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Article

Colorectal Cancer Screening: Prevalence and Predictors of Adherence in Department of Energy Workers

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Abstract: Objective: To assess colorectal cancer screening (CRC) practices in Department of Energy (DOE) workers enrolled in an occupational medical screening program. Methods: A telephone survey adapted from Behavioral Risk Factor Surveillance System 2020 questionnaire, addressing CRC screening history and CRC high risk conditions, was administered to participants aged 45–85 years, over 4 months in 2023. CRC screening adherence was reported as frequencies and percentages, and predictors of adherence as adjusted odds ratios (AOR) with 95% confidence intervals (CI), using multivariable logistic regression. Results: Overall, 823 (81%) of 1015 respondents reported a CRC screening history adherent to United States Preventive Service Task Force (USPSTF) guidelines. Age [45–59 years: AOR: 0.3 (0.2, 0.6), 60–69 years: AOR: 0.8 (0.5, 1.3), >75 years: AOR: 0.5 (0.3, 0.9) vs. 70–75 years], being high-risk for CRC [AOR: 2.6 (1.4, 5.0)], and geographic region of residence [South AOR: 2.0 (1.3, 2.9), Midwest AOR: 1.3 (0.8, 2.2), and East AOR: 3.3 (0.4, 26.4) vs. West] were associated with adherence to USPSTF CRC screening guidelines. Conclusion: Lower adherence to CRC screening recommendations among younger workers who are experiencing an increasing incidence in CRC offers occupational medicine programs an excellent opportunity to encourage CRC screening adherence among younger workers and thereby decrease the morbidity associated with colorectal cancer.

Keywords: colorectal cancer, screening, adherence, occupation, medical screening program

1. Introduction

Colorectal cancer is the 3rd most common cancer globally and the 2nd most common cause of cancer-related deaths in 2026 [1]. The CRC landscape is similar in the United States—CRC being the 4th most common cancer and 2nd leading cause of cancer deaths in 2025 [2]. The age distribution of CRC incidence trend in the United States has gradually evolved over the last few decades; with a decline reported in the age group 64 years and older, a plateau in age group 50–64 years, and a concomitant increase in age group 30–50 years [3]. Not only do younger adults account for 1 in 5 individuals with new CRC diagnoses in the United States, but they also have higher risk for advanced stage at the time of diagnosis and higher mortality rates [4–7]. Little is known why this epidemiological shift is occurring. The age-related discrepancy is alarming particularly because the younger age group forms the core of U.S. labor force [8]. The loss of productivity as well as increased financial and mental strain associated with a CRC diagnosis in the prime-age workforce is a societal burden.

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The United States Preventive Task Force (USPTF) endorses guidelines to screen people for CRC through the use of various modalities, including colonoscopy, sigmoidoscopy, and stool-based tests with the goal of early detection and reduced morbidity and mortality [9]. To address the rising CRC incidence in younger adults, and in line with numerous scientific organizations in the United States, the USPSTF recommended initiating CRC screening at age 45 years in 2021 [9]. While the decrease in CRC incidence and mortality in the older age group is largely attributed to increased CRC screening efforts, screening in the younger adults remains dismal [10]. Overall, approximately 60–70% of people in the United States are up to date with CRC screening [9,11]; this number dips to 20% among younger adults, aged 45–49 years [4,7]. In addition to age, adherence with CRC screening varies with race and ethnicity, access to care, and patient geography [11,12]. In rural areas, fewer providers are available to perform procedures, such as colonoscopy and sigmoidoscopy, and people are less likely to be screened compared to those in urban areas [13].

Of modifiable CRC risk factors, knowledge about occupational exposures is limited, though attention has been increasing [14–17]. Younger working people form a vulnerable population with regards to CRC, as they face occupational risk factors and are adversely affected by rising CRC incidence burden at the same time. Improved understanding of CRC occupational carcinogens is a pre-requisite for hazard identification and mitigation. Therefore, this younger demographic provides a window of opportunity for critical research in CRC prevention pertaining to occupational health and safety.

