Analysis Statistics in Practical Problems of Food Health

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Abstract

This study aimed at the application of dietary supplementation in elderly people and, after a period, to prepare a statistical diagnosis of before and after some dimensional information to verify the great influence of diet in these patients. In order to do so, statistical analyzes were used, which are important tools that allow us to perceive the transformations in different chronological periods. As a result, it was possible to verify the history of the patients that were being altered in the last months by the new food supplement implanted, having a statistical explanation besides the nutritional one. However, care has been taken to demonstrate how misunderstanding can hamper interpretation and originate erroneous information from work.

Keywords: Statistics, Nutrition, Statistics, Protein Supplementation and analysis.

Introduction

Sarcopenia is the loss of mass and strength in the skeletal muscles (such as biceps, triceps and quadriceps) with aging (SILVA, et al., 2006). The use of statistical methods for this study can be very beneficial for the monitoring of sarcopenia and how it develops with the application of certain diets.

According to Toledo and Ovalle (1985, p.13), they place the importance of statistics:

> "The use of statistics is increasingly accentuated in any professional activity in modern life. In its most diverse fields of activity, people are often in statistics, using it to a greater or lesser extent, because this is due to the many applications that the statistical method provides to those who need it."

Still in this context Vieira (2011, p.5), states that:

> "Learning to do statistical calculations using computer programs is not difficult, although it does require time, interest and attention. However, conducting and evaluating a research depends to a large extent on the researcher's knowledge of the potentialities and limitations of the techniques used. And between the calculation and the interpretation of the result there is a way to go."

Reflecting on the subject Toledo and Ovalle (1985, p.16), emphasize that:

> "In order to understand and understand the complexity that Statistics involve, they point out that any experimental science can not do without the techniques provided by Statistics, mentioning, for example, Physics, Biology, Business Administration, Economics, Psychology, Agronomy and others."

Statistic throughout history, as in other disciplines, originates in the beginnings of mankind. Among the Romans there was already the attempt of a systematic control of births and deaths; many centuries before, the Chinese demonstrated statistical intuitions, the same being true of the Egyptians, Persians, and other peoples of ancient times CASTRO (1967).

For Castro (1967, p.25) in his view on knowledge is:

> "The will to know is one of the congenital tendencies to the human being, who, seeing constantly around himself events whose greatness and whose cause he does not know, experiences a feeling of admiration and, consequently, of curiosity. With this, the Statistic, born of a compilation of numbers, does not have its own object, because it is an instrument and not an end."

For Karmel and Polasek (1970), Statistics deals with the collection, presentation, description and analysis of numerically measurable data and has a very broad field of application, but its basic principles and practice are independent of the field where it is applied.

The description of statistical data involves the calculation of measures that represent them, of which the most common is the mean and methods of analysis of statistical data are called Statistical Methods (KARMEL; POLASEK, 1970).

Given the relevance of Statistics to the development of several areas of knowledge, the study intends to contribute to the literature in calculating the implications of the hypercaloric diet on patients, comparing their values before and after the diet.

Firstly, a general analysis of the primary data collected was done, since the study is based on a nutritional analysis. Afterwards, the dispersions of the results were observed after the applied calculations, and finally, some demonstrations and interpretations were made regarding the obtained values.

The present study proposes to carry out statistical analyzes based on Measures of General Tendency, Measures of Dispersion and Test of Hypotheses that are important instruments that allow to realize the transformations in distinct chronological periods. That is, the study investigates the calculations performed and to what extent the results can be considered valid for the health area.

The work is divided into five more sections, in addition to the introduction. In the next section we approach statistical theory and how it relates in the area of health with the initial and final measurements of patients after applications of hypercaloric diets. Next, section 3 shows the methodology, which includes the description of the database and the procedures applied in the proposal. In the fourth section, the results are presented and a discussion is made of them and, finally, the final considerations and the references are presented.

