Positive and negative likelihood ratios of two anthropometric indices (Waist/Height Index versus Waist/Hip Index) in the diagnosis of overweight and obesity pathological nutritional situations

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ABSTRACT
Introduction. From an epidemiological approach, obesity can be considered as a risk factor for the development of some diseases, or as a disease in itself. Basically, the risk factors for the development of obesity are genetic, physiological and environmental, including unhealthy lifestyles. Non–healthy lifestyles are those that have the most influence as risk factors for the development or not of obesity. Objective. Determine whether or not each of two anthropometric indices has sufficient prognostic efficiency by combining sensitivity and specificity in a single expression using positive and negative likelihood ratios. Material and methods. Three hundred adult patients who attended the "Jose Maria
Morelos’ Integral Hospital were studied. As a reference test, the Equation of the Metropolitan Life Insurance Company was used. Results. The results for the positive likelihood ratios corresponded to 13.4 and 1.7 for the anthropometric indices Waist/Height Index and Waist/Hip Index, respectively. The results for the negative likelihood ratios corresponded, respectively, to 0.07 and 0.5 for the anthropometric indices Waist/Height Index and Waist/Hip Index. Conclusions. The results of the positive and negative likelihood ratios report sufficient prognostic efficiencies for the Waist/Height Index. On the other hand, the results of the positive and negative likelihood ratios report, respectively, insignificant prognostic efficiency and poor prognostic efficiency for the Waist/Hip Index.

Keywords: positive and negative likelihood ratios, anthropometric indices, overweight and obesity.

1 INTRODUCTION AND BACKGROUND

Overweight and obesity are two of the most frequent metabolic and nutritional disorders. They constitute an important public health problem in Mexico since they affect more than 30% of the adult population. Due to the high number of people who suffer from them and the risk involved in the biological, psychological and social spheres, as well as the physical disability they cause, they lead to a high percentage of increased risk of early mortality, also generating significant economic losses (1–3).

From an epidemiological approach, obesity can be considered as a risk factor for the development of some diseases, or as a disease in itself. Basically, the risk factors for the development of obesity are genetic, physiological and environmental, including unhealthy lifestyles. Non–healthy lifestyles are those that have the most influence as risk factors for the development or not of obesity (4–6).

There is no body composition estimation method that has sufficient statistical precision to be considered a reference method against which to validate other methods. For this reason, different methods coexist that present various advantages and disadvantages, selecting the researcher the one that best suits his needs. The most commonly used equations for estimating ideal body weight are Broca’s, Devine’s, Hamwi’s, Lemmens’, Lorentz’s, Miller’s, Metropolitan Life Insurance Company’s, Perroult’s and Robinson (7).

In the present study, the Equation of the Metropolitan Life Insurance Company (8) was used as a reference test or Gold Standard, which provides the ideal body weight for both genders: PCI= 50 [0.75 x (Height (cm) – 150)].

The objective of the present study was to determine whether or not each of the anthropometric indices Waist/Height Index and Waist–Hip Index have sufficient prognostic efficiency or, at least, moderate prognostic efficiency by combining sensitivity and specificity in a single expression using the ratios of positive and negative plausibility.
2 MATERIAL AND METHODS

– Epistemological approach

Quantitative, probabilistic or positivistic (9).

– Study design

Cross-sectional descriptive observational epidemiological study without directionality and with prospective temporality (10).

– Universe of study

The study was carried out in three hundred patients [119 (39.67%) of the male gender and 181 (60.33%) of the female gender] aged 18–64 years who attended for medical care (not control medical care) at the Integral Hospital "Jose Maria Morelos" of the Mayan municipality of Jose Maria Morelos, Quintana Roo, Mexico, in the period from August 1, 2018 to July 31, 2019.

Jose Maria Morelos is a town in the Mexican state of Quintana Roo, head of the municipality of Jose Maria Morelos. It is located in the interior of the state.

The current population of Jose Maria Morelos had its origin in the middle of the 20th century. It began as a camp that was dedicated to the exploitation of chicle and precious woods from the jungle that surrounds it. Most of its initial settlers were emigrants from other states of the country who arrived in Quintana Roo due to the promotion that the government gave to the colonization and economic development of the territory because it is located 50 km from Peto, Yucatan; it was initially known as Kilometer Fifty, a name by which it is still occasionally called.

