ORIGINAL RESEARCH

# Differences in Cardiovascular Health Metrics in Emergency Medical Technicians Compared to Paramedics: A Cross-Sectional Study of Emergency Medical Services Professionals

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**Conflicts of interest/funding:** The authors report that there was no funding source for the work that resulted in the article or the preparation of the article. The authors declare no conflicts of interest.

**Keywords:** cardiovascular health; Emergency Medical Services; emergency medical technicians; paramedics

**Abbreviations:**
BMI: body mass index
CVH: cardiovascular health
CVD: cardiovascular disease
EMS: Emergency Medical Services
EMT: emergency medical technician
LS7: Life's Simple 7
NREMT: National Registry of Emergency Medical Technicians
US: United States

**Received:** August 14, 2018
**Revised:** November 19, 2018
**Accepted:** November 30, 2018

doi:10.1017/S1049023X19004254

## Abstract

**Background:** Emergency Medical Services (EMS) professionals face high physical demands in high-stress settings; however, the prevalence of cardiovascular health (CVH) risk factors in this health care workforce has not been explored. The primary objective of this study was to compare the distribution of CVH and its individual components between a sample of emergency medical technicians (EMTs) and paramedics. The secondary objective was to identify associations between demographic and employment characteristics with ideal CVH in EMS professionals.

**Methods:** A cross-sectional survey based on the American Heart Association's (AHA; Dallas, Texas USA) Life's Simple 7 (LS7) was administered to nationally-certified EMTs and paramedics. The LS7 components were scored according to previously described cut points (ideal = 2; intermediate = 1; poor = 0). A composite CVH score (0-10) was calculated from the component scores, excluding cholesterol and blood glucose due to missing data. Multivariable logistic regression was used to estimate odds ratios (OR; 95% CI) for demographic and employment characteristics associated with optimal CVH (≥7 points).

**Results:** There were 24,708 respondents that were currently practicing and included. More EMTs achieved optimal CVH (n = 4,889; 48.8%) compared to paramedics (n = 4,338; 40.6%). Factors associated with higher odds of optimal CVH included: higher education level (eg, college graduate or more: OR = 2.26; 95% CI, 1.97-2.59); higher personal income (OR = 1.26; 95% CI, 1.17-1.37); and working in an urban versus rural area (OR = 1.31; 95% CI, 1.23-1.40). Paramedic certification level (OR = 0.84; 95% CI, 0.78-0.91), older age (eg, 50 years or older: OR = 0.65; 95% CI, 0.58-0.73), male sex (OR = 0.54; 95% CI, 0.50-0.56), working for a non-fire-based agency (eg, private service: OR = 0.68; 95% CI, 0.62-0.74), and providing medical transport service (OR = 0.81; 95% CI, 0.69-0.94) were associated with lower odds of optimal CVH.

**Conclusions:** Several EMS-related characteristics were associated with lower odds of optimal CVH. Future studies should focus on better understanding the CVH and metabolic risk profiles for EMS professionals and their association with incident cardiovascular disease (CVD), major cardiac events, and occupational mortality.

**Cash RE, Crowe RP, Bower JK, Foraker RE, Panchal AR. Differences in cardiovascular health metrics in emergency medical technicians compared to paramedics: a cross-sectional study of Emergency Medical Services professionals. *Prehosp Disaster Med.* 2019;34(3):288–296.**

## Introduction

The burden of cardiovascular disease (CVD) is high in the United States (US), responsible for approximately 801,000 deaths per year.[1] Due to the large burden of disease, there has been a focus on describing and improving the cardiovascular health (CVH) of at-risk groups, including minority populations, women, and some occupational groups. In an effort to measure and improve CVH, the American Heart Association (AHA; Dallas, Texas USA) developed the Life's Simple 7 (LS7), a set of seven modifiable health behaviors and factors classified into ideal, intermediate, and poor categories.[2,3] These seven factors are smoking, body mass index (BMI), physical activity, diet, total cholesterol, blood pressure, and fasting

glucose levels.[3] Associations have been found between ideal CVH and decreasing CVD incidence and mortality, but the prevalence of ideal CVH in the general population is low.[2] Approximately five percent of US adults meet the ideal criteria for six of the CVH factors, and very few meet ideal criteria for all seven.[1,4] This metric has been used previously to describe the CVH of some at-risk demographic groups, but not for at-risk occupational groups.[5–7] Understanding the CVH risk profiles for occupation groups at high-risk of CVD is important as poor health may directly impact the ability to complete job tasks or provide necessary services.

