eISSN 2255-0569

ORIGINAL

Prevalence of overweight and obesity in spanish working population along the Covid-19 pandemic. Adiposity indicators and related variables

Prevalencia de sobrepeso y obesidad en población laboral española durante la pandemia Covid-19. Indicadores de adiposidad y variables relacionadas

Mª Teófila Vicente-Herrero, MD, PhD[1], Mª Victoria Ramírez-Iñiguez de la Torre, MD, PhD[2], Luisa Capdevila García, MD, PhD[3], Angélica Partida-Hanon[4], Luis Reinoso-Barbero, MD, PhD[5], Ángel Arturo López González, MD, PhD[6]

1. Obesity and work group-Asociación Española de especialistas en Medicina del Trabajo-AEEMT 2. Occupational Health and safety Services of Correos, Albacete (Spain). Obesity and work group-Asociación Española de especialistas en Medicina del Trabajo-AEEMT 3. Occupational Health and safety Services MAPFRE, Valencia (Spain). Obesity and work group-Asociación Española de especialistas en Medicina del Trabajo-AEEMT 4. Health and Occupational Risk Prevention Service, Grupo Banco Santander, Madrid, (Spain). 5. Faculty of Health Sciences, Universidad Internacional de la Rioja, La Rioja (Spain). 6. Occupational Health and safety Services Servei de Salut de les Illes Balears. University School ADEMA, Palma de Mallorca (Spain).

Corresponding author
Mª Teófila Vicente-Herrero
Grupo de Investigación Medicina del Trabajo
Ramon y Cajal 25-42. 46007 Valencia
E-mail: vicenteherreromt@gmail.com

Received: 20 - XII - 2021
Accepted: 16 - II - 2022

doi: 10.3306/AJHS.2022.37.02.132

Abstract

Introduction: Obesity is a multifactorial and complex disease, being the Body Mass Index (BMI) the standardized method used to define and evaluate overweight or obesity in epidemiological studies, however and compared to adiposity indicators, this method presents low sensitivity and shows a high inter-individual variability.

Methods: A descriptive cross-sectional study was performed in 815 workers, aged between 18 and 66 years with data collected along regular health surveillance examinations of participating companies from March 2020 to June 2021. The following variables were collected: socio-demographic: age, sex, cultural level and social class; occupational variables: type of work and role; anthropometric variables: weight, height and BMI; and adiposity indicators: visceral fat, body fat, waist circumference and waist/height, and waist/hip indices, establishing interrelationships between them.

Results: Significant differences were found between obesity prevalence and gender, being higher in men and increasing with age. As well, the prevalence was higher in workers with elementary education as the highest degree obtained. In women, it was observed an inverse correlation between social class level and obesity prevalence. In men with non-manual jobs (white collar) and women with manual jobs (blue collar), the prevalence established was higher. It is worth highlighting the association between BMI, body fat and waist/height index.

Conclusions: The average BMI results of the workers were found to be overweight, showing higher values in men (27.49) than in women (26.33) and a relation to age and occupations. The BMI shows concordance with all the indicators of adiposity, with body and visceral fat and the waist/height index standing out.

Keywords: Obesity, Visceral adiposity, Anthropometry, body mass index.

Resumen

Introducción: La obesidad es una enfermedad multifactorial y compleja, siendo el Índice de Masa Corporal (IMC) el método estandarizado utilizado para definir y evaluar el sobrepeso u obesidad en los estudios epidemiológicos, sin embargo y en comparación con los indicadores de adiposidad, este método presenta una baja sensibilidad y muestra una alta variabilidad interindividual.

Métodos: Se realizó un estudio descriptivo transversal en 815 trabajadores, con edades comprendidas entre los 18 y los 66 años con datos recogidos a lo largo de los exámenes periódicos de vigilancia de la salud de las empresas participantes desde marzo de 2020 hasta junio de 2021. Se recogieron las siguientes variables: sociodemográficas: edad, sexo, nivel cultural y clase social; ocupacionales: tipo de trabajo y rol; antropométricas: peso, talla e IMC; e indicadores de adiposidad: grasa visceral, grasa corporal, perímetro de cintura y cintura/altura, e índices de cintura/cadera, estableciendo interrelaciones entre ellos.