Workers from Department of Energy (DOE) facilities are exposed to various occupational toxins, such as asbestos, beryllium, ionizing radiation, and volatile organic compounds, that have been used in the development, production and maintenance of nuclear weapons. Some of these occupational toxins, including asbestos, are implicated in the etiology of CRC [14,16]. Evidence indicates that incidence and mortality for various cancers, including CRC, remains elevated for the nuclear weapon industry workers years after their retirement [18].

Since 1998, the DOE has offered medical screening examinations to former workers at DOE's nuclear defense facilities, in the form of 'Former Worker Medical Screening Program' or 'FWP', to identify adverse health effects related to occupational exposures [19]. According to the DOE Former Worker Medical Screening Protocol, stool-based testing should be offered every 3 years with a recommendation to the participant to discuss colonoscopy with their primary care providers [20]. The FWP does not offer colonoscopy, sigmoidoscopy, colonography, or stool-based DNA tests that are a part of the USPSTF guidelines. We evaluated whether FWP participants, who mostly live in non-metropolitan areas, were up to date on their CRC screening based on the current USPSTF guidelines.

2. Materials and Methods

The Worker Health Protection Program (WHPP)—one of the DOE's four FWPs—is a voluntary union-associated, government-funded multisite occupational medical screening program for Department of Energy workers [19]. The FWP was mandated by the United States Congress under the National Defense Authorization Act of 1993; active screening was initiated in 1998. WHPP is administered by the Barry Commoner Center for Health and the Environment at Queens College of the City University of New York. Initiated in 1999, the WHPP provides free medical screening examinations to former and, to a lesser extent, current workers from 15 active and legacy DOE sites: Brookhaven National Laboratory (New York); Fernald Feed Materials Production Center, Mound Plant and Portsmouth Gaseous Diffusion Plant (Ohio); Idaho National Laboratory (Idaho); K-25 Gaseous Diffusion Plant, Oak Ridge National Laboratory and Y-12 National Security Complex (Tennessee); Paducah Gaseous Diffusion Plant (Kentucky); Lawrence Livermore, Lawrence Berkeley and Sandia National Laboratories (California); Los Alamos and Sandia National Laboratories (New Mexico); and Nevada National Security Site, Formerly Nevada Test Site (Nevada). WHPP offers an initial medical evaluation and a repeat medical evaluation every three years thereafter. WHPP recommends but does not provide CRC screening except for a stool-based test every three years at the periodic examination.

For this study, a short survey was conducted over a 4-month period from 5 May to 15 September 2023, during 10-min telephone interviews. The questionnaire was administered by trained program site coordinators to all willing screening participants aged 45–85 years, at all WHPP-operated DOE sites noted above. This survey was incorporated into the existing telephone scheduling communication with the participants, before their appointments, for medical screening examinations. Thirty-two (3.1%) of these interviews were conducted for initial/baseline examinations, while 983 (96.8%) were for rescreen examinations.

The study questionnaire administered by program site coordinators addressed: (I) non-modifiable risk factors for colorectal cancer, such as personal or family history of colorectal cancer, personal history of inflammatory bowel disease (IBD—Crohn's disease and ulcerative colitis) and history of familial colorectal cancer syndrome,

