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Factors Associated with Colorectal Cancer Prevalence Among Long-Haul Truck Drivers in the United States

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Abstract

Purpose: To determine the age-adjusted association between colorectal cancer (CRC) risk factors and CRC prevalence among long-haul truck drivers (aged 21–85), after adjustment for age.

Design: Pooled cross-sectional analysis using Commercial Driver Medical Exam (CDME) data. Setting. National survey data from January 1, 2005, to October 31, 2012.

Participants: 47,786 commercial motor vehicle drivers in 48 states.

Measures: CRC prevalence was the primary outcome; independent variables included demographics, body mass index (BMI), and concomitant medical conditions.

Analysis: Kruskal-Wallis tests to analyze continuous variables; Fischer's exact tests to analyze categorical variables; univariate and multivariable logistic regression for rare events (Firth method) to quantify the association between the independent variables of interest and CRC prevalence. Odds ratios (ORs) and 95% confidence intervals (CIs) were adjusted for age, gender, years with current employer, year of exam, and BMI in a multivariate logistic regression.

Results: Many factors were statistically significant. Obesity (OR = 3.14; 95% CI = 1.03–9.61) and increasing age (OR = 1.10 per year; 95% CI = 1.07–1.13) were significantly associated with

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Contributorship

CRR: Conceptualization, Writing (Original, Review, Editing), Supervision, Project administration, Funding acquisition. JXM: Conceptualization, Methodology, Validation, Formal analysis, Data Curation, Writing (Original, Review, Editing), Visualization, Funding acquisition. FQ: Methodology, Formal analysis, Data Curation, Writing (Original, Review, Editing), Supervision. LG: Validation, Formal analysis, Writing (Review, Editing). MH: Writing (Original, Review, Editing). ANH: Writing (Original, Review, Editing), Visualization, Funding acquisition. All authors contributed to revising the manuscript critically for important intellectual content, agreed to be accountable for all aspects of this study, and approved the final version.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Although unrelated to this study, Dr. Charles R. Rogers offers scientific input to research studies through an investigator services agreement between the University of Utah and Exact Sciences.

CRC prevalence. Truckers with 4 or more concomitant medical conditions were significantly more likely to have CRC (OR = 7.03; 95% CI = 1.83–27.03).

Conclusions: Our findings highlight mutable risk factors and represent an opportunity for intervention that may decrease CRC morbidity and mortality among truck drivers, a unique population in the United States estimated to live up to 16 years less than the general population.

Keywords

body mass index; colonic neoplasms; diabetes mellitus; gastrointestinal diseases; occupational health; gender role

Purpose

The American Cancer Society (ACS) estimates that 2021 will see 149,950 new colorectal cancer (CRC) diagnoses in the United States, although the number may be higher since due to the COVID-19 pandemic new CRC diagnoses declined by roughly 30% from January to mid-April 2020, compared with the same period in 2019.[1,2] In addition, an estimated 52,980 CRC-related deaths will occur in the United States in 2021.[1,3] Significant racial and ethnic disparities are apparent in CRC morbidity and mortality, with non-Hispanic (NH) Black and Indigenous people generally having higher incidence and mortality.[3,4]

It is estimated that over half of all CRC can be attributed to modifiable lifestyle factors,[5] including heavy alcohol use, obesity, high consumption of processed and red meat, a sedentary lifestyle, and tobacco use.[1,6–11] Little is known about the relationship between occupation type and CRC risk, especially among long-haul truck drivers—also called commercial motor vehicle (CMV) drivers—who experience several risk factors for CRC. Sedentary lifestyles, observed at relatively high rates among truck drivers, have been linked to CRC and may be a risk factor for CRC occurring in individuals aged under 50 (early-onset colorectal cancer, or EOCRC).[7,12–14] Obesity and tobacco use are twice as high among truckers as they are in the overall U.S. adult labor force,[15,16] and previous research has shown that truck drivers often smoke cigarettes to stay awake.[1,17,18] Truck drivers also often have few nutritious options available to them while commuting,[19] face challenges to eating healthily,[20] and have high rates of metabolic syndrome.[21,22] High-fat diets have been associated with poor health among truck drivers.[23] Essentially, compared with the general U.S. population, truck drivers have higher rates of virtually all risk factors associated with CRC,[12,15,24] with the exception of alcohol use.[25] The high prevalence of these risk factors poses significant health risks for truck drivers and also puts their livelihoods at risk.[16,22,25]

Despite a growing body of literature focused on the health of truck drivers and the risk factors associated with truck driving as an occupation, knowledge gaps remain, and available data on this population are inadequate.[12,15] Due to the difficulty of reaching the long-haul truck-driving population, much of the literature on this group consists of small-scale regionalized or localized studies.[12,15,25] Conventional survey methods such as mail and telephone surveys are impractical because drivers are often away from home and follow unpredictable work schedules.[15,25] To our knowledge, no studies have systematically investigated the health risk factors associated with long-haul truck drivers and CRC in the

United States. Truck drivers have been estimated to live up to 16 years less than the U.S. general male population.[26] With CRC currently the third leading cause of cancer death in the United States, it is important to examine whether an association exists between health risk factors and CRC prevalence in the truck-driving population.[3]

The purpose of this study was to determine how, after adjustment for age, an a priori list of potential risk factors were associated with CRC prevalence among long-haul truck drivers (ages 21–85). Our hypothesis was that, after adjusting for age, long-haul truck drivers with poor health would have a higher prevalence of CRC due to the confluence of CRC risk factors experienced by this population.

