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ORIGINAL

Values of body roundness index according different sociodemographic characteristics and healthy habits in caucasians

Valores del índice de redondez corporal según diferentes características sociodemográficasy hábitos saludables en los caucásicos

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Abstract

Introduction: Obesity is a chronic disease characterized by an increase in fat mass and consequently by weight gain. The increase in the prevalence of obesity implies an increase in the prevalence of several obesity-related comorbidities. Several indices have been developed to determine obesity. The BRI is a new index to assess obesity. So far, only a few studies have been done using BRI. To learn more about this new index, a study is proposed whose objective was to analyze, in a large population, the relationship between a new index to assess obesity, the LBBB, and different sociodemographic parameters and healthy habits.

Methods: Descriptive and cross-sectional study in 60,799 Caucasian adult workers in which the BRI (Body Roundness Index) has been evaluated as a measure of obesity and its relationship with different parameters of age, sex, social class and educational level and healthy habits such as tobacco consumption. physical activity, dietary consumption of fruits and vegetables, and alcohol consumption.

Results: Male sex, age 50 years and older, social classes II-III, non-university studies, smokers, poor diet and low physical activity increase the risk of presenting elevated BRI, the highest OR being for alcohol consumption OR: 75.77 (73.98-77.56) in women and OR: 80.65 (79.71-81.58) in men, and not physical exercise with OR: 8.97 (8.49-9.46) in women and OR: 11.02 (10.53-11.52) in men.

Conclusion: Unhealthy habits, especially alcohol consumption and a somewhat less low level of physical activity and unhealthy eating, greatly increase the risk of developing high LBBB values.

Keywords: Obesity, alcohol consumption, unhealthy habits, physical activity.

Resumen

Introducción: La obesidad es una enfermedad crónica que se caracteriza por el aumento de la masa grasa y, en consecuencia, por el aumento de peso. El aumento de la prevalencia de la obesidad implica un aumento de la prevalencia de varias comorbilidades relacionadas con la obesidad. Se han desarrollado varios índices para determinar la obesidad. El BRI es un nuevo índice para evaluar la obesidad. Hasta ahora, sólo se han realizado unos pocos estudios con el BRI. Para conocer mejor este nuevo índice, se propone un estudio cuyo objetivo fue analizar, en una población amplia, la relación entre un nuevo índice para valorar la obesidad, el BRI, y diferentes parámetros sociodemográficos y hábitos saludables.

Métodos: Estudio descriptivo y transversal en 60.799 trabajadores adultos caucásicos en el que se ha evaluado el BRI (Índice de Redondez Corporal) como medida de obesidad y su relación con diferentes parámetros de edad, sexo, clase social y nivel educativo y hábitos saludables como el consumo de tabaco, actividad física, consumo dietético de frutas y verduras y consumo de alcohol.

Resultados: El sexo masculino, la edad de 50 y más años, las clases sociales II-III, los estudios no universitarios, los fumadores, la mala alimentación y la baja actividad física aumentan el riesgo de presentar un BRI elevado, siendo la OR más alta la del consumo de alcohol OR: 75,77 (73,98-77,56) en mujeres y OR: 80,65 (79,71-81,58) en hombres, y la del ejercicio físico no con OR: 8,97 (8,49-9,46) en mujeres y OR: 11,02 (10,53-11,52) en hombres.

Conclusión: Los hábitos poco saludables, especialmente el consumo de alcohol y un nivel algo menos bajo de actividad física y una alimentación poco saludable, aumentan en gran medida el riesgo de desarrollar valores elevados de BRI.

Palabras clave: Obesidad, consumo de alcohol, hábitos no saludables, actividad física.

Introduction

Obesity is defined as a chronic disease characterized by an increase in fat mass and consequently by an increase in weight[1]. Due to continuous increase in prevalence in all ages and its serious health consequences[2], obesity has become one important public health problem.

In worldwide more than a billion adults are overweight and 300 million of them are obese. In Spain, according to the National Health Survey of 2017, obesity affects 17,4% of the adult population (18% of men and 16% of women) and if added also the percentage of overweight affect a 54,57%[3].