such as Familial Adenomatous Polyposis [21], Hereditary Non-Polyposis Colon Cancer (HNPCC) or Lynch Syndrome, and (II) CRC adherence questions, derived from Behavioral Risk Factor Surveillance System (BRFSS) questionnaire, version 2020, Core Section 17, which addresses CRC screening [22]. A response to each afore-mentioned non-modifiable risk factor was recorded by the program site coordinators as a 'yes' or 'no'. A participant responding affirmatively to any non-modifiable risk factor (personal or family history of CRC, personal history of IBD and personal history of familial syndromes) was considered high-risk in this study, in line with current clinical practice as outlined by American Gastroenterological Association (AGA) and American Cancer Society (ACS), which do not recognize occupational exposures as a risk factor [23,24]. The study questionnaire assessed the participants' adherence with 2021 USPTF CRC screening guidelines [9]. These questions addressed type of CRC screening test undertaken by the participant [colonoscopy, sigmoidoscopy, stool-based tests (Guaiac-based Fecal Occult Blood Test or gFOBT, Fecal Immunochemical test or FIT and stool DNA test or Cologuard), and/or CT colonography (virtual colonoscopy)], time since the last test and indication for the test (screening versus diagnostic). Prior to the data collection, all program site coordinators were trained to administer the study questionnaire using a prepared script. Adherence was the main outcome variable, defined as adherence with the 2021 USPTF CRC screening guidelines, as follows: (1) colonoscopy within 10 years, (2) sigmoidoscopy within 5 years, (3) stool-based test: gFOBT or FIT within 1 year, or stool DNA test within 1–3 years, and (4) CT colonography within 5 years [9]. Information were extracted on high risk for CRC (yes or no), age (categorized as 45–59 years, 60–69 years, 70–75 years, 76 and above), gender (male/female), race/ethnicity (White, African American, Hispanic, Native American/Alaskan Native and Mixed/others), smoking status (never, former or current), body mass index (BMI in kilograms per meter squared or pounds per inch squared, grouped as: underweight (<18.5), healthy weight (18.5–24.9), overweight (25–29.9), obese (30–39.9), and severely obese (40 & above)), geographic region of residence and site of primary DOE employment. States of residence were grouped into regions as follows: South: (Kentucky, Tennessee, Alabama, North Carolina, Texas and, Florida; Midwest (Ohio, Illinois, Indiana and Missouri); East: (New York); and West (California, Nevada and Idaho).

Participants who were identified as high risk for colorectal cancer or not up to date with the CRC screening (as per USPSTF 2021 guidelines) were sent a follow-up letter after the interview, which recommended prompt follow-up with their personal healthcare provider. Modification of the existing IRB application was obtained from the Central Department of Energy Institutional Review Board (CDOEIRB) (DOE ID No: DOE000923), who deemed it as 'Not Human Research' under the Federal regulations (10 CFR 745). An additional approval was sought from the CDOEIRB (DOE ID No: DOE001420) for analysis of the collected screening data and publication of our analyses in a medical journal, which was determined to be Exempt human subjects' research (approval date of 28 September 2026). Study procedures were performed in accordance with the protocol approved (ID: DOE000923). Only de-identified data were used for analysis.

3. Statistical Analysis

Coded data were entered into FileMaker database. De-identified data were extracted by the data manager from the FileMaker, which was then used for data analysis. All data analyses were performed with Stata Statistical Software, version 17 (StataCorp. 2021. *Stata: Release 17. Statistical Software*. College Station, TX: StataCorp LLC.). Data were summarized with frequencies and percentages for categorical variables or mean and standard deviation (SD) for quantitative variables. Adherence was calculated per person. A multivariable logistic regression was conducted and reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI). To assess factors associated with CRC screening adherence, a multivariable model was developed by selecting statistically or clinically significant variables using forced entry method. These included high risk for CRC, age, gender, race/ethnicity, smoking status, BMI, and region of residence. Using the likelihood ratio test, a p-value of <0.05 was considered significant.

4. Results

We queried 1117 WHPP participants during the data collection period, of whom 1015 (90.9%) participants completed the questionnaire (Figure 1).

Table 1 outlines the demographic characteristics of survey participants. 13.4% of survey participants were high-risk for CRC. The mean age of study participants was 70.3 years. Younger participants (45–59 years) who typically form the workforce represented 11.2% of the cohort. The majority of study participants were older, white, males, had high BMI and were never smokers. Nearly one-half of the survey participants lived in Southern states.

