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CHARACTERIZATION OF DIET IN BIOCHEMICAL AND ANTHROPOMETRIC PROFILES WITH PRINCIPAL COMPONENT ANALYSIS IN OBESE PATIENTS, GUAYAQUIL - ECUADOR

CARACTERIZACIÓN DE LA DIETA EN PERFILES BIOQUÍMICOS Y ANTROPOMÉTRICOS CON ANÁLISIS DE COMPONENTES PRINCIPALES EN OBESOS EN GUAYAQUIL-ECUADOR

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ABSTRACT

Objectives: Determine the characterization of the diet in biochemical and anthropometric profiles with the analysis of the principal components in obese Ecuadorian patients. **Methods:** Descriptive, comparative, longitudinal studies; we had access to the institutional health clinical history database and a study group was formed, they were offered a low-carbohydrate diet. The sample consisted of 110 obese people from the Hospital of Guayaquil-Ecuador. **Results:** The patients were between the ages of 25 to 65 years. The results showed a significant loss of BMI (kg/m2) (Δ-2,6±1.9) (p<0,001), waist circumference (cm) (Δ-5,1±4,7) (p<0,001), body fat (%) (Δ-3,6±3,6) (p<0,001), triglycerides (mg/dL) (Δ-25,4±72,9) (p<0,001) and glucose (mg/dL) (Δ-6,8±9,6) (p<0,001). **Conclusion:** The low carbohydrate diet reduces BMI, waist circumference, body fat, triglycerides and glucose in obese patients.

Keywords: Diet, Anthropometry, Biomarkers, Obesity. (Source: MESH-NLM)

RESUMEN

Objetivos: Determinar la caracterización de la dieta en los perfiles bioquímicos y antropométricos con análisis de componentes principales en pacientes obesos ecuatorianos. **Métodos:** Estudio descriptivo, comparativo, longitudinal; se tuvo acceso a la base de datos de la historia clínica institucional y se conformó un grupo de estudio al que se les ofreció una dieta baja en carbohidratos. La muestra estuvo conformada por 110 obesos del Hospital de Guayaquil-Ecuador. **Resultados:** Los pacientes tenían edades entre 25 a 65 años. Se obtuvo un efecto significativo de pérdida de IMC (kg/m2) (Δ-2,6±1,9) (p<0,001), perímetro abdominal (cm) (Δ-5,1±4,7) (p<0,001), grasa corporal (%) (Δ-3,6±3,6) (p<0,001), triglicéridos (mg/dL) (Δ-25,4±72,9) (p<0,001) y glucosa (mg/dL) (Δ-6,8±9,6) (p<0,001). **Conclusión:** La dieta baja en carbohidratos reduce el IMC, el perímetro abdominal, la grasa corporal, triglicéridos y glucosa en los pacientes obesos.

Palabras claves: Dieta, Antropometría, Biomarcadores, Obesidad. (Fuente: DeCS- BIREME)

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INTRODUCTION

According to the World Health Organization [1], non-communicable chronic diseases cause the death of 41 million people each year, accounting for 71% of deaths and occurring in individuals aged 30 to 69 in low-to middle-income countries. In the Americas, non-communicable diseases (NCDs) account for 81% of all deaths, with 39% of them being premature deaths in individuals aged 30 to 70. The leading causes of death are cardiovascular diseases (34.9%), cancer (24.3%), diabetes (6.2%), and other causes (25.7%)[2].

Over the past decades, the prevalence of obesity has been on the rise, defined as having a body mass index (BMI) greater than 30 kg/m2, particularly in developing Western societies[3]. Obesity can generally be considered a chronic, progressive, and recurring disease [4], and a major risk factor for global mortality. Low-carbohydrate diets have been associated with favorable effects on cardiovascular risk factors and body weight [5,6]. Some research shows a direct association between low-calorie food intake and decreased risk of mortality, diabetes, inflammation, and other conditions [7], leading to a better proportion of calories from proteins and fats and improved satiety [8]. This would restore the metabolic inflexibility caused by the accumulation of fatty acids [9] and thus reduce the risk of developing non-communicable chronic diseases.

