

Detección de riesgos nutricionales y metabólicos en trabajadores del Laboratorio Estatal de Salud Pública del Estado de Guanajuato

Detection of nutritional and metabolic risks in workers of State Laboratory of Public Health of the State of Guanajuato

Rebeca MONROY TORRES¹, Jessica Evelia RAMÍREZ ROBLEDO^{1,2}, Yessica TENORIO PALOS¹, Rosario SÁNCHEZ NAVARRO³

1. Laboratory of Environmental Nutrition and Food Safety. Department of Medicine and Nutrition, Division of Health Sciences, Campus Leon, University of Guanajuato. León, Gto., México.
2. Division of Health Sciences and Engineering, Campus Celaya-Salvatierra, University of Guanajuato.
3. Public Health Laboratory of the Institute of Public Health of the State of Guanajuato.

Recibido: 3/septiembre/2021. Aceptado: 8/febrero/2022.

ABSTRACT

Introduction: There is sufficient evidence of the risks associated with diabetes mellitus and cardiovascular disease with obesity. Occupational health continues to be a challenge to integrate the detection of metabolic risks and timely interventions that prevent disability and deterioration of the quality of life

Objective: To detect nutritional and metabolic risks in laboratory workers.

Materials and methods: A descriptive and cross-sectional study was carried out in 26 workers (21 women and 5 men) from a State Laboratory of Public Health of the State of Guanajuato; Anthropometric indicators (weight, height, circumference, percentage of body fat), biochemical indicators (glucose, cholesterol, LDL, HDL, triglycerides, creatinine and urea) were measured. Metabolic syndrome was analyzed in the participants.

Results: The average age of the participants was 36.5 ± 12 years; 50% of the women presented obesity and 76% a

percentage of body fat higher than recommended. Mean glucose was 79±9 g/dL, cholesterol 176 ± 31 mg / dL, HDL 12.9±49 mg/dL, LDL 23.9±97 mg/dL, triglycerides 152 ± 80 mg / dL, Creatinine 0, 6±0.1 mg/dL and urea 25 ± 6.6 mg/dL. Metabolic syndrome were detected in five women.

Conclusion: A cardiometabolic risk of 23.8% was found, mainly due to the presence of obesity, distribution, and percentage of body fat in the workers, which with the average age the early risk of type 2 diabetes mellitus, hypertension and dyslipidemia.

KEYWORDS

Glucose, cholesterol, nutritional status, adipose tissue, occupational health.

ABBREVIATIONS

WHO: World Health Organization.

BMI: body mass index.

T2DM: Type 2 Diabetes Mellitus.

MS: metabolic syndrome.

ENSANUT: National Health and Nutrition Examination Survey.

IMSS: Mexican Social Security Institute.

Correspondencia:

Rebeca Monroy Torres
rmonroy79@gmail.com

AHT: hypertension.

SPSS: system of social protection in health.

TC: total cholesterol.

WHR: Waist Hip ratio.

INTRODUCTION

The World Health Organization (WHO) defines health as a state of physical, psychological and social wellbeing of the people¹; in general, to state of proper nutrition and physical condition as result of the balance between their needs and intake of energy and nutrients for persons, which is influenced by factors such as education, the level of income, food and biological availability. The nutritional status is evaluated by anthropometric, biochemical, clinical and dietary indicators². The body mass index (BMI) provides the most useful measure of overweight and obesity in the population, since it is the same for both sexes and for adults of all ages. However, it should be considered as an indication that it may not match the same level of thickness in different people³.

Obesity and overweight are defined as abnormal or excessive fat accumulation that can be harmful to health. Overweight and obesity are risk factors for many chronic diseases, such as Diabetes Mellitus 2 (T2DM), cardiovascular diseases, and cancer³. Another instrument for measure risk factor (cardiometabolic diseases) is the waist-hip ratio is the ratio of waist circumference and hip circumference. This index represents the distribution of body weight and is an indirect indication of the amount of visceral fat and intra-abdominal fat⁴.