Resultados: Se encontraron diferencias significativas entre la prevalencia de obesidad y el género, siendo mayor en los hombres y aumentando con la edad. Asimismo, la prevalencia fue mayor en los trabajadores con estudios primarios como máxima titulación obtenida. En las mujeres se observó una correlación inversa entre el nivel de clase social y la prevalencia de obesidad. En los hombres con trabajos no manuales (cuello blanco) y en las mujeres con trabajos manuales (cuello azul), la prevalencia establecida fue mayor. Cabe destacar la asociación entre el IMC, la grasa corporal y el índice cintura/altura.

Conclusiones: Los resultados del IMC promedio de los trabajadores se encontraron con sobrepeso, mostrando valores más altos en los hombres (27,49) que en las mujeres (26,33) y una relación con la edad y las ocupaciones. El IMC muestra concordancia con todos los indicadores de adiposidad, destacando la grasa corporal y visceral y el índice cintura/altura.

Palabras clave: Obesidad, Adiposidad visceral, Antropometría, Índice de masa corporal.

Introduction

Obesity is a multifactorial and complex disease. Its world prevalence has doubled since 1980 and almost a third of the world's population is estimated to be overweight or obese; likewise, it is currently considered a global and progressing epidemic, affecting more than 2 billion people[1].

Obesity rates have been increasing along all ages and in both genders, regardless of geographic location, ethnic origin or socioeconomic level, although its prevalence increases with age and differs according to sex, varying between men and women[2].

Body Mass Index (BMI) is a standard method generally used to define and evaluate overweight or obesity in epidemiological studies, however, this method presents low sensitivity and shows a high inter-individual variability compared with adiposity indicators for any BMI given due to differences by age, sex and ethnicity. As well, obesity is related with an increased cardiometabolic risk, which is highly dependent on body fat location such as visceral, subcutaneous, and ectopic deposits within muscular tissue or the liver[3].

This background suggest that obesity might have a greater incidence in the population, thus requiring a more urgent attention than epidemiological studies suggest. An exclusive relying on BMI to assess its prevalence might difficult future interventions to prevent and control obesity.

The aim of this study is to estimate the prevalence of obesity in a sample of Spanish working population, taking into account BMI values and additional indicators such as adiposity, their interrelationships, and social and labor variables in order to establish additional preventive actions in the workplace.

Method

Study Design

A descriptive cross-sectional study performed in a sample of Spanish working population composed by 815 participants (481 males and 334 females), aged between 18 and 66 years who attended the regular health surveillance examinations of the participating companies from March 2020 to June 2021. Participation was voluntary and under an informed consent to use the results for epidemiological purposes.

The Ethics Committee for Clinical Research of the Health Area of the Balearic Islands (IB 4383/20) approved the current study.

Instruments and Procedure

In order to determine weight and height, it was used a SECA 700 scale divided into fractions of 50 grams, with a maximum capacity of 200 kg. Height was measured with a telescopic measuring meter SECA 220 incorporated in the scale with a measuring range of 60 to 200 cm divided on millimetric scale. BMI was calculated as the weight in kilograms divided by the squared height in meters. The BMI ranges defined by the WHO and included in this study were as follows: normal weight BMI < 25; overweight 25 ≥ BMI < 30; obese class I 30 ≥ BMI < 40; obese class II 40^4 ≥ BMI.

The hip and waistline perimeters were determined with a SECA 20 measuring tape, with a measuring range from 1 cm to 200 cm, divided on a millimetric scale. The ranges considered for the waistline perimeter were: Normal in men < 94 cm and in women < 80 cm. The hip perimeter was measured to determine the waistline/hip index only. The TANITABC-420MA analyzer was used to determine the body composition, estimating the percentage of body fat and visceral fat.

The following adiposity indicators (AI) have been calculated:

- Waist circumference (WC): considered normal in men when below 94 cm and in women below 80 cm.
- Waist to hip ratio (WHR): considered normal in men when below 0.94 and in women when below 0.84.
- Waist to height ratio (WHtR): considered normal when below < 0.5 for both genders.
- Total body fat percentage (TBF%): considered normal in men when below 10% and in women when below 20%.
- Visceral fat (VF): considered normal when below < 10 for both genders.