Methods

The University of Utah Institutional Review Board approved this pooled cross-sectional study (#35889). Participants were not required to provided informed consent for this study as this was a secondary data analysis-focused study. These data have been used in other reports and have been reported previously, and only relevant methodology is reported.[27–30] Commercial Driver Medical Exam (CDME) data were obtained from a private company that provides a web-based platform for recording CDME findings and medical certification decisions for CMV driver licensure. The anonymized database includes CDMEs performed by medical examiners on CMV drivers licensed in all 48 contiguous states. Most of the drivers are classified as long-haul drivers.

Sample

Commercial drivers require medical certification to obtain and maintain a commercial driver license. The medical examiner determines whether the driver meets the requirements for medical certification (up to 2 years) or is not medically qualified to maintain a commercial driver license. Examination data are entered into a computer program to ensure high data quality and capture. We analyzed data from January 1, 2005, to October 31, 2012 (the total span of time covered by the database) for 47,786 unique drivers. Data elements included demographics (age and gender); medical history (e.g., neurological problems, medications, sleep disorders, and diabetes mellitus); measured height, weight, and blood pressure; heart rate; urinalysis; other medical tests (e.g., vision, cardiovascular, and hearing whisper test); and examiner notes and comments. If drivers had multiple consecutive CDMEs in the database, only the first CDME was analyzed; all others were excluded.

Measures

Most single conditions were self-reported by the driver at the time of the exam. These were then verified by the examiner, who asked additional probing questions if warranted. Measured height and weight were used to calculate BMI. Concomitant medical conditions were defined based on recommendations from the Federal Motor Carrier Safety Administration (FMCSA). The FMCSA provides multiple sources of guidance for examiners evaluating a CDME; this guidance is drawn from multiple sources, including conference reports, evidence summaries, medical expert-panel recommendations, FMCSA Medical Review Board recommendations, and other documents.[31–36] Benchmarking

examples include 1-year certifications, which are recommended by the FMCSA in the presence of either hypertension or diabetes mellitus without any other condition.[36] We assessed the FMCSA Medical Review Board's multiple-condition matrix, using comparable data for most elements from the CDME. The purpose of the matrix is to provide guidance regarding CMV driver-certification length based on suspected risks. Therefore, all conditions within the matrix are weighted equally. For matrix analyses in this paper, counts of relative disqualifying conditions were analyzed in relationship to CRC. Application of the multiple-conditions table (Table 1) from the FMCSA recommendations data was also analyzed.

The CDME does not include a specific question about CRC diagnosis. We therefore used text recognition to identify specific terms in the CDME notes and comments and then reviewed the entire CDME to determine the presence of a definite or probable CRC diagnosis. We also identified 311 records by searching for the following terms: colon, rectum, cancer, colorectal, CRC, and polyp. These were then reviewed by two researchers, who were blinded to all other data, to identify definite and probable cases of CRC.

Analysis

The focus of these analyses was to assess relationships between health risk factors and CRC. Normality was assessed for continuous variables such as age and BMI. Continuous variables were analyzed using the Kruskal-Wallis test; categorical variables were analyzed using Fischer's exact test. Logistic regression with the penalized likelihood method (Firth method) for rare events was used to quantify the magnitude and direction of the association between individual factors and CRC. The odds ratio (OR) and 95% confidence interval (CI) were adjusted for age, gender, years with current employer, year of exam, and BMI in a multivariate logistic regression. All analyses were conducted using SAS 9.4 (SAS Institute, Cary NC).

Results

The study population comprised the 47,786 unique drivers with data in the database. Most participants (95.6%) were male, with a mean age of 49.9 years and a mean BMI of 31.6 kg/m^2. Twenty-six (.05%) had diagnosed CRC and an additional 30 (.05%) had probable CRC based on medical notes in the CDME. Age and BMI and were found to not be normally distributed. Additional descriptive statistics for the entire population are in Table 2.

As shown in Table 3, even after statistical adjustment, each additional year of age and each additional kg/m^2 of BMI was statistically significantly related to CRC risk. Diabetes mellitus, high blood pressure, and heart disease were statistically significantly increased in crude analyses; after adjustment, however, these increases were not significant, suggesting that the relationship was confounded by one or more of the adjusted factors. Digestive problems, using medication to control for high blood pressure and liver disease were statistically significantly related to probable or definite CRC.

Crude analyses found that decreasing duration of medical certification was associated with an increased risk of diagnosed or probable CRC; however, after adjustment, no statistically

significant association with a risk of diagnosed or probable CRC was seen for participants who were not medically certified or were certified for 3 months or less. Each additional concomitant medical condition was statistically significantly associated with an increased risk of diagnosed or probable CRC, and an increasing number of medical conditions was statistically significantly associated with a higher likelihood of diagnosed or probable CRC (test for trend $P < .0001$, data not shown). Also, a history of opioid use was strongly associated with an increased likelihood of diagnosed or probable CRC, even after adjustment for confounders. Results for the outcome of diagnosed CRC alone were analogous in direction and magnitude but were generally less statistically significant because of smaller number of cases and lower statistical power (data not shown).

Discussion

A high prevalence of CRC risk factors, including obesity, morbid obesity, increased age, and concomitant medical conditions in the long-haul truck-driving population suggests a need for investigation of truck-driver engagement with preventive health care and overall health. For this reason, we aimed to investigate CRC risk among truck drivers. We found that obesity was positively associated with the presence of diagnosed or probable CRC, reaffirming the findings of other studies.[37–39] Additionally, older drivers were more likely to have diagnosed or probable CRC. Truck drivers with comorbid medical conditions were also more likely to experience CRC, and the strength of this association rose as the number of medical comorbidities increased. Other studies have found elevated CRC incidence among individuals with chronic medical conditions, including obesity, inflammatory bowel disease, diabetes mellitus, and liver disease.[39–41] Thus, our findings align with our central hypothesis that truck drivers with poorer health would have a higher prevalence of CRC.