Low-carbohydrate diets have been used to treat obesity and type 2 diabetes mellitus for many years, and there is evidence regarding their safety and efficacy [10], although they have received little attention in clinical research studies until recently [11]. There are few studies on the effect of low-carbohydrate diets in obese patients. Therefore, the objective of this research is to determine the characterization of the diet in biochemical and anthropometric profiles using principal component analysis in obese patients from the city of Guayaquil, Ecuador.

METHODS

Design and Study Area

Descriptive, comparative, longitudinal study.

Study Location

Access was obtained to the database of the institutional medical records of obese patients attending the outpatient nutrition service of a hospital in the city of Guayaquil, Ecuador, in 2022. The study group consisted of patients who received a low-carbohydrate diet.

Population and Sample

The study population consisted of all male and female patients aged between 24 and 74 years attending the outpatient clinic of a hospital in Guayaquil, Ecuador, with a diagnosis of Obesity due to excess calories and other types of obesity. The sample comprised 110 patients, selected through convenience sampling.

Inclusion Criteria:

Patients attending outpatient clinics with overweight and obesity referred by other health units and from medical referrals with different hospital services. Patients with recorded anthropometric data including weight, height, BMI, waist circumference, and body fat percentage. Patients with recorded biochemical data including blood glucose and triglyceride levels. Patients who voluntarily agreed to participate in the study.

Exclusion Criteria

Patients with overweight and obesity who have a diagnosis of type 2 diabetes mellitus and other comorbidities not related to the study. Patients who declined to participate in the study.

Variables

Independent Variable: Low-carbohydrate diet, defined as a diet contributing <130g/d (12).

Dependent Variables: Anthropometric indicators including body mass index (BMI), with values of 25-29.9 kg/m2 indicating overweight and ≥30 kg/m2 indicating obesity according to the World Health Organization (1); abdominal circumference (cm) with normal values of <90 cm for men and <80 cm for women according to the International Diabetes Federation (IDF) criteria; body fat percentage calculated using equations: Men: 63 - (20 x height/circumference), normal range: 18-24; Women: 76 - (20 x height/circumference), normal range: 25-31. Biochemical indicators include triglycerides (mg/dl) and fasting blood glucose levels (mg/dl), analyzed using Trinder's colorimetric reagent kits[13].

Procedures

Data was collected from November 2021 to January 2022, including variables such as age and sex. The patients followed the low-carbohydrate diet for 3 months, and the data were recorded in an Excel file for subsequent analysis using RStudio and SPSS version 25.

Statistical Analysis

Statistical analysis was conducted using RStudio program. Descriptive analysis of the data was performed. Principal Component Analysis (PCA) was conducted using R programming environment version 3.5.1 and the libraries FactoMineR and factoextra[14] to simplify the set of interrelated variables and perform cluster analysis. Wilcoxon test was used to determine the effect of the low-carbohydrate diet on the biochemical and anthropometric indicators of Ecuadorian obese patients.

Ethical Considerations

Access to the database was obtained with informed consent from the highest authority of the Hospital in Guayaquil, Ecuador, and the study adhered to the principles established by the Helsinki Committee.

RESULTS

The participants consisted of 103 women (93.6%) and 7 men (6.4%) aged between 25 and 65 years. The individuals were analyzed for their correlation with the study variables (Figure 1), where it is observed that the cumulative variance percentage in the first two dimensions is 76.4%, which is considered adequate for interpreting PCA results. Dimension 1: The group of individuals including 109, 40, 54, 84, 68, 27, and 22 showed high values for body fat percentage, BMI, and waist circumference. The group including 50, 45, 32, 95, and 33 showed low values for waist circumference, BMI, body fat percentage, and triglycerides. Additionally, it can be observed that Dimension 1 is mainly represented by variables x1, x2, and x3.

Dimension 2: The group of individuals including 105, 36, and 47 showed high values for triglycerides, while the group including 50, 45, 32, 95, and 33 showed low values for waist circumference, BMI, body fat percentage, and triglycerides. Overall, Dimension 2 is mainly represented by variables x4 and x5.

