

## THE VALUE OF ABDOMINAL MEASUREMENTS IN PREGNANCY

### A STATISTICAL STUDY

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Since 1904 it has been customary for the assistants and students in my clinic at the San Francisco Maternity to measure the height of the fundus uteri above the symphysis in all cases of pregnancy. Measurements have been made with a tape-measure, placing one end on the upper border of the symphysis and the other on the ensiform cartilage. The uppermost margin of fundus of the uterus is located and read off the tape. In this paper, an effort will be made to estimate the value of these measurements in so far as they relate to the size of the unborn child and to the probable date for delivery.

Some years ago Ahlfeld<sup>1</sup> measured with a pelvimeter, the height of the fundus uteri in a series of cases and concluded that from the twenty-fourth to the fortieth week the height of the fundus increased gradually from 15 cm. to 26.1 cm. He also made the valuable observation that while with the same measurement the weight of the babies varied, the length was very constant and was always twice the inter-uterine axis. But he did not associate these measurements with any rule for estimating the probable date for delivery.

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1. Ahlfeld, F.: Bestimmungen der Grösse und des Alters der Frucht vor der Geburt, Arch. f. Gynäk., bd. II, 353, 1871.

Ahlfeld's work has been verified by Tramer,<sup>2</sup> Walraf,<sup>3</sup> Suttigen<sup>4</sup> and many others, but of late years so much attention has been given to estimating the size of the fetal head *in utero* by means of Muller's method of impression, or Stone's<sup>5</sup> modification of Perret's<sup>6</sup> method, that Ahlfeld's work has been neglected.

Suttigen<sup>4</sup> condemned the use of a tape-measure in measuring the fundus and stated very truly that the variations with a tape measure extended from 2 to as much as 13.5 cm. while with a pelvimeter, the variations were only from 2 to 5 cm. He observed that one of the chief causes for this variation was the contractions of the uterus. As the uterine contraction continues, the fundus rises higher and higher to subside at the end of the contraction to the original measurement. This is a very practical point and should always be taken into account in drawing conclusions from fundus measurements.

McDonald,<sup>7</sup> a few years ago, published a rule for estimating the period of pregnancy by measuring with a tape measure in a somewhat similar method to that which is described in the present paper but, unfortunately, his paper lacks statistical presentation and has overlooked the important point that as pregnancy advances the rate of uterine enlargement lessens. His rule is to divide the height of the fundus in centimeters by three and one-half in order to obtain the lunar month of pregnancy. About the same time I published a somewhat similar rule based on clinical observations, but also

2. Tramer, D.: Ueber die Bestimmung der Grösse des Kindes vor der Geburt, Bern, 1881.

3. Walraf, J.: Ueber Längemessung der Frucht während des Geburtsactes, Berlin, 1873.

4. Suttigen, V.: The Means of Ascertaining the Length of Gestation by Measurements of the Fetus and Gravid Uterus during the Second Period of Pregnancy, *Obst. Jour. Great Britain, London*, 1875-76, III, 397.

5. Stone, W. S.: Antepartum Measurements of the Fetal Head. *Med. Rec., New York*, Nov. 4, 1905, p. 725.

6. Perret: *Bull. Soc. d'obst. de Paris*, 1898, p. 58.

7. McDonald, E.: Mensuration of the Child in the Uterus with New Methods, *THE JOURNAL A. M. A.*, Dec. 15, 1906, p. 1979; *The Duration of Pregnancy with a New Rule for its Estimation*, *Am. Jour. Med. Sc.*, September, 1910.

without statistical study. My rule was to add four to the height of the fundus as measured in centimeters, which would equal the probable week of pregnancy.

During the last five or six weeks of pregnancy it is surprising how closely both these rules will compare to Naegle's rule, but they both have the same basic error and are not accurate in the period from the twenty-fourth to the thirty-fourth week.

