



Effectiveness of the Fecal Occult Blood Test for the Early Diagnosis of Colorectal Lesions

Maidelis del Carmen Trevin Licea^{1*} and Carlos Antonio Sánchez Portela¹

¹University of Medical Sciences Dr. Ernesto Che Guevara de La Serna. Pinar of the Rio, Cuba.

Authors' contributions

This work was carried out in collaboration between both authors. Author MDCTL she participated in the design of the study and in the collection of the primary data. She assisted in the development and approval of the final text. Author CASP participated in the writing and correction of the scientific report, data collection, data processing and bibliographic search. He assisted in the development and approval of the final text.

Article Information

Editor(s):

(1) Dr. Wagih Mommtaz Ghannam, Mansoura University, Egypt.

Reviewers:

(1) Tamer Akay, Bandırma Onyedi Eylül University, Turkey.

(2) Shubra Kochar, South Tyneside and Sunderland NHS Foundation Trust, UK.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/73991>

Original Research Article

Received 05 July 2021
Accepted 15 September 2021
Published 27 September 2021

ABSTRACT

Introduction: Colorectal cancer is health problem because of its high incidence and high morbidity and mortality associated, so being implemented strategies for early detection or prevention.

Objective: To determine the effectiveness of occult blood test stool for early diagnosis of colorectal lesions.

Materials and Methods: A descriptive, retrospective and transversal study of 220 patients attending consultation coloproctology Hospital program Abel Santamaria Cuadrado program of Pinar del Rio for presumptive symptoms of colorectal disease in the period June / 2013 to June / 2015 was made, studied variables such as age, sex, medical history, presentation and symptoms at baseline, occult blood test stool, colonoscopy results and location of lesions.

Statistical Processing: descriptive statistics were used, percentage calculation was performed and sensitivity, specificity, positive and negative predictive value and efficacy index was calculated on the gold standard colonoscopy to determine the effectiveness of the test, the results were expressed in tables and shapes.

Results: It was determined that these injuries are more frequent in females and in patients older than 60 years, the tumor prior colon was the antecedent more found, change in bowel habits was

*Corresponding author: E-mail: trevin@infomed.sld.cu;

the most frequent symptoms, colonoscopy is the fundamental review for positive diagnosis, the greater sensitivity and specificity of the test is to malignant lesions.

Conclusions: The blood test fecal occult employed, has a sensitivity and high specificity for colorectal cancer.

Keywords: Colorectal cancer; occult blood stool.

1. INTRODUCTION

The increase in the appearance of colorectal lesions worldwide is a concern of the health authorities, which is why strategies have been implemented for an early detection of these, whether premalignant or malignant, through different screening means such as the determination of occult blood in feces, [1] performing colonoscopy [2] periodically etc. to treat them promptly and thus improve the evolution, prognosis, and quality of life of patients with them.

The main objective of the screening programs is to detect early or, better still, to prevent the appearance of colon cancer, and thus reduce the mortality that derives from it. If detected early, it is very easy to treat, and the chances of a cure are very high. It is a tumor that does not usually cause any discomfort until the disease is very advanced, hence the importance of carrying out preventive tests in people without symptoms.

In Cuba, this disease occupies the third place within the neoplasms in order of frequency with a rate of 19.5 per 100,000 inhabitants, having increased its incidence during the decade of the 90s and the beginning of this century, therefore this pathology has acquired greater importance within general mortality, being the cause of approximately 9% of all deaths from this cause in this century; What contributes to this is the aging of the population, a phenomenon present in the country, together with the risk factors, habits and unfavorable lifestyles to promote this condition [3-5].

Colonoscopy is one of the diagnostic methods used for CRC screening, it is the most widely used in the United States. In 1997, the American Cancer Society (ACS) recommended it as a screening method and the Preventive Services Task Force (USPSTF) applied it in 2002. Currently, it is the first line of screening in numerous guides such as the USPSTF, American College of Gastroenterology (ACG) and ACS [2,6-8].

The objective of this work is to determine the effectiveness of the fecal occult blood test for early diagnosis of colorectal lesions in the program Abel Santamaría Cuadrado program hospital, June 2013 to June 2015.