Literature Review:
Statistics and the Health Area

This article seeks an association of statistical methods with a focus on food health. Through the same, it is sought to justify how the key answers are results of the application of the diet by statistical knowledge and with the aid of theoretical nutritional knowledge, because it is important the interaction between the two areas in this work. They will be used as Measures of Central Tendency, such as Dispersion Measures and Hypothesis Testing.

According to Hoffmann (2006), a measure of the central tendency of a set of data shows the value around which it is grouped as observation, while the total amplitude is a distinction between the highest and the lowest observed value. So the amplitude is one of the dispersion measures. The two times an effective data set is characterized.

According to Levin (1978), central tendency measure is a useful way of describing a group as a whole with only a single number representing a mean in that data set. The idea is that the new average is located around the middle or center of a distribution, where it holds the highest concentration of data.

In addition to a measure of central tendency, we need a measure of what is commonly called variability or dispersion that indicates the degree of dispersion of scores around the center of the distribution, that is, around the mean (Levin, 1978).

According to Levin and Fox (2004), a measure of central tendency, when used alone, gives only an incomplete picture of a data set, which can clarify, confuse or distort and therefore if variability measures such as variance and deviation standard, for example.

At the same time, the Hypothesis Test relates to the attempt to decide whether a parameter θ is in a subset of the parameter space or its complement. A statistical problem involves a parameter θ whose value is unknown but must be in a certain parameter space and can be partitioned, that is, divided into two subsets and the goal is to know which of them θ belongs (DEGROOT; SCHERVISH, 2012).

For Degroot and Schervish (2012), there are two choices: H_0 or H_1 and, since these subsets are disjoint, exactly one of the hypotheses H_0 or H_1 must be true, so a problem of this kind, in which there are only two possible decisions, is called the Hypothesis Testing Problem. A procedure to decide which hypothesis to choose is called a test procedure or simply a test. The hypothesis H_0 is called the null hypothesis and the hypothesis H_1 is called the alternative hypothesis.

Based on the results of a sample, Hoffmann (2006) states that it is not possible to make decisions to accept or reject H_0 so that they are definitely correct. However, one can calculate the probability that the decision taken is wrong.

According to Levin and Fox (2004), the null hypothesis is usually established with the intention of denying it, since most social researchers try to establish relations between variables, since these differences almost always provide the logical foundation of the research.

With this, we see the importance of Statistics in the study base and how it can aggregate in other areas such as health and how it influences, as it confirms in the literature its presence.

Research has concluded that from age 40 there is a 5% reduction in muscle mass every 10 years and that this percentage increases after 65 years of age (HAIRI N.N, et al., 2010).

With the implementation of a diet in the elderly in a certain period of time, it is necessary to be able to interpret the information after it is collected and use it in the most appropriate way possible, since the hypercaloric diet in the elderly provides the individual with a better nutritional status contributing to their quality of life. life, increased longevity, functional capacity and well-being (GRADIM; SOUZA; LOBO, 2007).

Methodology

Database

For the accomplishment of this work, a quantitative, descriptive statistical study was developed with the purpose of explaining the information collected before and after ingestion by elderly people of hyperprotein supplementation, since it was evaluated the supplementation in the elderly with the prevalence of sarcopenia.

The anthropometric data for the development of this article were measures of 26 elderly, 13 of the control group and 13 of the experimental group, residents of a philanthropic institution and who did not have associated serious pathologies.

In the control group, the anthropometric[3] data collected were: weight in kilograms (kg), Waist Circunference (WC), Hip Circunference (HP), Arm Circunference (AC) and Calves Circunference (CC), all circunferences unit in centimeters (cm).

It is observed the means of two normal distributions, assuming that it is the same population, but in two different moments: before and after a treatment of protein supplementation, since there is interest in verifying if the supplementation contributed to the average weight of the elderly and in their circumference measures, influencing their quality of life, ie if the mean weight and curvatures before treatment is less than the measurements after treatment, verifying if the diet has effect in the elderly.

