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Changes in Structural Components of Human Body from Six Lunar Months to Maturity

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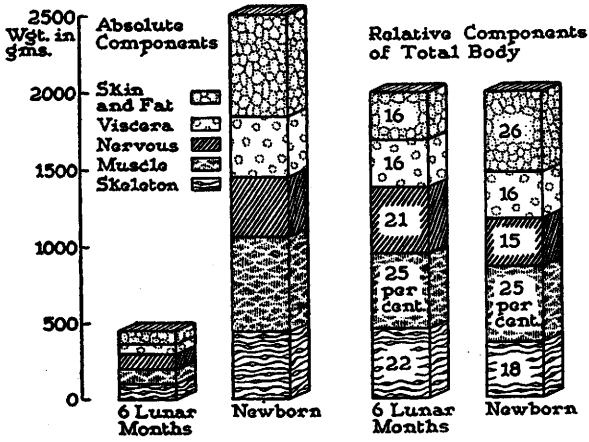
The changes of the various structural components of the human body in development are well illustrated by volumetric histograms. These are shown in Figs. 1 and 2. They are based upon data collected in this laboratory as well as a series of records collated from the literature.

In this presentation the structural components of the body considered are: skin and superficial fat *(paniculus adiposus)*, the visceral mass (including the heart), the nervous tissues (of both the peripheral and the central nervous systems), the voluntary musculature, and the fresh ligamentous skeleton.

The periods represented are: 6 lunar or fetal months, birth, and full maturity. Both sexes are included in each of the periods.

Figure 1 illustrates the differences in composition of the body at 6 lunar months and at birth. During this interval the net weight of the body increases approximately five-fold, from 500 to 2500 g.

The relative changes in the distribution of the body components are: the skin and superficial fat increase from about one-sixth to over one-fourth of the body mass. The nervous tissue component and the



Prenatal Growth

FIG. 1.

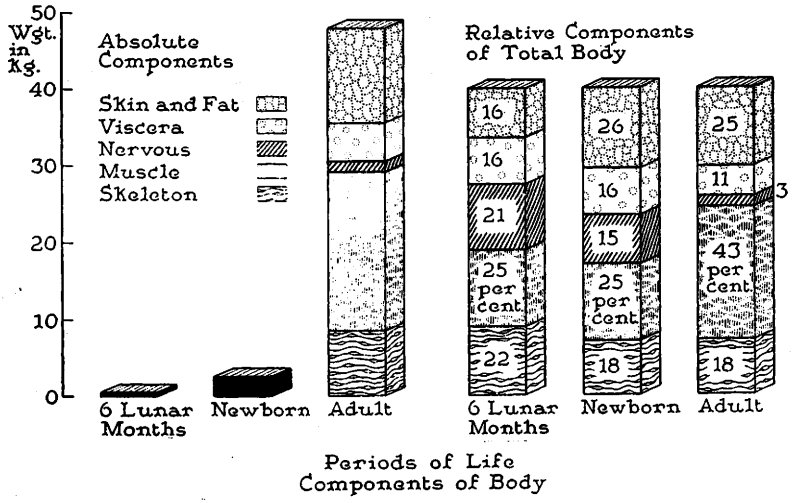


FIG. 2.

skeletal component both show a marked relative decrease. The visceral and the voluntary muscle components remain almost constant.

Fig. 2 shows the changes in components between birth and maturity. During this interval the net body weight increases almost twenty-fold. The postnatal changes in the relative distribution of components consist of: a marked increase in the voluntary muscle from about one-fourth to over two-fifths of the body mass. But the visceral component decreases from about one-sixth to about one-tenth of the body mass; and the nervous tissue component from about one-seventh to about one-thirtieth. The skin and superficial fat component and the component of the skeleton remain practically unchanged.

TABLE I.
Absolute and Relative Weights of the Various Components of the Body for Both Sexes. (Collated from Various Sources.)

	Absolute wt (g)			Relative wt (%)		
Body components	6 lunar months	Newborn	Adult	6 lunar months	Newborn	Adult
Skin and superficial fat	73.5	666.35	12,395.5	16.21	26.43	25.61
Muscle	111.5	625.25	20,846.3	24.60	24.80	43.07
Skeleton	101.0	446.00	8,518.6	22.28	17.69	17.60
Total viscera	71.1	398.20	5,185.5	15.68	15.79	10.71
Central nervous system	96.2	385.50	1,455.9	21.22	15.29	3.01
Sum*	453.3	2,521.30	48,401.8	100.00	100.00	100.00

* These sums do not include the weight of the blood or the weight lost in the determination of approximately 33 g in the 6 months fetus, 116 g in the newborn, 5270 g in the adult male and 4000 g in the adult female.

The numerical values for the absolute and relative sizes of all these components are shown in Table I.

The most striking of this series of changes is the increase of the range of variability of the several components forming the body. At 6 lunar months there is a maximum difference of only 9% in their relative distribution. By birth there is a maximum difference of 40%. And at maturity there is a maximum difference of over 1000%. These computations are in terms of the smallest component in each series, but they may also be demonstrated in terms of the largest component or in terms of absolute values.

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Keto-Reacting Substances in the Bile of Dogs.

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A study of the literature revealed that certain investigators have identified and isolated various ketonic acids from the bile of different animals. Fernholz[1] isolated 3-hydroxy-6-ketocholanic acid from hog bile and studied its properties. Schoenheimer and others[2, 3] confirmed the isolation of this ketonic acid, and further stated that the ketonic acids of hog bile comprise approximately 10% of the total crude acids. Wieland and Kishi[4] isolated and identified 3-hydroxy-12-ketocholanic acid from ox bile. Sobotka found 3-hydroxy-12-ketocholanic acid in human bile.[5]

No one apparently has reported a method for the quantitative determination of carbonyl or keto-reacting substances in bile. Since our work required such a method, we have been fortunate at having at our disposal a quantitative method which had been developed by Dr. Gustus of the Wilson Laboratories, Chicago. The principle of this method is as follows: The carbonyl or keto groups in the bile are allowed to react with an excess of hydroxylamine. The remaining hydroxylamine is combined with diacetyl-monoxime converting the

1 Fernholz, E., *H.-S. Z. f. Physiol. Chem.*, 1935, **232**, 202.

2 Schoenheimer, R., and Johnston, C. G., *J. Biol. Chem.*, 1937, **120**, 499.

3 Anchel, M., and Schoenheimer, R., *J. Biol. Chem.*, 1938, **124**, 609.

4 Wieland, H., and Kishi, S., *H.-S. Z. f. Physiol. Chem.*, 1933, **214**, 47.

5 Sobotka, H., *Chem. Rev.*, 1934, **15**, 334.