The social and labor variables included in the study were the following:

- Age: Individuals were classified in different age ranges: between 18 to 39 years, between 40 to 50 years and between 51 to 66 years.
- Gender: A categorical variable, with individuals classified as female or male.
- Social class and type of work: Determined on the basis of the National Classification of Occupations of the year 2011 (CNO-11) and on the basis of the proposal made by the Group of Social Determinants from the Spanish Society of Epidemiology[5]. For the statistical analysis, a reduced classification with three categories was used from the original seven categories:
  - Class I. Directors/managers, college professionals, sportsmen and artists.
  - Class II. Intermediate occupations and self-employed persons without employees.
  - Class III. Unskilled workers.
- Type of work: manual (blue collar) and not manual (white collar), as simplified from the previous authors[5].

- Study level: according to the current education system in Spain classified in three categories:
  - Elementary school: consisting of six basic levels, from first to sixth grade in primary school.
  - Intermediate: compulsory secondary education, with two cycles. The first cycle ranged from the first to third course, and the second cycle consisting of the fourth course.
  - Superior: completed university degrees or superior vocational education, in any of the forms established and in accordance with the legislation in force when they were completed.
- Workplace characteristics: manual handling of loads (MHL) and vehicle driving (at least 1/3 of the working day) and sedentary work (seated at least 50% of the working day) were included.

Statistical Analysis

A descriptive analysis of the categorical and quantitative variables was carried out by using descriptive statistics with means and standard deviations (SD) for continuous variables and percentage for categorical variables. A bivariate association analysis was performed using the 2-test (corrected with the Fisher exact test, if required) and Student's *t*-test for independent samples. The Cohen Kappa test was used to assess the concordance between the different scales.

Data were analyzed using Statistical Package for the Social Sciences version 27 (SPSS Inc, Chicago) and considering a p-value < 0.05 as statistically significant.

Results

The characteristics of the population sample are shown in **table I.** The average age of the population is 48 years old in both genders, with a global BMI value of overweight and being higher in men (27.49) than in women (26.33). As well, significant differences between all adiposity indicators (AI) were found between genders, taking into account the different reference values in some of the AI according to gender: with an almost normal waistline in men (94.6 cm) and high in women (84.5 cm). The waistline/height ratio was within the normal boundaries in both genders (men = 0.55 and women = 0.53). The waistline/hip ratio was normal in men (0.92) and slightly normal in women (0.85). Total body fat was high in both genders (24.7 in men and 36.08 in women). Visceral fat was high in men (11.35) and normal in women (7.5).

There are significant differences in the prevalence of overweight and obesity by gender, with higher percentages in men (**Figure 1**).

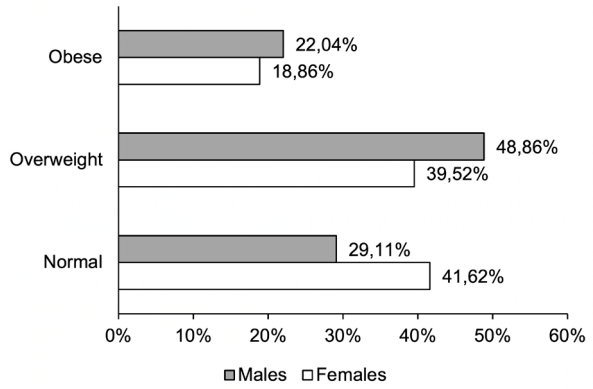
There were no significant differences in the educational level between men and women. Regarding the social class and type of work, social class III and manual work was predominant in both genders, being higher in men with statistically significant differences. There are significant differences observed in the characteristics of the workplace between genders: vehicle driving with manual handling of loads was predominant in male population, while women were majorly sedentary.

Table I: Characteristics of the Study Population. Comparison between genders.

