Conjecturas

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Preliminary comparative study of the Q angle in pregnant and non-pregnant women for the prevention of orthopedic problems

Estudo comparativo preliminar do ângulo Q em mulheres grávidas e não grávidas para prevenção de problemas

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RESUMO

Os problemas ortopédicos no joelho são a principal causa de dor em grávidas a partir do 3º trimestre de gravidez. Os problemas musculoesqueléticos que acometem as grávidas podem permanecer após o parto; nesse sentido, foi realizada uma análise comparativa entre as medidas do ângulo Q de amostras de grávidas e não grávidas para verificar as alterações desse ângulo para servir de base para tratamentos profiláticos quando o ângulo estiver aumentado. Foram obtidos dados de medida do ângulo Q, e outros para verificar a relação do ângulo Q com a idade, altura, peso, Índice Metabólico Corporal [IMC], circunferência do quadril, medida da espinha ilíaca anterior superior até a patela. Esses dados foram comparados com os valores de ângulo Q para ambas as amostras, e, posteriormente, os valores dos ângulos foram comparados entre grávidas e não grávidas. Os dados estatísticos e a análise de valores absolutos mostraram que ocorreu um aumento do ângulo Q das mulheres grávidas em relação às não grávidas e a comparação o IMC com o ângulo Q mostrou maior r^2 para mulheres grávidas.

Palavras-chave: Ortopedia; Problemas Músculo-esqueléticos; Grávidas; Ângulo Q; Dor.

ABSTRACT

Orthopedic knee problems are the main cause of pain in pregnant from the 3rd trimester of pregnancy. The musculoskeletal problems that affect pregnant women can remain after childbirth; in this sense, a comparative analysis was performed between the measurements of the Q angle of samples of pregnant and non-pregnant women to verify the changes in this angle to serve as a basis for prophylactic treatments when the angle is increased. Q angle measurement data, and others were obtained to verify the relationship of the Q angle with age, height, weight, Body Metabolic Index [BMI], hip circumference, measurement from the anterior superior iliac spine to the patella. These data were compared with the Q angle values for both samples, and subsequently the angle values were compared between pregnant and non-pregnant women. Statistical data and analysis of absolute values showed that there was an increase in the Q angle of pregnant women compared to non-pregnant women and the comparison of BMI with the Q angle showed a higher r^2 for pregnant women.

Keywords: Orthopedics; Musculoskeletal Problems; Pregnant women; Q angle; Pain

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INTRODUCTION

Traumatological processes should be seen as population epidemiologies (FUNK; ESTIVALET, 2015) due to the number of people affected worldwide, mainly by the sequelae associated with the various types of work or labor, therefore, they require prophylaxis as preventive measures (BISPO JUNIOR, 2010).

At least in Brazil, other medical areas such as parasitology and reproductive pathologies receive more attention in prophylactic terms (PINHEIRO; MEDEIROS, 2013) than traumatology in terms of primary and secondary prophylaxis, such as for osteoporosis (SOUZA et al., 2017).

For example, myofascial low back pain is one of the biggest musculoskeletal problems in the world in adults with occupational and postural causes, and the prophylactic procedures, although they exist, are little directed to the population in general, which generates a high economic burden on the state, including due to the decrease or loss of people's work capacity (SHARAN et al., 2014; URITS et al., 2020).

One of the factors linked to pain caused by orthopedic problems is general weight gain, especially in the case of pregnant women (OJUKWU; ANYANWU; NWAFOR, 2017), who undergo several changes in body structure, mainly affecting the musculoskeletal system (ROSSNER, 1997) which can lead to pain in general and low back pain, mainly. Changes that increase body mass are negatively associated with hip and knee flexion (HORA et al., 2017) and the knee joint is responsible for about 50% of musculoskeletal injuries (CABRAL; MONTEIRO-PEDRO, 2003).

Additionally, biochemical changes during pregnancy affect the musculoskeletal system with main effects on spinal and pelvic joints and ligaments in general due to the actions of estrogen and relaxin (RIBAS; GUIRRO, 2007), which is one of the examples of orthopedic problems during pregnancy (OJUKWU; ANYANWU; NWAFOR, 2017).

Pelvic modifications alter the morphology of the plantar arch (LARZARUS; PREMAWARDHANA, 2005; OJUKWU; ANYANWU; NWAFOR, 2017), generating changes in knee angulation due to weight changes (ROSSNER, 1997; EGWU et al., 2012).