In 1974, the municipality of Jose Maria Morelos was erected, becoming Kilometer Fifty in its head, for which it was elevated to the category of city and received the same name as the municipality, Jose Maria Morelos, in honor of the hero of the Independence of Mexico José María Morelos y Pavón.

Currently, Jose Maria Morelos is one of the main towns in the so-called Maya Zone of Quintana Roo; its main economic activities continue to be farming and forestry. The municipal territory is located in what was called the chiefdom of Cochuah upon the arrival of the conquerors of Yucatan at the beginning of the 16th century.

Jose Maria Morelos is one of the 11 municipalities of the Mexican state of Quintana Roo and one of the 7 municipalities with which the state of Quintana Roo was born in 1974. It is a border municipality with the states of Yucatan and Campeche. It is the only municipality in the state that does not have a maritime strip. Its surface is 6,739 km². It has a total of 64 communities and the main economic activities are agricultural such as agriculture, beekeeping, forestry and livestock.

The three green triangles that are in the lower part of the shield identify the countryside as the base of the economy, the wealth of flora and fauna in its jungles and exemplify the forest wealth of Quintana Roo. The flower is the Mayan Glyph of the Sun that indicates the origin of the Mayan population of the
municipality and also represents the agricultural economic activities of the municipality. The five grains signify the abundant production of their cultivated fields. This municipality is considered and operates as "The Granary of the State" because it has been characterized throughout its rich history as the main producer of a large part of the products of the field that the inhabitants of the State and the rest demand and consume. of the Yucatan Peninsula.

6.-JOSE MARIA MORELOS

José María Morelos is located in the interior of the state of Quintana Roo, in the central–western region, for which it is the only one of the 11 municipalities of Quintana Roo that does not have a coast; it limits to the east with the municipality of Felipe Carrillo Puerto and to the south with the municipality of Bacalar in the same state of Quintana Roo; to the west with the municipalities of Calakmul and Hopelchen in the state of Campeche and to the northwest with those of Tekax, Tzucacab and Peto in the state of Yucatan.

In the municipal seat there is a General Hospital; in Dziuche there is a Mayan doctor, the naturopathic doctor better known in the town as "the sorcerer" or "the black man"; it has a lot of popularity for being listed as excellent being visited by famous and famous people such as politicians and nationally renowned artists whom he has cured. The demarcation also has a hospital with doctors working 24 hours a day, as well as doctors with private hospitals and clinics.
In education, there are kindergartens with morning shifts, primary schools with morning and afternoon shifts in all communities, a general high school with morning and evening shifts in the municipal seat, a technical high school with morning shifts in Dziuche, and secondary schools. Tele–Secondary morning shift in the rest of the communities. It also has three High Schools (Jose Maria Morelos Plantel in the municipal capital with morning and evening shifts, Saban Plantel with morning shifts and Candelaria Plantel with morning shifts), an Agricultural Technological High School Center (CBTA) in Dziuche and a University that is the Universidad Intercultural Maya de Quintana Roo located in the municipal seat (https://es.wikipedia.org/wiki/Municipio_de_José_María_Morelos).

–Operational definitions of variables

—Ideal weight. Ideal weight is defined as the body weight that confers the longest life expectancy on a person. To calculate the ideal weight, various mathematical equations have been developed based on population studies. The most widely used predictive equations for estimating ideal body weight are Broca's, Devine's, Hamwi's, Lemmens', Lorentz's, Metropolitan Life Insurance Company's, Miller's, Perroult's and by Robinson. The values obtained from these predictive equations should be interpreted as indicative. Thus, the more variables the equation contemplates, the better it will estimate and the more it will adapt to the reality of each patient (9).

—Diagnostic test. Any more or less complex procedure that aims to establish in a patient the presence of a certain situation, supposedly pathological, that cannot be observed directly with any of the five senses (11).

—Reference test or Gold Standard. It constitutes the best existing diagnostic alternative to study a disease or event of interest in terms of sensitivity, specificity, safety, positive predictive value and negative predictive value; consequently, it is the best option to label patients with and without the disease or event of interest (8). Metropolitan Life Insurance Company equation: 50 [0.75 x (Height (cm) – 150)].