Statistical Equations

The work consists of essential formulas of Statistics as standard deviation, variance and arithmetic mean, but only, with these calculations can not make effective decisions. Therefore, for more precise and specific calculations will be used the Test of Hypotheses, because in the study is required to make a decision, which configures a problem of Hypothesis Testing for Differences between Population Averages for paired data.

One of the suggestions will be to check if the average before is less than the average afterwards. The best reference is the definition of the hypotheses H_0, is that the supplementation has no effect, ie, the means before and after the treatment are equal, so the difference between the means must be assumed equal to zero, we will then have:

$$H0 : \mu d = 0, \quad \text{where } \mu d = \mu \text{ antes} - \mu \text{depois}$$

[3] Anthropometric Data: A set of data that study measurements and dimensions of the human body.

$$H1 : \mu d < 0$$

Confidence levels were tested as α = 0.10 and α = 0.05, but a confidence level of 0.20 (20%) was established, thus:

$$\alpha = 0{,}20 \quad 1 - \alpha = 0{,}80$$

For our test variable, we have a sample of only 13 elements. Since the sample has less than 30 elements the test variable that will be used will be the variable t_{n-1}, then the critical value, which is obtained in the Student t distribution table, will be:

$$t_{n-1}, \text{crítico} = t_{13-1}; 0{,}20 = t_{12}; 0{,}20 = -t_{12}; 0{,}80 = -1{,}356$$

This result tells us that for values higher than -1,356 H_0 is accepted (that is, supplementation does not take effect, difference between means is zero). If t_{n-1} for less than -1.356 we reject H_0 (the mean then increased too much in relation to the mean before the supplementation so that the difference is due only to chance.

With the values obtained from the samples of the elderly before and after the diet, the difference d_i between each pair of values is calculated, where:

$$d_i = X_{before} - X_{after}$$

It is necessary to calculate the standard deviation of the mean difference and also the value of the test variable, hence the calculation of d_i^2.

After the calculations, one decides to accept or reject H_0 and interpret the decision within the context of the work performed.

After this part of tests of differences between means, we will redo the calculations, but now for the measurements (WC), (HP), (AC) and (CC) alone.

The norms for the accomplishment of the work were in accordance with the rules established for the development of such and the data were collected through questionnaires. The data, for this work, after being collected were tabulated by the statistical analyzes as mean, variance and standard deviation with the help of spreadsheets developed in Excel 2010.

Results and Discussion

The studied population of 13 elderly people underwent a hyperproteic diet. The weights, in kilograms, before and after the test with the di odie calculations are given below.

ELDERLY (KG)	1	2	3	4	5	6	7	8	9	10	11	12	13
BEFORE	35	51	37	61	47	39	58	51	61	62	40	46	67
AFTER	36	47	34	61	48	43	58	50	61	61	42	43	68
d	-1	4,2	2,8	0	-1	-4	0	1,6	0	0,5	-2	3	-1
d^2	1	18	7,8	0	1	14	0	2,6	0,1	0,3	4	9	1

Performing the calculations for the mean difference (d) and the standard deviation of the mean difference (S_d).

$$d = \frac{\sum d_i}{n} = \frac{3{,}03}{13} = 0{,}2331\ kg$$

$$S_d^2 = \frac{\sum d_i^2 - [\frac{(\sum d_i)^2}{n}]}{n-1} = \frac{58{,}1109 - [\frac{(3{,}03)^2}{13}]}{13-1} = S_d^2 = 4{,}78 = S_d = 2{,}19\ kg$$

Calculating the value of the test variable, we have:

$$t_{n-1} = \frac{d}{(S_d/\sqrt{n})} = t_{13-1} = \frac{0{,}2331}{(2{,}19/\sqrt{13})} = t_{12} = \frac{0{,}2331}{(2{,}19/\sqrt{13})} = 0{,}3838$$

As previously seen, if the value of the test variable were less than -2,681 the hypothesis H_0 would be rejected, but:

$$t_{n-1} > t_{n-1,critical}: t_{12} > t_{12;0,20}: 0{,}3838 > -1{,}356$$

Another procedure is to calculate a confidence interval for the population mean μ and see that the interval includes the value 0 (zero) as a plausible value.