Due to the physiological-anatomical characteristics of women, they have a higher incidence of knee osteoarthritis than men however studies associating reproductive

factors and changes in the knee joint are still inconclusive (FELSON, 1988; HUSSAIN et al., 2018).

These morphological problems generate discomfort and pain due to changes in the biomechanical synchronism of the lower limbs (DAHLE et al., 1991; GROSS et al., 2011; ERHART et al., 2012; CHO; KO; LEE, 2015).

Considering that changes in posture, problems with the joints and pelvic bones, and the rest of the lower limb are factors that influence each other, studies in the area of orthopedics are necessary to indicate the aptest variables to be analyzed to, at least, generate a preventive strategy for weight gain problems in the general population and pregnant women in particular.

For developing countries, where the population's access to magnetic resonance and tomography devices is limiting, an inexpensive and simpler test should be used as a measure to verify general changes in musculoskeletal structures for pregnant women.

As a result, the determination of the Q angle is a simple, easily reproducible test that can be easily performed in the clinic and indicates the morphometric alteration of the lower limb in patients with weight gain, which may indicate a quick clinical-orthopedic intervention. and preventive physiotherapy, because in the case of pregnant women, the anatomical changes that occurred during pregnancy can be maintained after delivery (BRANCO et al., 2013).

For a determination of the angle values that are critical to starting treatment, the comparative measures between the Q angles of healthy pregnant and non-pregnant women should indicate a threshold for which the professional should start the preventive/curative processes.

Therefore, the objective of this work was to measure the Q angle and hip circumference of non-pregnant women and compare them with pregnant women.

MATERIAL AND METHODS

This descriptive, quantitative study was approved by the Research Ethics Committee of the Centro Universitário Luterano de Palmas (CEULP/ULBRA), Tocantins state, Brazil, under Opinion No. 2,641,145, following Resolution 196/96 of the National Health Council.

After signing the informed consent form, the Q angle values of 47 young, non-pregnant, healthy women aged between 18 and 27 years and of 15 young, pregnant, healthy women aged between 17 and 30 years were measured at 10 to 39 weeks pregnant with an average of 28.13±9.24 weeks. All measurements were performed in Alfenas, Minas Gerais, Brazil and none showed and/or cited pathology in the lower limbs.

Concomitantly, data on heights and weights were obtained to calculate the Body Mass Index [BMI], age, distances between the superior and inferior iliac spine to the patella, pelvis-patella distance [PPD], and hip circumferences.

A goniometer was used to calculate the Q angle and an inextensible tape measure for the other measurements.

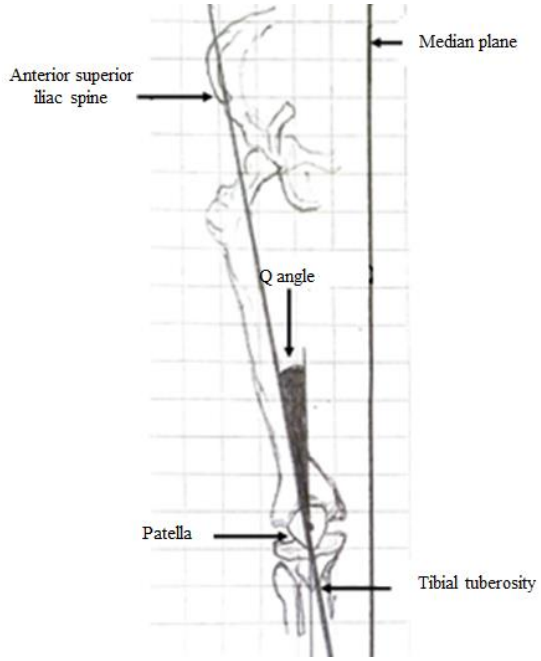
Q angle

The Q angle is formed by a line that represents the resultant force of the quadriceps that starts in the anterior superior iliac spine to the approximate central point of the patella, regarding the tibial tuberosity.

From this point, a line is drawn at 90º with the transverse axis of the patella towards the hip. The angle between the line from the direction of the superior anterior iliac spine to the patella and the line orthogonal to the transverse position is the Q angle, which, here, was made with a goniometer.