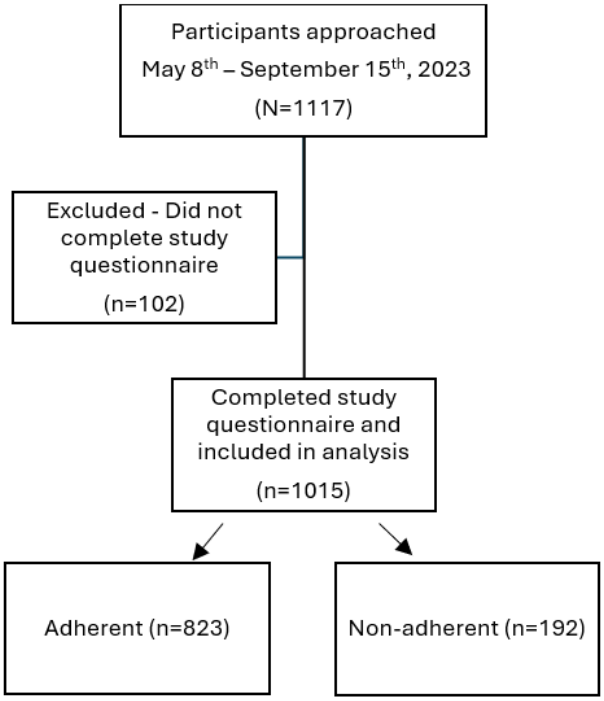


Figure 1. Flow Diagram of participant selection.

Table 1. Sociodemographic characteristics of study participants.

Variables	**Totals N = 1015 (%)**
Age (in years) *	
45–59	114 (11.2)
60–69	307 (30.2)
70–75	300 (29.6)
76 & above	294 (28.9)
CRC risk *	
Average	879 (86.6)
High	136 (13.4)
Gender **	
Female	268 (26.4)
Male	746 (73.5)
Race/Ethnicity **	
White	824 (81.2)
African American	98 (9.7)
Hispanic	21 (2.1)
Native American/Alaskan Native	14 (1.4)
Multiple/Others	9 (0.9)
BMI (kg/m^2) **	
Underweight (<18.5)	8 (0.8)
Healthy weight (18.5–24.9)	164 (16.2)
Overweight (25–29.9)	402 (39.6)
Obese (30–39.9)	381 (37.5)
Severely obese (40 & above)	47 (4.6)
Smoking status **	
Never	556 (54.8)
Former	350 (34.5)
Current	92 (9.1)
Region of residence *,**	
East: New York	17 (1.7)
West: California, Nevada, Idaho	333 (32.8)
Midwest: Ohio, Illinois, Indiana, Missouri	181 (17.8)
South: Kentucky, Tennessee, AL, FL, NC, TX	483 (47.6)

Table 1. *Cont.*

Variables	Totals N = 1015 (%)
DOE site **	
X-10, Y-12, K-25 (TN)	313 (30.9)
Fernald, Mound, Portsmouth (OH)	176 (17.3)
Paducah (KY)	172 (16.9)
Idaho National Lab (ID)	145 (14.3)
Nevada Test Site (NV)	112 (11.0)
Northern California (CA)	80 (7.9)
Brookhaven National Lab (NY)	16 (1.6)

AL = Alabama, CA = California, FL = Florida, ID = Idaho, KY = Kentucky, NC = North Carolina, NV = Nevada, NY = New York, OH = Ohio, TN = Tennessee, TX = Texas; * variables statistically significant ($p < 0.05$) at univariate level. ** discrepancy in total numbers of these variables is due to missing value/s. Region of residence of one participant, who was non-adherent was missing. One adherent participant's DOE site worked at, was missing.