Variable	Male (N = 481)	Female (N = 334)	P
Anthropometric and adiposity variables: mean (SD)			
Age	48.25 (8.35)	48.89 (8.16)	0.277
Weight	82.79 (13.93)	67.97 (11.98)	<0.0001
Height	173.42 (6.81)	160.72 (5.98)	<0.0001
BMI	27.49 (4.01)	26.33 (4.47)	<0.0001
Waist	94.61 (10.96)	84.35 (11.43)	<0.0001
Waist/height	0.55 (0.06)	0.53 (0.07)	<0.0001
Hip	106.22 (58.83)	99.00 (10.13)	0.027
Waist/Hip	0.92 (0.07)	0.85 (0.06)	<0.0001
Total body fat	24.70 (6.58)	36.08 (7.78)	<0.0001
Visceral fat	11.35 (4.53)	7.53 (2.65)	<0.0001
BMI classification (%)			
Normal	29.11	41.62	0.001
Overweight	48.86	39.52	
Obesity	22.04	18.86	
Study level (%)			
Elementary	49.06	41.92	0.116
Intermediate	32.43	35.63	
Superior	18.50	22.46	
Social class and type of work (%)			
Class I	3.33	2.40	<0.0001
Class II	20.58	36.83	
Class III	76.09	60.78	
Type of work (%)			
Non-manual work	23.91	39.22	<0.0001
Manual work	76.09	60.78	
Workplace characteristics (%)			
Sedentary work (seated > 50% working day)	25.16	41.92	<0.0001
Driving of vehicles and MHL (at least 1/3 of the working day)	71.93	53.29	<0.0001

SD = Standard deviation. Abbreviations: BMI, Body mass index; MHL, Manual handling of loads.

Figure 1: Percentage of overweight and obesity prevalence by gender.



The prevalence of overweight/obesity in relation to social, cultural and work variables are included in **table II**.

BMI values differ significantly between genders; normal weight was predominant in in women aged between 18 and 50 years, while they were majorly overweight aged above 50. In men, BMI increases with age, with normal parameters until aged 39, then, predominantly overweighed. In men, the prevalence of obesity increases progressively in with age, while in women the relationship is not linear, being more frequent in the 40 to 50 years interval.

In women, overweight and obesity levels were more prevalent in people with elementary studies, while in men and although obesity is predominant among those in elementary studies, a high percentage of overweight in men with higher education still stands out.

In both genders, overweight is more prevalent in social class II workers. In women, obesity increases with the social class, unlike in men, on which a it was found a higher percentage of obese workers belonging to the social class I and its prevalence declined as the class increased.

Regarding the type of work, there were also significant differences within gender. There was a higher obesity prevalence in women with manual jobs (blue-collar), while in men, obesity was higher in white-collar workers. Overweight was more frequent in non-manual workers for both genders, with a higher prevalence in men.

Among men, both overweight and obesity predominate in jobs with a sedentary behavior during more than 50% of the working day; however, obesity is higher in those who perform other tasks that do not involve sedentary behavior. In both sedentary and non-sedentary jobs, the prevalence of overweight or obesity was higher in men than in women.

Overweight and obesity were most often associated with work that does not require motor vehicle driving or MHL in men; nevertheless, in women there is a higher percentage of obesity among MHL drivers and

Table II: Prevalence of overweight/obesity in relation to social, cultural and work variables.

Age (years)	**Females**				**Males**			
BMI Classification	18-39	40-50	51-66	P < 0.0001	18-39	40-50	51-66	P < 0.0001
Normal	56.00	40.60	37.75		45.57	32.8	19.72	
Overweight	34.00	37.59	43.05		40.51	44.97	55.4	
Obesity	10.00	21.80	19.21		13.92	22.22	24.88	
Study level								
BMI Classification	Elementary	Intermediate	Superior	P < 0.0001	Elementary	Intermediate	Superior	P < 0.0001
Normal	35.71	46.22	45.33		24.58	32.69	34.84	
Overweight	42.86	37.82	36.00		49.15	46.79	51.68	
Obesity	21.43	15.97	18.67		26.27	20.51	13.48	
Social class								
BMI Classification	Class I	Class II	Class III	P < 0.0001	Class I	Class II	Class III	P < 0.0001
Normal	50.00	39.84	42.36		37.50	18.18	31.69	
Overweight	37.50	43.09	37.44		37.50	57.58	46.99	
Obesity	12.50	17.07	20.20		25.00	24.24	21.31	
Type of work								
BMI Classification	Non manual	Manual		P < 0.0001	Non manual	Manual		P < 0.0001
Normal	40.46	42.36			20.87	31.69		
Overweight	42.75	37.44			54.78	46.99		
Obesity	16.79	20.2			24.35	21.31		
Workplace characteristics: sedentary								
BMI Classification	Seated < 50%	Seated ≥ 50%		P < 0.0001	Seated < 50%	Seated ≥ 50%		P < 0.0001
Normal	43.30	39.29			32.22	19.83		
Overweight	37.11	42.86			46.67	55.37		
Obesity	19.59	17.86			21.11	24.79		
Workplace characteristics: MHL and vehicle driving								
BMI Classification	MHL only	MHL + driving		P < 0.0001	MHL only	MHL + driving		P < 0.0001
Normal	37.18	45.51			25.93	30.35		
Overweight	44.23	35.39			50.37	48.27		
Obesity	18.59	19.10			23.70	21.39		

Abbreviations: BMI, Body mass index; MHL, Manual handling of loads

higher overweight prevalence among non-drivers MHL workers. It is worth highlighting the presence of statistical significance in these results.