It can be measured with the person lying down or standing up. In this study, the option was made to measure the angle while the person was in an erect anatomical position, not in decubitus, as it is the upright position that causes discomfort if there is knee pathology (figure 1).

Figure 1 – Data schema and structures associated with Q angle measurement.



Source: Aversi-Ferreira, T. A. (2022).

Statistical analysis

All data obtained were recorded in Office Excel spreadsheets for proper descriptive and quantitative analysis. Statistical analysis was performed using StatPlus: mac software, AnalystSoft Inc. - statistical analysis program for macOS®. Version v7, available at: https://www.analystsoft.com/en/.

First, the normality of the sample was tested, and then the mean, the standard deviation, and the comparison of means via the paired t-test of the samples two by two for $p<0.05$, including the Q angles between pregnant and non-pregnant women, and, additionally, linear regression was calculated to compare BMI with the Q angle of each group and to compare the Q angles between pregnant and non-pregnant women.

RESULTS

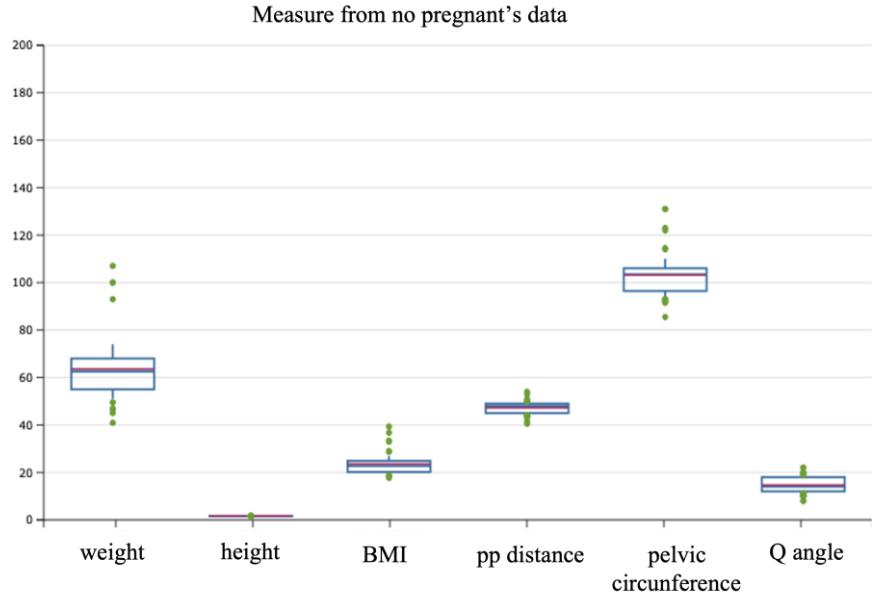
All data were tested for normality and, in all cases, the results showed that they are compatible with normal distribution. The mean age and standard deviation of non-pregnant women were 21.60±2.71 years; weight, 64.00±14.10 kg; the height of 1.64±0.06 m; the body mass index (BMI) 23.78±4.91. The mean and standard deviation of the superior anterior iliac spine-patella (pp distance) measurement was 47.10±2.90 cm; the

measurement of the largest hip circumference was 103.90±10.33 cm. The mean and standard deviation of the Q angle of non-pregnant women was 14.61º ±3.54º.

The ratio of the averages of the Q angle was calculated two by two with the angle and each parameter, i.e., 1) the weight, 2) the height, 3) the body mass index, 4) the largest hip measurement, 5) the superior anterior iliac spine to patella distance [pp distance], done using the paired comparison of the means test for $p<0.05$ showed that, for all cases, H0 was accepted for non-pregnant women (figure 2).

Linear regression between BMI and Q-angle for non-pregnant women generated an $r^2=0.0038$.