5. CRC Screening Tests

Overall, 823 (81%) study participants reported a CRC screening history that was adherent to USPSTF guidelines. Among average CRC risk participants, 700 (79.6%) were adherent, and 179 (20.4%) were non-adherent. Of the 136 (13.4%) participants who were at high-risk for CRC, 123 (90.4%) were adherent and 13 (9.6%) were non-adherent. Participants overall reported taking the following CRC screening tests: colonoscopy, n = 777 (84%), stool DNA, n = 82 (9%), stool FIT test, n = 36 (4%), sigmoidoscopy, n = 21 (2.3%) and CT colonography, n = 9 (0.9%). Some participants overall took multiple tests. The screening test distribution for the high-risk adherent participants was similar to that of average risk participants. Of the total 925 tests taken, 91.2% were explicitly for screening purposes, while 8.8% were for symptoms or as a follow up of another test, though these tests performed for symptoms or as follow-up also served the purpose of CRC screening.

6. Factors Associated with Adherence

Adherence among participants differed based on various factors, including age, gender, race/ethnicity, BMI, and region of residence (Table 2), though only differences in age and region reached statistical significance. Lowest adherence was observed among the youngest participants (45–59 years); 78 (68.4%) were adherent compared with adherence among people aged 60–69 years: 82.7%, and 70–75 years: 86.3%. Slightly higher adherence was observed in the males as compared to the females, at 82.2% vs. 78.0%, respectively. With regards to race and ethnicity, white participants were the most adherent at 81.9% versus adherence rates of 74.5% and 71.4%, among African American and Hispanic participants, respectively. Adherence also varied based on the region of residence with Western states as the least adherent and Eastern as the most adherent, at 75.7% vs. 88.2%, respectively.

In the multivariable model (Table 3), age [45–59 years: AOR: 0.3 (0.2, 0.6), 60–69 years: AOR: 0.8 (0.5, 1.3), and >75 years: AOR: 0.5 (0.3, 0.9) vs. 70–75 years], being high-risk for CRC [AOR: 2.6 (1.4, 5.0)] and region of residence [South AOR: 2.0 (1.3, 2.9), Midwest AOR: 1.3 (0.8, 2.2), and East AOR: 3.3 (0.4, 26.4) vs. West] were associated with CRC screening adherence, after adjusting for covariates, including gender, race/ethnicity, BMI and smoking status. The age group 70–75 years was used as the reference group as this group demonstrated the highest adherence (86.3%) to CRC screening guidelines. Participants with BMI outside the healthy range (18.5–24.9) and history of smoking (former and current smokers) were less likely to be adherent. As compared to the participants living in the West, adherence was significantly elevated among Southern residents as well as East and Midwest residents, though the increases in the latter two regions were not statistically significant.

Table 2. Prevalence of CRC screening adherence in 1015 participants.

Variables	Adherent N = 823 (%)	Non-Adherent N = 192 (%)	*p*-Value
Age (years)			0.000
45–59	78 (68.4)	36 (31.6)	
60–69	254 (82.7)	53 (17.3)	
70–75	259 (86.3)	41 (13.7)	
76 & above	232 (78.9)	62 (21.1)	
Gender **			0.4
Female	209 (78.0)	59 (22.0)	
Male	613 (82.2)	133 (17.8)	