Additionally, the concordance between BMI and adiposity indicators (AI) was studied by using the Cohen's kappa statistic. The results are shown in **table III** and **table IV**, which illustrate that the BMI is the index that presents higher concordance with the rest of the AI. Within the total population studied, the relationship between BMI and AI found was moderate for the total body fat and visceral fat and strong with the waist to height ratio. In women, it was moderate with the total body fat and strong with the waist to height ratio; and in men, it was shown a moderate relationship between BMI and the waist to height ratio and strong between the BMI and the visceral fat and the total body fat.

Regarding the relationship between the different adiposity indicators, the concordance was variable. Global data showed that the total body fat has a moderate level of agreement with the waist to height ratio (0.46), as well between the waist to height ratio and the waist to hip ratio (0.49). In women, the findings were similar, with moderate concordance between the total body fat and the waist to height ratio (0.55) and between the waist to height ratio and the waist to hip ratio (0.49). In men, there was a strong relationship between the visceral fat and the waist to height ratio (0.62); and moderate between the visceral fat and the total body fat (0.56), the waist to height ratio and the total body fat (0.41), and between the waist to height ratio and the waist to hip ratio (0.47). For the rest of the parameters analyzed, the level of agreement were either poor or weak and none of them presented and almost perfect level of agreement.

Discussion

Through the last years, obesity and the actions taken on its associated risk factors have been an important part of health promotion programs in Spain and other developed countries; however, the prevalence is still variable. Studies based on BMI criteria in the USA show a prevalence of obesity around 27.7% in working population6, while epidemiologic studies in Spain (Aragon) show different numbers, with overweight rate around 38.6% and obesity at 18.4%, with higher incidence in men than in women[7].

Along the present study, the prevalence rates found were higher for both overweight and obesity in men (48.50% and 22.04%, respectively) and in women (39.52% and 18.86%, respectively). It is worth highlighting that the data of this study was collected during the COVID-19 pandemic, which had its impact in the workers lifestyle such as changes in eating habits and the decrease of physical activity.
The influence of social, cultural and personal variables

Table III: Concordance between BMI and adiposity indicators. Global results and by gender.

Concordance: Global results				
	Visceral fat	Body fat	Waist to height ratio	Waist to hip ratio
BMI	**0.471**	**0.574**	**0.610**	0.281
Concordance: Females				
	Visceral fat	Body fat	Waist to height ratio	Waist to hip ratio
BMI	0.177	**0.510**	**0.723**	0.380
Concordance: Males				
	Visceral fat	Body fat	Waist to height ratio	Waist to hip ratio
BMI	**0.664**	**0.624**	**0.544**	0.251

Value of Kappa (level of agreement): < 0.20 Poor; 0.21 – 0.40 Weak; 0.41 – 0.60 Moderate; 0.61 – 0.80 Strong; 0.81 – 1.00 almost perfect.

Table IV: Concordance between adiposity indicators. Global results and by gender.

Concordance: Global results	Visceral fat	Body fat	Waist to height ratio	Waist to hip ratio
Visceral fat	1	0.311	0.360	0.165
Body fat		1	**0.462**	0.207
Waist to height ratio			1	**0.490**
Waist to hip ratio				1
Concordance: Females				
Visceral fat	1	0.070	0.130	0.118
Body fat		1	**0.546**	0.224
Waist to height ratio			1	**0.493**
Waist to hip ratio				1
Concordance: Males				
Visceral fat	1	**0.556**	**0.616**	0.329
Body fat		1	**0.411**	0.200
Waist to height ratio			1	**0.465**
Waist to hip ratio				1

Value of Kappa (level of agreement): < 0.20 Poor; 0.21 – 0.40 Weak; 0.41 – 0.60 Moderate; 0.61 – 0.80 Strong; 0.81 – 1.00 almost perfect.

is generally accepted in obesity related studies, but still showing contradictory results. Epidemiologic studies performed in USA between 1990 and 2006 show that the association between obesity and the aforementioned variables is dynamic and complex, and therefore, population programs and health policies are needed to facilitate preventive interventions[8]. Our results highlight the influence of age, gender, social class and cultural level on obesity, which is in agreement with other authors in terms of age and gender, but not totally in terms of social class and cultural level[9].