The metabolic syndrome (MS) is a set of risk factors characterized by the presence of insulin resistance and compensatory hyperinsulinemia associated with disorders of metabolism of carbohydrates and lipids, high blood pressure, and obesity⁵. Hypertension and dyslipidemia are linked to high risk for cardiovascular disease; and excess fat which is associated with a metabolic imbalance such as insulin resistance state of inflammation, dyslipidemia and hypertriglyceridemia, called SM⁵.

In the National Health and Nutrition Examination Survey (ENSANUT) 2018 the prevalence of overweight and obesity in adults was 75.2% representing 58.4 million people; according to BMI cutoff points the percentage of obesity was 36.1% and 39.1% overweight. Obesity and overweight were higher in women with 40.2% and 30.5% respectively; the prevalence for obesity for the men were 42.5% and for women 36.6%⁶. In the state of Guanajuato prevalence of overweight and obesity were 77.9% in women and 66.2% for men; starting with a BMI >30 kg/m² a percentage of 34.8% in women and 23.7% in men was found to be 57% higher in women than in men, whereas the prevalence of overweight was higher in women (43.1%) than men (42.5%)⁷; Also considering the na-

tional prevalence of T2DM was 10.3% and 18.4% hypertension respectively⁸.

According to the Statistics Mexican Social Security Institute (IMSS in Spanish abbreviation) 2010-2012 permanent diseases have been ruled as invalid in the work of the same nature have increased in recent years; for example, neoplasms malignant in 2010 had reported 46 men and 44 women, in 2012 increased to 57 men and 53 women, in diseases such as renal failure, T2DM and cerebrovascular diseases in 2010 had reported the same cases in 2012 to a low in 2011, indicating that this year there were deaths from these diseases but in 2012 new cases of workers were reported with these diagnoses, for example in T2DM in 2010 there were 81 men and 13 women with the disease in 2011 a 67 men and 14 women and in 2012 again 81 men and 14 women, this is also the case of liver diseases where there has been a decrease from 2010 to 2012 due to deaths from this disease⁹.

The total annual cost of patients with T2DM for IMSS was mexican pesos corresponding to 3.1% of operating expenses. The average annual cost per patient was \$ 41,518.75, corresponding \$ 35 624.42 and patient without complications was \$ 46 152.21¹⁰, Mexico refers ENSANUT 2012 annual expenditures for patients with T2DM of 3872 million mexican pesos¹¹. Cardiovascular diseases have a total annual cost of national health care 7 114 million for acute myocardial infarction, 3424 million for cerebrovascular disease according to a report in 2006 (IMSS)¹². Overall, the annual investment in cardiovascular disease is up to 51% of the total budget allocated to health¹³.

Regarding the treatment of hypertension (AHT) Public Health of Mexico referred in 2002 an annual cost per person at the social security rests on average mexican pesos, the annual expenditure on AHT equivalent to 13.95% of the budget allocated to health and 0.71% of GDP¹⁴. However, in a study by Alcocer in Mexico mentioned that the annual cost associated with hypertension were estimated at 2.5 billion dollars for the period 2005-2007, corresponding to 6.8% of total expenditure on health; 57% of this expenditure is attributable to complications of AHT¹⁵.

Disabilities have been a public health problem, defined as the presence of a physical, mental, temporary, or permanent cognitive limitation. According to the census of housing in Mexico the disabled population has risen the past three years, the goal of medical services that address chronic diseases, such as delayed development of the disease, proper rehabilitation for people with injuries or disabilities is the effective quality care, being health institutions responsible for meeting the needs and expectations of the population to these issues⁷. Based on the implementation of the system of social protection in health has increased membership to medical services from 2004, however the results of the ENSANUT 2012 revealed the perception of people served in different in-

stitutions and found that the quality of care is higher in the private sector than in the public. No changes were identified in the perception of quality of life in the ENSANUT 2018⁷.