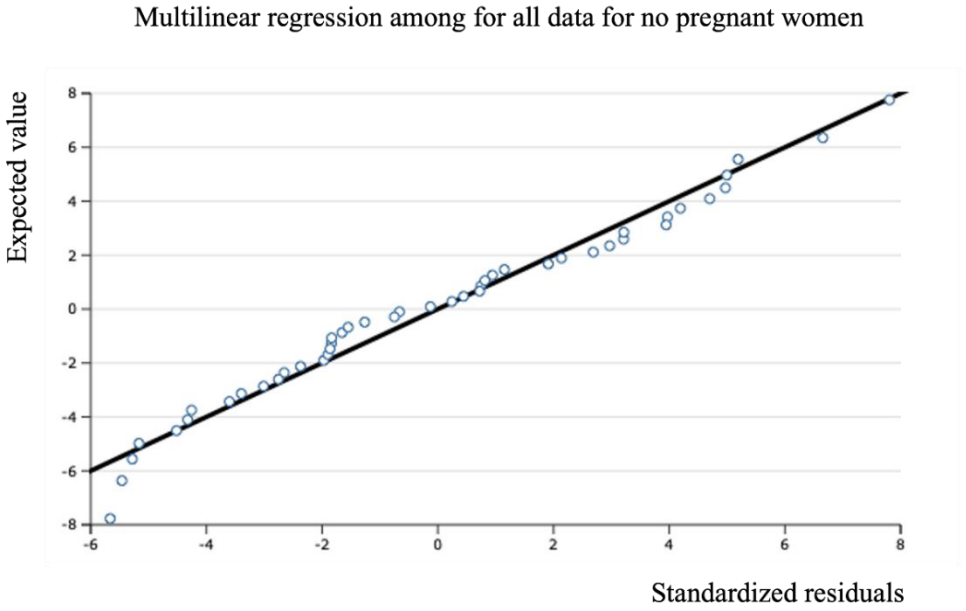
Figure 2 – Graph with the mean and standard deviation of the parameters analyzed in relation to the Q angle for non-pregnant women. BMI is the body mass index, and DEIAS-P is the distance from the superior anterior iliac spine to the patella.



Source: Authors (2022).

Multilinear regression analysis for all data obtained for non-pregnant women showed high adherence between all parameters analyzed in relation to residuals (figure 3), in accordance with the data calculated with the paired t-test.

Figure 3 – Multilinear regression graph of the parameters analyzed about the Q angle for non-pregnant women.

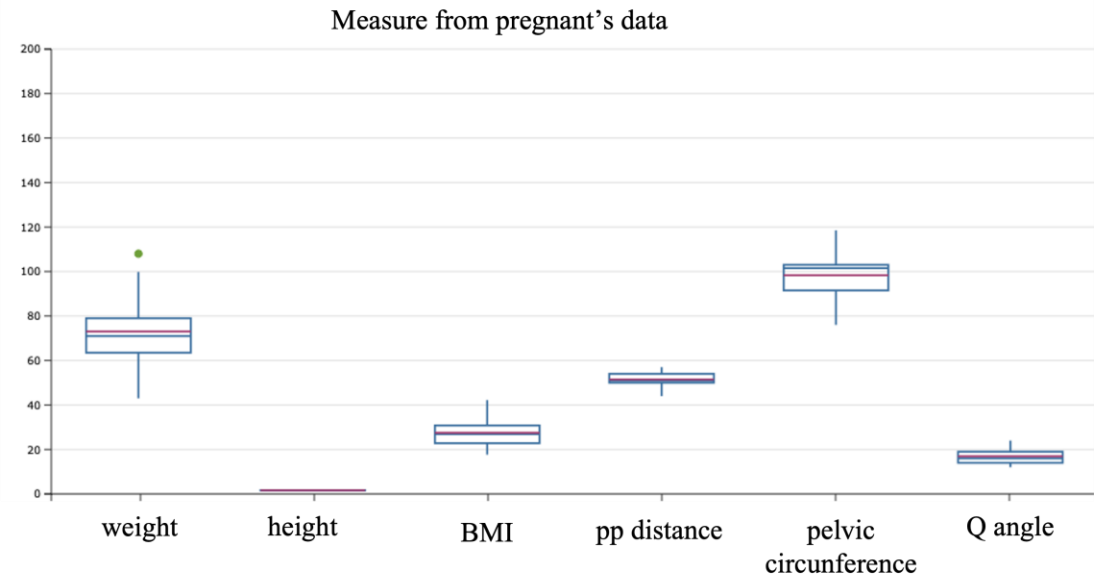


Source: Authors (2022).

The mean age and standard deviation of pregnant women were 25.60±3.71 years; weight, 73.05±16.67 kg; the height of 1.62±0.06 m; the body mass index (BMI) 27.50±6.03. The mean and standard deviation of the superior anterior iliac spine-patella [pp distance] measurement was 51.47±3.38 cm; the measurement of the largest hip circumference was 98.3.90±11.58 cm. The mean and standard deviation of the Q angle of pregnant women was 25.61º ±3.71º.