As n = 13, d = 0.2331 and S_d = 2.19 for the differences, then:

$$SE = \frac{S_d}{\sqrt{n}} = \frac{2{,}19}{\sqrt{13}} = 0{,}6074$$

And a - t value of 1.356 is obtained from column P = 0.20 and line r = n – 1 = 12. A confidence interval of 80% for μ is therefore:

(0.2331- 1.356, 0.6074; 0.2331 + 1.356, 0.6074) = (- 0.5905; 1.0567)

Thus, we accepted H_0 at 20% significance, thus, we concluded with 80% confidence (or a chance of error of 20%) that the diet did not contribute to the increase of the mean weight of the elderly.

Repeating the calculation for Waist Curvature (WC), the unit being in centimeters.

ELDERLY (WC)	1	2	3	4	5	6	7	8	9	10	11	12	13
BEFORE	90	82	83	95	92	79	102	75	95	95	67	92	90
AFTER	94	78	88	93	95	86	105	74	105	94	70	88	91
d	-4	4	-5	1,5	-3	-7	-3	1	-10	1	-3	4	-1
d^2	16	16	25	2,3	9	49	9	1	100	1	9	16	1

Performing the calculations for the mean difference (d) and the standard deviation of the mean difference (S_d).

$$d = \frac{\sum d_i}{n} = \frac{-24{,}5}{13} = -1{,}88cm$$

$$S_d^2 = \frac{\sum d_i^2 - [\frac{(\sum d_i)^2}{n}]}{n-1} = \frac{254,25 - [\frac{(-1,88)^2}{13}]}{13-1} = S_d^2 = 21,16 = S_d = 4,6cm$$

Calculating the value of the test variable, we have:

$$t_{n-1} = \frac{d}{(S_d/\sqrt{n})} = t_{13-1} = \frac{-1,88}{(4,6/\sqrt{13})} = t_{12} = \frac{-1,88}{(4,6/\sqrt{13})} = -1,47$$

As previously seen, if the value of the test variable were less than -1.356 the hypothesis H_0 would be rejected, but:

$$t_{n-1} < t_{n-1,critical}: t_{12} < t_{12;0,20}: -1,47 < -1,356$$

Another procedure is to calculate a confidence interval for the population mean μ and see that the interval includes the value 0 (zero) as a plausible value.

As n = 13, d = -1.88 and S_d = 4.6cm for the differences, then:

$$SE = \frac{S_d}{\sqrt{n}} = \frac{4,6}{\sqrt{13}} = 1,2758$$

And a t - value of 1.356 is obtained from column P = 0.20 and line r = n – 1 = 12. A confidence interval of 80% for μ is therefore:

(- 1.88 - 1.356. 1.278; - 1.88 + 1.356. 1.278) = (-3.60; - 0.1551)

Thus, we accepted H0 at 20% significance, thus, we concluded with 80% confidence (or a chance of error of 20%) that supplementation contributed to increase the mean weight of the elderly.

Repeating the calculation for the Curvature of the Hip (HP), the unit being in centimeters.