Self-care is defined as a lifestyle-related behaviors, beliefs, attitudes and emotional states that show how people interact with the social environment through coping strategies in the everyday work, relating to psychological processes such as self-concept and self-efficacy¹⁶; it relates to the health care conceiving it as a state of physical, mental, social welfare and not just the absence of disease, giving importance to the conduct of health risks such as eating behaviors, rest, personal hygiene, social environment, work safety and self-care¹⁶. But despite that people have the tools or skills to care for their health do not make use of them, this may be related to the perception of each individual because if they are consenting healthy then not to worry about taking care of your health until they recognize that their health may be compromised¹⁷.

The WHO defines psychosocial factors and interactions between work, environment, job satisfaction, terms of its organization and employee capabilities (needs, culture and personal situation) which influence health and performance workers¹³. A healthy work environment is essential, not only to achieve the health of workers, but also to improve productivity, work motivation, the spirit of work, job satisfaction and quality of life in general. However, despite its proven benefits, healthy work environments are not a reality for much of the labor force¹⁸.

As already described the prevalence of overweight and obesity are considered risk factors for the development of metabolic diseases; Added to this the unhealthy life styles and consumption of snuff, alcohol, illicit drugs, physical inactivity and intake of high calorie diets cause major cause of death among adults; for this reason that the main objective was to analyze the nutritional status and metabolic risks for workers in the state of Guanajuato and to have indicators for indicators for occupational health program.

MATERIAL AND METHODS

A cross-sectional descriptive study in 26 workers of State Laboratory of Public Health of the State of Guanajuato (LESP abbreviature in Spanish); september to october of 2013 was performed. The sample size was consecutive cases and voluntary. The LESP, in 2013, had a total of 84 workers (26 men and 58 women) but only 26 workers accept to participate in the study and the informed consent was applied.

The main indicators of cardiometabolic risks were: a) Anthropometry: body fat percentage, weight, waist and hip circumference, b) biochemical: glucose, cholesterol, HDL, LDL, triglycerides, creatinine and urea; c) the presence of metabolic syndrome in the participants.

For the anthropometric analysis, weight and height were measured according to Lohman¹⁹; with these variables the BMI was obtained²⁰, the percentage of body fat was obtained with an impedance scale (SECA 804® brand) based on the criteria Durnin and Womersley (measured folds: triceps, biceps, subscapular, suprailiac)²¹; the circumferences of waist and hip were measured with a tape (SECA 201®) with technique of Lohman¹⁹, thus obtaining the waist-hip ratio and with this normal, android and gynecoid body fat distribution were classified¹⁹.

For the analysis of biochemical indicators, the participants were presenting with 12 hours of fasting for the study, all instructions were according to the Official Mexican Standards *NOM-007-SSA3-2011 (for the organization and operation of clinical laboratories and NOM-087-ECOL-SSA1-2002, Environmental Protection - Environmental Health - Hazardous waste biological-infectious - classification and management specifications)*; in which the specifications for the operation and organization of clinical laboratory, management of material resources, hygiene and biosecurity and the sampling and handling of this and waste management are established. The serum and blood samples for glucose, cholesterol, HDL, LDL, triglycerides, creatinine and urea were analyzed in the laboratory of the Maternity Hospital by dry chemistry technique.

For measure the risk factors for metabolic syndrome, the NCEP ATP III criteria was used and distributed by sex and range age.

Statistical treatment

The Microsoft Office Excel 2007 was used: for quantitative and qualitative variables for data capture measures of absolute frequency and percentage were applied.

Ethical aspects

This study was part of an undergraduate thesis at the University of Guanajuato, it was reviewed in the research seminars of the students by a committee of external professors made up of: Dra. Silvia del Carmen Delgado Sandoval, Dr. Benigno Linares and Dr. Segovia. Xochitl Sofia Ramírez Gómez, Dr. Nicolás Padilla being part of the thesis committee and for their comments. Therefore, the study was approved with this Committee who reviewed that the study complied with ethical considerations and good research practices in accordance with the Official Mexican Standard NOM-012-SSA3-2012, which establishes the criteria for the execution of research projects for Health in human beings General Health in Human research.

RESULTS

The median age of the participants was 36.5 (range of 12 to 60). A 43% of woman had normal weight, 43% overweight and 14% had obesity; for the men three participants had normal weight and two participants obesity.