The paired mean comparison t-test for $p<0.05$ was performed two by two with the Q angle values and the data 1) weight, 2) height, 3) body mass index, 4) the largest hip measurement, 5) the superior anterior iliac spine distance to the patella (pp distance) showed acceptance of the H0 for all cases (figure 4).

Figure 4 – Graph with the mean and standard deviation of the parameters analyzed in relation to the Q angle for pregnant women. BMI is the body mass index, and P-DEIAS is the distance from the superior anterior iliac spine to the patella**.**

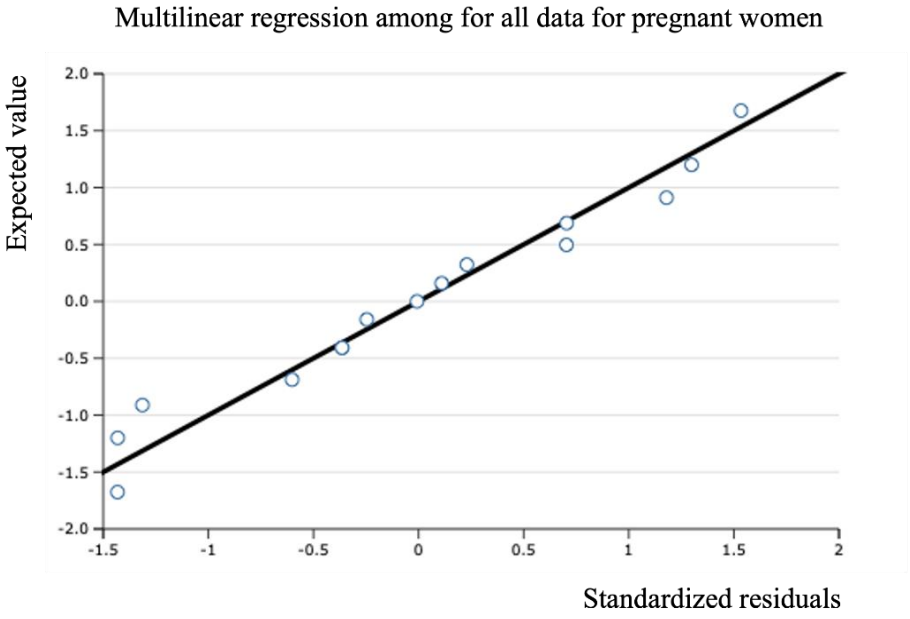


Source: Authors (2022).

The multilinear regression analysis between all parameters obtained for non-pregnant women showed high adherence between all data about the Q angle considering the normality of the residues (figure 5), corroborating the data obtained by the paired t-test.

Linear regression between BMI and Q angle for pregnant women generated an r^2= 0.408, which indicates an average relationship between the variables

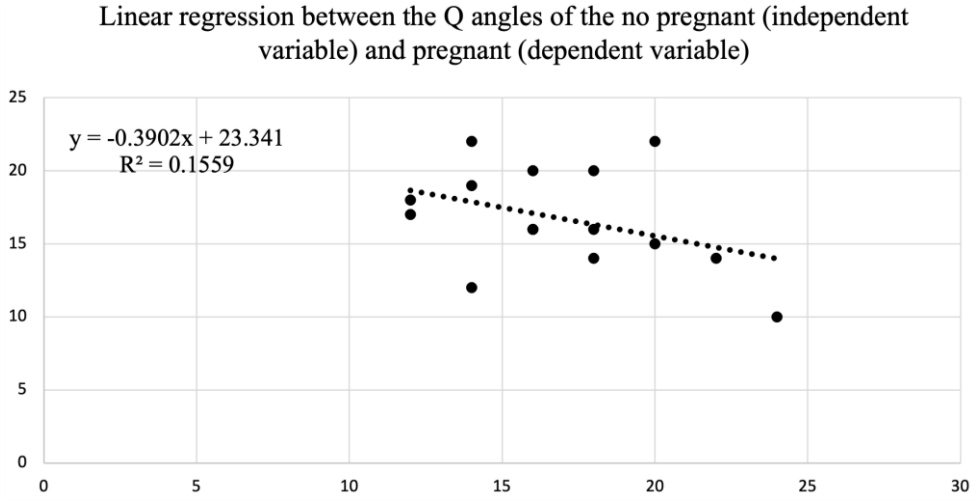
Figure 5 – Multilinear regression graph of the parameters analyzed in relation to the Q angle for pregnant women.