—Likelihood ratios. Likelihood ratios (LRs) are a valuable procedure for evaluating a diagnostic test. Likelihood ratios, also known as likelihood ratios (LR), probability ratios (PR) or prognostic efficiency ratios (PEI), combine sensitivity and specificity in a single expression. Likelihood ratios take positive and negative values. They offer the advantage over other indicators that they are not dependent on the prevalence of the disease in a population, or in a representative sample of a population. Each diagnostic test is characterized by two likelihood ratios: 1. The positive likelihood ratio; and 2. The negative likelihood ratio (12).

—Positive likelihood ratio. The positive likelihood ratio compares the probability that a sick patient will have a positive result in a diagnostic test (Sensitivity) versus the probability of obtaining a positive result in a healthy patient (the complement of specificity, that is, 1 − Specificity) (12). The positive likelihood ratio is calculated by dividing the probability of a positive result in sick patients by the
probability of a positive result in healthy patients. It is, consequently, the ratio obtained between the true positives (Sensitivity) and the false positives (1 – Specificity). It is always expressed as a proportion (up to tenths). The positive likelihood ratio responds to the following formula: Sensitivity / (1 – Specificity) \(\frac{11, 13}{11, 13}\).

—Negative likelihood ratio. The negative likelihood ratio is the ratio of the complement of the sensitivity to the specificity; the negative likelihood ratio assesses the contribution that a negative result makes to the NO–confirmation of the disease \(\text{14}\). The negative likelihood ratio is calculated by dividing the probability of a negative result in the presence of disease by the probability of a negative result in the absence of disease. Therefore, it is the ratio obtained between the false negatives (1 – Sensitivity) and the true negatives (Specificity). It is always expressed as a proportion (up to tenths). A positive likelihood ratio > 1 indicates that there is a high probability that the patient has the disease and the higher the value obtained, the greater the probability of having the disease \(\text{14}\). Conversely, a negative likelihood ratio < 1 decreases the probability that the patient has the disease or event of interest \(\text{11, 15–17}\).

—Waist/Height Index. For a long time, the Body Mass Index was the parameter par excellence used to assess cardiovascular risk and the nutritional status of people; however, over time, other indicators emerged, such as the Waist/Height Index, which today is considered more effective than the Body Mass Index. A recent study that analyzed data from nearly three thousand adults found that evaluating the relationship between waist and height is more effective than the Body Mass Index for knowing cardiovascular risk and, at the same time, easier because it is not even. It is necessary to have a scale or tape measure for its measurement. With a simple rope or a loop with which we can mark our height and by folding it in half we can know if we have more or less than half of our height as waist circumference. If the result of dividing our waist circumference (in cm) by our height (in cm) is greater than 0.5, it indicates the presence of a higher cardiovascular risk. The study found that 12% of people who had a Body Mass Index within normal values had a Waist/Height Index greater than 0.5, which indicated that they had too much fat concentrated in the abdominal area and this was associated with higher values of cholesterol \(\text{C}_{27}\text{H}_{46}\text{O}\) and glycosylated hemoglobin (HbA1c) which is linked to increased cardiovascular risk. These parameters were even lower in those with a high Body Mass Index who had a Waist/Height Index less than 0.5; therefore, it is believed that the Body Mass Index that does not evaluate the distribution of body fat can wrongly evaluate 12% of people at risk and that, therefore, the Waist/Height Index is more effective and more practical. In fact, we have known for a long time that visceral fat is more dangerous than that which accumulates in the gluteal–femoral region; therefore, visualizing where fat is stored in our body, regardless of our body weight, may be more valuable in assessing cardiovascular risk \(\text{18}\).

—Waist/Hip Index. The World Health Organization establishes normal values for the Waist/Hip Index \(\leq 1.00\) units for the male gender and \(\leq 0.80\) units for the female gender. Higher values indicate
abdominovisceral obesity, which is associated with increased cardiovascular risk and an increased probability of acquiring diseases such as hypertensive vascular disease and type 2 diabetes mellitus. The Waist/Hip Index is the ratio obtained by dividing the perimeter of the waist at the height of the last floating rib between the maximum perimeter of the hip at the level of the buttocks (15–19).