One at-risk occupational group that has been widely studied is firefighters, who have a higher occupational mortality rate from CVD than any other occupational group.[8,9] The increased CVD risk is thought to arise from the nature of intermittent strenuous activity during an emergency response, interspersed with long periods of inactivity, as well as the high prevalence of risk factors such as obesity, smoking, poor diet, and physical inactivity.[10] While there has been a clear focus on the CVH of firefighters, not all emergency medical responders work in the fire service. Emergency Medical Services (EMS) professionals working in non-fire-based settings may face similar physical and metabolic demands in high-stress environments. For non-firefighter EMS professionals, the occupational demands and work settings can vary more widely than do those of firefighters, including hospital-based, private company, and non-emergency settings.[11] Over 300,000 nationally-certified EMS professionals currently work in communities across the US, and their health status may impact their job performance.

Importantly, the burden of disease, prevalence of CVD risk factors, and prevalence of ideal CVH in EMS professionals specifically is not well-understood. Furthermore, health disparities may exist between emergency medical technicians (EMTs) and paramedics, potentially driven by differences in working environments and exposures. For example, paramedics report higher levels of stress, burnout, pre-existing medical conditions, and even workplace violence compared to EMTs.[12–15] These factors may result in poorer health behaviors and poor CVH.

Therefore, the primary objective of this study was to compare the distribution of CVH and its individual components between a sample of EMTs and paramedics. The secondary objective was to identify associations between demographic and employment characteristics with ideal CVH in EMS professionals.

## Methods

### *Design, Setting, and Sample*

This was a cross-sectional study of nationally-certified EMS professionals included in the National EMS Certification database maintained by the National Registry of Emergency Medical Technicians (NREMT; Columbus, Ohio USA). As part of an annual census, an invitation to complete a survey was emailed in October 2013 to approximately 310,000 individuals certified with the NREMT, of which 99% had a valid email address (n = 307,853). Completion of this survey had no bearing on an individual's certification, no personal identifying information was requested, and participants were blinded to the study goals and objectives. The American Institutes for Research (Washington, DC USA) Institutional Review Board approved this study, and a waiver of consent was granted.

The questionnaire collected data regarding demographic and EMS employment characteristics, and also included questions adapted from the LS7.[3,16] After the initial email invitation, reminder messages were sent out one and two weeks later to increase survey participation.[17] Survey responses were collected via Snap 10 Professional computer-based survey software (Snap Surveys Ltd.; Portsmouth, New Hampshire USA). Due to trends in decreasing survey response rates, both overall and in the EMS population,[18,19] an abbreviated non-responder survey was conducted by telephone to assess non-response bias. The abbreviated questionnaire contained items related to employment characteristics, demographics, and two of the seven CVH factors assessed in the full survey. A total of 150 individuals who did not respond to the full electronic questionnaire were interviewed with computer-assisted telephone interviewing.

### *Cardiovascular Health Metrics*

The outcomes of interest included component CVH scores and an overall score. Respondents received a score of zero, one, or two for each poor, intermediate, or ideal classification, respectively. The BMI was calculated from self-reported height and weight. The healthy diet score was based on five key dietary recommendations: (1) consumption of 4.5 cups or more of fruits and vegetables every day; (2) consumption of two 3.5-ounce servings of fish per week; (3) consumption of three or more 1.0-ounce equivalent servings of whole grains per day; (4) consumption of <1,500 milligrams of sodium per day; and (5) drinking 36 ounces or less of sugar-sweetened beverages per week. Cognitive testing was conducted with 10 practicing EMS personnel to verify that the CVH-related items were performing as intended. Based on feedback from the testing process, the assessment of daily salt consumption was modified from one question to three to more validly assess healthy low-sodium diet behaviors.

As described in past work, responses were scored based on the categorization of ideal, intermediate, and poor CVH (Table 1) for each of the seven components based on self-report.[3] Respondents with missing item responses, or who marked that they did not know specific values, were considered as missing for those component scores. An overall CVH score was created by summing the component scores for each respondent. Due to a large proportion of respondents marking unknown for blood glucose and cholesterol, these components were excluded from the CVH score. Therefore, the LS7 score was calculated from the remaining five components, and thus classified as optimal (7-10), average (3-6), and inadequate (0-2). The CVH score was further dichotomized to optimal (7-10) or sub-optimal (0-6) for modeling.