Non-manual workers have been emphasized in some studies as people with higher risk of obesity, especially in sedentary administrative work. In our study, gender differences were observed, with obesity being more prevalent in men who performed sedentary work contrasting with women. These results differ as well in studies carried out in workers[10] in Portugal which, while showing differences in the type of work, vary according to the regional location of the studied population[11].

In obesity, anthropometric measures such as body mass index (BMI) and waistline circumference are widely used as suitable adiposity indices, although there are still limitations in the estimation of body fat. BMI does not take into account variabilities in body composition by gender and age, and new studies are increasingly including the waistline circumference, and the relationship between the BMI and body fat as indicators[12].

In our study, the level of agreement between BMI and diverse adiposity indicators was established, being the waistline/height index and body fat the most consistent indicators with the BMI in relation to the classification of overweight and obesity. The correlation between other adiposity indicators such as the visceral fat and BMI was not entirely clear in women; however, it was strong in men.

Other authors highlight the importance of taking into account the body fat location, as there are individuals classified as non-obese based entirely on BMI (BMI < 30), but still with high body fat values, and recommend the inclusion of body fat composition measures in common medical practice for both diagnosis and therapeutic decision-making[13].

Our results are consistent with other authors who reaffirm that anthropometric measures are simple, economic and non-invasive tools, useful for diagnosing obesity and assessing the risk of morbidity and mortality. Some of them are easy to obtain, such as abdominal perimeter[14]. Still, the most commonly used parameters are BMI, waistline circumference, the ratios between waist to hip and waist to height, visceral fat and body fat[15].

A high amount of visceral adipose tissue leads to a higher mortality rate rather than the absolute increase in body fat[16,17]. All the variables related to obesity have been incorporated in our work, including body fat, visceral fat and the waistline to height ratio, being the last one used as well in other studies[18,19], but with less importance than the rest of the indicators.

Conclusions

The average BMI results of the workers were found to be overweight, showing higher values in men (27.49) than in women (26.33) and a relation to certain ages and occupations. In both genders it increases with age, but in women it is more frequent in the interval betwen 40-50 years old. In both genders, overweight's prevalence is higher in non-manual workers. The BMI shows the highest concordance with all the indicators of adiposity, with a moderate relationship with body fat and visceral fat and a strong relationship with the waist/height index.

Interests conflict

The researchers declare that they have no conflict of interest.

References

1. Caballero B. Humans against Obesity: Who Will Win? Adv Nutr. 2019 Jan 1;10(suppl_1):S4- S9. doi: 10.1093/advances/nmy055. PMID: 30721956; PMCID: PMC6363526.

2. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019 Mar;92:6-10. doi: 10.1016/j.metabol.2018.09.005. Epub 2018 Sep 22. PMID: 30253139

3. Daud A, Shahadan SZ. Association Between Body Mass Index and Cardiometabolic Risks Among Malay Obese Adults. Clin Nurs Res. 2019 Feb;28(2):202-216. doi: 10.1177/1054773817724041. Epub 2017 Aug 6. PMID: 28782381.

4. World Health Organitation. Body mass index – BMI. 2020. Available at: https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi

5. Domingo-Salvany A, Bacigalupe A, Carrasco JM, Espelt A, Ferrando J, Borrell C. Propuestas de clase social neoweberiana y neomarxista a partir de la Clasificación Nacional de Ocupaciones 2011. Gac Sanit [Internet]. 2013 Jun [citado 2021 Sep 07] 27(3):263-272. Disponible en: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0213-11120130003000013&lng=es. https://dx.doi.org/10.1016/j.gaceta.2012.12.009

6. Luckhaupt SE, Cohen MA, Li J, Calvert GM. Prevalence of obesity among U.S. workers and associations with occupational factors. Am J Prev Med. 2014 Mar;46(3):237-48. doi: 10.1016/j.amepre.2013.11.002. PMID: 24512862.