The increase in prevalence of obesity involves an increase in the prevalence of several obesity-related comorbidities[4-6]. Among others, adiposity is supposed to be the physiological characteristic of obese and overweight individuals, which puts such individuals at-risk for cardiovascular disease[7-8]. In fact, the relationship between overall adiposity and risk for cardiovascular disease is well documented[9-10]. Furthermore, several studies, including the Framingham heart study[11], shows the relation between the adipose tissue accumulation and the incidence of adverse metabolic events and, also, with a higher risk for developing metabolic diseases[12-14]. Obesity also increases the risk of diabetes and certain types of cancer[15].

In addition to the consequences of their illness on the health of individual, it has been estimated that obesity and the diseases related to it, are a health cost of 2% to 7%[16].

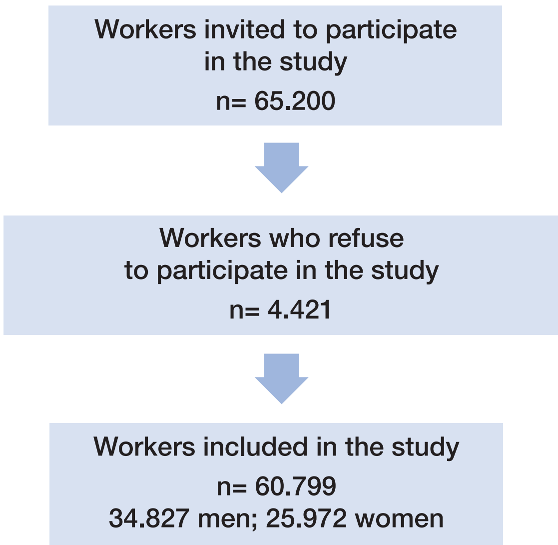
Several indices have been developed for determining obesity. Among others, the body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WtHR). The BMI is the most widely used and accepted index for classifying overweight and obesity in clinical practice[17]. However, BMI presents some important and well documented limitations, such as: a different behavior in men and women, limited usefulness in children and athletes, differences between ethnic groups and especially in determining the composition and distribution of body fat, which can represent a limitation in epidemiological studies or clinical practice. Among other errors, the above indicated limitations could lead to classify individuals with high muscle mass as overweight or obese. On the other hand, subjects with BMI in the normal range may have a high percentage of fat. In last years they have emerged new indices to determine obesity, among them we can highlight the body adiposity index (BAI) and the body roundness index (BRI). The BAI was developed by Bergman et al[8] in African Americans and Mexican Americans and is determined from measurements of hip circumference and height. This index showed a high correlation with the measured body fat using DXA (r = 0.85; p <0.001). However, a recent study in Spanish Mediterranean population suggested that BAI does not exceed the limitations of BMI[18]. The BRI is a new index to value the obesity, was developed in 2013 by Thomas et al[19] and to estimate waist circumference and height are needed. BRI values range from 1 to 16, and rounder individuals tend to have large values. Up to now, only a few studies have been conducted using the BRI. To know more this new index is proposed a study whose objective was to analyze, in a large population, the relationship between a new index to value the obesity, the BRI, and different socio demographic parameters as age, gender, social class and educational level and healthy habits as tobacco consumption, physical activity, dietary consumption of fruits and vegetables and alcohol consumption.

Material and methods

Subjects and Study Protocol

A cross-sectional study with Caucasians adult workers (ages, 20-69 years) was performed. All subjects were from Russia and belong to different productive sectors. Participants in the study were systematic selected during their work health periodic examination between January and December 2019. Every day each worker was assigned a number and half of the examined workers were randomly selected using a random number table. Thus, from a total population of 130.487 workers, 65.200 of them were invited to participate in the study. 4.421 (6.8%) refused to participate, being the final number of participants 60.799 (93.2%), with 25.972 women (42.7%) and 34.827 men (57.3%).

Figure 1



The mean of age of participants in the study was 39.98 years (SD±10.36). All participants were informed of the purpose of this study before they provided written informed consent to participle. Following the current legislation, members of the Health and Safety Committees were informed as well. The study protocol was in accordance with the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee. After acceptance, a complete medical history, including family and personal history was recorded.

Inclusion criteria:

- Age between 18 and 69 (working age population),
- Agreement to participate in the study and to be gainfully employed.
- Subjects who did not meet any of the inclusion criteria and those who refused to participate were excluded from the study.