### *Independent Variables*

Demographic variables of interest included: age; sex; race/ethnicity (dichotomized to white, non-Hispanic or minority); marital status (single, married/in a relationship, or divorced/widowed); educational level (high school/some college, college graduate, graduate degree); personal income from all sources; and total number of jobs worked (dichotomized to one or two or more). Income was collapsed from 15 categories to a binary variable (<$50,000 or ≥$50,000) based on the median reported income in this sample and the 2013 US Census Bureau (Suitland, Maryland USA) estimate of median household income for the adult US population. Age did not meet an assumption of logistic regression by failing to demonstrate a linear relationship with optimal CVH on the log-odds scale, and thus was categorized into quartiles for modeling. Respondents were asked to answer items relating to EMS occupational characteristics, including: current provider level (Emergency Medical Responder, EMT, EMT-Intermediate,



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

| Health Metric | Category | Definition |
|---|---|---|
| **Smoking** | Ideal | Never smoker or quit > 12 months |
| | Intermediate | Smoked 100 or more cigarettes and quit ≤ 12 months ago |
| | Poor | Current smoker |
| **Body Mass Index** | Ideal | < 25.0 kg/m$^2$ |
| | Intermediate | 25.0-29.9 kg/m$^2$ |
| | Poor | ≥ 30.0 kg/m$^2$ |
| **Diet**[a] | Ideal | 4-5 components |
| | Intermediate | 2-3 components |
| | Poor | 0-1 component |
| **Physical Activity** | Ideal | ≥ 150 minutes/week moderate exercise, or<br>≥ 75 minutes/week vigorous exercise, or<br>≥ 150 minutes/week moderate and vigorous |
| | Intermediate | 1-149 minutes/week moderate exercise, or<br>1-74 minutes/week vigorous exercise, or<br>1-149 minutes/week moderate and vigorous |
| | Poor | No moderate or vigorous exercise |
| **Blood Pressure** | Ideal | <120/<180 mmHg without medication |
| | Intermediate | SBP 120-139 or DBP 80-89 mmHg or treated to goal |
| | Poor | SBP ≥ 140 or DBP ≥ 90 mmHg |
| **Total Cholesterol** | Ideal | < 200 mg/dl without medication |
| | Intermediate | 200-239 mg/dl or treated to goal |
| | Poor | ≥ 240 mg/dl |
| **Blood Glucose** | Ideal | < 100 mg/dl without medication |
| | Intermediate | 100-125 mg/dl or treated to goal |
| | Poor | ≥ 126 mg/dl |



**Table 1.** Definition for Categories of Life's Simple 7 Components as Defined Previously by Lloyd-Jones, et al
Note: All responses were self-reported via electronic questionnaire.
Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure.
[a] Diet components included: ≥ 4.5 cups of fruits or vegetables a day; two 3.5-ounce servings of fish per week; ≥ three 1-ounce equivalent servings of whole grains per day; < 1,500 milligrams of sodium per day; ≤ 36 ounces of sugar-sweetened beverages per week.

Advanced EMT, or paramedic); EMS agency type (fire, private, hospital, government, military, or tribal); primary service provided (911 response with or without transport capability, medical transport, other [air medical, specialty care transport, rescue, paramedic intercept, hazmat, or other]); years of EMS experience (quartiles); community size where they live/work (dichotomized to rural [<25,000 residents] or urban [≥25,000 residents]); and weekly call volume (tertiles).

*Statistical Analyses*

Analyses included completed surveys from respondents who reported currently working in EMS at the EMT or paramedic certification level. Respondents with missing component scores were included when examining individual components, but were excluded from further analyses. All analyses were carried out using STATA IC version 15.1 (StataCorp LP; College Station, Texas USA) at the $\alpha = 0.05$ level. Proportions were reported as frequencies (%). Chi-square tests and tests of linear trend were used to assess differences in characteristics by CVH score category.