Our results suggest that, compared with truck drivers of normal weight, obese, and morbidly obese drivers have 3.58- and 4.33-times greater odds, respectively, of having diagnosed or probable CRC. These findings align with the extensive body of literature demonstrating a positive association between obesity and CRC, with a stronger relationship for men compared with women and for colon cancer compared with rectal cancer.[42–47] Several factors are thought to contribute to this relationship, including gender-specific fat distribution, chronic inflammation, insulin resistance, and nutrition.[37,42,47,48] In general, women have a greater proportion of peripheral subcutaneous fat, whereas men have more centrally located visceral fat.[42] Visceral fat is more metabolically active, secreting molecules that can have inflammatory, coagulative, and other metabolic effects that likely contribute to the higher association between BMI and risk of cancer in the colon, specifically, among men.[42,47,49,50] Inflammation, both systemic and in the colorectal mucosa, is strongly linked to CRC risk.[51–54] Additionally, abdominal obesity is associated with insulin resistance, leading to increased concentrations of insulin in the bloodstream that can have direct or indirect effects on mitogenic processes, suggesting another possible explanatory link between obesity and CRC risk.[55,56] A 2015 review of the published scientific evidence relating to diet and CRC risk found that obesity increases the risk of CRC by 19%.[57] As obesity is twice as high among truckers as it is in the overall U.S. adult labor force[15,16] and as truckers have also been shown to have poorer diet and nutrition than the overall U.S.

adult labor force,[20,58,59] it is important for future research to consider interventions aimed at reducing the impact of obesity on CRC risk in this population.

Diet and nutrition also play a key role in inflammation and obesity.[48] Consuming large amounts of fatty foods, red meat, processed meat, and sugar are risk factors for CRC; this is an important consideration because high-fat diets are common among truck drivers.[3,60,61] One intake of red meat per week increases CRC risk by about 40%; consumption of 50 g of processed meat per week increases CRC risk by 20%.[62] Foods with a higher glycemic index and glycemic load have also been shown to have statistically significant direct associations with CRC risk, especially among men.[63] Given the significant CRC burden in the United States and recent increases in EOCRC incidence that have been postulated to be partially attributable to poor diet quality,[3,64,65] our findings warrant further investigation.

In our study, increasing age was positively associated with an increased probability of CRC prevalence among truck drivers. Like many cancers, CRC is a disease that occurs more frequently in older individuals, and our analyses suggest that this is also true for older truck drivers.[1,3] Older drivers have had prolonged exposure to risk factors such as a sedentary lifestyle and smoking and more time to develop colorectal polyps and cancer-causing mutations.[1,7,12–14,17,18] Due to the increased exposure to CRC risk factors among truck drivers[12,15,24] amplified awareness and education about the importance of early-detection screening for CRC may aid in reducing CRC morbidity and mortality in this population.

We saw a clear association between the prevalence of concomitant medical conditions and CRC prevalence in our cohort. The trend of increasing CRC risk as the number of chronic medical conditions increased also supports this relationship, which is further reinforced by the association with opioid use. Our study design does not allow us to suggest directionality or causation in this relationship; however, there are many reasons why this relationship might exist. First, as age increases, the risk of both CRC and many chronic medical conditions (e.g., hypertension, diabetes mellitus, and cardiovascular disease) increases. Thus, age may confound the observed relationship. Second, several additional risk factors (e.g., tobacco use, alcohol use, and physical inactivity) for comorbidities that we included in our analysis and that are common among long-haul truck drivers are also risk factors for CRC.[66] These may be indicators of poor health behaviors that are more prevalent in this population. Third, health professionals who provide individuals with a cancer diagnosis may be more attuned to the screening, detection, and documentation of concomitant medical conditions and/or physical disabilities, which may be a marker of increased health care utilization and therefore increased screening and detection of CRC among these individuals.

Lastly, biologic etiologies may explain the association between specific medical conditions and CRC risk. Obesity, metabolic disease, and liver conditions, for example, are independent risk factors for colorectal adenomas and CRC, both of which may result from a chronic low pro-inflammatory state, pro-inflammatory cytokines, or hormonal pathways.[67,68] Overall, the presence of many chronic medical conditions may serve as an indicator or proxy of advancing age, poor overall health, unhealthy lifestyle, receipt of medical care, or direct cancer risk among long-haul truck drivers. As chronic conditions can also complicate CRC treatment, increase risk for complications, and influence the likelihood of surviving CRC, it

is critical that both providers and patients are aware of this association and that providers emphasize the importance of CRC screening among truck drivers who have multiple medical problems.[69,70] Future studies should investigate how chronic medical conditions and specific lifestyle behaviors augment cancer risk among truck drivers, as many of these factors are mutable and thus are potentially modifiable.

Limitations and Strengths

This is a pooled cross-sectional study that is not able to establish a temporal relationship or demonstrate a potential causal association between statistically significant factors and diagnosed or probable CRC. However, these data meet other A.B. Hill criteria for causation,[71] including strength of association and dose response. The cross-sectional design may also result in a healthy-worker effect, in which participants who have multiple concomitant conditions are not in the working population, either by self-selecting out of the workforce or because of the need to obtain medical certification to drive a commercial vehicle.

Additionally, some cases of CRC may not be documented in these data. Although drivers are required to report all medical conditions to their examiner, under-reporting may occur. However, unlike with conditions such as diabetes or seizure disorders, which directly affect the ability to obtain medical certification to drive, there is no rationale for drivers to under-report CRC outcomes. It is therefore likely that any under-reporting would be random and would introduce only random error that underestimates associations. For this reason, the associations reported here may be underestimates.