Table 2. *Cont.*

Variables	Adherent N = 823 (%)	Non-Adherent N = 192 (%)	*p*-Value
Race/Ethnicity **			0.4
White	675 (81.9)	149 (18.1)	
African American	73 (74.5)	25 (25.5)	
Hispanic	15 (71.4)	6 (28.6)	
Native American/Alaskan Native	11 (78.6)	3 (21.4)	
Multiple/Others	7 (77.8)	2 (22.2)	
BMI (kg/m^2) **			0.3
Underweight (<18.5)	5 (62.5)	3 (37.5)	
Healthy weight (18.5–24.9)	137 (83.5)	27 (16.5)	
Overweight (25–29.9)	327 (81.3)	75 (18.7)	
Obese (30–39.9)	309 (81.1)	72 (18.9)	
Severely obese (40 & above)	37 (78.7)	10 (21.3)	
Smoking status **			0.8
Never *	454 (81.6)	102 (18.3)	
Former	284 (81.1)	66 (18.9)	
Current	72 (78.3)	20 (21.7)	
Region of residence **			0.003
East: New York	15 (88.2)	2 (11.8)	
West: California, Nevada, Idaho	252 (75.7)	81 (24.3)	
Midwest: Ohio, Illinois, Indiana, Missouri	145 (80.1)	36 (19.9)	
South: Kentucky, Tennessee, AL, FL, NC, TX	411(85.1)	72 (14.9)	

AL = Alabama, FL = Florida, NC = North Carolina, TX = Texas. Percentages (in parentheses) are calculated across rows. Gender of one adherent participant was missing. Race/Ethnicity was missing for 49 participants (42 adherent, 7 non-adherent). BMI was missing for 13 participants (8 adherent and 5 non-adherent) Smoking status of 17 participants missing (13 adherent, 4 non-adherent). Region of residence for one non-adherent participant was missing. ** discrepancy in total numbers of these variables is due to missing value/s. * Percentages may not sum to 100% due to rounding.

Table 3. Multivariable analysis—association of CRC screening adherence with other factors.

Variables	Adjusted Odds Ratio (95% CI)
Age (in years)	
70–75	1.0
45–59	0.3 (0.2, 0.6)
60–69	0.8 (0.5, 1.3)
76 & above	0.5 (0.3, 0.9)
CRC risk	
Average	1.0
High (non-modifiable factors)	2.6 (1.4, 5.0)
Gender	
Female	1.0
Male	1.3 (0.9, 2.0)
Race/Ethnicity	
White	1.0
Native American/Alaskan Native	0.9 (0.2, 3.5)
African American	0.8 (0.4, 1.3)
Hispanic	0.8 (0.3, 2.3)
Mixed/others	1.3 (0.2, 6.7)
BMI (kg/m^2)	
Healthy weight (18.5–24.9)	1.0
Underweight (<18.5)	0.4 (0.1, 1.8)
Overweight (25–29.9)	0.9 (0.5, 1.4)
Obese (30–39.9)	0.8 (0.5, 1.4)
Severely obese (40 & above)	0.7 (0.3, 1.8)
Smoking status	
Never	1.0
Former	0.9 (0.6, 1.3)
Current	0.7 (0.4, 1.3)

Table 3. *Cont.*

Variables	Adjusted Odds Ratio (95% CI)
Region of residence	
West: California, Nevada, Idaho	1.0
South: Kentucky, Tennessee, AL, FL, NC, TX	2.0 (1.3, 2.9)
Midwest: Ohio, Illinois, Indiana, MO	1.3 (0.8, 2.2)
East: New York	3.3 (0.4, 26.4)

AL = Alabama, FL = Florida, NC = North Carolina, TX = Texas.

7. Discussion

Our study reports CRC screening practices and adherence with the most recent USPSTF screening guidelines in workers who actively participate in an occupational medicine screening program and have a history of variable exposure to occupational carcinogens. We observed an overall adherence of 81.0% among the study participants, which surpasses the national adherence of 71.1% among the 45–75 years old, based on the 2024 BRFSS data [25]. Our overall study adherence is also remarkably higher than the target set by the U.S. Department of Health and Human Services 'Healthy People 2030' objectives, which aims to have 72.8% of adults screen for CRC [26]. Although the 68.4% adherence in our youngest participants is the lowest in this study, it is remarkably higher than the national rate—52% among 45–54 years reported by the American Cancer Society [27], and 29.8% among 45–49 years reported by the 2022 BRFSS data [28]. The higher adherence in our study population may be due to selection of a health-oriented cohort (participating in the WHPP program) or the health education component of the WHPP program medical evaluation.

