Anthropometric parameters, glycemia level and chronotype of adults from Popayan-Colombia

Parámetros antropométricos, nivel de glicemia y cronotipo de adultos de Popayán-Colombia

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Abstract

The university adult population shows health difficulties related to their glucose level and variations in the sleep-wake relationship, which an early diagnosis will allow preventive actions, for which we seek to identify the association of anthropometric parameters, blood glucose level and chronotype of adults from the city of Popayán-Colombia; Through a correlational descriptive study with 182 university adults between 36 and 68 years old, evaluating anthropometric parameters, determining the chronotype with the Horne-Ostberg questionnaire and measuring capillary glycemia. In the same way, normality analysis and verification of the correlation were performed using the Pearson statistic coefficient ($p < 0.05$). As results, normality of the anthropometric parameters was found, with indication of pre-diabetics, and an intermediate chronotype, the correlation analysis showed moderate associations of the glycemia levels with the anthropometric parameters, but low association with the chronotype. It was possible to conclude that the women presented alterations in blood glucose levels as with the Body Adiposity Index, with intermediate chronotype registration.

Keywords: Anthropometry, glycemia, chronotype, adults.

Resumen

La población adulta universitaria evidencia dificultades de salud relacionadas con su nivel de glucosa y variaciones en la relación sueño-vigilia, lo que un diagnóstico temprano permitirá realizar acciones preventivas, para lo cual se buscó identificar la asociación de parámetros antropométricos, nivel de glicemia y cronotipo de adultos de la ciudad de Popayán-Colombia; a través de un estudio descriptivo correlacional con 182 adultos universitarios entre 36 a 68 años, evaluando parámetros antropométricos, determinación del cronotipo con el cuestionario de Horne-Ostberg y medición de la glicemia capilar. De la misma manera se realizaron análisis de normalidad y verificación de la correlación mediante el coeficiente el estadístico de Pearson ($p < 0.05$). Como resultados se encontró normalidad de los parámetros antropométricos, con indicación de pre-diabéticos, y un cronotipo intermedio, el análisis de correlación mostró asociaciones moderadas de los niveles de glicemia con los parámetros antropométricos, pero baja asociación con el cronotipo. Se pudo concluir que las mujeres presentaron alteraciones en los niveles de glicemia como con el Índice de adiposidad corporal, con registro de cronotipo intermedio.

Palabras clave: Antropometría, glicemia, cronotipo, adultos.

Introduction

The health of the university adult population is influenced by numerous actions related to lifestyles (Sánchez-Ojeda & De Luna-Bertos, 2015). These include a range of components many of which associated with living conditions or individual patterns of behavior (García-Laguna et al., 2012). Food is thus a determining parameter and mediator of the health-disease process, an aspect today considered of vital importance from the field of public health (Valdés-Badilla et al., 2017).

The World Health Organization (WHO) reports that the rate of overweight and obesity has increased worldwide. Indicators from 2016 establish that "more than 1.9 billion adults aged 18 years or older were overweight, of which more than 650 million were obese". In Colombia there is no evidence that things are, otherwise, which allows us to assert that there is a latent risk in terms of health (Ríos-García et al., 2013).

The disorders associated with overweight, and obesity are varied and include different aspects, not only psychological in nature but physical and metabolic (Rodríguez-Flores, M., 2014). It has thus been shown that overweight and obesity are generating alterations in the sleep-wake relationship (Salin-Pascual, 2015), leading to disturbances associated with the response of the body, specifically in the nervous and cardiovascular systems, where the processing of fundamental hormones (insulin, glucagon, growth hormone, leptin) triggers a series of mechanisms that affect health (Gómez-Abellán et al., 2012 and Tan et al., 2017).

The use of anthropometric measurements is important today in establishing the presence of overweight or obesity (Tanaka et al., 2016), but the novelty focuses on the distribution that houses adipose tissue and more in adults (Neefs et al., 2019). The use of new indices therefore allows making further projections on the distribution of body fat and its impact on health, allowing the correlation to be established as to the risk of the population of diseases such as diabetes, since this disease is a pathology of high mortality and more and more is associated with obesity (Han et al., 2017).

Moreover, it shows up as reduced sleep time in adulthood (Kani et al., 2016) due in part to the different responsibilities not only of a work nature, but also related to work, the family and the social sphere. Research has established that the wake-sleep relationship tends to decrease with age (García Naveira et al., 2015), facts linked to a greater risk of increasing the epidemiological incidence of obesity and resistance to insulin (Marcadenti et al., 2017). A shorter sleep duration generates activation of the sympathetic nervous system - adrenocorticoid activity - which rises, leading to an alteration in insulin sensitivity. Furthermore, studies with workers indicate that nocturnal food consumption also leads to an energy imbalance that promotes body weight gain (Nuñez, 2014).