Percent body fat was acceptable in 10% of women, 14% high and 76% acceptable fat percent; the men showed no parameter values acceptable in fat mass, but two cases had acceptable and four high fat mass (Table 1).

Table 1. Anthropometric characteristics

Anthropometric characteristics	Men n=5	Women n=21
Body mass index (BMI)		
Normal	3	9
Overweight	0	9
Obesity	2	3
Percentage fat mass		
Acceptable	2	5
Not healthy	3	16
Type of distribution of fat mass		
Normal	2	4 (20%)
Android	2	11 (52%)
Gynecoid	1	6 (28%)
Metabolic syndrome		
20 to 40 years	0	2
41 to 60 years	0	3

Respect to the distribution of body fat in women, 11 with android distribution and 6 with gynecoid distribution; one man had gynecoid distribution. For biochemical results glucose in a range of 61 to 100 mg/dL was found, for the total cholesterol in the range of 123 to 223 mg/dL; HDL was found to lower range for both women and men, for LDL was found greater range with an average of 61 to 144 mg/dL; triglyceride ranges 63 to 305 mg/dL (Table 2).

It was observed that capillary glucose was not altered in any of the study participants, abdominal circumference was altered to predominance of the female gender with 67% and two cases for man; HDL were lower in men and women (Table 3).

Table 3. Risk factors for metabolic syndrome (NCEP ATP III) distributed by sex.

Risk factors for metabolic syndrome	Men (n= 5)	Women (n= 21) n(%)	Total (n= 26) n (%)
Abdominal Circumference (≥ 102 cm)	2	14 (67)	16 (61.6)
Capilar Glucose (≥ 100 mg/dL)	0	0	0
Triglycerides (≥ 150 mg/dL)	1	9 (43)	10 (38.5)
HDL (< 40 y 50 mg/dL)	3	11 (52)	14 (53.9)

Table 2. Results of biochemical parameters and their comparison with the reference values

Variable Media \pm S (Range)	Obtained values Media \pm S (Range)	Reference values
Glucose (mg/dL)	79.2 \pm 8.96 (61-100)	$<100^{(8)}$
Total Cholesterol (mg/dL)	176.04 \pm 31.43 (123-223)	$<200^{(21)}$
HDL Cholesterol (mg/dL)	48.72 \pm 12.99 (29-78)	>40 y $50^{(8)}$
LDL Cholesterol (mg/dL)	96.8 \pm 23.98 (61-144)	$<130^{(21)}$
Triglycerides (mg/dL)	151.96 \pm 80.52 (63-305)	$<150^{(8)}$
Creatinine (mg/dL)	0.67 \pm 0.11 (0.5-0.9)	Men: 0.8-1.4 Women: 0.6-1.2 ⁽⁴⁴⁾
Urea (mg/dL)	24.78 \pm 6.6 (16-32)	7-20 ⁽⁴⁴⁾

*6

The presence of metabolic syndrome was determined by presenting 3 of the 5 risk factors based on the NCEP-ATP III. The diagnosis of MS was found in 5 of the workers. When analyzed by age group and sex, it was observed that only female present SM, reaching 40% in the group of 20-40, and 60% for the group of 41-60 years.

DISCUSSION

The anthropometric and biochemical alterations found in this study as BMI in overweight and obesity, unhealthy percentage of fat mass, increased waist and hip circumference, levels above the reference values regarding cholesterol, triglycerides and LDL are similar to those described by other authors in similar studies that have evaluated metabolic and cardiovascular risks^{22,23}.

Some of the participants had a BMI within the normal range, however in the percentage of body fat distribution obtained most of fat mass at high and unhealthy acceptable according to the criteria of Nieman²⁴; it is known that adipose tissue function in addition to its lipid storage in the body, is currently regarded as an important endocrine organ; but given their endocrine function is emphasized by the metabolic consequences caused by an excess of adipose tissue, particularly visceral compartment; this excess has been associated with a number of metabolic imbalances as are hypertriglyceridemia, dyslipidemia, and hypertension⁵.