—Fagan’s nomogram. Fagan, in 1975, described a nomogram for Bayes’s theorem based on the ability to convert Bayes’s theorem to a simple linear summation function. The Fagan Nomogram has 3 columns: the first is the probability of having the disease before applying the test (prevalence); the second is the likelihood ratios; and the third is the posterior probability. A ruler draws a line between the preliminary probability and the likelihood ratios. The extension of this line cuts in the third column the probability of having the disease based on the test result. It is important to emphasize that the properties of the diagnostic test that allow us to quantify the magnitude and direction of the change from "pre-test" probability to "post-test" probability are the likelihood ratios. In practice, if we know or can determine the "pre-test" probability of a given disease or event of interest and we know the likelihood ratios of the diagnostic test, we can use the "Fagan Nomogram" to determine the "post-test" probability. In it, the left column represents the "pre-test" probability, the center column represents the likelihood ratios, and the right column the "post-test" probability. By drawing a straight line, the first two values are joined and we can thus determine the "post-test" probability. In this nomogram, the most significant changes in the probability of the disease or event of interest occur with diagnostic tests that have positive likelihood ratio values > 10.0 or negative likelihood ratio values < 0.1, which are usually very useful to confirm or rule out the determined disease or event of interest (20).

—Techniques and procedures

The data were collected in the Department of Clinical Records of the "Jose Maria Morelos" Integral Hospital in the Maya municipality of Jose Maria Morelos, Quintana Roo, Mexico. The Integral Hospital "Jose Maria Morelos" belongs to Sanitary Jurisdiction No. 3 of the Mexican state of Quintana Roo. Sanitary Jurisdiction No. 3 is located in the Mayan municipality of Felipe Carrillo Puerto.

—Data processing

In the preparation stage, the data was reviewed (information quality control); classified (on qualitative and quantitative scales); computerized (IBM SPSS Statistics 22 software was used); presented (in Tables and Graphs); and summarized (corresponding summary measures were used for data graded on qualitative and quantitative scales). In the analysis and interpretation stages, the data were analyzed and interpreted, respectively.

Two x two contingency tables were constructed from which the sensitivity, specificity, safety, the positive likelihood ratio with their corresponding estimation intervals at the 95% confidence level and the negative likelihood ratio with their corresponding intervals were calculated. Estimation intervals at the
95% confidence level for each of the two diagnostic tests. As a reference test, Gold Standard, the Equation of the Metropolitan Life Insurance Company (8) was used, which provides the ideal body weight for both genders.

\[
\text{PCI} = 50 [0.75 \times (\text{Height (cm)} - 150)]
\]

3 RESULTS

According to the reference test or Gold Standard (8), 171 (57.00%) patients were labeled with overweight and obesity and 129 (43.00%) patients without overweight and obesity. Of the 171 patients labeled as overweight and obese, 56 (32.75%) and 115 (67.25%) patients corresponded to the male and female genders, respectively. On the other hand, of the 129 patients without overweight and obesity, 63 (48.84%) and 66 (51.16%) patients corresponded, respectively, to the male and female genders.

Table 1 shows the absolute frequencies of the three hundred patients for positivity (Waist/Height Index > 0.5 units) and for negativity (Waist/Height Index ≤ 0.5 units) according to the diagnostic test Waist/Height Index and for overweight pathological nutritional situations and obesity according to the reference test or Gold Standard. Sensitivity, specificity, reliability, positive likelihood ratio and negative likelihood ratio corresponded, respectively, to 0.9357, 0.9302, 0.9333, 13.4 and 0.07.

<table>
<thead>
<tr>
<th>WAIST/HEIGHT INDEX (in units)</th>
<th>Benchmark Test or Gold Standard: Metropolitan Life Insurance Company Equation</th>
<th>Present</th>
<th>Absent</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivity &gt; 0.5</td>
<td></td>
<td>160 (52 ♂ y 108 ♀)</td>
<td>9 (1 ♂ y 8 ♀)</td>
<td>169 (53 ♂ y 116 ♀)</td>
</tr>
<tr>
<td>Negativity ≤ 0.5</td>
<td></td>
<td>11 (4 ♂ y 7 ♀)</td>
<td>120 (105 ♂ y 15 ♀)</td>
<td>131 (109 ♂ y 22 ♀)</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>171 (56 ♂ y 115 ♀)</td>
<td>129 (106 ♂ y 23 ♀)</td>
<td>300 (162 ♂ y 138 ♀)</td>
</tr>
</tbody>
</table>

♂ = Male gender; & ♀ = Female gender.