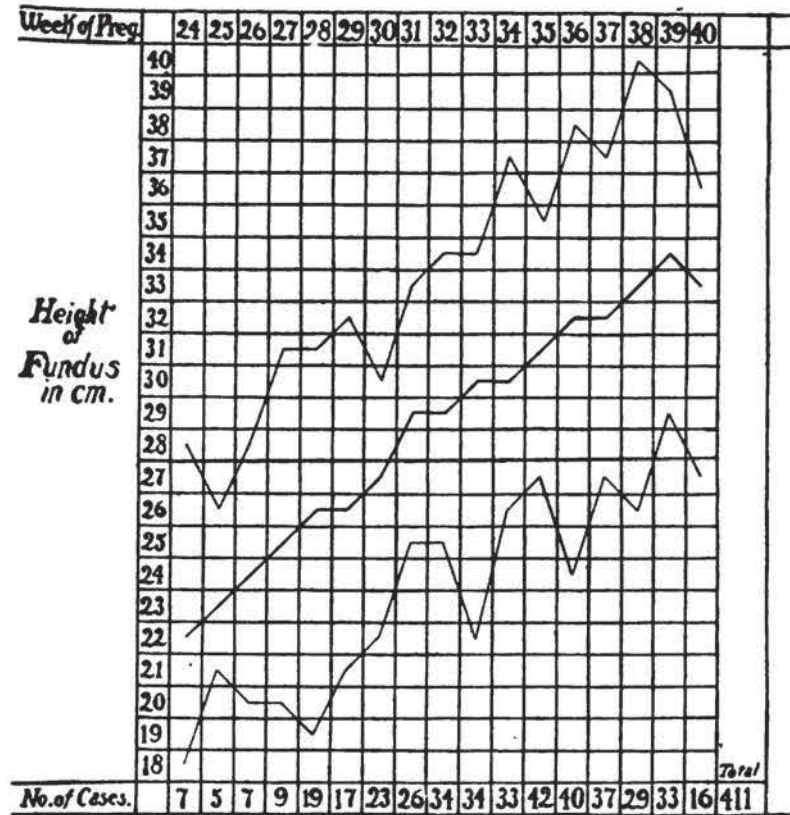


Chart 2.—Fundus measurements in series of 411 pregnancies. Upper and lower curves show limits of variations—middle curve shows average measurements.

The literature is overburdened with many fantastic rules for estimating the weight of the unborn child such as that of A. Goenner, who stated that the weight of the unborn child could be estimated by measuring the foot, and such problems in mathematics as are presented by Roberts,<sup>8</sup> Tuttle,<sup>9</sup> etc.

8. Roberts, R. C.: The Uniform Lineal Growth of the Human Fetus, *Lancet*, London, Feb. 3, 1906, p. 295.  
 9. Tuttle, L.: The Relation Between Weight and Age in the Fetus, *THE JOURNAL A. M. A.*, Sept. 9, 1908, p. 919.



Consequently, it is with many misgivings that the present statistical paper to estimate the value of uterine measurements is presented. Over two thousand records of confinement have been reviewed. On Chart 1 will be found the weights of babies taken immediately after delivery in a series of 300 labors where the height of the fundus and the degree of settling, or in other words, the total uterine axis was carefully observed. It will be noted that 157, or over half of the series, give fundus measurements between 34 and 37 cm. with average weights for the babies, between 3,275 and 3,395 gm. This might be considered a rough standard for average normal babies. Eighty-eight give fundus measurements between 38 and 45 cm., with average weights for the babies between 3,555 and 4,100 gm., besides five cases of twin delivery. This is a rough standard for over-maturity of the child. Fifty-five fundus measurements averaged between 2,125 and 2,930 gm. This also could roughly be stated as a standard of imperfectly matured babies. With experience, one can utilize these measurements to advantage in certain cases of toxemia, nephritis, heart-disease, etc., to determine the best period for the induction of premature labor or of the advisability of inducing labor at term; but unfortunately the possibility of error in exceptional cases precludes the utilization of these measurements in the management of contracted pelvis. It will be seen on the chart that with the same abdominal measurement, there is a variation in the weight of the child in exceptional cases of as much as 1 or 2 kilos. A great deal depends on the care with which the measurements are made, on the condition of contraction or relaxation of the uterus, on the skill of estimating the degree of settling and on the thickness of the abdominal walls, as well as the accuracy in diagnosing such conditions as hydramnios and multiple pregnancy.

Chart 2 presents the measurements of the uterus made at various weeks of pregnancy in a series of 411 patients. The patients in this series knew the date of

their last menstrual period, gave birth to normal-weight babies within seven days of the expected time according to Naegle's rule and were not complicated with hydramnios or multiple pregnancy. The measurements begin with the twenty-fourth week of pregnancy and extend to the forty-first week. For each week the number of patients measured, which vary from five to forty-two, is stated on the charts. The upper and lower curves represent the greatest and the least measurements while the middle curve represents the average measurement obtained each week. The variations are the same that Suttigen noted and are due not only to personal equation, but to contractions in the uterus caused by manipulation of the fundus. I have tested this in personal cases and find that with a single examination these errors of variation are always possible, but with care and with repeated examinations at intervals, averages according to the middle curve are very constant.