7. Ramón Arbués E, Martínez Abadía B, Gracia Tabuenca T, Yuste Gran C, Pellicer García B, Juárez-Vela R, et al. Prevalencia de sobrepeso/obesidad y su asociación con diabetes, hipertensión, dislipemia y síndrome metabólico: estudio transversal de una muestra de trabajadores en Aragón, España. Nutr Hosp. 2019 Mar 7;36(1):51-59. doi: 10.20960/nh.1980. PMID: 30834762.

8. Wang Y, Beydoun MA. The obesity epidemic in the United States--gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. Epidemiol Rev. 2007;29:6-28. doi: 10.1093/epirev/mxm007. Epub 2007 May 17. PMID: 17510091.

9. De Silva AP, De Silva SH, Haniffa R, Liyanage IK, Jayasinghe KS, Katulanda P, Wijeratne CN, Wijeratne S, Rajapakse LC. A cross sectional survey on social, cultural and economic determinants of obesity in a low middle income setting. Int J Equity Health. 2015 Jan 17;14:6. doi: 10.1186/s12939-015-0140-8. PMID: 25595202; PMCID: PMC4300585.

10. Narisada A, Suzuki K. Association between procrastination, white-collar work and obesity in Japanese male workers: a cross-sectional study. BMJ Open. 2019 Nov 18;9(11):e029931. doi: 10.1136/bmjopen-2019-029931. PMID: 31740465; PMCID: PMC6887083.

11. Alves L, Stringhini S, Barros H, Azevedo A, Marques-Vidal P. Inequalities in obesity in Portugal: regional and gender differences. Eur J Public Health. 2017 Aug 1;27(4):775-780. doi: 10.1093/eurpub/ckx041. PMID: 28407055.

12. Pasco JA, Nicholson GC, Brennan SL, Kotowicz MA. Prevalence of obesity and the relationship between the body mass index and body fat: cross-sectional, population-based data. PLoS One. 2012;7(1):e29580. doi: 10.1371/journal.pone.0029580. Epub 2012 Jan 13. PMID: 22253741; PMCID: PMC3258232.

13. Gómez-Ambrosi J, Silva C, Galofré JC, Escalada J, Santos S, Millán D, et a. Body mass index classification misses subjects with increased cardiometabolic risk factors related to elevated adiposity. Int J Obes (Lond). 2012 Feb;36(2):286-94. doi: 10.1038/ijo.2011.100. Epub 2011 May 17. PMID: 21587201.

14. Fang H, Berg E, Cheng X, Shen W. How to best assess abdominal obesity. Curr Opin Clin Nutr Metab Care. 2018 Sep;21(5):360-365. doi: 10.1097/MCO.0000000000000485. PMID: 29916924; PMCID: PMC6299450.

15. Gažarová M, Galšneiderová M, Mečiarová L. Obesity diagnosis and mortality risk based on a body shape index (ABSI) and other indices and anthropometric parameters in university students. Rocz Panstw Zakl Hig. 2019;70(3):267-275. doi: 10.32394/rpzh.2019.0077. PMID: 31515986.

16. Ibrahim MM. Subcutaneous and visceral adipose tissue: structural and functional differences. Obes Rev. 2010 Jan;11(1):11-8. doi: 10.1111/j.1467-789X.2009.00623.x. Epub 2009 Jul 28. PMID: 19656312.

17. Swainson MG, Batterham AM, Tsakirides C, Rutherford ZH, Hind K. Prediction of whole-body fat percentage and visceral adipose tissue mass from five anthropometric variables. PLoS One. 2017 May 11;12(5):e0177175. doi: 10.1371/journal.pone.0177175. PMID: 28493988; PMCID: PMC5426673.

18. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev. 2012 Mar;13(3):275-86. doi: 10.1111/j.1467-789X.2011.00952.x. Epub 2011 Nov 23. PMID: 22106927.

19. Tsatsoulis A, Paschou SA. Metabolically Healthy Obesity: Criteria, Epidemiology, Controversies, and Consequences. Curr Obes Rep. 2020 Jun;9(2):109-120. doi: 10.1007/s13679-020-00375-0. PMID: 32301039.