2. MATERIALS AND METHODS

This is a descriptive, retrospective and transversal study to determine the effectiveness of the fecal occult blood test in the early diagnosis of colorectal lesions in patients treated for presumptive symptoms of colon disorders in the coloproctology consultation of the surgery service General Hospital General University program Abel Santamaría Cuadrado, in the period from June 2013 to June 2015. The universe and the sample consisted of 220 patients seen in the coloproctology consultation for presumptive symptoms of colon affections in the general surgery service of the General University Hospital program Abel Santamaría Cuadrado program.

The data were extracted from the medical records, they were taken to an automated database, in an Excel spreadsheet. The variables were processed using the statistical package SPSS version 13.0 for Windows.

3. RESULTS

The study sample consisted of 220 patients. regarding age, most patients are between 60 and 69 years old, for 28.6% of the total, and those over 80 years old represented only 8.2%.

In relation to sex, 64.5% of the patients treated for presumptive symptoms of colon affections were female. (Female-male ratio = 1.5: 1).

In this study, the mean age of the patients was 60.8 ± 14.0 years, with the age group of 60 to 69 years predominant, followed by the age group of 70 to 79 years, the age range where screening is indicated in many countries. (Table 1).

Of the 220 patients who underwent the fecal occult blood test, it was positive in 35.9% and negative in 64.1%. (Fig. 1)

Table 1. Distribution of patients according to age and sex. General University Hospital program Abel Santamaría Cuadrado program. 2013 - 2015

Age (years)	Male No.%		Female No. %		Total No. %	
Less than 50 years	15	17.2	27	20.3	42	19.1
50 – 59	20	23.0	28	21.1	48	21.8
60 – 69	25	28.7	38	28.6	63	28.6
70 – 79	22	25.3	27	20.3	49	22.3
More than 80 years	5	5.8	13	9.7	18	8.2
Total	87	39.5	133	64.5	220	100.0

Source: Medical records

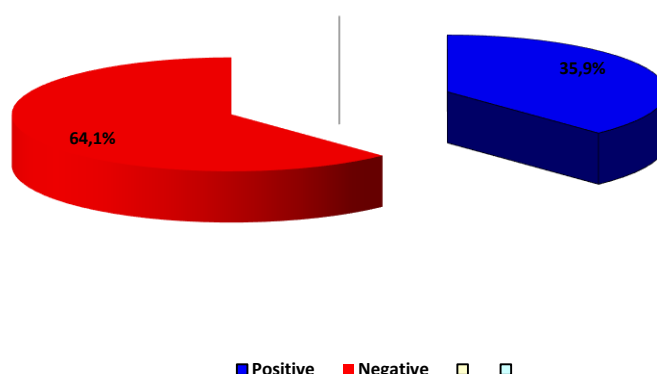


Fig. 1. Distribution of patients according to the result of the fecal occult blood test, General University Hospital program Abel Santamaría Cuadrado program 2013-2015

Source: Medical records

Endoscopic studies are the main weapon to reach an etiological diagnosis of colorectal lesions and sometimes depending on the type of lesion, they also serve as a therapy, in relation to their performance, it was found that in approximately 67% of patients An endoscopic diagnosis of malignant or premalignant lesions was made, which confirms the high frequency of these lesions among symptomatic patients and patients over 50 years of age who undergo this type of examination. Malignant lesions were diagnosed in 35 patients (15.9%) and premalignant lesions in 112 (50.9%). (Table 2).

An important aspect in the early diagnosis of colorectal lesions is to be able to correlate the results of the fecal occult blood test and the colonoscopy result of the 79 patients with a positive fecal occult blood test, in 27 of them, 34.2% were diagnosed with a colorectal malignant lesion and in 48, (60.7%) a premalignant or suspected malignancy was

found, so the effectiveness of the test for the early detection of some type of colorectal lesion could be verified, this being 94.9%. (Table 3).

When determining the efficacy of the fecal occult blood test as a predictor of malignant colon lesions, using colonoscopy as a reference test, it had a sensitivity of 77.11% for neoplasms, a specificity of 71.89%, a value positive predictive value (PPV) 34.17%, negative predictive value (NPV) of 94.32% and an efficacy index of 75.38%.

When evaluating the efficacy of the test for the diagnosis of colon polyps, the sensitivity of the test was 35.95%, specificity 64.41%, PPV 40.50%, NPV of 59.57% and an efficacy index of 54.82%.

In the diagnosis of ulcerative colitis, the test had a sensitivity of 73.91%, a specificity of 68.52%, a PPV of 21.51%, a NPV of 95.74% and an efficacy index of 71, 25% (Table 4).