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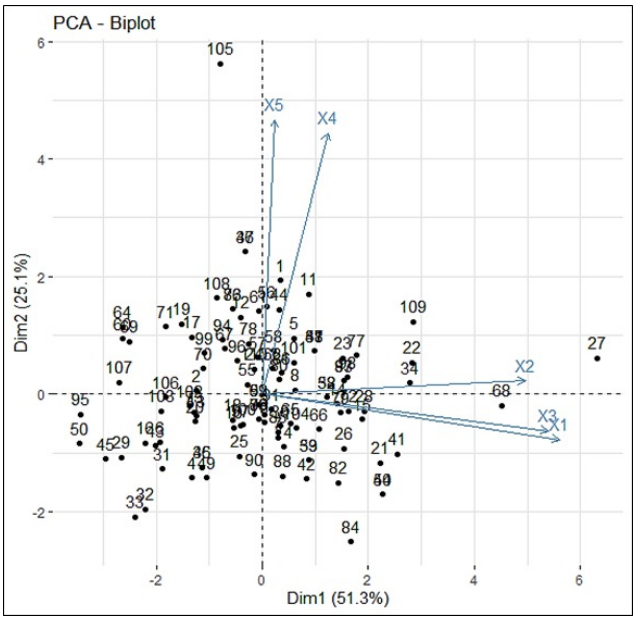

Figure 1. Individual Analysis

Note: X1: IMC (kg/m2), X2: Waist circumference (cm), X3: Body fat percentage (%), X4: Triglycerides (mg/dL), X5: Glucose (mg/dL)

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Regarding the hierarchical classification, three groups were obtained (Figure 2). The first group consists of individuals such as 32, 45, 50, 60, 64, and 95. This group is characterized by low values for waist circumference (before and after treatment), body fat percentage (before and after treatment), BMI (before and after treatment), triglycerides (before and after treatment). The second group consists of individuals such as 1, 4, 36, 44, and 105. This group is characterized by high values for triglycerides and glucose, and low values for BMI (before and after treatment). Lastly, the third group consists of individuals such as 27, 34, 68, and 84. This group is characterized by high values for BMI (before and after treatment), body fat percentage (before and after treatment), and waist circumference (before and after treatment).

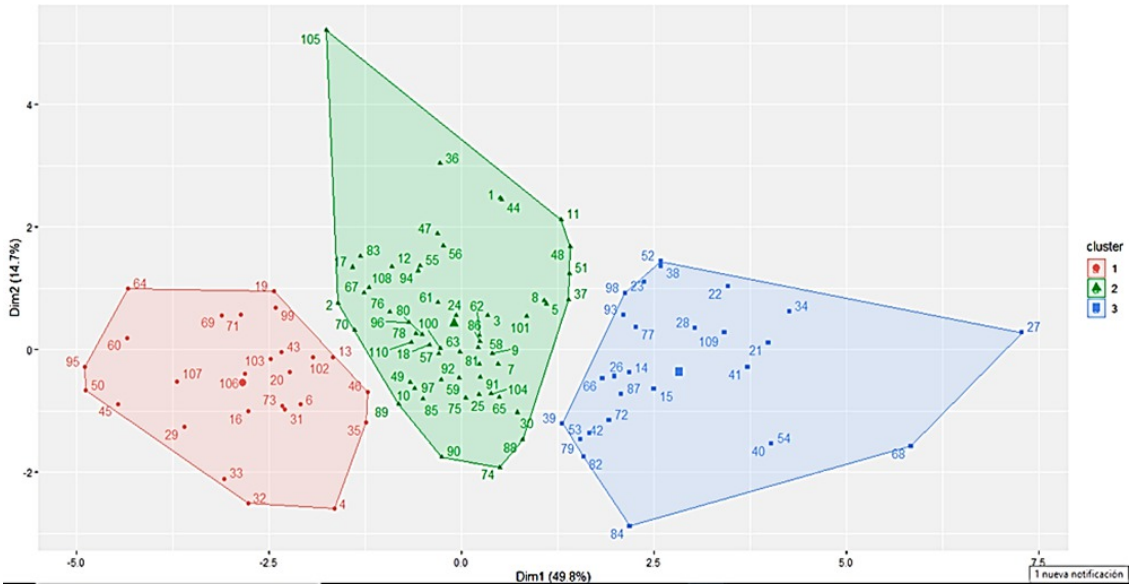

Figure 2. Hierarchical Classification of Clusters.