Similar to other published studies of commercial drivers, our sample included relatively few women (4.4%). We performed a *post hoc* assessment for effect modification between female gender and age, obesity, high blood pressure, heart disease, certification length, and number of conditions, and detected no interaction. However, because of the small proportion of women drivers in our sample, we cannot generalize these results to all women truck drivers.

We chose to exclude exams beyond the first one, as we have done in previous analyses, because including multiple exams from the same driver in our analyses would violate the assumption of independence for the statistical tests. We considered analyzing this subset in a panel analysis but were unable to do so for two reasons: First, the number of drivers with consecutive CDMEs in our sample (8.2%) was insufficient for analysis. Second, with only a couple of cases of CRC in this subset, it was statistically underpowered.

Lastly, some of the data collected on examination report forms are self-reported, thus introducing the risk of potential biases, such as recall or reporting bias. However, CRC outcomes are documented by the examiner, rather than reliant on participant self-report. Additionally, the examiner must attest under penalty of law that all examination-related data collection is completely accurate, thus reducing the likelihood of reporting bias.

This study also has multiple strengths, the greatest of which is a large, nationally representative sample collected over 7 years. No other study of commercial drivers has such a large sample size, which allows for stable statistical estimates of risk for the rare

outcome of diagnosed or probable CRC in this population. Moreover, our study contributes to the sparse literature on CRC prevalence specifically among long-haul truck drivers, as we currently know only that truck drivers are at an increased risk for death from cancer (33%), heart disease (30%) and roadway accidents (11%).[72] Other strengths are the use of objective measures of potential confounders such as BMI and the collection of data by a trained health professional. Lastly, this study was able to control for many confounders, providing robust estimates for relationships between CRC outcomes and other factors.

In conclusion, this pooled cross-sectional study of a large, anonymized sample of long-haul truck drivers found that obesity, older age, and the presence of concomitant medical conditions were associated with an increased risk for diagnosed or probable CRC. Given that about 50% of CRC incidence and mortality is attributable to modifiable risk factors, our data call for further research to identify the best approaches to reaching this vulnerable population with education and interventions to reduce the toll of this preventable disease.

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References

1. American Cancer Society. Colorectal Cancer Facts & Figures 2020–2022. Atlanta: American Cancer Society; 2021. https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2021.html
2. Periyanayagam U, Dwyer A, Kim J, Garcia R, Worrall S, Davis A. New Colorectal Cancer Diagnoses Fall by One-Third as Colonoscopy Screenings and Biopsies Grind to a Halt during Height of COVID-19. KomodoHealth and Fight Colorectal Cancer; 2020. https://www.komodohealth.com/insights/2020/05/new-colorectal-cancer-diagnoses-fall-by-one-third-and-colonoscopies-grind-to-a-halt-during-height-of-covid-19.
3. Siegel RL, Miller KD, Sauer AG, et al. Colorectal cancer statistics, 2020. CA: Cancer J. Clin 2020;70(3):145–164. doi:10.3322/caac.21601 [PubMed: 32133645]
4. DeSantis CE, Miller KD, Goding Sauer A, Jemal A, Siegel RL. Cancer statistics for African Americans, 2019. CA Cancer J Clin. 2019;69(3):211–233. doi:10.3322/caac.21555 [PubMed: 30762872]
5. Islami F, Sauer AG, Miller KD, Siegel RL, et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. CA: Cancer J Clin. 2018;68(1):31–54. doi:10.3322/caac.21440 [PubMed: 29160902]
6. Jochem C, Wallmann-Sperlich B, Leitzmann MF. The influence of sedentary behavior on cancer risk: Epidemiologic evidence and potential molecular mechanisms. Curr Nutr Rep. 2019;8(3): 167–174. doi:10.1007/s13668-019-0263-4. [PubMed: 30887424]
7. Kerr J, Anderson C, Lippman SM. Physical activity, sedentary behaviour, diet, and cancer: An update and emerging new evidence. Lancet Oncol. 2017;18(8):e457–e471. doi:10.1016/S1470-2045(17)30411-4. [PubMed: 28759385]
8. Keum N, Giovannucci E. Global burden of colorectal cancer: Emerging trends, risk factors and prevention strategies. Nat Rev Gastroenterol and Hepatol. 2019;16(12):713–732. doi:10.1038/s41575-019-0189-8. [PubMed: 31455888]