Source: Authors (2022).

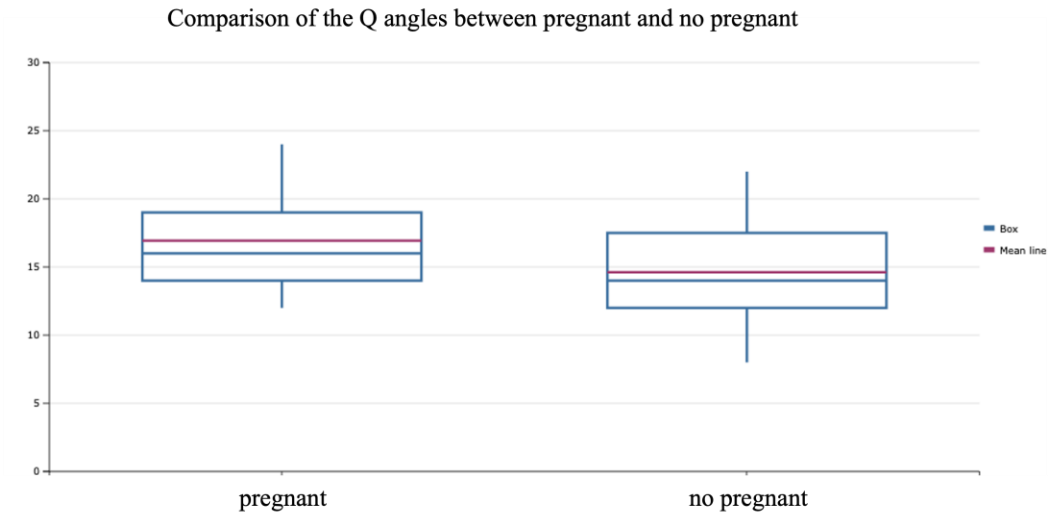
The linear regression test between the Q angles of pregnant and non-pregnant women showed that there is little relationship between the values for $p<0.05$ with $r^2=0.1559$ (figure 6), and the paired t-test indicated the rejection of H0 for the comparison between the angles of pregnant and non-pregnant women (figure 7), for the same value of $p<0.05$.

Figure 6 – Linear regression graph of Q angles to pregnant and non-pregnant women.



Source: Authors (2022).

Figure 7– Graph with mean and standard deviation of Q angles in relation to pregnant and non-pregnant women.



Source: Authors (2022).

DISCUSSION

Even considering the limitations of paired t-tests and linear regression, it was possible to conclude that differences were observed between the Q angles of pregnant and non-pregnant women (figures 6 and 7).

The statistical analysis showed, through the paired t-test, that the data collection occurred with few errors due to the acceptance of H0 (figures 2,3,4 and 5), which, in turn, served as a parameter to show that the conclusion of the difference between samples for Q angle values between pregnant and non-pregnant women, as the paired t-test indicated rejection of H0.

For a more detailed verification, linear regression was performed with the data of the non-pregnant women of this work with the literature data derived from Vieira and collaborators (2016) who obtained data from the Q angles of 9 pregnant women, and a small correlation was found, r^2=0.0876 for linear regression analysis, similarly, the value of r^2=0.1559 (figure 6) was found for the relationship between the Q angles of pregnant and non-pregnant women with the data from this work.

Data from the literature were not found for further analysis to be carried out, indicating that few studies on orthopedic problems of pregnant women use the Q angle measurement as verification of these types of problems worldwide (KHASAWNEH et al., 2019).

From this, and since much more studies are needed on the Q angle in pregnant women compared to non-pregnant women and, even more importantly, in the three trimesters of pregnancy, it will be able to indicate more accurately the morphometric differences in the knee of women in this process of anatomic-physiological changes, considering that few studies in the world use the Q angle to verify knee pathologies (KHASAWNEH et al., 2019).

According to the data from this study, comparative measures of the Q angle may be a more direct and easier way to obtain data on orthopedic problems in pregnancy, as there is a strong correlation between knee pathologies, lumbar and hip joint alterations, and alterations of the plantar arch from the second trimester of pregnancy (BRANCO et al., 2013), and, in terms of maintenance of posture and movement, the variables above are directly related.