In Figure 3, it is shown that 86.36% of the patients experienced significant changes in the Quetelet index over the three-month period, as indicated in Figure 3.

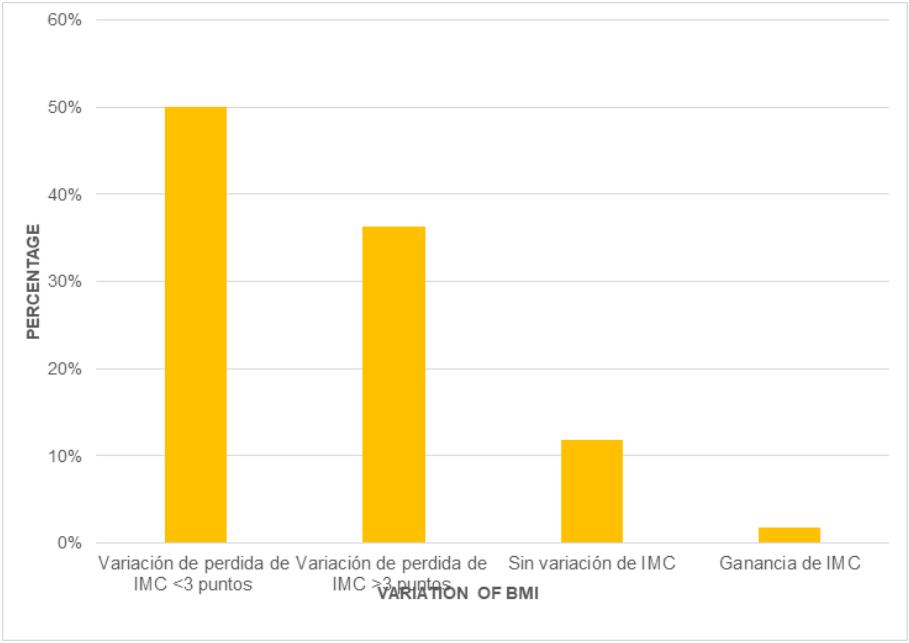

Figure 3. BMI Loss Variation in obese patients over 3 months.

In Figure 4, it can be observed that the values of BMI, waist circumference, body fat, triglycerides, and glucose decrease hen comparing the medians before and after the low-carbohydrate diet.

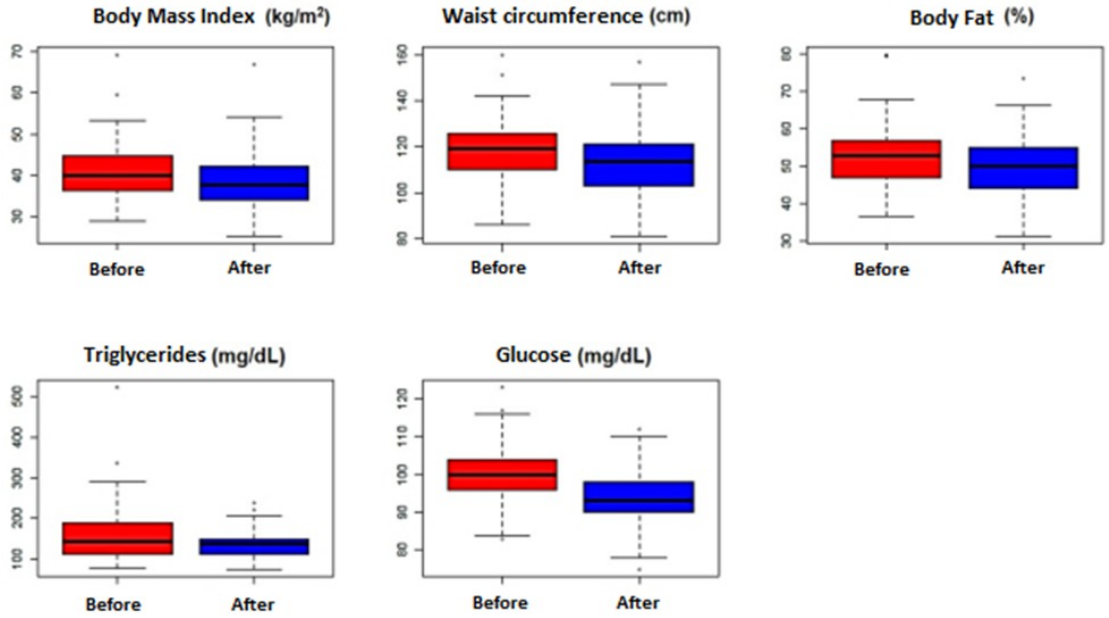

Figure 4. Diagram of variables before and after the carbohydrate diet.