Binary logistic regression modeling was used to identify factors associated with optimal CVH based on the five-component score, with sub-optimal CVH used as the reference category. Maximum likelihood estimation with logistic regression was used under the assumption of data missing at random. Purposeful selection with likelihood ratio tests was used to build the preliminary main effects model.[20] Variables were considered confounders and retained if removal resulted in a 10% or more change in the coefficient for certification level. Plausible interactions were assessed, though none were retained based on a P <.05 cut point. Adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. The Hosmer-Lemeshow Goodness-of-Fit test was performed to assess model calibration. The associations were confirmed using ordinary least squares regression with the five-component score as a continuous variable, though logistic regression was used as the main analytic strategy due to the meaningful cut point described previously.

With the high number of missing cases for the component scores of blood glucose and cholesterol, these health factors were dropped from the CVH score. Several sensitivity analyses were completed to examine the potential bias associated with this decision. First, the complete case analysis was repeated with the seven-component score (optimal = 10-14; average = 5-9; inadequate = 0-4). Next, returning to the five-component CVH score, the assumptions that all respondents with missing component scores were classified as ideal, average, or poor were tested separately. Estimates from each model were compared to the estimates from the initial model to determine the change and direction of information and misclassification biases.



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

| | Overall Sample (n = 24,708) n (%) | Optimal CVH (n = 9,227) n (%) | Suboptimal CVH (n = 11,489) n (%) | P Value[a] |
|---|---|---|---|---|
| **Age Categories** | | | | <.001 |
| < 30 Years | 5,385 (25.9%) | 2,911 (32.2%) | 2,330 (20.7%) | |
| 30-39 Years | 5,656 (27.2%) | 2,466 (27.3%) | 3,055 (27.1%) | |
| 40-49 Years | 5,421 (26.1%) | 1,989 (22.0%) | 3,325 (29.5%) | |
| 50 or More Years | 4,319 (20.8%) | 1,678 (18.6%) | 2,549 (22.6%) | |
| *Missing* | 3,927 | | | |
| **Sex** | | | | <.001 |
| Male | 15,571 (74.5%) | 6,247 (68.5%) | 8,995 (79.9%) | |
| Female | 5,323 (25.5%) | 2,870 (31.5%) | 2,270 (20.1%) | |
| *Missing* | 3,814 | | | |
| **Race/Ethnicity** | | | | <.001 |
| White, Non-Hispanic | 17,692 (86.8%) | 7,565 (85.5%) | 9,729 (88.0%) | |
| Minority[b] | 2,693 (13.2%) | 1,286 (14.5%) | 1,331 (12.0%) | |
| *Missing* | 4,323 | | | |
| **Marital Status** | | | | <.001 |
| Married/Unmarried Couple | 14,367 (68.3%) | 5,968 (65.2%) | 8,093 (71.2%) | |
| Single | 4,272 (20.3%) | 2,223 (24.3%) | 1,897 (16.7%) | |
| Divorced/Widowed/Separated | 2,405 (11.4%) | 963 (10.5%) | 1,379 (12.1%) | |
| *Missing* | 3,664 | | | |
| **Educational Level** | | | | <.001 |
| High School/GED or Below | 1,491 (7.1%) | 452 (4.9%) | 975 (8.6%) | |
| Some College | 7,984 (37.9%) | 2,987 (32.6%) | 4,789 (42.1%) | |
| Associate Degree or Higher | 11,609 (55.0%) | 5,726 (62.5%) | 5,616 (49.4%) | |
| *Missing* | 3,624 | | | |
| **Home Community Size** | | | | <.001 |
| Rural (< 25,000 Residents) | 9,929 (47.2%) | 3,931 (43.0%) | 5,715 (50.3%) | |
| Urban (≥ 25,000 Residents) | 11,111 (52.8%) | 5,212 (57.0%) | 5,647 (49.7%) | |
| *Missing* | 3,668 | | | |
| **Personal Income (Any Source)** | | | | <.001 |
| < $50,000 | 10,049 (53.2%) | 4,221 (51.4%) | 5,691 (55.2%) | |
| $50,000 or More | 8,837 (46.8%) | 3,992 (48.6%) | 4,625 (44.8%) | |
| *Missing* | 5,822 | | | |



**Table 2.** Demographic Characteristics of Respondents Overall (n = 24,708) and by CVH Category[c]

Abbreviations: CVH, cardiovascular health; GED, general equivalency diploma.

