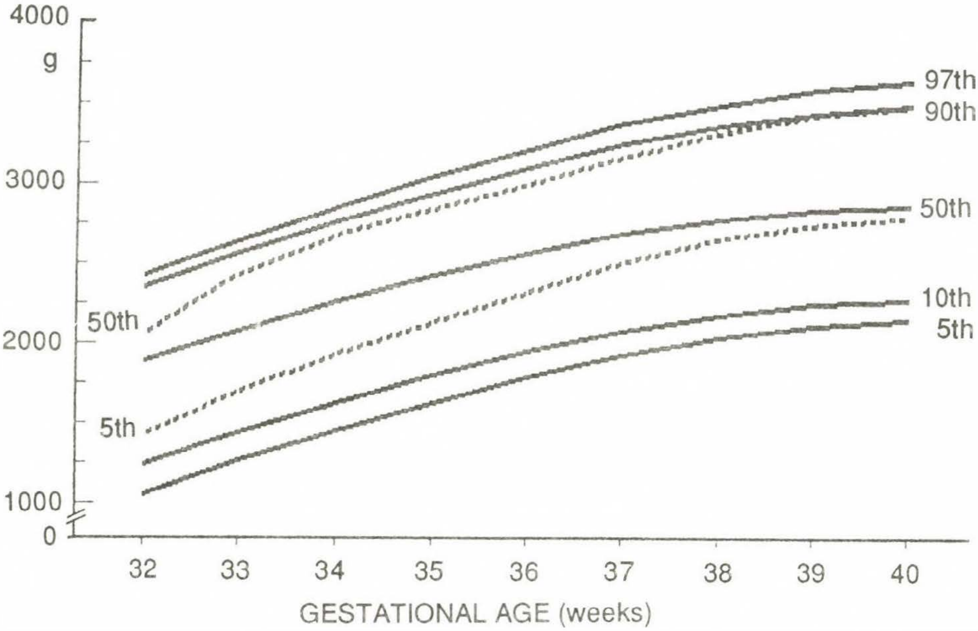


*Fig. 3:* Comparison between standards for birth weight in twins (solid line: 5th, 10th, 50th, 90th, 95th centiles) and in singleton (dashed lines: 5th and 50th centiles), for boys

Differences in birth weight between twins and singletons increase with gestational age (from 0.3 to 0.7 kg between 32 and 40 weeks). At all gestational ages and for both sexes, the 90th centile of twins is rather similar to the 50th centile of singletons (see *Figure 3* as an example). The differences in length or head size are lower, and the 50th centile of singletons are consistently below the 90th centile of twins.

## Discussion

Above results show that modal gestation's length is in twins 3 weeks shorter than in singletons included in the same survey: analogous results are given in literature (Bleker et al. 1979, Hemon et al. 1982). The percentage (43%) of preterm births (i.e. births occurring before 37 weeks) is in twins four times higher than in singletons (Bertulessi et al. 1983): similar or slinghtly lower percentages of preterm births among twins are reported by other authors (Koivisto et al. 1975, Keith et al. 1980, Secher et al. 1985).

Pregnancy at risk does not seem to exert prominent effects upon somatic growth of twins. This unexpected finding might be ascribed to several causes: (1) risk factors differ largely as to severity, (2) risk factors could affect gestation length more than size at a given gestational age, (3) severe impairment of somatic growth is more likely to yield fetal death and stillbirths in twins than in singletons and, therefore, to be unobservable.

Neonatal standards for twins, as well as those for singletons presented in previous papers (Bossi and Milani 1986, 1987), were based on reference babies selected according to clear-cut criteria. Not only stillbirths and neonates with congenital anomalies were excluded, but also all babies whose mothers had any known risk factor for pregnancy or outcome, connected with impaired fetal growth. Furthermore, since information on ultrasound assessment of gestational age was not available, the strict criteria mentioned in section "Variables" were adopted to try to ensure the reliability of gestational age's estimates in the reference sample. Because of this selection, the reference babies were only one third of all singletons (in particular, GAs estimates were considered unreliable for some 33% of the excluded neonates), with a small proportion of preterm neonates (less than 10%). Nevertheless, some reference babies (mainly before 35 gestation weeks) had size too large for their GA: the persistence of similar inconsistencies was observed also in other surveys where GA was assessed by ultrasound (Yudkin et al. 1987). In any case, the effects of possible errors in GA values (mainly as regards the estimate of 90th and 95th centiles) appeared to be much lower in reference twins than in singletons: this fact and the use of a new method of smoothing (Healy et al. 1988) resulted in the rather regular shape of twin norms here presented.

Between-sexes differences in weight are slightly lower for twins than for singletons: in other terms, the effects of twin pregnancy on birth weight seem to be larger for boys (Guttmacher and Kohl 1958). As to body size, sex related differences were found by Berman et al. (1987), but not by Newton et al. (1984) who analysed data from 1126 babies born in 13 hospitals between 1970 and 1975. From the latter study, it emerged that average length of gestation is shorter for pairs of male twins than for pairs "female–female" or "female–male". In the sample analysed in the present study, no difference of this kind was apparent.

The differences in body size between singletons and twins appeared to be roughly similar to those reported by Wilson (1974), with particular regard to the overlapping between singletons' 50th centile and twins' 90th centile (for weight), and to the small positive difference between singletons' and twins' head circumference (2 cm) and length (3 cm). However, this Author pooled data from girls and boys together (299 boys and 298 girls, born in 8 hospitals of USA), and compared twins and singletons who were not included in the same survey, nor belonged to the same population. These results may suggest that the intrauterine limitations that are typical of twin pregnancies tend to depress weight gain more than bone growth.

Studies carried out by Stefos et al. (1989), Keith et al. (1980), and Simon et al. (1989) show that twins' limited growth does not depend on genetic factors, but relates to differences in feto-placental unit concerning oxigenisation of blood removal of waste products, production of essential metabolites, vascular perfusion, placental metabolism. Therefore, birth weight differences in a pair of twins could suggest different uterine vascularization when there are two placentas, otherwise, different hematic distribution between twins when there is one placenta only (Naeye et al. 1966). Unfortunately, the number of placentas had not been recorded during the survey, so that the effect of this factor on twin's growth could not be analysed.

It is widely accepted that limitations given by nutritional support tend to reduce fetal growth of twins, with respect to singletons, after 28–30 weeks of gestation (Hendriks 1966, Naeye et al. 1966, Wilson 1974, Hemon et al. 1982, Secher et al. 1985, Bleker et al. 1988, Simon et al. 1989, Stefos et al. 1989). Further, there are limits to uterus' development that are expected to inhibit somatic growth of twins after 36–37 weeks: this seems to be confirmed by the progressive approach of twins' median value to singletons'

5th centile for all traits here examined. For these reasons, the assessment of body size of twins by standards based on singletons leads to overestimate, chiefly in the case of full-term pregnancies, the proportion of neonates below the reference limits which are generally accepted as warning limits.

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*Mailing address:* Prof. Silvano Milani
Istituto di Statistica Medica e Biometria
Universita di Milano
Via Venezian, 1
20133 Milano
Italy