ELDERLY (HP)	1	2	3	4	5	6	7	8	9	10	11	12	13
BEFORE	95	84	98	98	93	86	91	91	98	99	80	85	92
AFTER	99	84	94	96	94	87	92	90	104	99	81	89	92
d	-4	0	4	2	-1	-1	-1	1	-6	0	-1	-4	0
d^2	16	0	16	4	1	1	1	1	36	0	1	16	0

Performing the calculations for the mean difference (d) and the standard deviation of the mean difference (S_d).

$$d = \frac{\sum d_i}{n} = \frac{-11}{13} = -0,846cm$$

$$S_d^2 = \frac{\sum d_i^2 - [\frac{(\sum d_i)^2}{n}]}{n-1} = \frac{93 - [\frac{(-0,846)^2}{13}]}{13-1} = S_d^2 = 7,74 = S_d = 2,78cm$$

Calculating the value of the test variable, we have:

$$t_{n-1} = \frac{d}{(S_d/\sqrt{n})} = t_{13-1} = \frac{-0{,}846}{(2{,}78/\sqrt{13})} = t_{12} = \frac{-0{,}846}{(2{,}78/\sqrt{13})} = -1{,}096$$

As previously seen, if the value of the test variable were less than -1.356 the hypothesis H_0 would be rejected, but:

$$t_{n-1} > t_{n-1,critical}: t_{12} > t_{12;0,20}: -1{,}096 > -1{,}356$$

Another procedure is to calculate a confidence interval for the population mean μ and see that the interval includes the value 0 (zero) as a plausible value.

As n = 13, d = - 0.846e S_d = 2.78cm for the differences, then:

$$SE = \frac{S_d}{\sqrt{n}} = \frac{2{,}78}{\sqrt{13}} = 0{,}7710$$

And a - t value of 1.356 is obtained from column P = 0.20 and line r = n - 1 = 12. A confidence interval of 80% for μ is therefore:

(– 0,846 – 1,356. 0,7710; – 0,846 + 1,356. 0,7710) = (–1,89; + 0,1995)

Thus, we accepted H_0 at 20% significance, thus, we concluded with 80% confidence (or a chance of error of 20%) that the diet did not contribute to the increase of the mean weight of the elderly.

Repeating the calculation for the Arm Curvature (AC), the unit being in centimeters.

ELDERLY (AC)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
BEFORE	95	22	25	34	25	23	27	28	28	28	19	22	30
AFTER	99	22	26	32	26	22	32	25	32	29	22	23	30
d	-4	0	-2	1,5	-1	0,5	-6	3	-4	-1	-3	-1	0,5
d^2	16	0	2,3	2,3	1	0,3	30	9	12	0,3	9	0,3	0,3

Performing the calculations for the mean difference (d) and the standard deviation of the mean difference (S_d).

$$d = \frac{\sum d_i}{n} = \frac{-13}{13} = -1{,}0cm$$

$$S_d^2 = \frac{\sum d_i^2 - [\frac{(\sum d_i)^2}{n}]}{n-1} = \frac{71 - [\frac{(-1{,}0)^2}{13}]}{13-1} = S_d^2 = 5{,}91 = S_d = 2{,}43cm$$

Calculating the value of the test variable, we have:

$$t_{n-1} = \frac{d}{(S_d/\sqrt{n})} = t_{13-1} = \frac{-1{,}0}{(2{,}43/\sqrt{13})} = t_{12} = \frac{-1{,}0}{(2{,}43/\sqrt{13})} = -1{,}48$$

As previously seen, if the value of the test variable were less than -1.356 the hypothesis H_0 would be rejected, but:

$$t_{n-1} < t_{n-1,critical}: t_{12} < t_{12;0,20}: -1,48 < -1,356$$

Another procedure is to calculate a confidence interval for the population mean μ and see that the interval includes the value 0 (zero) as a plausible value.

As n = 13, d = - 1.0 e S_d = 2.43cm for the differences, then:

$$SE = \frac{S_d}{\sqrt{n}} = \frac{2,43}{\sqrt{13}} = 0,6740$$

And a t - value of 1.356 is obtained from column P = 0.20 and line r = n - 1 = 12. A confidence interval of 80% for μ is therefore:

(– 1,00 – 1,356. 0,6740; – 1,00 + 1,356. 0,6740) = (–1,914; – 0,086)

Thus, we accepted H_0 at 20% significance, thus, we concluded with 80% confidence (or a chance of error of 20%) that the diet contributed to the increase of the mean weight of the elderly.