9. Molmenti CL, Hibler EA, Ashbeck EL, et al. Sedentary behavior is associated with colorectal adenoma recurrence in men. Cancer Causes and Control: CCC. 2014;25(10):1387–1395. doi:10.1007/s10552-014-0444-9. [PubMed: 25060482]
10. Namasivayam V, Lim S. Recent advances in the link between physical activity, sedentary behavior, physical fitness, and colorectal cancer. F1000Research. 2017;6:199. doi:10.12688/f1000research.9795.1. [PubMed: 28344777]
11. Thanikachalam K, Khan G. Colorectal cancer and nutrition. Nutrients. 2019;11(1):164. doi:10.3390/nu11010164.
12. Guest AJ, Chen YL, Pearson N, King JA, Paine NJ, Clemes SA. Cardiometabolic risk factors and mental health status among truck drivers: A systematic review. BMJ Open. 2020;10(10): e038993. doi:10.1136/bmjopen-2020-038993.
13. Hofseth LJ, Hebert JR, Chanda A, et al. Early-onset colorectal cancer: Initial clues and current views. Nat Rev Gastroenterol Hepatol. 2020;17(6):352–364. doi:10.1038/s41575-019-0253-4. [PubMed: 32086499]
14. Mullane SL, Connolly D, Buman MP. The perceived value of reducing sedentary behavior in the truck driving population. Publ Health Forum. 2019;7:214. doi:10.3389/fpubh.2019.00214.
15. Sieber WK, Robinson CF, Birdsey J, et al. Obesity and other risk factors: The national survey of U.S. Long-haul truck driver health and injury. Am J Ind Med. 2014;57(6):615–626. https://doi-org.ezproxy.lib.utah.edu/10.1002/ajim.22293 [PubMed: 24390804]
16. Thiese MS, Hanowski RJ, Moffitt G, et al. A retrospective analysis of cardiometabolic health in a large cohort of truck drivers compared to the American working population. Am J Ind Med. 2018;61(2):103–110. [PubMed: 29114913]
17. Kagabo R, Okuyemi K, Eden E, et al. Psychosocial factors and tobacco use among commercial truck drivers. J Occup Environ Med. 2020;62(6):439–444. doi:10.1097/JOM.0000000000001858. [PubMed: 32502084]
18. Kagabo R, Thiese MS, Eden E, Thatcher AC, Gonzalez M, Okuyemi K. Truck drivers' cigarette smoking and preferred smoking cessation methods. Subst Abuse Res Treat. 2020;14: 1178221820949262. doi:10.1177/1178221820949262.
19. Wilson JL, Wolf DM, Olszewski KA. Reducing commercial truck driver BMI through motivational interviewing and self-efficacy. Workplace Health & Saf. 2018;66(6):270–275. doi:10.1177/2165079918754585.
20. Passey DG, Robbins R, Hegmann KT, et al. Long haul truck drivers' views on the barriers and facilitators to healthy eating and physical activity. Int J Workplace Health Manag. 2014;7(2): 121–135. doi:10.1108/IJWHM-08-2013-0031.
21. Mabry JE, Hosig K, Hanowski R, Zedalis D, Gregg J, Herbert WG. Prevalence of metabolic syndrome in commercial truck drivers: A review. J Transp Health. 2016;3(3):413–421. doi:10.1016/j.jth.2016.06.012.
22. Robbins RB, Thiese MS, Ott U, et al. Metabolic syndrome in commercial truck drivers. J Occup Environ Med. 2020;62(7): 453–459. doi:10.1097/JOM.0000000000001863. [PubMed: 32730019]
23. Okorie O, Thiese MS, Murtaugh MA, Sheng X, Handy R, Hegmann K. Relationships between poor health and calories from fat among commercial truck drivers. J Occup Environ Med. 2019;61(11):944–948. doi:10.1097/JOM.0000000000001706. [PubMed: 31490320]
24. Korelitz JJ, Fernandez AA, Uyeda VJ, Spivey GH, Browdy BL, Schmidt RT. Health habits and risk factors among truck drivers visiting a health booth during a trucker trade show. Am J Health Promot. 1993;8(2):117–123. [PubMed: 10146826]
25. Birdsey J, Sieber WK, Chen GX, et al. National survey of US long-haul truck driver health and injury. J Occup Environ Med. 2015;57(2):210–216. doi:10.1097/JOM.0000000000000338. [PubMed: 25654523]
26. Lemke M, Apostolopoulos Y. Health and wellness programs for commercial motor-vehicle drivers. Workplace Health and Saf. 2015;63(2):71–80. doi:10.1177/2165079915569740.
27. Thiese MS, Hanowski RJ, Kales SN, et al. Multiple conditions increase preventable crash risks among truck drivers in a cohort study. J Occup Environ Med. 2017;59(2):205–211. doi:10.1097/jom.0000000000000937. [PubMed: 28079676]