Measurements and Calculations

All anthropometric measurements were made in the morning, after an overnight fast, at the same time (9 a.m.), and according to the recommendations of the International Standards for Anthropometric Assessment (ISAK)[20]. Furthermore, all measurements were performed by well trained technicians or researchers to minimize coefficients of variation. Each measurement was made three times and the average value was calculated. Weight and height were determined according to recommended techniques mentioned above. Body weight was measured to the nearest 0.1 kg using an electronic scale (Seca 700 scale, Secagmbh, Hamburg). Height was measured to the nearest 0.5 cm using a stadiometer (Seca 220 (CM) Telescopic Height Rod for Column Scales, Seca gmbh, Hamburg). BMI was calculated as weight (kg) divided by height (m) squared (kg/m^2). Criteria to define overweight were the ones of the World Health Organization (WHO)21 which considers obesity when BMI ≥ 30 kg/m^2. Abdominal waist was measured using a flexible steel tape (Lufkin Executive Thinline W 606). The plane of the tape was perpendicular to the long axis of the body and parallel to the floor. Waist circumference was measured at the level of the umbilicus and the superior iliac crest. The measurement was made at the end of a normal expiration while the subject stood upright, with feet together and arms hanging freely at the sides. Waist circumference (WC) circumference (HC) was measured using a tapeline at the level midway between the lateral lower rib margin and iliac crest as well as at the levels of trochanters. WHtR was calculated by dividing WC by height in cm.

The BRI was calculated using the equation 364.2-365.5 x $\sqrt{1-((WC/2\pi)^2/(0.5\ \text{height})^2)}$ developed by Thomas et al19 The cut off for normal and abnormal values was calculated with ROC curve.

Venous blood samples were taken from the antecubital vein with suitable vacutainers without anticoagulant to obtain serum. Blood samples were taken following a 12 h overnight fast. Participants were seated at rest for at least 15 minutes before blood samples were taken. Serum was obtained after centrifugation (15 min, 1,000 g, 4°C) of blood samples. Serum was stored at -20°C and analyses were performed within 3 days. Concentrations of glucose, cholesterol and triglycerides were measured in serum by standard procedures used in clinical biochemistry laboratory.

Blood pressure was determined after a resting period of 10 minutes in the supine position using an automatic and calibrated sphygmomanometer. As indicated for the anthropometrical measures, blood pressure was measured three times with a one-minute gap between each measurement and an average value was calculated.

For social class, the 2011 National Classification of Occupations (CNO-11) was used with the proposal made by the social determinants group of the Spanish Society of Epidemiology[22], classifying in 3 categories: Class I: Directors/managers, university professionals, athletes, and artists; Class II: Intermediate occupations and self-employed workers without employees; and Class III: Unskilled workers.

Smoking, diet, and physical activity were assessed by clinical interview. Tobacco was considered a dichotomous variable, being able to have the value of yes/no. A smoker was the person who had regularly consumed at least 1 cigarette/day (or the equivalent in other types of consumption) in the previous month or had stopped smoking less than a year before. Healthy eating included a daily consumption of vegetables and fruits; physical activity was considered adequate when performing at least 30 minutes a day or 150 minutes a week of moderate intensity aerobic physical activity or 75 minutes a week of vigorous activity.

Quantification of consumption in standard drinking units is currently the reference method at all levels of care. Assessment of consumption in standard drinking units allows a rapid quantification of consumption and its easy conversion into grams of pure alcohol[23]. The value of standard drinking units in Russia is set at 10 g of alcohol and is equivalent to one consumption of wine (100 ml), champagne (100 ml), or beer (200 ml) and half a consumption of spirits or mixed drinks (25 ml). If a man exceeds 35 standard drinking units in a week and a woman over 20 in a week, there is a significant risk to their long-term health[24].

Statistical Analyses

All the data were tested for their normal distribution (Kolmogorov-Smirnov test). Results are expressed as means and standard deviations (SD) and, when required, in percentages. Student t test for unpaired data was used to evaluate differences in anthropometric and biochemical characteristics between genders. Chi-square test was used for the difference of proportions.