Table 2. Distribution of patients according to colonoscopy results, General University Hospital program Abel Santamaría Cuadrado program 2013-2015

Colonoscopy		Frequency	Percentage
	Polyps	89	40.5
Premalignant lesions	Idiopathic ulcerative colitis	23	10.4
Malignant lesions		35	15.9
Absence of lesions		73	33.2
Total		220	100.0

Source: Medical records

Table 3. Distribution according to the result of the colonoscopy and the fecal occult blood test, General University Hospital program Abel Santamaría Cuadrado program 2013 - 2015

Colonoscopy	Positive fecal occult blood test	Percentage
Premalignant lesions	48	60.7
Malignant lesions	27	34.2
Absence of lesions	4	5.1
Total	79	100.0

Source: Medical records

Table 4. Efficacy of the fecal occult blood test in the diagnosis of malignant lesions, polyps and idiopathic ulcerative colitis, General University Hospital program Abel Santamaría Cuadrado program 2013 - 2015

Occult blood test	Colonoscopy								
	Malignant Lesions			Polyps			Idiopathic Ulcerative Colitis		
	Yes	No	Total	Yes	No	Total	Yes	No	Total
Positive	27	52	79	32	47	79	17	62	79
Negative	8	133	141	57	84	141	6	135	141
Total	35	185	220	89	131	220	23	197	220

Source: Medical records

Malignant lesions: Sensitivity: 77,11%; IC (59,07 -89,25), Specificity: 71,89%; IC (64,58 - 78,23), Positive predictive value (PPV):34,17%; IC (23,91 – 46,03), Negative Predictive Value (NPV): 94,32; IC (88,56 – 97,44), Efficiency index: 75,38%.

Polyps: Sensitivity: 35,95%; IC (26,08 – 47,08), Specificity: 64,41%; IC (55,33 – 72,61) Positive predictive value (PPV): 40,50%; IC (29,56 - 52,39, Negative Predictive Value (NPV): 59,57; IC (50,8 – 67,8), Efficiency index: 54,82%.

Idiopathic ulcerative colitis: Sensitivity: 73,91%;IC (50,75 – 89,57), Specificity: 68,52%;IC (61,32 – 74,95) Positive predictive value (PPV): 21,51%; IC (13,32 – 32,67), Negative Predictive Value (NPV):95,74%; IC (90,39 – 98,35), Efficiency index: 71,25%

4. DISCUSSION

Screening tests are performed as part of the process of determining the presence of cancer or

pre-malignant lesions in people who do not have any symptoms of the disease, these tests that are done regularly are one of the most powerful weapons to prevent this cancer.

Screening is recommended at age 50 for people who are not at increased risk for colorectal cancer. People at higher risk, such as those with a strong family history of colorectal cancer, may benefit from starting screening at an earlier age [9,10].

Numerous studies reviewed, including that of Montiel et al. [11], mention age as a risk factor for colorectal lesions, stating that around 90% of CRC develop in people over 50 years of age with a peak incidence between 65 and 75 years.

In this study, the mean age of the patients was 60.8 ± 14.0 years, with the age group of 60 to 69 years predominant, followed by the age group of 70 to 79 years, the age range where screening is indicated in many countries. This result coincides with what has been reported by numerous

authors who suggest that colorectal alterations increase with age, sedentary lifestyle, low calorie intake and increased drug consumption [11,12].

Sex is one of the variables studied, in the casuistry presented, a predominance of female patients was found, and although we cannot speak of prevalence since this work is not population-based, it does not correspond to the results of other investigations in which the male sex is the most affected [13].

However, in our country, in a study carried out by Torres R [14], it is suggested that CRC occupies the third place in mortality among malignant tumors for both sexes and is the cause of approximately 9% of all deaths from malignant tumors. In this century, with higher levels of mortality in women, like De Valle Llufrío [3] determined that the sex most affected was the female, in his study the highest percent (61.54%) corresponded to the female sex which opposes most of what is reported in the reviewed bibliography.

For most adults, the American Cancer Society recommends starting one of these screening tests at age 50. Some people at higher risk for colorectal cancer may need to start screening at an earlier age [9].

Most malignant tumors develop from adenomatous polyps, and on average it takes 10 years for a polyp smaller than 1 cm to transform into invasive CRC. Given the finding that adenomatous polyps are precursors to cancer and that polyps or early malignant tumors are almost always asymptomatic, screening tests are needed for their detection and prevention [15-17].