28. Thiese MS, Moffitt G, Hanowski RJ, Kales SN, Porter RJ, Hegmann KT. Commercial driver medical examinations. J Occup Environ Med. 2015;57(6):659–665. doi:10.1097/JOM.0000000000000422. [PubMed: 25710607]
29. Thiese MS, Moffitt G, Hanowski RJ, Kales SN, Porter RJ, Hegmann KT. Repeated cross-sectional assessment of commercial truck driver health. J Occup Environ Med. 2015;57(9): 1022–1027. doi:10.1097/JOM.0000000000000422. [PubMed: 26340292]
30. Thiese MS, Moffitt G, Hanowski RJ, et al. What medical conditions limit or medically disqualify truck drivers. J Occup Environ Med. 2021;63(2):139–146. doi:10.1097/jom.0000000000002101. [PubMed: 33523617]
31. Federal Motor Carrier Safety Administration. Evidence Reports' Executive Summaries and Medial Expert Panel Recommendations. Washington, DC: U.S. Depatment of Transportation. http://www.fmcsa.dot.gov/regulations/medical/reports-how-medical-conditions-impact-driving (2010).
32. Federal Motor Carrier Safety Administration. The Medical Review Board (MRB) of the US Department of Transportation's Federal Motor Carrier Safety Administration (FMCSA) Was Convened on January 6, 2010. Washington, DC: Meeting Summary; 2010.
33. Federal Motor Carrier Safety Administration. Large Truck and Bus Crash Facts 2010: Final Report. Washington, DC: U.S. Depatment of Transportation. https://www.fmcsa.dot.gov/safety/research-and-analysis/large-truck-and-bus-crash-facts-2010 (2012).
34. Hegmann KT, Andersson GB, Greenberg MI, Phillips B, Rizzo M. FMCSA's medical review board. J Occup Environ Med. 2012;54(4):424–430. doi:10.1097/JOM.0b013e3182480535. [PubMed: 22418277]
35. Parker D, Hoffman B. Motor Carrier Safety Advisory Committee and Medical Review Board Task 11–05 Report. Washington DC: Federal Motor Carrier Safety Administration; 2012. [cited 2015 Feb 11]. (2019).
36. United States Department of Transportation. Federal Motor Carrier Safety Administration Medical Examiner Handbook. Washington, DC: National Registry of Certified Medical Examiners:260. https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/mission/advisory-committees/mrb/83401/fmcsamedicalexaminerhandbook_0.pdf (2014).
37. Dong Y, Zhou J, Zhu Y, et al. Abdominal obesity and colorectal cancer risk: Systematic review and meta-analysis of prospective studies. Biosci Rep. 2017;37:6. doi:10.1042/BSR20170945.
38. Ma Y, Yang Y, Wang F, et al. Obesity and risk of colorectal cancer: A systematic review of prospective studies. PLoS One. 2013;8(1):e53916. doi:10.1371/journal.pone.0053916. [PubMed: 23349764]
39. Soltani G, Poursheikhani A, Yassi M, Hayatbakhsh A, Kerachian M, Kerachian MA. Obesity, diabetes and the risk of colorectal adenoma and cancer. BMC Endocr Disord. 2019; 19(1):113. doi:10.1186/s12902-019-0444-6. [PubMed: 31664994]
40. Parizadeh SM, Parizadeh SA, Alizade-Noghani M, et al. Association between non-alcoholic fatty liver disease and colorectal cancer. Expert Rev Gastroenterol Hepatol. 2019;13(7): 633–641. doi:10.1080/17474124.2019.1617696. [PubMed: 31092057]
41. Yashiro M Ulcerative colitis-associated colorectal cancer. World J Gastroenterol. 2014;20(44):16389–16397. doi:10.3748/wjg.v20.i44.16389. [PubMed: 25469007]
42. Aleksandrova K, Nimptsch K, Pischon T. Obesity and colorectal cancer. Front Biosci. 2013;E5:61–77. https://www.fbscience.com/Elite/articles/pdf/Elite596.pdf
43. Bergström A, Pisani P, Tenet V, Wolk A, Adami HO. Over-weight as an avoidable cause of cancer in Europe. Int J Cancer. 2001;91(3):421–430. doi:10.1002/1097-0215(200002)9999:9999<::aid-ijc1053>3.0.co;2-t. [PubMed: 11169969]
44. Lee IM, Paffenbarger RS Jr. Quetelet's index and risk of colon cancer in college alumni. J Natl Cancer Inst. 1992;84(17): 1326–1331. doi:10.1093/jnci/84.17.1326. [PubMed: 1495102]
45. Moore LL, Bradlee ML, Singer MR, et al. BMI and waist circumference as predictors of lifetime colon cancer risk in Framingham study adults. Int J Obes. 2004;28:559–567. doi:10.1038/sj.ijo.0802606.
46. Ning Y, Wang L, Giovannucci EL. A quantitative analysis of body mass index and colorectal cancer: Findings from 56 observational studies. Obes Res. 2010;11(1):19–30. doi:10.1111/j.1467-789x.2009.00613.x.

