INTRODUCTION

Pregnancy imposes adaptations on abdominal muscles morphology with implications on functional capacity of women during the postpartum period. A muscle that undergoes changes during pregnancy is the rectus abdominis (RA). However, a few studies are available about abdominal muscles changes and the risk factors involved on common abdominal-strengthening exercises, during pregnancy and the post-partum period. Thus, a case study was developed in order to identify and discuss the relevant parameters to use on the description of the morphologic changes on the abdominal wall, namely on RA muscles, during pregnancy and postpartum period.

METHODS

A 31 years old healthy pregnant woman participated in this study from the 18th gestational weeks until 10 weeks of postpartum. Ultrasound images from superficial abdominal musculature, including RA and linea alba, were obtained by means of an ultrasound diagnostic scanner (Hitachi EUB-7500) with a 108 mm linear array transducer at 7,5 MHz. With the subject in supine position and knees bent at 90º measurements of the resting abdominal musculature were taken. The bottom edge of the probe was placed centrally in a transverse plane of linea alba on three locations on the abdominal wall: one distal and two locations cephalic to the umbilicus. Pre-defined distances from the umbilicus were used: the 2PDD (2 cm) and 5 PDD (5 cm) distances. These pre-defined distances were estimated in function of subject height, according to the ISAK formula PDD x height/170,18.

In this study, the 2PDD was 1,95 cm and the 5PDD was 4,88 cm. An anthropometric tape was used to estimate the three locations for the probe/transducer, assuming the center of the umbilicus as a reference for the linear distance. The bottom edge of the probe was then placed on each location. On each location, the probe was moved laterally until the internal edge of both RA muscles was obtained. The angle of the probe was adjusted to optimize visualization and particular attention was taken about pressure made by the probe avoiding women muscle reflexive response and/or from fetus. A set of 16 ultrasounds measurements and 4 anthropometric measurements were collected, started at 18th gestational weeks, with intervals of approximately 10 days, until delivery. Anthropometric measurements were taken at 18th, 23th, 28th and 35th gestational weeks. These measurement were repeated on the 10th week of postpartum. Anthropometric assessment followed a standardized measurement protocol (ISAK protocols) of women thorax and abdomen length, diameter and perimeter, as well as abdominal skinfolds. Anthropometric parameters included: body mass (Kg); biiliocristale diameter (cm); hip perimeter (cm); abdominal perimeter (cm); thoracic diameter (cm); and the uterine height (cm). Anthropometric measurements were obtained using portable measurement
devices (DKSH, Switzerland) and a calibrated precision scale (Seca Vogel & Halke, model 761 7019009, Germany), and an anthropometric tape (Rosscraft Innovations, Vancouver, Canada). Ultrasonographic parameters include the IRD and the linea-alba thickness (LAT), estimated by mean of specific software (ImageJ, Image Processing Analysis in Java) and expressed as a percentage of increment across all recording moments. For IRD estimation, the linear distance between both edges of the RA muscle was recorded from a single frame obtained on each PDD probe locations. The LAT was measured on three locations: at the middle part of the linea alba and close to both edge of the RA muscles. The LAT correspond to the linear distance between the top and bottom edge of the linea alba. Descriptive statistics were calculated to summarize data.

RESULTS AND DISCUSSION
The results showed that the IRD increased gradually while LAT reduce during pregnancy (Figure 1). It was noticed that the IRD increased 178.9% on the locations above the umbilicus after 133 days. The LAT is decreasing gradually as the rectus separates from the middle line and comparing the first and the last moment of measurements there is -56.2%, -57.5% and -55.6% for the same previous locations. The anthropometric measurements (Figure 2) increased gradually also, as expected for this period. The uterine height and the abdominal perimiter were the anthropometric parameters that showed a better agreement with ultrasound parameters. On the 10th week of postpartum period the values tend to be close to the ones found on the beginning of the study on the 18th gestational week.

![Image](image_url)

**Figure 1:** Inter-Rectus-Distance (IRD) and the Linea Alba Thickness. Percentage of changes with respect to the first moment. (Above: 5 cm above umbilicus; Middle: 2 cm above; Below: 2 cm below. See text for details).

**CONCLUSIONS**

Pregnancy imposes various changes in woman abdominal wall morphology. It seems to be a symmetrical relationship between the DIR and the LAT, so as the two RA are separating from each other, the LA is getting thinner. The location where this is more evident just above the umbilicus. Apparently the LA is thinner in the middle point between the two RA, but the thickness at this point seems to decrease slowly when comparing to the insertion points of the RA, both on the left and right sides where there is a very pronounced decrease of the LAT.

![Image](image_url)

**Figure 2:** Anthropometric data. Percentage of changes with respect to the first moment.

On the postpartum period the values are close to the ones found in the beginning of the study on the 18th gestational week. However on that moment there were already obvious modifications on the morphology of the woman body, so we can think that the recovery on the 10th week after birth is not yet completed. Besides the limitations this preliminary study accomplished the main goal which was to test all the proceedings and to give insights about possible solutions to the difficulties found. The recommendations stated here will help us on the future study with a bigger sample. The period of collecting data should include information from the 3 trimesters of pregnancy and also from more moments on the post-partum period in order to see how the abdominal wall adapts and recovers from the maintained stretch during the pregnancy. The sample should be of at least 100 subjects. A new measurement of the length of the RA should be included on the variables in study in order to have information of the longitudinal stretch of the RA during pregnancy.

**REFERENCES**