The statistical method of ROC curves (Receiver operating characteristic) curves were used to determine BRI discriminatory capacity of obesity). Cutoff values were derived mathematically from the ROC curves. Statistical analysis was carried out using IBM SPSS Statistics 20.0 software (SPSS/IBM, Chicago, IL, USA). Significance was accepted at p<0.05.

Results

The sociodemographic, analytical and clinical characteristics of the population are shown in **table I**.

The mean BRI values increase with age in both sexes. There is also an increase in the BRI in the most disadvantaged social classes and the lower the level of studies. People with a healthy diet and who do physical activity regularly have lower mean LBBB values. All data is presented in **table II**.

The **figure 1** shows the area under the BRI curve for both men and women to detect obesity, establishing the cut-off points:

- Men cut-off 3.84 (sensitivity 0.762 specificity 0.762 Youden index 0.524.
- Women cut-off 3.17 (sensitivity 0.793 specificity 0.793 Youden index 0.586

In **table III** we observe that the prevalences of high BRI values in both sexes follow a similar trend to that observed with the mean values, that is, there is an increase in prevalence as age increases and as social class decreases. and the level of studies. Higher prevalences are also observed in people with unhealthy habits (smokers, poor diet and low level of physical activity). In all cases, as shown in **table III**, the prevalences are higher in men.

In the multivariate analysis using binary logistic regression, male sex, age 50 years and older, social classes II-III, non-university studies, smokers, poor diet and low physical activity were established as covariates. **Figure 3** shows how all the covariates increase the risk of presenting elevated BRI, the highest OR being for alcohol consumption and not physical exercise.

Table I: Sociodemographic, analytical and clinical characteristics of the population.

Characteristics	Women (n=25972)	Men (n=34827)	Total (n=60799)	p-value
Age (years)	39.45 ± 10.17	40.38 ± 10.48	39.98 ± 10.36	<0.0001
Weight (kg)	161.29 ± 6.52	81.28 ± 13.89	168.48 ± 9.23	<0.0001
Height (cm)	65.05 ± 13.08	173.85 ± 7.05	74.35 ± 15.75	<0.0001
BMI (kg/m²)	25.03 ± 4.91	26.88 ± 4.23	26.09 ± 4.63	<0.0001
Waist circumference (cm)	75.39 ± 9.82	88.58 ± 9.69	82.95 ± 11.73	<0.0001
Waist-to-height ratio	0.47 ± 0.06	0.51 ± 0.06	0.49 ± 0.06	<0.0001
Systolic BP (mmHg)	114.59 ± 15.11	125.35 ± 15.68	120.75 ± 16.33	<0.0001
Diastolic BP (mmHg)	70.43 ± 10.41	76.00 ± 10.84	73.62 ± 11.01	<0.0001
Total cholesterol (mg/dl)	192.97 ± 36.39	196.89 ± 38.69	195.22 ± 37.77	<0.0001
HDL-C (mg/dl)	54.97 ± 9.17	50.50 ± 7.61	52.41 ± 8.60	<0.0001
LDL-C (mg/dl)	120.47 ± 36.89	121.78 ± 37.25	121.22 ± 37.10	<0.0001
Triglycerides (mg/dl)	87.87 ± 45.96	125.30 ± 88.76	109.31 ± 75.88	<0.0001
Glycaemia (mg/dl)	85.21 ± 15.08	90.62 ± 21.20	88.31 ± 19.02	<0.0001

Table II: Values of BRI according sociodemographic variables and healthy habits by sex.