47. Whitlock K, Gill RS, Birch DW, Karmali S. The association between obesity and colorectal cancer. Gastroenterol Res Pract. 2012;2012:768247. doi:10.1155/2012/768247. [PubMed: 23304128]
48. Johnson IT, Lund EK. Review article: Nutrition, obesity and colorectal cancer. Aliment Pharmacol Ther. 2012;26:161–181. doi:10.1111/j.1365-2036.2007.03371.x.
49. Galic S, Oakhill JS, Steinberg GR. Adipose tissue as an endocrine organ. Mol Cell Endocrinol. 2010;316(2):129–139. doi: 10.1016/j.mce.2009.08.018. [PubMed: 19723556]
50. Wajchenberg BL, Nery M, Cunha MR, Silva ME. Adipose tissue at the crossroads in the development of the metabolic syndrome, inflammation and atherosclerosis. Arq Bras Endocrinol Metabol. 2009;53(2):145–150. doi:10.1590/s0004-27302009000200005. [PubMed: 19466206]
51. Esposito K, Pontillo A, Di Palo C, et al. Effect of weight loss and lifestyle changes on vascular inflammatory markers in obese women. JAMA. 2003;289(14):1799–1804. doi:10.1001/jama.289.14.1799. [PubMed: 12684358]
52. Munkholm P Review article: The incidence and prevalence of colorectal cancer in inflammatory bowel disease. Aliment Pharmacol Ther. 2003;18(Suppl 2):1–5. doi:10.1046/j.1365-2036.18.s2.2.x.
53. Pendyala S, Neff LM, Suárez-Fariñas M, Holt PR. Diet-induced weight loss reduces colorectal inflammation: Implications for colorectal carcinogenesis. Am J Clin Nutr. 2011;93(2):234–242. doi:10.3945/ajcn.110.002683. [PubMed: 21147860]
54. Tsilidis KK, Branchini C, Guallar E, Helzlsouer KJ, Erlinger TP, Platz EA. C-reactive protein and colorectal cancer risk: A systematic review of prospective studies. Int J Cancer. 2008; 123(5):1133–1140. doi:10.1002/ijc.23606. [PubMed: 18528865]
55. Kaaks R, Lukanova A. Energy balance and cancer: The role of insulin and insulin-like growth factor-I. Proc Nutr Soc. 2001; 60(1):91–106. doi:10.1079/pns200070. [PubMed: 11310428]
56. Nutrition Kaaks R., insulin, IGF-1 metabolism and cancer risk: A summary of epidemiological evidence. Novartis Found Symp. 2004;262:247–268. [PubMed: 15562834]
57. Baena R, Salinas P. Diet and colorectal cancer. Maturitas. 2015; 80(3):258–264. doi:10.1016/j.maturitas.2014.12.017. [PubMed: 25619144]
58. Olson R, Thompson SV, Wipfli B, et al. Sleep, dietary, and exercise behavioral clusters among truck drivers with obesity. J Occup Environ Med. 2016;58(3):314–321. doi:10.1097/JOM.0000000000000650. [PubMed: 26949883]
59. Apostolopoulos Y, Sönmez S, Shattell M, Haldeman L, Strack R, Jones V. Barriers to truck drivers' healthy eating: environmental influences and health promotion strategies. J Workplace Behav Health. 2011;26(2):122–143. doi:10.1080/15555240.2011.573754.
60. Lipkin M, Reddy B, Newmark H, Lamprecht SA. Dietary factors in human colorectal cancer. Annu Rev Nutr. 1999;19: 545–586. doi:10.1146/annurev.nutr.19.1.545. [PubMed: 10448536]
61. Boyle P, Langman JS. ABC of colorectal cancer: Epidemiology. BMJ. 2000;321(7264):805–808. doi:10.1136/bmj.321.7264.805. [PubMed: 11009523]
62. Aykan NF. Red Meat and Colorectal Cancer. Oncol Rev. 2015; 9(1):288. doi:10.4081/oncol.2015.288 [PubMed: 26779313]
63. Franceschi S, Maso LD, Augustin L, et al. Dietary glycemic load and colorectal cancer risk. Ann Oncol. 2001;12(2):173–178. doi: 10.1023/a:1008304128577 [PubMed: 11300319]
64. Loomans-Kropp HA, Umar A. Increasing incidence of colorectal cancer in young adults. J Cancer Epidemiol. 2019;2019: 9841295. doi:10.1155/2019/9841295 [PubMed: 31827515]
65. Zheng X, Hur J, Nguyen LH, et al. Comprehensive assessment of diet quality and risk of precursors of early-onset colorectal cancer. J Natl Cancer Inst. 2021;113(5):543–552. doi:10.1093/jnci/djaa16. [PubMed: 33136160]
66. Hegmann KT, Andersson GB, Greenberg MI, Phillips B, Rizzo M. FMCSA's medical review board. J Occup Environ Med. 2012;54(4):424–430. doi:10.1097/jom.0b013e3182480535. [PubMed: 22418277]
67. Kellokumpu I, Kairaluoma M, Mecklin JP, et al. Impact of age and comorbidity on multimodal management and survival from colorectal cancer: A population-based study. J Clin Med. 2021; 10(8):1751. doi:10.3390/jcm10081751. [PubMed: 33920665]

68. Shen H, Lipka S, Kumar A, Mustacchia P. Association between nonalcoholic fatty liver disease and colorectal adenoma: A systemic review and meta-analysis. J Gastrointest Oncol. 2014; 5(6):440–446. doi:10.3978/j.issn.2078-6891.2014.061. [PubMed: 25436123]

69. Transportation USD. Federal Motor Carrier Safety Administration Medical Examiner Handbook. Electronic;2014. Available from: http://www.fmcsa.dot.gov/regulations/medical/fmcsa-medical-examiner-handbook

70. van Leersum NJ, Janssen-Heijnen ML, Wouters MW, et al. Increasing prevalence of comorbidity in patients with colorectal cancer in the South of the Netherlands 1995–2010. Int J Cancer. 2013;132(9):2157–2163. doi:10.1002/ijc.27871. [PubMed: 23015513]

71. Hill AB. The environment and disease: Association or causation? Proc Roy Soc Med. 1965;58(5):295–300. [PubMed: 14283879]

72. Birdsey J, Alterman T, Li J, Petersen MR, Sestito J. Mortality among members of a truck driver trade association. AAOHN J. 2010;58(11):473–480. doi:10.3928/08910162-20101018-01. [PubMed: 20964270]

So What?

• What is already known on this topic?

Colorectal cancer (CRC) is common, and CRC risk is largely attributed to modifiable lifestyle factors. Commercial motor vehicle drivers (long-haul truck drivers) experience many risk factors for CRC, including poor diet, obesity, tobacco use, physical inactivity, and multiple medical problems.

• What does this article add?

Obesity, increasing age, and an increasing number of concomitant medical conditions were associated with CRC prevalence. Our results provide information that may aid in improving understanding and screening of individuals in this high-risk population. Additionally, it may educate prescribers and medical professionals who perform occupationally required exams, such as commercial driver medical exams, about increased risks for CRC among long-haul truck drivers.

• What are the implications for health promotion practice or research?

Long-haul truck drivers have reduced life expectancy and considerable CRC risk. Our findings highlight several mutable risk factors for CRC in this population and may help researchers develop interventions that effectively reduce CRC morbidity and mortality among long-haul truck drivers. Findings from this study can be used to develop tailored education about CRC risk in this population and, with CDME approval, make this information available to the long-haul truck driver population either electronically or via mailed materials.

Table 1.

Multiple-Conditions Matrix and Data Used from the CDME Form for each Condition.