Teachers undoubtedly develop a sedentary lifestyle due to their academic work (Bauman et al., 2012). This leads to a predisposition to overweight and obesity, associated in turn with metabolic diseases, classifying them as an at-risk population (Molano-Tobar et al., 2017), Their dedication is not only restricted to class hours. Their work forces them to allocate time to study, usually corresponding to the evenings or early mornings. This, added to stressful situations, can trigger health problems.

The above suggests that the sleep-wake relationship is of fundamental importance for human health; more so in this population. Hence the need to find out more about this process and how the lack of sleep, or an increase in sleep might contribute to obesity and to insulin resistance (Koren et al., 2015). It was therefore established as an objective to identify the association between anthropometric parameters, glycemia levels and chronotypes of university adults.

Methodology

The study was cross-sectional and used the descriptive-correlational method.

Participants

The sample was intentional with a total of 182 university professionals - 100 women and 82 men - from a Public Higher Education Institution (PHEI) in Popayán, a city in southwestern Colombia. The inclusion criteria corresponded to being adults over 18 years of age, university lecturers with a full-time indefinite contract at the PHEI, who do not show any kind of musculoskeletal or mental illness and decide to take part in the entire fieldwork process.

Instruments and Procedures

The survey used compiled general data such as age, sex, socioeconomic stratum - for Colombia this is related to family income level - and medical personnel supporting the project. Evaluation of the anthropometric and biochemical parameters was carried out. For the anthropometric aspects, the standards of the International Society for the Advancement of Kineanthropometry described by Pérez et al., (2012) were taken into account in measuring height and body weight. To obtain the body mass index it was ensured that the person was in light clothing without shoes, removing all kinds of metal objects or jewelry that could interfere with the results. Body weight was measured on an OMRON bioelectrical impedance balance (model HBF-514C), which passes a 50 kHz current; height was assessed with a Seca portable stadiometer with a range 0-205 cm and precision 1 mm. The indications of the WHO were taken into account for the classification that included the ranges malnutrition, normal, overweight and obesity (Resolution 2465, 2016).

One of the parameters evaluated was circumference of the waist, measured on the largest circumference that passes anteriorly through the navel and laterally through the upper edge of the iliac crests (Martín-Castellanos et al., 2017). From these direct measurements, waist-hip ratio was established, which according to WHO classification determines risk for men, greater than 0.90, and for women, greater than 0.80 (Paternina-de la Ossa et al., 2018). Body adiposity index was also measured (BAI) using the formula (Fedewa et al., 2018):

$$\frac{\text{Circunference of waist}}{\text{Height} \times \sqrt{\text{Height}}}$$

The blood glucose sample was taken after fasting for a minimum of eight hours. A capillary blood sample was drawn taking into account the glucose levels during fasting of ≥ 110 mg/dl, with a glucose meter and EasyGluco test

strips, and this was classified according to the standards of the American Diabetes Association (Real de Asua et al., 2014).

To determine the chronotype, the Horne-Ostberg questionnaire was used. This contains 19 questions (in which an option must be selected) such as "What time would you get up in conditions of absolute freedom to organize your day?", "What time would you go to bed in conditions of absolute freedom to organize your day?" and "Once you wake up, how alert do you feel during the first half hour?". At the end, the resulting points are totaled and result in a classification according to the ranges: 59 - 86 morning-type or morning lark, 42 - 58 intermediate-type and 16 - 41 evening-type or night owl (Valladares et al., 2016).

Data analysis

The Statistical Package for Social Science® software, version 24 (SPSS; Chicago, IL, USA) was used for statistical analysis. The Kolgomorov-Smirnov statistic was used to identify the normality of the sample. Basic statistical methods were applied. Continuous values were expressed as mean (±) standard deviation and proportions in percentages. Analysis of variance (ANOVA) was performed to study chronotype differences, while correlational analyzes were done using the Pearson correlation coefficient considering a level of statistical significance of $p < 0.05$.

Ethical considerations

The study was approved by the ethics committee of the PHEI and conducted in compliance with the ethical-legal standards set forth in the Helsinki Declaration for studies conducted with humans, such as resolution 8439 of 1993 of the Ministry of Health and Social Protection of Colombia. All participants gave and signed their informed consent prior to the explanation of the objectives and management of the confidentiality of the data of the participants in the study, according to resolution 1581 of 2012 in Colombia.

Results

Population characteristics

The sample corresponded to 182 adult teachers of a PHEI, comprising 100 women (54.89%) and 82 men (45.1%), with a mean age of 51.15 ± 5.21 years. As regards the sociocultural part, it was found that the adults live to a great extent in socioeconomic stratum 4 (47.8%), followed by 3 with 36.5%. On observing marital status, it could be seen that most were in a free union relationship (33.5%) or married (26.4%).