The Wilcoxon test, a non-parametric statistic, was used to compare the means of the study variables and determine if there were significant changes before and after the low-carbohydrate diet treatment. It can be observed that the changes occur at a significance level of 5% in obese patients (Table 1).

Table 1. Results of the Wilcoxon test for the study variables before and after.

Variables	Initial	Final	Difference	p-value
BMI (kg/m2)	40.7 ± 6.7	38.1± 6.8	2.6±1.9	0.000
Waist circumference (cm)	118.1 ± 13.2	112.9 ± 13.6	5.1±4.7	0.000
Body fat percentage (%)	52.9 ± 7.7	49.4 ± 7.7	3.6±3.6	0.000
Triglycerides (mg/dL)	161.8 ± 66.4	136.4 ± 31.3	25.4±72.9	0.002
Glucose (mg/dL)	100.3 ± 7.2	93.5 ± 7.7	6.8±9.6	0.000

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DISCUSSION

The research demonstrated that a low-carbohydrate diet over a period of 3 months resulted in decreased levels of triglycerides, BMI, waist circumference, body fat, and glucose in obese patients. Other studies conducted in obese individuals also showed significant changes in biochemical parameters such as triglycerides, cholesterol, and weight loss after consuming a low-carbohydrate diet for 6 to 12 months [15,16,17] . Similarly, Gordillo et al.[18] found significant reductions in BMI and waist circumference in individuals at risk of diabetes who followed a low-carbohydrate diet for 6 months, which aligns with the results observed in obese patients over a 3-month period.

Although nutrition is a modifiable risk factor, many individuals with obesity do not adhere to dietary recommendations due to eating habits that are associated with emotional aspects and eating disorders [19]. Additionally, the availability and access to food, particularly processed products, contribute to increased consumption of foods high in simple sugars and saturated fats, which are associated with overweight, obesity, and the risk of morbidity and mortality from chronic degenerative diseases. This consumption increases the risk of overweight, obesity, hypertension [20,21,22], and a high prevalence of metabolic syndrome associated with the consumption of ultra-processed foods [23].

On the other hand, a study by Krebs et al. found that diabetic patients who followed a low-carbohydrate, high-fat diet for 24 weeks experienced significant weight loss [24,25] and improvements in biochemical parameters such as triglycerides and glucose [24], which is consistent with the findings of the current study involving obese patients on a low-carbohydrate diet for 3 months. Similarly, a retrospective study of a group of obese patients with diabetes mellitus who switched from a high-carbohydrate diet (55-60%) to a diet consisting of 20% carbohydrates, 30% protein, and 50% fat showed significantly superior results after 6 months of treatment [26].

Another study identified a significant reduction in triglyceride levels after 3 months of low-carbohydrate diet treatment in diabetic patients [27], similar to the results observed in our study involving obese patients over a 3-month period. Currently, dietary recommendations for individuals with obesity are not being followed or adhered to. The effect of a low-carbohydrate diet is important due to its greater adherence and association with a lower risk of cerebrovascular diseases [28], while a diet that induces increased glucose levels is associated with a higher risk of coronary heart disease [29]. Weight gain also increases vulnerability to chronic diseases, leading to disability and a decrease in life expectancy [30].

The study did not record the physical activity levels of the patients, which may introduce bias, as patients may have engaged in physical activity with the intention of losing weight. The results may not be generalizable to other contexts and populations.

STUDY LIMITATIONS

One of the limitations is the lack of measurement of visceral fat, as a high percentage of visceral fat is associated with a greater risk of developing cardiovascular diseases.

CONCLUSION

A low-carbohydrate diet over a 3-month period significantly reduces both anthropometric and biochemical parameters, with 86% of patients experiencing significant changes.

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