Multiple Conditions for Qualified Certification Time from the FMCSA's Medical Review Board[30,31]	**Data Used in This Report from the Road Ready Database of CDME Forms for These Analyses**
1. Body Mass Index>35 kg/m^2	Body Mass Index>35 kg/m^2
2. Diabetes mellitus requiring medication	Diabetes mellitus controlled by medication
3. Cardiovascular disease or dysrhythmias	Heart disease, heart surgery, or heart abnormalities
4. Hypertension	Elevated blood pressure above 140/90, or hypertension medication, or self-reported history of hypertension
5. Requirement for a visual exemption	Corrected vision in both eyes worse than 20/40 or horizontal field of vision <70 degrees in either eye
6. Obstructive sleep apnea	Sleep problems
7. Renal disease	Kidney disease
8. Pulmonary disease with pulmonary function test abnormality	Lung and chest abnormalities
9. Epilepsy seizure free for >10 years	Seizures/epilepsy
10. Musculoskeletal disease requiring medical, surgical or prosthetic treatment	Spine or other musculoskeletal disorder
11. Stroke	Stroke or paralysis
12. Major psychiatric illness (as defined pending formal review by the MRB)	Nervous or psychiatric disorders
13. Opioid or benzodiazepine use	Opioid or benzodiazepine medication, including generic and trade names, in the record

MRB: Medical Review Board.

Table 2.

Descriptive Statistics.

Variable	n or Mean	Percent or Standard Deviation
Diagnosed colorectal cancer	26	.1%
Probable colorectal cancer	30	.1%
Diagnosed or probable colorectal cancer	56	.1%
Female gender	2093	4.4%
Age (years)	45.9 years	10.3 years
Body mass index (kg/m^2)	31.6 kg/m^2	7.2 kg/m^2
Diabetes	3263	6.8%
Diabetes control diet	1982	4.2%
Diabetes control pills	2644	5.5%
Digestive problems	712	1.5%
High blood pressure	8273	17.3%
Medication use for high blood pressure	4962	10.4%
Heart disease	832	1.7%
Liver disease	70	.2%
Certification length		
Not medically certified	3249	6.8%
1–3 months	2289	4.8%
4–6 months	763	1.6%
7–12 months	10244	21.4%
13–24 months	31241	65.4%
Obesity categories		
Underweight below 18.5	223	.5%
Normal weight 18.5–24.9	7384	15.5%
Overweight 25.0–29.9	14954	31.3%
Obese 30.0–34.9	12680	26.5%
Morbidly obese ≥35.0	12545	26.3%
Number of concomitant multiple conditions		
0 conditions	25528	53.4%

Variable	**n or Mean**	**Percent or Standard Deviation**
1 conditions	14520	30.4%
2 conditions	5728	12.0%
3 conditions	1617	3.4%
4 or more conditions	393	.8%
Opioid use	464	1.0%
Years with current employer	.4 years	.9 years

Table 3.

Crude and Adjusted Odds Ratios with 95% Confidence Intervals for Relationships with Definite and Probable Colorectal Cancer (n = 56) among a Sample of Truck Drivers (n = 47,786).

	Crude Odds Ratio	95% Confidence Interval		Adjusted Odds Ratios	95% Confidence Interval	
Age (per year)	**1.09***	**1.06**	**1.12**	**1.10***	**1.07**	**1.13**
Female gender	1.00	.28	3.56	.60	.12	2.94
Diabetes	**2.39***	**1.15**	**4.97**	1.02	.47	2.22
Diabetes control diet	**2.47***	**1.02**	**5.96**	.99	.38	2.59
Diabetes control pills	**3.00***	**1.45**	**6.22**	1.28	.59	2.80
Body mass index (per unit kg/m2)	**1.04***	**1.00**	**1.07**	**1.05***	**1.02**	**1.09**
Body Mass Index categories						
Underweight (below 18.5)	4.72	.24	92.15	6.06	.32	116.08
Normal weight (18.5–24.9)	1.00	Reference		1.00	Reference	
Overweight (25.0–29.9)	1.48	.44	4.97	1.29	.39	4.25
Obese (30.0–34.9)	**3.75***	**1.22**	**11.57**	**3.14***	**1.03**	**9.61**
Morbidly obese	**3.62***	**1.17**	**11.21**	**3.80***	**1.24**	**11.62**
Digestive problems	**8.57***	**3.77**	**19.46**	**5.55***	**2.31**	**13.35**
High blood pressure	**3.36***	**1.98**	**5.69**	1.66	.94	2.93
High blood pressure medication	**4.16***	**2.39**	**7.25**	**2.41***	**1.35**	**4.29**
Heart disease	**6.05 ***	**2.51**	**14.63**	2.17	.82	5.74
Liver disease	**18.53***	**3.56**	**96.52**	**14.73***	**2.84**	**76.42**
Certification length						
Not medically certified	**4.38***	**1.85**	**10.39**	2.05	.80	5.29
1–3 months	2.90	.93	9.19	1.62	.51	5.12
4–6 months	**8.71***	**2.74**	**27.68**	**5.45***	**1.65**	**18.05**
7–12 months	**5.09***	**2.77**	**9.38**	**2.44***	**1.27**	**4.66**
13–24 months	1.00	Reference		1.00	Reference	
Number of concomitant conditions						
0 conditions	1.00	Reference		1.00	Reference	
1 condition	**2.40***	**1.27**	**4.53**	**2.20***	**1.14**	**4.22**
2 conditions	**2.84***	**1.31**	**6.16**	**2.24***	**1.01**	**4.96**

	Crude Odds Ratio	95% Confidence Interval		Adjusted Odds Ratios	95% Confidence Interval	
3 conditions	**5.27***	**2.01**	**13.86**	**3.42***	**1.28**	**9.17**
4 or more conditions	**13.86***	**4.35**	**44.16**	**7.03***	**1.83**	**27.03**
History of opioid use	**6.70***	**2.26**	**19.86**	**7.21***	**2.45**	**21.22**
Years with current employer (per year)	**1.24***	**1.01**	**1.52**	1.22	.99	1.49

Adjusted for age, gender, years with current employer, year of medical exam, and body mass index P<.05.