It also should be reconsidered diagnose overweight or obese only with BMI, although estimated as the "gold standard" to determine normal weight and percentage of healthy fat according to other studies the population do not always has the same distribution of body fat or lean.

Respect to waist circumference, similar results were found in men and women, three participants men had increased risk and 66.6% of women; Other studies have noted this relationship in increased waist circumference and mortality associated with morbidity, as there is risk of both cardiovascular disease and metabolic²⁵.

Based on the biochemical tests showed workers triglycerides, triglycerides and LDL above normal ranges according to NCEP-ATP III, which is associated with risk factors for coronary heart disease, increasing 70% cardiovascular risk according to Human et al, who conducted a study in active working population aged 20 to 79 years²².

The creatinine test does not range unusual obtained, but in testing urea values were above the limit, this indicates that the present urea nitrogen above the reference value is possible that the kidneys are not found working at full capacity, and the existence of a possible dehydration or heart failure are causes of increased levels of blood urea nitrogen⁵. It is also positively associated with hyperinsulinemia and metabolic syndrome, it is a demonstrable factor indicating high likelihood of developing hyperinsulinemia and metabolic syndrome²².

It was observed that capillary glucose was found not altered in any of the study participants, however the range was from borderline acceptable (61 to 100 mg/dL). As stated by Lizarazu et al, in their study of workers in Barranquilla university in Colombia, although workers had normal range of blood glucose levels were not exempt from suffering metabolic risk if the abdominal circumference and lipid profile are high²⁶.

This study showed that the three most common metabolic factors were visceral obesity, high triglycerides, high LDL and decreased HDL. Visceral obesity, represented by waist circumference was the most frequent criterion metabolic syndrome on all participants regardless of sex, elevated triglyc-

erides were found in women (42.9%) and in one participant and, HDL had decreased in both sexes; as noted in the study of Oliveira et al, in which the lipid profile was evaluated also finding triglycerides in women and in men and high LDL and HDL decreased significantly²⁷. Abreu Et al, also found these three variables as the most common metabolic syndrome factors in workers 20 to 60 years old attended a family medicine center in Venezuela²⁸. There is the presence of nutritional risk based on the criteria Muñoz²⁹, in which anthropometric indicators as fat mass, percentage of unhealthy fat mass, waist-hip ratio with android distribution and again BMI overweight and obese indicate the presence of both nutritional and metabolic risks. Oliveira et al, where nutritional risk and metabolic risk with BMI was associated indicators and Waist Hip ratio with lipid profile where both positively related risks²⁷ was found. Some authors also mention similar results in terms of metabolic and nutritional risk population groups between 20 to 60 years, finding high metabolic and nutritional supply to have as anthropometric variables with results overweight and obesity percentages of unhealthy fat mass, waist circumference raised to cardiovascular disease and high lipid biochemical basis and decreased HDL lipids form^{23,26,29}.

The frequency of metabolic syndrome was 23.8% using the NCEP-ATP III, leaving a lower when compared with the study by Open B et al, who also used the diagnostics NCEP-ATP III criteria and obtained the frequency of MS 33.8%²⁸. In another study conducted in Mexico in a group of workers in health by Palacios et al, will apply the NCEP-ATP III an overall frequency of MS of 40% was found and by gender 35% in men and 42% in women²⁹. It should be noted that the presence of metabolic syndrome was found in females, and it increased with age from 40% between 20 and 40 to 60% between 41 and 60 years. Some studies report that the prevalence of metabolic syndrome with increasing age is high²⁹.

Metabolic diseases are a global problem and Mexico figures risk of T2DM, hypertension and dyslipidemia, are increased with overweight and obesity with a BMI of 21 kg/m², thus reducing life expectancy, along with a very important health costs increase. Currently in the world, obesity is the 6th cause of economic costs due to cardiovascular disease³⁰. An annual investment is calculated by cardiovascular disease by 51% of the total budget allocated to health¹³. Given this global epidemic because of the chronic degenerative diseases that companies need to redefine their role in prevention programs, as a systemic information is required because preventive actions are known to be cheaper and better effects long-term and direct intervention would help counteract the effects of these diseases³¹. Currently statistics risk of disease and disability in the workplace are some character cardiovascular and other diseases triggered by poor nutrition. Cardiovascular disease is perceived as a set of non-work elements, which apparently does not directly affect organizational productivity

and therefore is considered a public health problem. However, should carry out health promotion and wellness workers and overcome the curative approach thus end the vicious circle involving the economic burdens of disease status of the population which means higher fees to workers and these turn on production goals that become stressful demands that weaken the productive force.