Repeating the calculation for the Calf Curvature (CC), the unit being in centimeters.

ELDERLY (CC)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
BEFORE	26,5	24	28	31	29	27	30	29	30	28	27	27	31
AFTER	30	24	28	31	29	27	27	29	35	30	28	28	32
d	-3,5	0	-0,5	-0,5	-0,5	0,5	3	-0,5	-5	-3	-2	-2	-2
d^2	12,3	0	0,3	0,3	0,3	0,3	9	0,3	20	6,3	2,3	2,3	2,3

Performing the calculations for the mean difference (d) and the standard deviation of the mean difference (S_d).

$$d = \frac{\sum d_i}{n} = \frac{-13,5}{13} = -1,04cm$$

$$S_d^2 = \frac{\sum d_i^2 - [\frac{(\sum d_i)^2}{n}]}{n-1} = \frac{55,75 - [\frac{(-1,04)^2}{13}]}{13-1} = S_d^2 = 4,64 = S_d = 2,15cm$$

Calculating the value of the test variable, we have:

$$t_{n-1} = \frac{d}{(S_d/\sqrt{n})} = t_{13-1} = \frac{-1,04}{(2,15/\sqrt{13})} = t_{12} = \frac{-1,04}{(2,15/\sqrt{13})} = -1,774$$

As previously seen, if the value of the test variable were less than -1.356 the hypothesis H_0 would be rejected, but:

$$t_{n-1} < t_{n-1,critical}: t_{12} < t_{12;0,20}: -1,774 < -1,356$$

Another procedure is to calculate a confidence interval for the population mean μ and see that the interval includes the value 0 (zero) as a plausible value.

As n = 13, d = - 1.04 and S_d = 2.15cm for the differences, then:

$$SE = \frac{S_d}{\sqrt{n}} = \frac{2,15}{\sqrt{13}} = 0,5974$$

And a - t value of 1.356 is obtained from column P = 0.20 and line r = n - 1 = 12. A confidence interval of 80% for μ is therefore:

(– 1,04 – 1,356. 0,5974; – 1,04 + 1,356. 0,5974) = (–1,85; – 0,23)

Thus, we accepted H_0 at 20% significance, thus, we concluded with 80% confidence (or a chance of error of 20%) that the diet contributed to the increase of the mean weight of the elderly.

Conclusion

In the present study studies were made on the intake of protein supplementation in the elderly and based on assumptions and or conjectures (statistical hypotheses) can be done through statistical calculations to better evaluate certain parameters. It is worth mentioning that keeping the same parameters as the confidence power increases, however the work was developed with 13 individuals. Even so, with the tests made and presented, a value of 80% of confidence was found which may already be decisive for a decision-making process.

On a decision-making process, it was proved that when the test variable was adopted a confidence interval was constructed, and with this, a test value greater than the level of significance (20%) was found. The higher the level of significance, the less chance of making a mistake and consequently the power of the test increases.

Unfortunately, due to the lack of resources, the sample can not be increased, and because of lack of resources it is not possible to apply protein intake for a longer time to patients. It is believed that the performance and quality of life of the elderly can be increased with protein intake even in a short time and sarcopenia can be stabilized at certain times.

The study of hypothesis testing is very important for decision-making by a nutritionist or a team of specialists who want to improve the quality of life of the elderly of an institution, for example, or even of a manager who needs analyzed data to make decisions about changing a diet or not. A decision-making of this magnitude needs precise calculations to prove that a change can or does not benefit the lives of many people, or even prevent illness, in the specific case of this work on the elderly.

The result obtained in this work was allowed to observe that with the hypothesis tests it is possible a decision making for the choice of protein intake even with a sample smaller than 30. They are of extreme importance for a better analysis and decision making and that will contribute to the muscular development of the patients considered as reference in the present study and can give credibility to the development of feeding practices for the elderly.

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