Colorectal conditions have various symptoms and signs for the onset of the disease, with changes in bowel habit being the one most frequently found in this study and the most frequent cause of indication for colonoscopy (30%), the weight request being the sign that appeared less frequently with 11.8%, finding that some authors report in their studies the following frequency of the same: abdominal pain, change in bowel habit and bleeding with anemia, so that the sequence of presentation of the symptoms vary in the different studies reviewed [18].

The positivity of the method is greater than that found in reviewed studies that report lower percent positivity. In a study carried out by

García Rodríguez and collaborators [19], 6.15% positivity was found. This difference could be explained because in our study the sample consisted of symptomatic patients, which increases the possibility of presenting some colorectal pathology and in turn increases the possibility of bleeding from it.

In approximately 67% of the patients, an endoscopic diagnosis of malignant or premalignant colon lesions was made, which confirms the high frequency of these lesions in patients over 50 years of age who undergo these examinations [20]. Malignant lesions were diagnosed in 35 patients, a result that is comparable with other similar experiences whose detection rates vary between 10 and 25% [3,21].

In this regard, there are no doubts about the value of endoscopy, which is the fundamental means of current diagnosis. Its safety as a procedure, anatomical refinement, and its ability to obtain tissue samples support its use as the main diagnostic tool.

The frequency of colorectal cancer varies according to the colonic section where the lesions are located, considering that more than 50% of these are in the distal colon, this being an important aspect to bear in mind, since it has been proven that malignant lesions of the proximal colon bleed more frequently than those located in other regions of the same and in this study, [18] patients that represent 51.4% of all diagnosed malignant lesions were located in this segment of the colon. In recent decades, a proximal deviation of this has been observed in some studies, attributed to the aging of the population, [22,23] which agrees with this study, where there is a predominance of malignant lesions in the proximal colon, which may be due to the advanced age of the patients studied and also because the predominant sex of the sample was female, suggesting by multiple authors that in women colorectal cancer located in the proximal colon is more frequent than in males where rectal cancer is the most frequent [14,24].

Rectal cancer, its incidence has been increasing in a similar way to colon cancers. In this study, the frequency of rectal cancer was similar to that described in the reviewed literature, among which we have Decanini [24] who reported a high incidence of rectal cancer in males compared to females.

The fact that more than half of the patients with malignant lesions were located in the proximal colon and the presence of some synchronous lesions, raises the need and importance of a complete exploration of the colon whenever possible, which allows diagnosis and treatment of proximal lesions, which is not possible with sigmoidoscopy.

Regarding the histological variety, 91.4% of the neoplasms in this study were adenocarcinomas and only one patient was diagnosed with signet ring cell carcinoma 2.9%, 54.3% of the adenocarcinomas were moderately differentiated. This is a favorable factor for patients with this type of injury, since the least differentiated have a worse evolution and prognosis.

The occult blood in feces was positive in almost all the patients with lesions diagnosed by colonoscopy, only 4 of them had a positive test with a negative colonoscopy, which coincides with that reported in studies carried out by other reviewed authors [25,26] where evaluating the efficacy of the test, they report a high sensitivity and specificity for colon pathologies with a negative predictive value of 94.1%. This last piece of information is of great importance, as it means that the vast majority of patients with a negative test must not have any condition, which would make it possible to avoid unnecessary endoscopic examinations [21].

The fecal occult blood test used has a high sensitivity and specificity [27] for the diagnosis of colorectal cancer, so screening programs for colorectal cancer and premalignant lesions should be promoted, based on this test and on colonoscopy in the population over 50 years of age, with the aim of contributing to the program recommended by the WHO for the early detection of colon tumors [18].

The positivity of the method in this series turned out to be (36%) higher than that found in other studies [28]. This difference may be related to the fact that the subjects studied were symptomatic patients, which increases the possibility that they have a colonic condition.

Malignant lesions were diagnosed in 35 patients 15.9% of the cases, a result that is comparable with other similar experiences whose detection rates vary between 10 and 25% [28].

Occult blood was positive in almost all the patients with malignant lesions of the colon, only eight had the negative test, which coincides with

that reported by other authors [29] where, when evaluating its efficacy for the diagnosis of colorectal cancer, it is observed a high sensitivity and specificity with a negative predictive value of 94.11%; This is of great importance as it means, as has already been stated, that a high percentage of patients with a negative result are very unlikely to have any lesions, which would allow patients not to be subjected to endoscopic examinations unnecessarily [21,30].