Some limitations of this study, the sample size was limited and it did not calculate. One of which was that the diet of each participant must be measured; therefore, it was not possible to obtain a more detailed dietary habits analysis, another limitation was unable to perform the taking of blood pressure to participants, since it was not possible to be considered to determine the presence of metabolic syndrome and this creates a bias in the research may underestimate the diagnosis. Finally, it is recommended to investigate the type of physical activity performed by employees or if they lead a sedentary life.

WHAT DOES THIS STUDY CONTRIBUTE AND SOME CONSIDERATIONS?

The use of a diagnostic tool such as BMI, whose weight-for-height formula has changed its reliability due to changes in the population's lifestyle, for which other anthropometric and biochemical variables must be integrated as was done in this study. We know that, given the economic problems, in addition to the lack of a research culture, the use of accessible tools such as the BMI will continue to be a resource that can carry out diagnostic biases, therefore it should be recommended to use the BMI and as a complement to the variables studied. in this studio.

Work environments generate stress that has been associated with greater overweight and obesity and with it an increased risk of metabolic syndrome, type 2 diabetes, hypertension and dyslipidemia mainly, but despite the vast scientific evidence, the implementation of the Findings of the studies have remained in identifying and diagnosing as we have done in this study but not in the effective and immediate implementation of interventions in the workplace, so one of the descriptive and analytical study is that operational research is promoted and therefore Therefore, the institutions know the risk factors that their workers present or develop and thereby achieve the sensitization of decision makers to change their institutional policies and implement intervention programs. Finally, it should be noted that these data from this study allowed the design of a pilot intervention program in occupational health. Finally, although the sample was not representative for buying men and women, we can derive the problem that occurs in women regarding a greater cardiovascular risk and this does allow the visibility of gender in the intervention, especially since it is an institution with a greater number of women and by age range.

CONCLUSIONS

According to the results of nutritional and metabolic risks in workers of State Laboratory of Public Health of the State of Guanajuato were overweight and obesity in 2 men and 12 women; waist circumference in 66.6% of women were increased and percentage of body fat was detected as unhealthy in 76% of women and in three participants men; with distribution of type android fat mass in 52% of women and in two participants men. Regarding the biochemical parameters were above results of reference values cholesterol, triglycerides and LDL and for HDL was decreased. Although blood glucose levels found not altered in any of the participants included if neighboring levels were found, and it is necessary to perform immediate action steps, since a glucose uptake in the presence refers upper limit resistance insulin, which in the long term can develop T2DM.

Relating anthropometric and biochemical parameters based on the NCEP-ATP III metabolic syndrome was diagnosed in 5 workers. It should be noted that the metabolic syndrome only found in women and, it increased with the age. It was evident that the three most frequent in participants metabolic factors were visceral obesity, high triglycerides and decreased HDL.

Given these results is considered critical promote good habits that could be through a healthy program with optimizing resources of the institution that benefit the work conditions, considering that the workplace is an appropriate environment to implement health programs including prevention, control and management of chronic diseases, as this is where workers spend most of their time; Since all workers should enjoy the highest attainable standard of physical and mental health and favorable working conditions, it is not only important for primary prevention of risks but also for increasing life expectancy. The knowledge generated could be helpful to establish new strategies work as a self-management program, which must become a priority for intervention, given the importance of taking action in a timely manner in the workplace, to prevent and control metabolic diseases which favor the work loss and increase health costs.

ACKNOWLEDGEMENTS

Dra. Silvia del Carmen Delgado Sandoval, Dr. Benigno Linares and Dr. Segovia. Xochitl Sofia Ramírez Gómez, Dr. Nicolás Padilla being part of the thesis committee and for their comments.