[a] P value from $\chi^2$ tests, $\alpha = 0.05$.

[b] Minority included Hispanic, black, Asian, or other race (non-white).

[c] A total of 3,992 respondents (16.2%) had missing component scores and were excluded from comparisons based on overall CVH score.

## Results

A total of 32,314 responses were received to the electronic questionnaire (response rate = 10.5%) with 24,708 (76.5%) meeting inclusion criteria. Respondents were excluded due to certification at a level other than EMT or paramedic (n = 5,283) or not currently practicing in EMS (n = 3,263). Respondents could have been excluded for multiple reasons. A total of 20,716 respondents (83.8%) had complete information for the five components comprising the CVH score, whereas only 45.3% (n = 11,188) had complete information for the full seven components. There was no difference in the proportion of responders and non-responders reporting ideal BMI (P = .388) or blood pressure (P = .965).

### *Descriptive Characteristics*

Similar to previous samples of EMS professionals, the majority of respondents were under 40 years old (n = 11,041; 53.1%), male (n = 15,571; 74.5%), and white, non-Hispanic (n = 17,692; 86.8%; Table 2). A majority of respondents were married or coupled (n = 14,367; 68.3%), and 11,609 (55.0%) reported holding an Associate Degree or higher. There were nearly equal proportions of respondents from rural and urban communities. One-half of the respondents were certified as EMTs, and 14,179 (57.4%) held two or more jobs (EMS and/or non-EMS; Table 3). Approximately 36.7% (n = 9,058) of respondents' main EMS agency was a fire department with 18,874 (77.9%) of them providing primarily 911



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

| | Overall Sample (n = 24,708) n (%) | Optimal CVH (n = 9,227) n (%) | Suboptimal CVH (n = 11,489) n (%) | P Value[a] |
|---|---|---|---|---|
| **Certification Level** | | | | <.001 |
| EMT | 12,461 (50.4%) | 4,889 (53.0%) | 5,134 (44.7%) | |
| Paramedic | 12,247 (49.6%) | 4,338 (47.0%) | 6,355 (55.3%) | |
| **Total Number of Jobs** | | | | .014 |
| 1 | 10,529 (42.6%) | 3,937 (42.7%) | 4,708 (41.0%) | |
| 2 or More | 14,179 (57.4%) | 5,290 (57.3%) | 6,781 (59.0%) | |
| **Years of EMS Experience** | | | | <.001 |
| 2 or Less Years | 6,204 (25.1%) | 2,532 (27.4%) | 2,202 (19.2%) | |
| 3-7 Years | 5,558 (22.5%) | 2,233 (24.2%) | 2,360 (20.5%) | |
| 8-15 Years | 5,804 (23.5%) | 2,205 (23.9%) | 2,841 (24.7%) | |
| 16 or More Years | 7,142 (28.9%) | 2,257 (24.5%) | 4,086 (35.6%) | |
| **Agency Type** | | | | <.001 |
| Fire Department | 9,058 (37.3%) | 3,622 (39.5%) | 4,168 (36.5%) | |
| Private | 7,436 (30.6%) | 2,643 (28.8%) | 3,663 (32.0%) | |
| Other[b] | 7,782 (32.1%) | 2,915 (31.8%) | 3,601 (31.5%) | |
| *Missing* | 432 | | | |
| **Primary Service Provided** | | | | <.001 |
| 911 Response | 18,874 (77.9%) | 7,107 (77.2%) | 9,237 (80.5%) | |
| Medical Transport | 1,287 (5.3%) | 444 (4.8%) | 618 (5.4%) | |
| Other[c] | 4,066 (16.8%) | 1,657 (18%) | 1,619 (14.1%) | |
| *Missing* | 481 | | | |
| **Primary Role** | | | | <.001 |
| Patient Care Provider | 19,112 (78.4%) | 7,438 (80.7%) | 8,672 (75.6%) | |
| Administrator/Manager/ Supervisor | 3,150 (12.9%) | 1,034 (11.2%) | 1,770 (15.4%) | |
| Other[d] | 2,116 (8.7%) | 740 (8.0%) | 1,026 (9.0%) | |
| *Missing* | 330 | | | |
| **Weekly Call Volume** | | | | <.001 |
| < 5 Calls | 7,856 (33.6%) | 3,304 (35.9%) | 3,688 (32.2%) | |
| 5-10 Calls | 8,992 (38.5%) | 3,431 (37.3%) | 4,541 (39.6%) | |
| 20 or More | 6,538 (28.0%) | 2,468 (26.8%) | 3,231 (28.2%) | |
| *Missing* | 1,322 | | | |



**Table 3.** EMS-Related Characteristics of Respondents Overall (n = 24,708) and by CVH Category[e]

Abbreviations: CVH, cardiovascular health; EMS, Emergency Medical Services; EMT, emergency medical technician; GED, general equivalency diploma.