Most pregnant women were 18 weeks pregnant with an average of 28.11 weeks, just above the second trimester of pregnancy. As the average value of the Q angle within the normal range is 18° in women (NISSEN et al., 1998; CABRAL and MONTEIRO-PEDRO, 2003; BELCHIOR et al., 2006), in the case of this study, the average for non-pregnant women was 14.61° ±3.58° and 16.9º ±3.41° for pregnant women, but with 46.67% of pregnant women with Q angle values above 18° with a BMI above 25.5 kg/m², except for one case in which the Q angle was 20º and the BMI was 22 kg/m². These observed data confirm the statistical calculations that show that there was an increase in the Q angle in pregnant women, mainly from the 2nd trimester of pregnancy and that this is associated with weight gain more for pregnant women (r^2=0.408) than for non-pregnant women (r^2=0.0038). The linear regression calculation for the relationship between Q-angle measurements and BMI is practically non-existent but shows an average relationship for pregnant women.

For example, modifications that generate alterations in the plantar arch (LARZARUS; PREMAWARDHANA, 2005; OJUKWU; ANYANWU; NWAFOR, 2017), affect the knee, modifying the tensions that are exerted on the elements of the joint, which may or may not change its angulation. according to several factors, the main one being the strength of the quadriceps that stabilizes it, a fact observed in the measurement of the Q angle made with and without contraction of this muscle (BELCHIOR et al., 2006), and among the main causes of these changes is the weight gain (ROSSNER, 1997;

EGWU et al., 2012), which often occurs above what is desired for good health in some women who become pregnant.

If the differences in the Q angle between pregnant and non-pregnant women were experimentally proven by more scientific works and by measurements made by health professionals (GROSS; GEORGE, 2016), the possibility of planning preventive actions would increase (FUNK; ESTIVALET, 2015) to avoid knee pain and other pain resulting from anatomical changes in pregnant women (BELCHIOR et al., 2006; GROSS; GEORGE, 2016) and also in people with weight gain.

In fact, knee pain starts with weight gain in the second trimester of pregnancy with weight gain values above 16.8 kg (SPAHN et al., 2015).

Preventive processes are essential to avoid discomfort with weight gain, as early recognition of the pathology helps to reduce symptoms (GROSS; GEORGE, 2016), especially considering that this rarely occurs in developing countries such as Brazil (OJUKWU; ANYANWU; NWAFOR, 2017).

In anatomical and physical terms, using the force balance and cosine law data, the Q angle as an indicator of knee alignment is associated with the force of the quadriceps femoris on the component elements of its joint, and the increase in the Q angle is a strong indicator of pathologies, as there will be, at least, a lateral tension on the patella (KHASAWNEH et al., 2019), and that, in the case of pregnant women, additional factors such as hormonal changes cause relaxation of the joints requiring greater strength of the muscles of the pelvis and thigh (DUMAS; REID, 1997; RIBAS; GUIRRO, 2007).

Based on the data from this work, which showed that there is a difference between the measurements of the Q angle in samples of non-pregnant women compared to pregnant women, prevention and the clinical work of health professionals are fundamental for the health of the joints linked to the pain causes in pregnant women and, additionally, by deduction, also for people with weight gain, especially pregnant women, since the morphological changes that occur and are not corrected during pregnancy can accompany the woman in the postpartum period (BRANCO et al., 2013).

CONCLUSIONS

In general, this work has several limitations that can be overcome in others, such as 1) the low number of subjects; 2) the absence of data directly obtained from pregnant women; 3) the lack of data obtained from the same subjects during different periods of pregnancy.

However, the incipient data studied here showed that there are few studies associating measurements of the Q angle in pregnant women.

Several articles related to knee anatomy mention pain, variations in lumbar angles, hip joints, and changes in the plantar arch.

However, between the hip and foot, the knee has the crucial joint for transmitting body weight to the plantar arch and has a synovial joint held by lateral ligaments more than any other supporting force.

These facts are enough to indicate the use of the Q angle measure as one of the tools to verify changes in the joints of women and men with weight gain, especially in pregnant women, having as evidence this study that showed an increase in the Q-angle in pregnant women compared to non-pregnant women.

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