It is relevant to have found in 89 patients, (40.5%) polyps larger than 1 cm, considered premalignant lesions, which confirms the high frequency of these lesions among patients older than 50 years [15,31].

In the case of polyps larger than 1 cm, most of the positive test results did not coincide with the endoscopic diagnosis; however, most of the patients who had a negative result did not present this lesion, which shows a low sensitivity and specificity, for a positive and negative predictive value of around 50%. This could be due to the fact that the polyps are not necessarily bleeding at the time of the study [31].

Ulcerative colitis patients are known to have a higher risk of colorectal cancer than the rest of the population. Among the factors that influence its appearance, it is well established that the duration and extension of the disease are the most studied. That is why this study only included patients with more than 10 years of evolution and of great extension, who represented 10.0% of colonoscopy diagnoses; other studies report higher incidences [32].

In ulcerative colitis, bleeding was observed as part of the clinical picture, which is why it will give a positive result regardless of whether there is a premalignant lesion or not, so in order to reduce mortality from colorectal cancer in these patients, it is recommended performing periodic colonoscopies with taking numerous biopsies to detect dysplasia. When studying ulcerative colitis, it is more appropriate to speak of a screening for dysplasia than for cancer, since the risk of cancer is very low in the absence of this. [21].

5. CONCLUSIONS

The performance of the fecal occult blood test was of high value in the early diagnosis of colorectal lesions in patients with presumptive

symptoms of colon affections, so it should be performed on all patients over 50 years of age.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Syful Azlie MF, Hassan MR, Junainah S, Rugayah B. Immunochemical Faecal Occult Blood Test for Colorectal Cancer Screening: A Systematic Review. *Med J Malaysia* [Internet]. 2015 [cited 2019 Dec 70(1):24-30: [approx. 7p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/26032525>
2. Montes de Oca Megías E, Noa Pedroso G, García Jordá E, Seijas Cabrera O, Pérez Triana F, et al. Colonoscopy as a gold standard for colorectal cancer screening. *Rev cubana med* [Internet]. 2013; [cited 2019 Jun 23];52(1): 60-71: [approx. 12 p.]. Available:http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75232013000100007&lng=es
3. Del Valle Llufrío P, Romero Bareiro SR, Santana Fuentes Y. Colon lesions diagnosed by colonoscopy in patients with positive occult blood. *Rev Méd Electrón* [Internet] 2014 [cited: 2020 Jun 19];36 Suppl 1. Available:<http://www.revmatanzas.sld.cu/revista%20medica/ano%202014/supl1%202014/tema02.htm>
4. Statistical Yearbook of Health of Cuba [Internet]. Havana: MINSAP; 2015 [cited 2019 Jun 18]. Available:<http://files.sld.cu/bvscuba/files/2015/04/anuario-estadistico-de-salud-2014.pdf>
5. Machado Pineda M, Rodríguez Fernández Z, González Tuero JH, Rodríguez Ramírez R. Diagnosis and survival relationship in colon cancer MEDISAN [Internet]. 2011 [cited 2019 Jun 23];15 (11):1566-76: [approx. 11 p.]. Available:<http://scielo.sld.cu/pdf/san/v15n11/san091111.pdf>
6. Smith RA, Cokkinides V, Brawley OW. Cancer Screening in the United States, 2012. A Review of Current American Cancer Society Guidelines and Current Issues in Cancer Screening. *Ca Cancer J Clin*. [Internet]. 2012 [Cited 2020 Jan 6];62 (2):129-42: [approx. 14 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/22261986>.
7. Wang A, Lieberman D. Screening Guidelines for Colorectal Cancer: What Should We Advocate to Our Patients? *Curr Colorectal Cancer Rep* [Internet]. 2010 [cited 2020 Jul 3];6:8-15: [approx. 7 p.]. Available:<http://link.springer.com/article/10.1007/s11888-009-0036-3#page-1>
8. Lieberman D. Progress and Challenges in Colorectal Cancer Screening and Surveillance. *Gastroenterology*. [Internet]. 2010 [cited 2019 Jan 6];138(6):2115-26: [approx. 12 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/20167216>.
9. Colorectal cancer. Important Colorectal Cancer Statistics. [Internet]; 2012 [cited 2020 Jun 18] Available:<http://www.cancer.org/acs/group/s/cid/documents/webcontent/002290-pdf.pdf>
10. Davis DM, Marcet JE, Frattini JC, et al. Is it time to lower the recommended screening age for colorectal cancer? *J Am Coll Surg* [serial on the Internet]. 2011 [cited 2020 Jun 18];213(3):352-61: [approx. 10 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/21737316>
11. Montiel A, Castro M, Martínez S, Ramos G, Reyes P, Llata AM, et al. Colonoscopy in the diagnosis of colorectal cancer. *Cir. Gen*. [Internet]. 2006; [cited 2019 Dec 27];28(2):72-6: [approx. 5 p.]. Available:<http://www.medigraphic.com/pdfs/cirgen/cg-2006/cg062b.pdf>
12. Ferlay J, Parkin DM, Steliarova-Foucher E. Estimates of cancer incidence and mortality in Europe in 2008. *Eur J Cancer*. [Internet]. 2010; [cited 2019 Dec 27];46(4): 765-81: [approx. 17]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/20116997>
13. Sobrino Cossío S, Fenocchi E, Hernández Guerrero A, Alonso Lárraga JO, De la Mora-Levy JG, et al. Immune test for fecal occult blood vs. Serum ferritin for the detection of colorectal neoplasms in asymptomatic high-risk population *Rev Gastroenterol Mex*. [Internet]. 2011 [cited