	Women	Men	Total	
Characteristics	Mean ± SD	Mean ± SD	Mean ± SD	p-value
20-29 years	2.48 ± 0.95	3.14 ± 0.93	2.84 ± 0.99	<0.0001
30-39 years	2.67 ± 1.08	3.45 ± 1.06	3.11 ± 1.13	
40-49 years	3.02 ± 1.25	3.75 ± 1.13	3.43 ± 1.24	
50-59 years	3.27 ± 1.26	4.00 ± 1.21	3.72 ± 1.28	
60-69 years	3.35 ± 1.22	4.10 ± 1.19	3.83 ± 1.26	
Social class I	2.53 ± 1.02	3.52 ± 1.09	2.94 ± 1.16	<0.0001
Social class II	2.91 ± 1.35	3.67 ± 1.15	3.29 ± 1.31	
Social class III	2.90 ± 1.09	3.60 ± 1.13	3.34 ± 1.16	
Elementary	3.02 ± 1.21	3.60 ± 1.12	3.41 ± 1.19	<0.0001
High School	2.75 ± 1.15	3.63 ± 1.16	3.16 ± 1.24	
University	2.52 ± 1.03	3.57 ± 1.11	2.96 ± 1.18	
Non smokers	2.89 ± 1.19	3.65 ± 1.12	3.32 ± 1.21	<0.0001
Smokers	2.77 ± 1.15	3.53 ± 1.14	3.23 ± 1.20	
Physical activity	2.30 ± 0.63	2.99 ± 0.65	2.67 ± 0.72	<0.0001
Non physical activity	3.45 ± 1.34	4.10 ± 1.19	3.85 ± 1.29	
Correct feeding	2.31 ± 0.62	2.99 ± 0.65	2.66 ± 0.72	<0.0001
Non correct feeding	3.40 ± 1.35	4.02 ± 1.20	3.79 ± 1.29	
Non alcohol consumption	2.74 ± 1.06	3.37 ± 0.96	3.08 ± 1.05	<0.0001
Alcohol consumption	4.39 ± 1.61	4.90 ± 1.11	4.78 ± 1.27	

Figure 1: ROC curve.

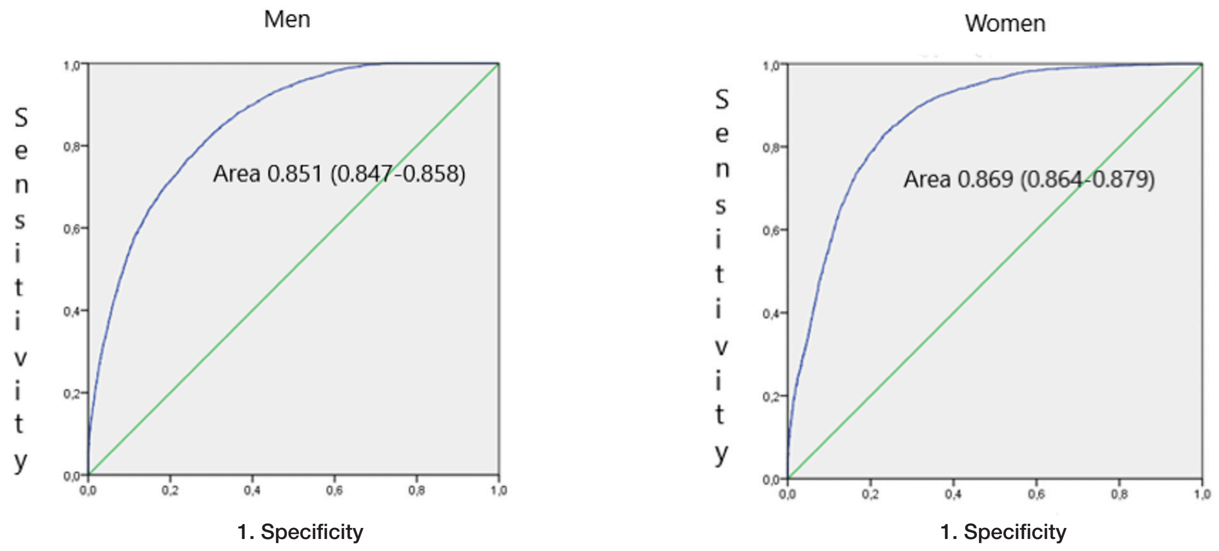
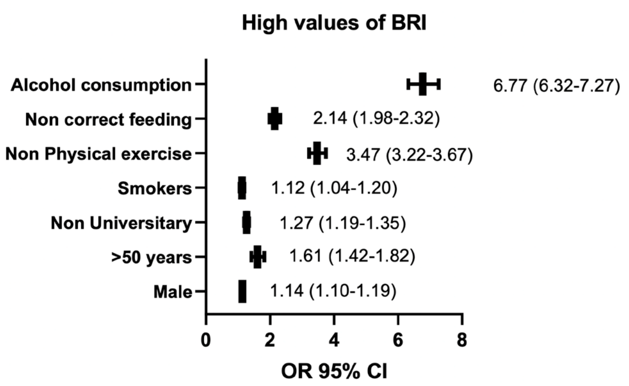


Table III: Prevalence of high values of BRI according sociodemographic variables and healthy habits by sex.