Program Revolving stay and professional practices (PREPP) in its pilot stage. The staff of the State Laboratory of Public Health and the support provided for translating this article to ISAPEG.

To the University Observatory of Food and Nutritional Security of the State of Guanajuato for the support in the reagents and materials for the analysis of glucose and hemoglobin.

REFERENCES

- Organización Mundial de la Salud. Preguntas frecuentes [monografía en internet] suiza 2014 [cited 2021 July 10] Available from: <http://www.who.int/suggestions/faq/es/>
- Food and Agriculture Organization of the United Nations. Nutrition guidelines and standards for school meals: a report from 33 low and middle-income countries. Rome. 2019. [cited 2021 July 10] Available from: https://www.fao.org/3/CA2773EN/c_a2773en.pdf
- World Health Organization. Discussion Paper: Draft recommendations for the prevention and management of obesity over the life course, including potential targets. 2021 [cited 2021 July 10] Available from: https://cdn.who.int/media/docs/default-source/obesity/who-discussion-paper-on-obesity---final190821.pdf?sfvrsn=4cd6710a_24&download=true
- Lippincott Williams & Wilkins. Guidelines for Exercise Testing and Prescription. American College of Sports Medicine. 10th ed. 2017.
- Bovolini A, Garcia J, Andrade MA, Duarte JA. Metabolic Syndrome Pathophysiology and Predisposing Factors. *Int J Sports Med*. 2021 Mar;42(3):199-214. <https://doi.org/10.1055/a-1263-0898>.
- Shamah T, Vielma E, Heredia O, Romero M, Mojica J, Cuevas L, et al. Encuesta Nacional de Salud y Nutrición 2018-19. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), 2020. Available from: https://ensanut.insp.mx/encuestas/ensanut2018/doctos/informes/ensanut_2018_informe_fi nal.pdf
- Instituto Nacional de Salud Pública. Encuesta nacional de salud y nutrición 2018. Resultados de Guanajuato. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), 2020. Available from: https://ensanut.insp.mx/encuestas/ensanut2018/doctos/informes/Resultado_Entidad_Guanajuato.pdf
- Instituto Nacional de Salud Pública. Encuesta nacional de salud y nutrición 2018. Presentación de resultados. [cited 2021 July 10] Available from: https://ensanut.insp.mx/encuestas/ensanut2018/doctos/informes/ensanut_2018_presentacion_resultados.pdf
- Secretaría del trabajo y prevención social. Información sobre accidentes y enfermedades de trabajo [monograph on the internet]; Guanajuato, 2003-2012. [cited 2021 July 10] Available from: <http://www.stps.gob.mx/bp/secciones/dgsst/estadisticas/Guanajuato%202003-2012.pdf>
- Rodríguez R, Reynales L, Jiménez J, Juárez S, Hernández M. Costos directos de atención médica en pacientes con Diabetes mellitus tipo 2 en México: análisis de micro costeó. *Rev Panam Salud Pública*. 2010; 28(6):412-20.
- Hernández M, Gutiérrez J. Encuesta nacional de salud y nutrición. Diabetes Mellitus: la urgencia de reforzar la respuesta en políticas públicas para su prevención y control (MX), 2012.
- Reynales L, Rodríguez R, Jiménez J, Castro A, Hernández M. Costos de la atención médica atribuibles al consumo de tabaco en el Instituto Mexicano del Seguro Social. *Salud Pública México*. 2006; 48(1):48-64.
- Juárez A. Factores psicosociales laborales relacionados con la tensión arterial y síntomas cardiovasculares en personal de enfermería en México. *Salud Pública México*. 2007; 49(2):109-117.
- Villarreal E, Garza M, Núñez G, Salinas A, Gallegos A. Costo de la atención de la hipertensión arterial y su impacto en el presupuesto destinado a la salud en México. *Salud Pública México* 2002; 44(1):7-13.
- Alcocer L. Diseño de estrategias para disminuir los daños a la salud asociados a hipertensión arterial. *Gac Méd Méx*. 2009; 145(4):299-303.
- Chia-Chien L, Shioh-Ru C, Shioh-Ching S. The self-care coping process in patients with chronic heart failure: A qualitative study. *Journal of Clinical Nursing*. 2018; 28(3-4):509-519. <https://doi-org.e-revistas.ugto.mx/10.1111/jocn.14640>
- Britz JA, Dunn KS. Self-care and quality of life among patients with heart failure. *Journal of the American Academy of Nurse Practitioners*. 2010; 22(9): 480- 487. <https://doi.org/10.1111/j.1745-7599.2010.00538.x>
- Glympi A, Chasioti A, Bälter K. Dietary Interventions to Promote Healthy Eating among Office Workers: A Literature Review. *Nutrients*. 2020; 12(12):3754. <https://doi.org/10.3390/nu12123754>
- Lohman T, Roche A, Martorell R. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics Books; 1998.
- Shils M, Olso J, Shike M, Ross C, Caballero B, Cousins R. Modern nutrition in health and disease. 10° ed. Baltimore, Maryland; William and Wilkins: 2006.
- Durning J, Womersley J. Body fat assessment from total body density and its estimation from skin fold thickness: measurements on 481 men and women aged 16-72 years. *BR J Nutr*. 1974; 32(1):77-97.
- Estepa Galindo E, Prado Martínez C, Carmenate Moreno M, Acevedo Cantero P, García García C, Marrodán Serrano MD. Edad de menopausia, condición nutricional y componentes del síndrome metabólico en mujeres españolas. *Nutrición Clínica y Dietética Hospitalaria*. 2020; 40(4). <https://doi.org/10.12873/404marrodan>
- Castro-Díaz SD, Rojas-Humpire R, Condori-Meza B, Bonifacio-García LE, Gutiérrez-Ajalcriña R, Huancahuire-Vega S. Cambios hematológicos relacionados con componentes del síndrome metabólico en personal de salud con alimentación balanceada. *Nutrición Clínica y Dietética Hospitalaria*. 2021; 41(1). <https://doi.org/10.12873/411huancahuire>
- Emmons K, Linnan L, Shadel W, Marcus B, Abrams D. The working healthy project: a worksite health-promotion trial targeting physical activity, diet and smoking. *J occup environ med* 1999; 41(7):545-555.
- Agredo R, García E, Osorio C, Escudero N, López C, Ramírez R. Obesidad abdominal y ausentismo por causa médica en una empresa de la industria metalmeccánica en Cali, Colombia. *Rev Peru Med Exp*. 2013; 30(2):251-5.
- Lizarazu I, Rossi C, Iglesias J, Villanueva D. Prevalencia de factores de riesgo cardiovascular y evaluación del riesgo cardiovascu-