- 2019 Jun 18];7693):191-8: [approx. 7 p.]. Available:<http://www.revistagastroenterologiamexico.org/es/pricaci3n-inmunologica-sangre-oculta-heces/articulo-resumen/X0375090611284837/>
14. Torres R, Gran M. Impact of colon cancer on the morbidity and mortality of the Cuban population. 1979-2003. Havana: National Directorate of Statistics. Ministry of Public Health. [monograph on the Internet]; 2005 [Cited 2020 Sep 6]. Available:<http://www.sld.cu/galerias/pdf/sitios>
 15. De la Cruz Alfonso N, Hernández Urra MC. Polyps and superficial neoplastic lesions of the colon. Medical Record of the Center. [Internet]. 2011; [cited 2019 Jun 22]5(2). Available:http://www.actamedica.sld.cu/r2_11/colon.htm
 16. Tuohy TM, Rowe KG, Mineau GP, Pimentel R, Burt RW, et al. Risk of colorectal cancer and adenomas in the families of patients with adenomas: a population-based study in Utah. Cancer [Internet]. 2014;[cited 2020 Apr 28];120 (1): 35-42: [approx. 8 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/24150925>
 17. Sanjurjo García JL. Pólipos y cáncer de colon. Rev de Gastroenterol Méx [Internet]. 2011;[cited 2020 feb 16]; Supl.1(76):100-101: [approx. 1 p.]. Available:<http://www.revistagastroenterologiamexico.org/index.php?p=watermark&idApp=UINPBA000046&piitem=X0375090611252789&origen=gastromexico&web=gastromexico&urlApp=http://gastromexico.elsevier.es&estadotem=S300&idiomaltem=es>
 18. Tusen Toledo Y, Chao González L, Barroso Márquez L, De Armas Fernández MC, Fernández Maderos I. Test de sangre oculta y colonoscopia en el diagnóstico del cáncer colorrectal. Rev Cub Med Mil[Internet]; 2009 [cited2019Jun22];1(2) : Available:<http://www.revcimeq.sld.cu/index.php/imq/article/view/72/254>
 19. García Rodríguez MA, Cubillo Durán E, Moreno Camelo S, Mata Román L, Muñoz Moreno MF, et al. Impacto del cribado de cáncer colorrectal mediante análisis inmunológico en una zona básica de salud urbana. Semergen – Medicine of Family. [Internet]. 2013; [cited 2019 Jun 18]; 39(5):252-58: [approx. 7 p.]. Available:http://apps.elsevier.es/watermark/ctl_servlet?_f=10&pident_articulo=90209147&pident_usuario=0&pcontactid=&pident_revista=40&ty=149&accion=L&origen=zonadelectura&web=www.elsevier.es&lan=es&fichero=40v39n05a90209147pdf001.pdf
 20. Umpiérrez García I, Herrera Hernández N, Hernández Ortega A, Román Castellini V, Alonso Pereira Y, et al. Caracterización clínica, epidemiológica y endoscópica del cáncer colorrectal en pacientes geriátricos. Rev. Med. Electrón. [Internet]. 2009 [cited2019Mar26] ;31(6): Available:http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18242009000600010&lng=es
 21. Tusen Toledo Y, Chao González L, Barroso Márquez L. Valor de la prueba de sangre oculta en heces fecales para la detección de lesiones premalignas y malignas del colon. Rev Cub Med Mil[Internet]. 2011;[cited2020Jun22];40(3-4): 234-40: [approx. 7 p.]. Available:http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0138-65572011000300005&lng=es.
 22. Doubeni CA, Laiyemo AO, Major JM, et al. Socioeconomic status and the risk of colorectal cancer: an analysis of more than a half million adults in the National Institutes of Health-AARP Diet and Health Study. Cancer [serial on the Internet]. 2012 [cited 2019 Jun 18];118(14):3636-44: [approx. 9 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/22898918>
 23. Doubeni CA, Major JM, Laiyemo AO, et al. Contribution of behavioral risk factors and obesity to socioeconomic differences in colorectal cancer incidence. J Natl Cancer Inst [serial on the Internet]. 2012 [cited 2020 Jun 18];104(18):1353-62: [approx. 10 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/22952311>
 24. Decanini Terán CO, González Acosta J, Obregón Méndez J, Vega de Jesús M. Cáncer de recto. Diagnóstico, estadificación y tratamiento. Cir Cir [Internet]. 2011[cited 2020 feb 16];79:481-87 : [approx. 7 p.]. Available:<http://www.medigraphic.com/pdfs/circir/cc-2011/cc115o.pdf>
 25. Perrone F, Lampis A, Bertan C, Verderio P, Ciniselli CM, et al. Circulating free DNA in a screening program for early colorectal cancer detection. Tumori. [Internet] 2014 [cited: 2020 May 6]; 100(2):115-21: [approx. 7 p.].