In relation to marital status and sex, it was found that of the women, the majority were married (n = 33), while for the men, a high percentage lived in a free union (n = 36).

Anthropometric Characteristics

It was possible to establish, as shown in Table 1, the descriptions of each variable, showing some general measures with a tendency to normality. Additionally, most variables showed a statistical significance of relevance for the study.

Table 1. Anthropometric characteristics of the adult university population

Anthropometry	Mean ± DE	Range	P<0.05
Body weight (Kg)	66.09±10.95	46 - 97	P = 0.891
Body size (mt)	1.63±0.08	1.43 - 1.91	P = 0.000
BMI (kg/mt2)	24.85±3.69	17.3 - 41.7	P = 0.05
Waist circumference (cm)	77.45±10.35	51 - 106	P = 0.000
Hip circumference (cm)	94.83±9.06	65 - 140	P = 0.000
Waist hip ratio	0.81±0.075	0.64 - 1.05	P = 0.000
Body adiposity index	19.37±5.71	6.50 - 38.60	P = 0.782

The previous variables subjected to an analysis in relation to sex made it possible to determine that the BMI that prevailed corresponded to normality in 57.1% and overweight was found in the general population in a percentage of 32.4%. Distribution according to sex is shown in Table 2.

Table 2. Distribution of BMI according to sex in the adult university population

SEX		Frequency	Percentage	Valid percentage	Accumulated percentage
FEMININE	Normal	51	51.0	51.0	51.0
	Overweight	35	35.0	35.0	86.0
	Obesity-I	12	12.0	12.0	98.0
	Obesity-2	2	2.0	2.0	100.0
	Total	100	100.0	100.0	
MALE	Normal	53	64.6	64.6	64.6
	Overweight	24	29.3	29.3	93.9
	Obesity-I	5	6.1	6.1	100.0
	Total	82	100.0	100.0	

For circumference of waist, 93.9% of the men were found to have low risk parameters and the rest in substantially increased risk (4.9%). Women, meanwhile, although found in greatest concentration in the low risk bracket (55%), some were found to fall into the substantially increased risk category (27%) as well as the increased risk one (18%).

On evaluation of the waist-hip ratio, it was possible to determine that men were not at risk (89%), while 54% of women did show risk.

Body adiposity index (BAI) was another indicator for body composition taken into account, revealing that the population was located between the standards of low for women (n = 61) and healthy for men (n = 71).

Regarding blood glucose, the population had a mean of 103.60 ± 14.79 mg/dl, with 48.4% being considered as prediabetic and 44.5% normal according to the classification of the American Diabetes Association (ADA). Regarding association with sex, these presented more normal ranges in men (n = 45) while in women only 37 fell in the normal range. In contrast, it was established that the prediabetes bracket contained 53 women and only 35 men, moreover, revealing in the population that the ranges of 10 of the women established them as diabetic, but only two men.

It was established that university adults had a chronotype according to the proposed scale of intermediate type (65.4%). The other parameter that scored well was moderate morning-type (29.7%), where the average of the sample corresponded to 55.41 ± 7.40. The relationship with sex showed that women tend to be more intermediate-type (n = 70) - in other words they adapt easily to morning or night - while men had values between intermediate-type (n = 49) and moderate morning-type (n = 26).

Relationships with moderate and low indicators were identified as shown in Table 3. These revealed that glycemia is a variable associated with the anthropometric measurements proposed for this study.

Table 3. Result of the Pearson correlation of the crossing of the study variables

Variables	R-value	P-value	Correlation
Glycemia/BAI	0.583	0.000	Moderate
Blood glucose/Waist	0.500	0.000	Moderate
Glycemia/Hip	0.493	0.000	Moderate
Glycemia/BMI	0.490	0.000	Moderate
ICC/Gender	0.426	0.000	Moderate
BAI/Gender	- 0.313	0.000	Short
Chronotype/ Glycemia	0.237	0.001	Short
BAI/aGE	0.212	0.004	Short
Chronotype / Gender	- 0.550	0.005	Moderate

Discussion

The study identified that university adults show conditions related to the middle class, which for Colombia indicates that they live in houses with public services and a certain comfort that allows them to develop as people and individuals. This is related to studies such as that of Querales. et al., (2012), indicating that the lower socioeconomic strata are linked with low quality and short sleep duration. This is because many of the people located in these low strata need not only one job, but several, and the working day stretches through the whole weekend, contrary to the adults in this study, who work only during the week, an observation that merits future research on aspects of work.

The data showed that most university adults are in common-law or married relationships, consistent with national and international studies (Fhon et al., 2016) stating that after middle age, the population has formed bonds and established a family or couple. Prevalence of cohabitation as a couple was also established. Studies mention that having a partner somehow reinforces confidence and tranquility, reflecting in the gain of some anthropometric measurements such as the incidence of sedentary lifestyle (Laclaustra et al., 2014). This too might constitute a perspective of future research.