Comparing these curves with the results obtained by Ahlfeld<sup>1</sup> and Suttigen<sup>4</sup> in a similar series of cases measured with a pelvimeter, it will be noticed that, even though the error of variation is less when measurements are made with a pelvimeter, the rate of increase noted from week to week is so small that no practical rule for estimating the period of pregnancy could be devised. In other words, measuring with a tape measure magnifies the results obtained with a pelvimeter (not only the errors but the averages as well) and permits of utilizing these measurements in a practical way.

In studying the curve of the averages, it will be noticed that there is a gradual increase in the height of the fundus from the twenty-fourth to the thirty-sixth week; after that, an irregular increase to the thirty-ninth week, and then a sudden drop to the forty-first week. The irregularity after the thirty-sixth week can be accounted for in the settling, which also causes some of the errors of variation noted throughout by the upper and lower curves.



Comparing the known week of pregnancy with the average measurements of the height of the fundus, it will be noted that between the twenty-fourth and twenty-eighth week or during the seventh month, the fundus measures 2 cm. less than the week of pregnancy; between the twenty-ninth and thirty-third week, or roughly the

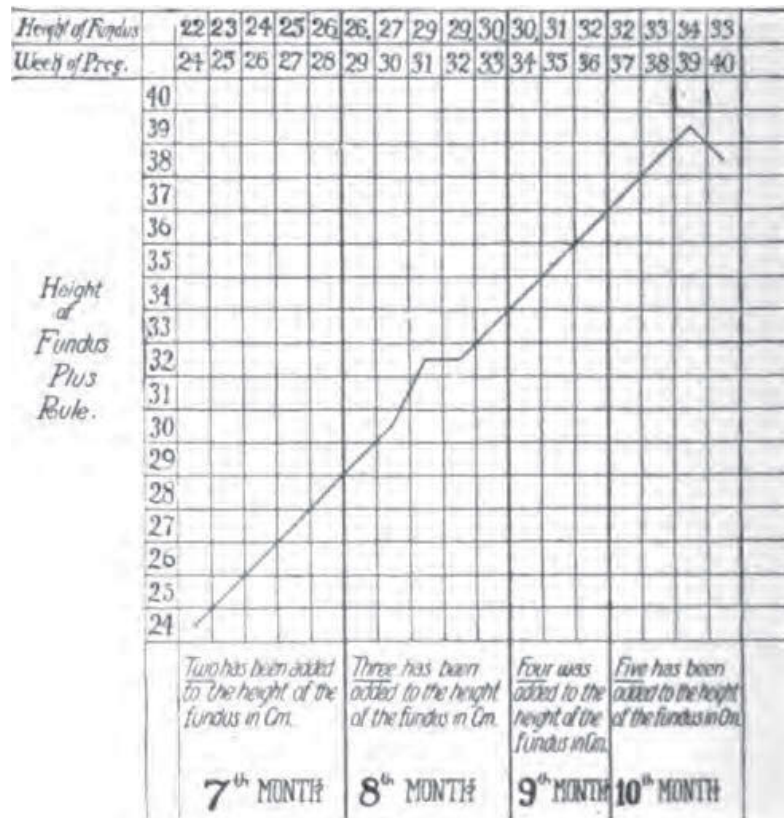


Chart 3.—Application of rule to measurements of Chart 2.

eighth month, the fundus measures 3 cm. less than the week of pregnancy; between the thirty-fourth and thirty-sixth week, or in the ninth month of pregnancy, the fundus measures 4 cm. less than the week of pregnancy; and after the thirty-sixth week, or in the last month of pregnancy, the fundus measures 5 cm. less than the week of pregnancy.

Transposing these figures, it is easy to compute a rule for estimating an unknown week of pregnancy from the measurements of the height of the fundus. This has

been done and has been found of considerable value, particularly in clinic patients, in whom so often no menstrual history can be obtained. The rule is: Measure with a tape measure the height of the fundus above the symphysis in centimeters, making allowance for settling when present, and add two to measurements between 22 and 26 cm., three to measurements between 26 and 30, four to measurements between 30 and 32 and five to measurements over 32, which sum will equal the probable week of pregnancy.