- Available:<http://www.ncbi.nlm.nih.gov/pubmed/24852853>
26. Marten Marén D, Ramírez Arias MC, Fernández Duharte J. Valor de la sangre oculta en heces fecales para el diagnóstico de cáncer colorrectal. MEDISAN[Internet]. 2014 [cited 2020 Jun 22];18(1):1763-68: [approx. 6 p.]. Available:http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1029-30192014001200017&lng=es
27. Chen JG, Cai J, Wu HL, Xu H, Zhang YX, et al. Colorectal cancer screening: comparison of transferrin and immuno fecal occult blood test. World J Gastroenterol. [Internet]. 2012 [cited: 2020 May 6] 7;18(21):2682-8: [approx. 7 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/22690078>
28. Dong Wu, Han-Qing Luo, Wei-Xun Zhou, Jia-Ming Qian, Jing-Nan Li. The Performance of Three-Sample Qualitative Immunochemical Fecal Test to Detect Colorectal Adenoma and Cancer in Gastrointestinal Outpatients: An Observational Study. Plos One [Internet] 2014 [cited 2019 Dec 27];9(9):e106648. Available:<http://www.ncbi.nlm.nih.gov/pubmed/25198288>
29. Klabunde CN, Cronin KA, Breen N, et al. Trends in colorectal cancer test use among vulnerable populations in the United States. Cancer Epidemiol Biomarkers Prev [serial on the Internet] 2011 [cited 2019 Jun 18];20(8):1611-21: [approx. 11 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/21653643>
30. Denters MJ, Deutekom M, Bossuyt PM, Stroobants AK, Fockens P, et al. Lower risk of advanced neoplasia among patients with a previous negative result from a fecal test for colorectal cancer. Gastroenterology. [Internet]. 2012 [cited: 2020 May 6];142(3):497-504: [approx. 8 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/22108194>
31. Cubiella J, Castro I, Hernández V, González Mao C, Rivera C, et al. Characteristics of adenomas detected by fecal immunochemical test in colorectal cancer screening. Cancer Epidemiol Biomarkers Prev. [Internet]. 2014 [cited: 2020 May 6];23(9):1884-92: [approx. 9 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/24962836>
32. Rutter MD. Surveillance programmes for neoplasia in colitis. J Gastroenterol [serial on the Internet]. 2011 [cited 2020 Jan 24]; 46 Suppl 1:1-5 : [approx. 4 p.]. Available:<http://www.ncbi.nlm.nih.gov/pubmed/20798970>

© 2021 Licea and Portela; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle4.com/review-history/73991>