DOE workforce is distinctive in that they are occupationally exposed to known and some possible CRC carcinogens, such as asbestos, radiation, benzene, and diesel engine exhaust [29]. Meta-analyses published in 2024 found evidence of increased CRC risk among people occupationally exposed to asbestos [14] and possibly benzene [29]. Similarly, evidence has shown elevated lifetime risk of CRC among occupationally exposed medical radiation workers [30]. Limited studies suggest connection between diesel exhaust/gasoline exposure and rectal cancer [31,32]. A review of this topic in 2014 estimated that about 11–15% of excess CRC risk is attributable to occupational toxins [16]. This is highly relevant to CRC screening, because recognizing occupational CRC risk may help screening programs target screening populations [33]. Asbestos and ionizing radiation—the two most important occupational exposures with regards to CRC—were present at all the DOE sites though some sites had higher radiation levels on average than others [34]. Internal data review shows that the occupational radiation exposure, although crudely assessed in a prior study [34], and non-malignant asbestos-related disease (NMARD) did not significantly change the CRC screening adherence and did not alter the results when added to the multivariable logistic regression model. NMARD is an indicator of but underestimates the prevalence of occupational asbestos exposure in a population.

Consistent with prior literature, our study found age to be an important determinant of adherence with CRC screening guidelines [9]. We found that the adherence among the youngest people (age 45–59 years) was 70% lower than the 70–75 years age group [AOR: 0.3 (0.2, 0.6)]. These findings are comparable to the national CRC screening prevalence data [7]. Although uptake among younger people has increased following USPSTF's recommendation to start screening at age 45 years, it remains sub-optimal [35]. This is concerning given that 10–12% of all new cases of CRC are now diagnosed in people less than 50 years of age, who tend to have more aggressive tumors with worse prognosis [5]. The change in age-related CRC incidence and associated change in USPSTF guidelines provides occupational medicine programs an excellent opportunity to increase adherence of active workers, particularly of the aged 45–59 years, to participate in CRC screening.

The geographic variation in terms of CRC screening adherence is conspicuous, both in national (BRFSS, 2022) and in our study data. Our prevalence trend was similar to that of state-specific data but showed consistently higher levels of screening [25]. For instance, adherence prevalence was 47–64% in the Western states (BRFSS, 2022) vs. 75.4% for the current study, state-specific rates of 64.1–69.6% vs. 80.7% in the Midwest region; state-specific rates of 64.1–69.6% vs. 85.1% the Southern region (mostly Kentucky and Tennessee), and state-specific rates of 66.9–69.6% vs. 88.2% in the Eastern region [25].

Notably, our study found high adherence occurring in largely non-metropolitan populations. In general, rural states have lower cancer screening rates and poor health outcomes [36], despite highest CRC incidence and mortality rates in rural areas and parts of South and Midwest [7]. A pro-active occupational medical screening program can assist in overcoming sub-optimal CRC screening rates in such rural populations, thereby addressing this health disparity. Our results show that optimal adherence in such non-metropolitan/rural areas is achievable.

Centralized organized cancer screening programs, as opposed to a practice-based, individual-oriented screening, use a systematic population-level strategy to effectively increase the CRC screening uptake, as well as curb CRC incidence and mortality [37]. It is noteworthy that the predominant CRC screening method used in the United States is opportunistic, which relies on patients and health care providers to pursue cancer screening [38]. By contrast, many countries worldwide have adopted centralized organized methods [38]. The Veterans Health Administration [39] and Kaiser Permanente organizations in the U.S. have had great success in accomplishing higher CRC screening uptake among its enrollees (78.4% adherence to endoscopic screening and 80.9% adherence to any screening test, respectively), using the organized strategy [40]. Similarly, another DOE-sponsored medical screening program, Building Traces National Medical Screening Program, specific for construction trade workers, has reported higher CRC screening adherence leading to a reduced CRC mortality [41]. It is therefore not surprising to see a higher-than-national-average CRC screening compliance among our study participants, currently enrolled in an occupational medical surveillance program, WHPP, which is designed to promote health, detect diseases at an early stage and improve health outcomes.