Source. Own elaboration

- Sensitivity = (A / (A + C)) = (160 / 171) = 0.9357 = 93.57%
- Specificity = (D / (B + D)) = (120 / 129) = 0.9302 = 93.02%
- Security = (A + D) / (N) = (160 + 120) / 300 = (280) / 300 = 0.9333 = 93.33%
- Positive likelihood ratio = Sensitivity / 1 – Specificity = 0.9357 / 1 – 0.9302 = 0.9357 / 0.0698 = 13.4 = Sufficient prognostic efficiency
- Negative likelihood ratio = 1 – Sensitivity / Specificity = 1 – 0.9357 / 0.9302 = 0.0643 / 0.9302 = 0.07 = Sufficient prognostic efficiency
The absolute frequencies of the 300 patients for positivity (Waist/Hip Index $\geq 1.01$ units in males and $\geq 0.81$ units in females) and for negativity (Waist/Hip Index $\leq 1.00$ units in males and $\leq 0.80$ units in female gender) according to the Waist/Hip Index diagnostic test and for pathological nutritional situations, overweight and obesity according to the reference test or *Gold Standard* are presented in Table 2. The sensitivity, specificity, safety, positive likelihood ratio and the negative likelihood ratio corresponded to 0.7193, 0.5814, 0.6600, 1.7 and 0.5, respectively.

Graph 1. "Preliminary" probability (left column), positive and negative likelihood ratios (middle column), and "posterior" probabilities (right column) for the Waist/Height Ratio diagnostic test according to Fagan's Nomogram.

**Positive test**
Positive likelihood ratio = 13.41
Posterior probability = 95%
Conclusion = Approximately 1 patient out of 1.1 with a positive test is sick.

**Negative test**
Negative likelihood ratio: 0.07
Posterior probability = 8%
Conclusion = Approximately 1 patient out of 1.1 with a negative test is healthy.
Table 2. Absolute frequencies of the three hundred patients by positivity (Waist/Hip Index ≥ 1.01 units in males and ≥ 0.81 units in females) and by negativity (Waist/Hip Index ≤ 1.00 units in males and ≤ 0.80 units in males). Female gender according to the Waist/Hip Index diagnostic test (in units) and by overweight and obesity pathological nutritional situations according to the reference test or Gold Standard. Jose Maria Morelos, Quintana Roo, Mexico.

<table>
<thead>
<tr>
<th>WAIST/HIP INDEX (in units)</th>
<th>Benchmark Test or Gold Standard: Metropolitan Life Insurance Company Equation</th>
<th>Overweight and obesity</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Positivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men ≥ 1.01</td>
<td></td>
<td>123 (8 ♂ y 115 ♀)</td>
<td>54 (27 ♂ y 27 ♀)</td>
</tr>
<tr>
<td>Women ≥ 0.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negativity</td>
<td></td>
<td>177 (35 ♂ y 142 ♀)</td>
<td></td>
</tr>
<tr>
<td>Men ≤ 1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women ≤ 0.80</td>
<td></td>
<td>123 (84 ♂ y 39 ♀)</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>300 (119 ♂ y 181 ♀)</td>
<td></td>
</tr>
</tbody>
</table>

♂ = Male gender; ♀ = Female gender

Source. Own elaboration

- Sensitivity = (A / A + C) = (123 / 171) = 0.7193 = 71.93%
- Specificity = (D / B + D) = (75 / 129) = 0.5814 = 58.14%
- Security = (A + D) / (N) = (123 + 75) / (300) = (198) / (300) = 0.6600 = 66.00%
- Positive likelihood ratio = Sensitivity / 1 – Specificity = 0.7193 / 1 – 0.5814 = 0.7193 / 0.4186 = 1.7 = Negligible prognostic efficiency
- Negative likelihood ratio = 1 – Sensitivity / Specificity = 1 – 0.7193 / 0.5814 = 0.2807 / 0.5814 = 0.5 = Low prognostic efficiency

Graph 2. "Preliminary" probability (left column), positive and negative likelihood ratios (middle column) and "posterior" probabilities (right column) for the Waist/Hip Ratio diagnostic test according to Fagan’s Nomogram.

Source. Table 2
Positive test
Positive likelihood ratio= 1.72
Posterior probability= 70%
Conclusion= Approximately 1 patient out of 1.4 with a positive test is sick.

Negative test
Negative likelihood ratio= 0.48
Posterior probability= 39%
Conclusion= Approximately 1 patient out of 1.6 with a negative test is healthy.