As regards anthropometric parameters, the population in general were normal for BMI, but when relating this to sex, women showed diverse variations in the BMI items. This is verified by the national survey of health generated in 2010 by the National Administrative Department of Statistics (DANE, from the Spanish acronym) in Colombia (Bravo et al., 2013), showing that women tend to be overweight and obese (Alencar et al., 2016), reaffirming what was mentioned in other studies carried out with Latin American women (Blümel et al., 2015), which indicate this prevalence and allow association with this study.

The presence of adiposity in the waist and hip, with the relationship that occurs with the BMI, allows us to indicate the close association with cardiovascular risk, showing that on increasing the measurements in the waist and hip areas, a risk is established for women over men, finding similarity with the study by Urquidez-Romero et al., (2016), indicating that these events predict the progression of future chronic diseases and their direct association with metabolic syndrome.

In this study it was clearly demonstrated that women showed higher indicators in the waist-hip ratio, in agreement with the study by Alvim et al., (2014), which establishes that this is a better predictor than BMI, associating it with type 2 diabetes mellitus. As could be seen, the association of these parameters (waist-hip) showed moderate correlations with glycemia in the university adults, allowing a positive evaluation of the risk of the population and being able to establish the health risk for women. In this same sense, Silva et al., (2014) suggest that an increase in abdominal fat is associated with insulin resistance, high blood pressure and other cardiovascular pathologies, making it an economical and easy method to perform to determine the obesity epidemic and the distribution of abdominal fat.

The BAI is a relatively new indicator for evidence of adiposity. In the study it was discovered that the population in this item was in low i.e. healthy conditions. According to the data, its association with the circumference of the waist and the hip could be demonstrated, a fact that gives an additional possibility - to observe the distribution of body fat and its association with diseases such as hypertension, diabetes and cardiovascular diseases (Taing et al., 2016); this was confirmed by Chen et al., (2018) indicating high

sensitivity when compared to kidney diseases as well as cardiovascular and cerebrovascular risk. One of the existing concerns today on the part of obesity relates to the diseases derived from it, such as insulin resistance, hypertension, or cardiovascular diseases. For this study it was estimated that the adult university population showed a classification of prediabetes and normality, which is consistent with Latin American studies that state the increasing probability of the disease (Lizarazu-Diazgranados et al., 2013), conditioning it more in workers, due to their work rhythms, diet and physical activity.

The moderate correlation found in this study with waist and hip circumference allows us to determine that adipose tissue affects insulin production, causing the adipocyte to become a gland that produces hormones such as leptin, tumor necrosis factor and resistin, among others (Evans et al., 2016), which determine the presence of diabetes. Complementing with studies by Reuter et al., (2013), they specify the prevalence of glycemia alterations in the female gender, which is associated with the physiological changes of sex and the activation of adipose tissue differentiation pathways and the production of inflammatory cells, such as macrophages, that increase the possibility of harboring more adipose tissue in the waist and hip areas (Ortiz et al., 2017).

The above forms the foundation of the relationship of human beings with the biological clock, which mediates the activation or inhibition of different hormones. The study revealed that university adults have a tendency towards intermediate-type, contrary to the research by Valladares et al., (2016), who found a prevalence of evening-type; just as it did not show a correlation according to sex, although this was able to be associated in this study.

Analyzing the population of women, a higher prevalence was found for the intermediate type. This can be explained from the point of view that women, having responsibilities at home and at work, have generated adaptations in their sleeping and eating schedules, causing alterations in the dynamics of daily life (Souza et al., 2012). This further results in changes in the distribution of the meal time and in the time dedicated to it, preventing the absorption of food, changes such as the alteration in hormonal production for the optimal development of the circadian rhythm (Moreno et al., 2015).

The previous correlation found between glycemia and chronotype differs from those put forward by Gómez-Abellán et al., (2012) who specify that alterations in sleep time "show an alteration in glucose tolerance and a decreased insulin response resulting in increased plasma glucose".

One of the limitations of the study is the cross-sectional type of the research, which does not reveal the cause and effect of adiposity as regards the circadian rhythm. Although it does allow establishing new measurements in relation to adiposity, it is necessary to implement equipment that allows the real differentiation and distribution of body fat. In light of this, other research could be directed to the type and time of feeding with metabolic and hormonal aspects of the circadian rhythm.

Conclusions

The adult university population was found to have a strong correlation between adiposity and the glycemia parameters, determining that overweight and obesity in this population could be a risk factor in the future. Similarly, a low association was observed between the blood glucose levels with chronotype, which leads to the search for new paths and other methodologies for their study.

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