Our study has several strengths. We evaluated CRC screening practices of a unique cohort enrolled in an occupational medical surveillance program, with conventional CRC risk factors and additionally exposed to occupational carcinogens of CRC. We had an excellent response rate of 90.9% versus BRFSS response rate of 45%. All our interviewers underwent training twice on the procedures and questionnaire administration—before the start of the survey, followed by a refresher session to ensure high-quality data. Our study questionnaire was based on the 2020 BRFSS questionnaire, permitting a standardized approach to surveying CRC screening and a ready comparison group. Our definition of CRC screening adherence was based on the USPSTF guidelines, which provides recommendations for average-risk people [21]. Limitations included a smaller proportion of the youngest study participants aged 45–59 years (n = 20 under age 50 years) but enough to allow an analysis of trend by age. We did not have information on some other modifiable risk factors of CRC, such as diet, alcohol intake, exercise and socioeconomic status [16,42]. Additionally, other risk factors of CRC, such as high BMI, smoking history, and occupational exposures etc. were not included in the definition of high-risk for CRC in this study. Of note, there is lack of formal CRC screening recommendation for these modifiable risk factors. Furthermore, there is wide variance in the number of participants in each region of residence as some of the largest DOE sites in the WHPP are in Tennessee (X-10, Y-12 and K-25 Gaseous Diffusion Plant). On the East coast, we only have one participating DOE site, i.e., Brookhaven National Lab in New York, which is a much smaller site in terms of number of DOE employees. This is also reflected in our study population. However, given enough number of individuals in the West, Midwest and Southern regions, the confidence intervals are narrow rendering precision to the adjusted odds ratios of these regions. Moreover, generalizability of our findings maybe limited given that the participants were enrollees in an occupational medical screening program.

8. Conclusions

Our results show a high overall CRC screening adherence of 81% in a unique occupational cohort, which surpasses the national benchmark. Colonoscopy was the most prevalent screening modality, followed by stool DNA, FIT, sigmoidoscopy and CT colonography. Among risk factors for CRC, age and region of residence were associated with CRC screening adherence, after adjusting for covariates. Our results underscore the importance of an organized, multi-pronged approach, specifically targeting the significant determinants to improve adherence with CRC screening, thereby reducing the CRC burden and alleviating outcomes. Notably, the high CRC screening adherence of 68.4% among the youngest participants (aged 45–59 years) substantiates the unique opportunity occupational medicine programs have in promoting CRC screening, in a younger population, who have been newly found to have an increasing risk of CRC.

Author Contributions

K.K.: Conceptualization, Writing—original draft, methodology, data analysis and interpretation; J.C.: Methodology, writing—review & editing; H.T.: Methodology, writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki. Modification of the existing IRB application was obtained from the Central Department of Energy Institutional Review Board (CDOEIRB) (DOE ID No.: DOE000923), who deemed it as 'Not Human Research' because under the Federal Regulations (10 CFR 745) the former worker screening program does not meet the definition of research. The date of notification of 'not human subject research' determination was 22 August 2023. An additional approval was sought from the CDOEIRB (DOE ID No.: DOE 001420) for analysis of the collected screening data and publication of our analyses in a medical journal, which was determined to be Exempt human subjects' research (approval date of 28 September 2026).

Informed Consent Statement

Given that this survey was incorporated into the on-going pre-examination telephone calls to the participants of a medical screening program, the consent form was not revised. The authors confirm that the manuscript does not contain any information that could identify the study participants.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare no conflict of interest. The Department of Energy had no involvement in any aspect of the research study. The authors take full responsibility for the content of the published article.

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper.

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