- lar global en trabajadores de la universidad libre seccional. Salud Uni. Bar Col. 2013; 29(1):52-63.
27. Oliveira M, Martins R, Machado E, Santos E, Carvalho T. Relación de indicadores antropométricos con factores de riesgo para enfermedad cardiovascular. Arq Bras Cardiol. 2010; 94(4):462-469.
28. Abreu B, Ledesma S, Mármol N, Morón V. Frecuencia del síndrome metabólico en trabajadores atendidos en un centro de medicina familiar. Médico de Familia. 2013; 21(1):18-21.
29. Palacios R, Paulín P, López M, Acosta V, Cabrera D. síndrome metabólico en personal de salud de una unidad de medicina familiar. Rev Med Inst Mex Seguro Soc. 2010; 48(3):297-302.
30. Gutiérrez J, López J, Rodríguez C, Garcés M, Llorens T. Prevalence of metabolic syndrome (MS) in laboral population. Theheart of Asepeyo. An. Med. Interna. Madrid. 2008; 25(7):325-330.
31. Abdo JM, Bosques FJ, Gutiérrez P, Sobrino SR. El daño colateral de la atención de la pandemia de COVID-19. Cir Cir. 2020; 88(6):799-804. Available from: <https://doi.org/10.24875/CIRU.20000647>