	Women			Men		
	n	High BRI	p-value	n	High BRI	p-value
Social class I	3670	18.88 (17.62-20.15)	<0.0001	2582	32.26 (30.46-34.07)	<0.0001
Social class II	8482	29.68 (28.70-30.65)		8173	36.46 (35.42-37.51)	
Social class III	13820	31.68 (30.90-32.45)		24071	34.22 (33.62-34.82)	
Elementary	12240	34.98 (34.13-35.82)	<0.0001	23670	34.60 (33.99-35.20)	<0.0001
High School	10517	25.65 (24.82-26.49)		8882	34.83 (33.84-35.83)	
University	3215	18.94 (17.59-20.30)		2274	33.73 (31.78-35.67)	
20-29 years	4950	17.01 (15.96-18.06)	<0.0001	5892	18.11 (17.13-19.09)	<0.0001
30-39 years	8435	23.71 (22.80-24.62)		11019	28.41 (27.56-29.25)	
40-49 years	7840	34.38 (33.32-35.43)		10399	39.22 (38.28-40.15)	
50-59 years	4096	42.75 (41.23-44.27)		6339	49.65 (48.41-50.88)	
60-69 years	651	46.08 (42.24-49.92)		1177	53.56 (50.50-56.21)	
Non smoker	17541	30.85 (30.16-31.53)	<0.0001	22081	36.16 (35.49-36.76)	<0.0001
Smoker	8431	31.82 (30.89-32.76)		12745	36.97 (36.16-37.78)	
Physical activity	12410	51.34 (50.46-52.22)	<0.0001	19483	53.17 (52.47-53.87)	<0.0001
Non physical activity	13562	8.97 (8.49-9.46)		15343	11.02 (10.53-11.52)	
Correct feeding	12829	49.88 (49.01-50.75)	<0.0001	20870	50.46 (49.78-51.13)	<0.0001
Non correct feeding	13143	9.05 (8.56-9.54)		13956	10.89 (10.37-11.41)	
Non alcohol consumption	23768	24.90 (24.35-25.45)	<0.0001	28011	23.40 (22.90-23.89)	<0.0001
Alcohol consumption	2204	75.77 (73.98-77.56)		6815	80.65 (79.71-81.58)	

Figure 3: Binary logistic regression.



Discussion

Our results show a higher prevalence of BRI in men compared to women, which is consistent with studies carried out by other authors[25]. The mean values of systolic and diastolic blood pressure were also higher for men than for women, which was to be expected due to the hormonal effect that progesterone and estrogens produce on the regulation of blood pressure in women[26].

We found that unhealthy eating habits are associated with a higher percentage of BRI in both sexes with a small, albeit positive, effect of healthy eating on BRI, which is consistent with the study by Ching et al conducted in Malaysia. Although in this study what was valued was the percentage of metabolic syndrome between vegetarians and non-vegetarians, in the latter a lower percentage of obesity was revealed[27]. These vegetarian diets are more similar to healthy eating patterns characterized by the consumption of foods high in vitamins, minerals, antioxidants, fiber, MUFA (monounsaturated fatty acids) and n-3 fatty acids. In fact, greater adherence to healthy dietary patterns is associated with a lower risk of glucose intolerance, weight gain, inflammation, insulin resistance, and a higher level of HDL cholesterol[28].

In our study, alcohol appears as one of the unhealthy lifestyle habits that is most related to obesity. Taking into account that 1 gram of alcohol provides 7.1 kcal and that the energy created by alcohol is added to that of other foods, the energy increase from alcohol consumption can produce a positive energy balance with weight gain[29]. In addition, different studies support the fact that habitual alcohol consumption modifies dietary intake and this is dose dependent. This effect on diet affects the intake of specific macronutrients differently. Thus, when alcohol consumption is related to higher dietary intake, the most frequent is fat and protein intake and, less frequently, carbohydrate intake[30].