In Chart 3 the rule just stated has been applied to the measurements shown in Chart 2. It will be noted that with one exception, the estimated week of pregnancy corresponds exactly with the known week of pregnancy to the thirty-ninth week. It will be found that, with care, it is possible, as illustrated in this paper, to estimate accurately the probable week of pregnancy from the fundus measurements and in about three-fourths of all cases to estimate as closely as with Naegle's rule the date for the probable delivery.

#### CONCLUSIONS

Abdominal measurements are of value in estimating the degree of maturity of the unborn child. It is possible to estimate with considerable accuracy the probable week of pregnancy from accurate measurements taken with a tape measure of the height of the fundus above the symphysis.

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#### ABSTRACT OF DISCUSSION

DR. FREDERICK E. LEAVITT, St. Paul, Minn.: I have never accustomed myself to the use of the tape measure in the estimation of the size of the abdomen. I have depended rather on my own judgment and the estimate made from the manual examination. Dr. Spalding stated that in three-fourths of the cases it was possible in this way to estimate the date of labor correctly. From my own experience I think that I could strike it a little closer than that by estimating the probable date of labor from the date of the last menstruation. I do not see that there is any particular advantage in these



abdominal measurements when we have accurate dates as to the last menstruation or the probable time of fertilization. The thing which interests me in abdominal measurements is to find out the proportions. The fetus is largely an unknown quantity, and in considering whether a patient is going to have a difficult or easy labor it is desirable to know how large the fetus is and whether or not it is out of proportion to the size of the mother. If the measurements indicated will help us, the idea is an advantage and of more importance than estimating the probable time of labor from dates. I have in mind several instances in which measurements of this kind would not have been of much value. In a family of two or three sisters and nieces there is a tendency to deliver short of full-term pregnancies. Some have gone thirty-four weeks, quite a number thirty-six, but none the full forty weeks. In these cases the measurements would not have helped to decide the date of labor.

DR. E. GUSTAV ZINKE, Cincinnati: A good obstetrician always regrets to accept a case of labor at, or just before, labor has begun. Some of the questions to be determined beforehand are: Is the patient pregnant? If pregnant, can she give birth to a child at full term? If so, what is the position of the child *in utero*? What is the general health and condition of the patient? And many other questions of great importance. Unfortunately, there are many who practice obstetrics who do not take the necessary care. It is this negligence which frequently gets both practitioner and patient into trouble. There is really no excuse on the part of the obstetrician, who is "engaged" long before labor, not to know the case before him and whether or not he will have a stormy time. Are the kidneys doing their duty? Are the emunctories of the body in perfect order? These queries bear significantly on the course and treatment of pregnancy and of labor. He who studies his cases carefully will not be taken by surprise.

DR. A. B. SPALDING, San Francisco: I think that we all realize how often women do not know the time of their last menstruation. I have seen a great number of charts which state that the labor is two months past the expected date for delivery. Again, when treating patients of a higher class—and the two classes that receive good service are the very poor and the rich—it will often be noticed that the pregnancy has run over the expected time for delivery. When pregnancy runs over, we should measure the height of the fundus as well as the pelvis. These measurements are of particular value in the class of patients who rest and eat too much. We have at our disposal good methods for the induction of labor at any time we desire, and that time should be when we think the child is large enough to survive and small enough to do the least injury to the mother's genital organs. In patients with habitual short-term pregnancies, we can



measure the baby *in utero* and if we find that it is too small we can overfeed the mother and get it up to a normal weight. The operation for preventing prolapse of the uterus is of great interest to all of us. One of the best methods to prevent prolapse is to measure the abdomen every two or four weeks during the latter weeks of pregnancy, in order to know when the baby is fully developed and, at the same time, not so large as to cause serious injury to the woman's organs during labor, which will require subsequent serious surgical work or, more often, years of misery for the woman. It is the shame of obstetricians that so many of these cases go to the gynecologist afterward. There is no reason to my mind why patients should leave the hands of the obstetrician with damaged or diseased abdominal or genital organs if he does his work completely and properly. That is why I have presented this simple obstetrical paper. It is in the hope of encouraging enthusiasm for prophylactic gynecologic work rather than enthusiasm for repair work on women after years of misery due to poor obstetrics.