Table 3 and Graph 1 show the sensitivities, specificities, positive likelihood ratios, negative likelihood ratios and diagnostic capabilities according to tests (Waist/Height Index and Waist/Hip Index). The results observed for the positive likelihood ratios corresponded to 13.4 and 1.7 for the Waist/Height Index and Waist/Hip Index diagnostic tests, respectively. These results indicate sufficient (≥ 10.0) and insignificant (≥ 1.0) prognostic efficiencies, respectively. The results observed for the negative likelihood ratios corresponded to 0.07 and 0.5 for the Waist/Height Index and Waist/Hip Index diagnostic tests, respectively. The observed results indicate, respectively, sufficient (≤ 0.01) and poor (≤ 0.2) prognostic efficiencies.

Table 3. Sensitivities, specificities, positive and negative likelihood ratios and diagnostic capabilities according to tests (Waist/Height Index & Waist/Hip Index). Jose Maria Morelos, Quintana Roo, Mexico.

<table>
<thead>
<tr>
<th>Diagnostic tests</th>
<th>Sensitivities</th>
<th>Specificities</th>
<th>Positive likelihood ratio</th>
<th>Diagnostic capabilities</th>
<th>Negative likelihood ratio</th>
<th>Diagnostic capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist/Height Index (in units)</td>
<td>0.9357</td>
<td>0.9302</td>
<td>13.4</td>
<td>Sufficient</td>
<td>0.07</td>
<td>Sufficient</td>
</tr>
<tr>
<td>Waist/Hip Index (in units)</td>
<td>0.7193</td>
<td>0.5814</td>
<td>1.7</td>
<td>Negligible</td>
<td>0.5</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source. Own elaboration

Graph 3. Sensitivities, specificities, positive and negative likelihood ratios and diagnostic capacities according to tests (Waist/Height Index & Waist/Hip Index). Jose Maria Morelos, Quintana Roo, Mexico.
4 DISCUSSION

The results observed in the present study are consistent with the results observed by other authors (21).

The observed results indicate that the Waist/Height Index is the diagnostic test that has the greatest capacity to correctly identify those who do suffer from the disease (Sensitivity) (93.57%) and the greatest capacity to correctly identify those who do not suffer from the disease (Specificity) (93.02%). In addition, the Waist/Height Index is the diagnostic test that resulted with the greatest certainty (93.33%), that is, with the highest percentage of true positives and true negatives with respect to the total number of patients studied.

Two or more diagnostic tests can be combined to increase the sensitivity or specificity of the screening process. There are two main forms of combination: 1. Tests in parallel; and 2. Serial tests. With parallel diagnostic testing, the patient is labeled positive if he or she tests positive for any of the tests. When diagnostic tests are done serially, the patient is only labeled positive if he tests positive for all tests. The first approach (parallel testing) increases the sensitivity of diagnostic tests. The second approach (serial testing) increases the specificity of diagnostic tests (22). This is important, since instead of using a single diagnostic test, two or three diagnostic tests can be used in parallel to increase sensitivity, or two or three diagnostic tests can be used in series to increase specificity. Based on the observed results, it is concluded that the diagnostic test with the highest sensitivity (93.57%), the highest specificity (93.02%) and the highest security (93.33%) was the Waist/Height Index (in units).

Positive and negative likelihood ratio tests were performed to determine whether or not the tests have sufficient prognostic efficiency or at least moderate prognostic efficiency when combining sensitivity and specificity in a single expression. The result observed for the positive likelihood ratio test was 13.4 for the Waist/Height Index, which indicates sufficient prognostic efficiency. However, the observed result for the positive likelihood ratio test was 1.7 for the Waist/Hip Ratio, which indicates negligible prognostic efficiency (see Table 2).

The result observed for the negative likelihood ratio test was 0.07 for the Waist/Height Index, which indicates sufficient prognostic efficiency. However, the result observed for the negative likelihood ratio test was 0.5 for the Waist/Hip Index, which indicates poor prognostic efficiency (see Table 2).

Based on these results, the use of the Metropolitan Life Insurance Company Equation is recommended, which provides the ideal body weight for male and female genders, or the use of predictive or estimative equations (Broca, Devine, Lemmens, Lorentz, Miller, Perroult and Robinson) which also provide the ideal body weight for both genders (7).

Finally, the use of positive and negative likelihood ratios is recommended in order to jointly evaluate the sensitivity and specificity of any diagnostic test, which is generally not done.
REFERENCES