Physical exercise promotes the reduction of body fat and the increase of lean mass. Aerobic exercise is the most recommended; however, the addition of resistance exercises is essential to increase strength and prevent loss of fat-free mass[31]. In our work, the lack of physical exercise on a regular basis is the second cause that is most related to a high BRI value. Although the way to evaluate the amount of fat tissue is different from that of other studies, our results coincide with these, finding a higher proportion of fat tissue in those with a low level of physical activity[32].

In our literature search, we have not found in the different databases studies examining the influence of sociodemographic variables on BRI values, therefore we can not compare our results with those obtained by other authors. Regarding healthy habits and their influence on BRI values, Sánchez et al studied it in the ILERVAS[33] project carried out in 6672 middle-aged people and observed a beneficial effect of physical activity and the Mediterranean diet, just like us.

Strengths and limitations

As strengths of the study, we will highlight the large sample size, more than 60,000 people, the large number of variables analyzed and the establishment of cut-off points for the BRI.

As limitations, it should be noted that our data is based on the Russian population, so it cannot be extrapolated to other countries and only those patients who have attended the company's medical check-ups are included. Another limitation is that physical activity and diet have not been determined through validated scales, but rather through a survey.

Finally, as it is a cross-sectional study, it does not allow establishing causal relationships between the assessed factors.

Conclusions

In our work, the main conclusion is that unhealthy habits, especially alcohol consumption and somewhat less low level of physical activity and unhealthy eating, greatly increase the risk of presenting high LBBB values. Sociodemographic variables such as age, sex, and educational level have a much smaller effect.

Interests conflict

The researchers declare that they have no conflict of interest.

References

1. Barbany M, Foz M. Obesidad: concepto, clasificación y diagnóstico. An Sist Sanit Navar. 2002;25 Suppl 1: 3-6.

2. Hetherington MM, Cecil JE. Gene-environment interactions in obesity. Forum Nutr. 2010; 63: 195-203.

3. ENSE 2017 https://www.mscbs.gob.es/estadEstudios/estadisticas/encuestaNacional/encuesta2017.htm

4. Dietz WH, Robinson TN. Clinical practice. Overweight children and adolescents. N Engl J Med. 2005; 352: 2100-9.

5. Must A, Spadano J, Coakley EH, Field AE, Colditz G, et al. The disease burden associated with overweight and obesity. JAMA.1999; 282: 1523-9.

6. Ross R, Berentzen T, Bradshaw AJ, Janssen I, Kahn HS, et al. Does the relationship between waist circumference, morbidity and mortality depend on measurement protocol for waist circumference? Obes Rev. 2008; 9: 312-25.

7. Piché ME, Tchernof A , and Després JP. Obesity Phenotypes, Diabetes, and Cardiovascular Diseases. Circ Res. 2020;126(11):1477-1500. https://doi.org/10.1161/CIRCRESAHA.120.316101

8. Bergman RN, Stefanovski D, Buchanan TA, Sumner AE, Reynolds JC, et al. A better index of body adiposity. Obesity (Silver Spring).2011; 19: 1083-9.

9. Katzmarzyk PT, Gagnon J, Leon AS, Skinner JS, Wilmore JH, et al. Fitness, fatness, and estimated coronary heart disease risk: the HERITAGE Family Study. Med Sci Sports Exerc.2001; 33: 585-90.

10. Tanaka H, Clevenger CM, Jones PP, Seals DR, DeSouza CA. Influence of body fatness on the coronary risk profile of physically active postmenopausal women. Metabolism.1998; 47: 1112-20.

11. Kannel WB, Dawber TR, Kagan A, Revotskie N, Stokes J. Factors of risk in the development of coronary heart disease–six year follow-up experience. The Framingham Study. Ann Intern Med. 1961;55: 33-50.

12. Eckel RH, Alberti KG, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet.2010; 375: 181-3.

13. Mathieu P, Poirier P, Pibarot P, Lemieux I, Despres JP. Visceral obesity: the link among inflammation, hypertension, and cardiovascular disease. Hypertension.2009; 53: 577-84.

14. Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet.2009;373: 1083- 96.

15. Heber D. An integrative view of obesity. Am J Clin Nutr.2010; 91 (1): 280S-283S.

16. Low S, Chin MC, Deurenberg-Yap M. Review on Epidemic of Obesity. Ann Acad Med Singapore 2009; 38 (1): 57-9.

17. Bouchard C. BMI, fat mass, abdominal adiposity and visceral fat: where is the 'beef'? Int J Obes (Lond).2007; 31: 1552-3.

18. Lopez AA, Cespedes ML, Vicente T, Tomas M, Bennasar-Veny M, et al. Body adiposity index utilization in a Spanish Mediterranean population: comparison with the body mass index. PLoS One.2012; 7: e35281.

19. Thomas DM, Bredlau C, Bosy-Westphal A, Mueller M, Shen W, Gallagher D, et al. Relationships between body roundness with body fat and visceral adipose tissue emerging from a new geometrical model. Obesity.2013;21(11):2264-71

20. Bioelectrical impedance analysis in body composition measurement: National Institutes of Health Technology Assessment Conference Statement. Am J Clin Nutr. 1996;64:524S-532S.

21. Organization WH. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. 2000. Ginebra:WHO

22. Domingo-Salvany A, Bacigalupe A, Carrasco JM, Espelt A, Ferrando J, Borrell C. Propuesta de clase social neoweberiana y neomarxista a partir de la Clasificación Nacional de Ocupaciones 2011. Gac Sanit 2013;27(3):263-72

23. Silla Stoel M, Rosón Hernández B. Evaluación del consumo de alcohol y diagnóstico de patrón de consumo. Trastornos Adictivos. 2009;11(3):191-9

24. Rodríguez-Martos A, Gual A, Llopis Llacer JJ. La unidad de bebida estándar: un registro simplificado del consumo de bebidas alcohólicas. Med Clin (Barc) 1999; 112: 446-50

25. Nkwana MR, Monyeki KD, Lebelo SL. Body Roundness Index, A Body Shape Index, Conicity Index, and Their Association with Nutritional Status and Cardiovascular Risk Factors in South African Rural Young Adults. Int J Environ Res Public Health. 2021 Jan 1;18(1):281. doi: 10.3390/ijerph18010281.

26. Wenner MM, Stachenfeld NS Regulación de la presión arterial y el agua: comprensión de los efectos de las hormonas sexuales dentro y entre hombres y mujeres. J. Physiol. 2012; 590 : 5949–5961. doi: 10.1113 / jphysiol.2012.236752.

27. Ching YK, Chin YS, Appukutty M, Gan WY, Chan YM. Comparisons of conventional and novel anthropometric obesity indices to predict metabolic syndrome among vegetarians in Malaysia. Sci Rep. 2020 Nov 30;10(1):20861. doi: 10.1038/s41598-020-78035-5.

28. Fung TT, Willett WC, Stampfer MJ, Manson JE, Hu FB Dietary patterns and the risk of coronary heart disease in women. Arco. Interno. Medicina. 2001; 161 : 1857–1862. doi: 10.1001 / archinte.161.15.1857.

29. Yeomans MR. Alcohol, appetite and energy balance: is alcohol intake a risk factor for obesity? Physiol Behav. 2010;100:82–9. doi: 10.1016/j.physbeh.2010.01.012

30. Cummings JR, Gearhardt AN, Ray LA, Choi AK, Tomiyama AJ. Experimental and observational studies on alcohol use and dietary intake: a systematic review. Obes Rev. 2020 Feb;21(2):e12950. doi: 10.1111/obr.12950. Epub 2019 Nov 5.

31. Swift DL, McGee JE, Earnest CP, Carlisle E, Nygard M, Johannsen NM. The Effects of Exercise and Physical Activity on Weight Loss and Maintenance. Prog Cardiovasc Dis. 2018 Jul-Aug;61(2):206-213. doi: 10.1016/j.pcad.2018.07.014. Epub 2018 Jul 9.

32. Xiao T, Fu YF. Resistance training vs. aerobic training and role of other factors on the exercise effects on visceral fat. Eur Rev Med Pharmacol Sci. 2015 May;19(10):1779-84.

33. Sánchez M, Sánchez E, Hernández M, González J, Purroy F, Rius F et al. Dissimilar impact of a Mediterranean diet an physical activity on anthropometric indice: a cross-sectional study from the ILERVAS-Project. Nutrients 2019;11(6):1359