[a] P value from $\chi^2$ tests, $\alpha = 0.05$.

[b] Other agency types included hospital-based, municipal/third service, military, and tribal.

[c] Other primary service included hazardous materials response, specialty care transport, rescue, paramedic intercept, air medical, other (free entry).

[d] Other roles included educator, preceptor, other (free entry).

[e] A total of 3,992 respondents (16.2%) had missing component scores and were excluded from comparisons based on overall CVH score.

response. The majority of respondents (n = 19,112; 78.4%) were primarily patient care providers. When comparing these demographics and EMS-related characteristics by certification level, all were statistically significant. As expected, based on known risk factors for poor CVH, those reporting optimal CVH tended to be younger, female, and more highly educated (Table 2). A larger proportion of EMTs reported optimal CVH than paramedics (Table 3).

*CVH Metrics*

Breaking down the components of the LS7 by certification level, all but blood pressure were statistically different between EMTs and paramedics (Appendix 1; available online only). Figure 1 displays the distribution of each CVH component among EMTs and paramedics. A more than five-point difference in the proportion of EMTs and paramedics classified as ideal was seen for BMI (n = 3,208; 30.6% of EMTs versus n = 2,182; 20.0% of paramedics), physical activity (n = 4,929; 46.8% of EMTs versus n = 4,454; 40.7% of paramedics), and glucose (n = 3,943; 63.9% of EMTs versus n = 6,112; 70.0% of paramedics). The proportion of EMTs and paramedics reporting optimal CVH based on the five components differed, with 48.8% (n = 4,889) of EMTs classified as optimal compared to 40.6% (n = 4,338) of paramedics. More paramedics



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

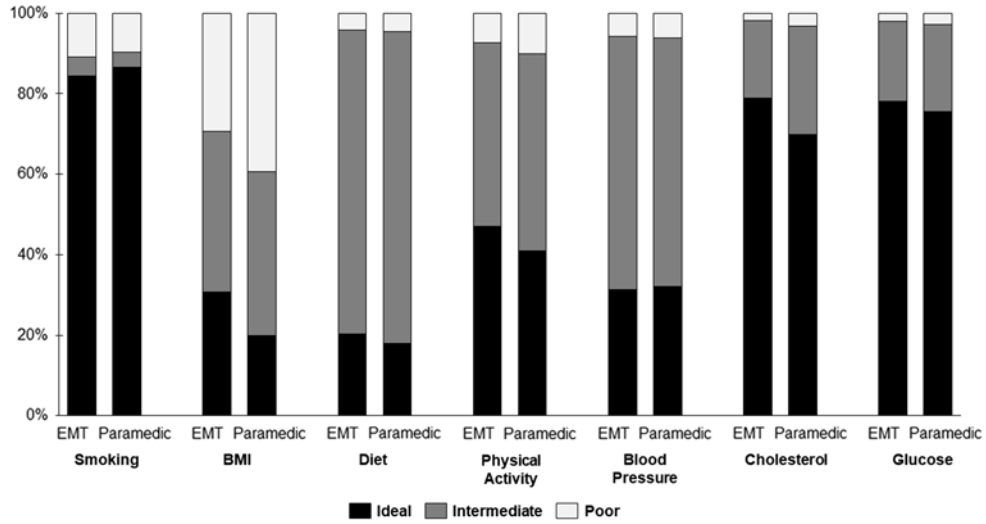




**Figure 1.** Distribution of the Cardiovascular Health Components in EMTs and Paramedics.
Note: All respondents with a score for that component were included.
Abbreviations: BMI, body mass index; EMT, emergency medical technician.

reported average CVH (57.3%; n = 6,129) than EMTs (49.6%; n = 4,971). A small proportion of both were classified as inadequate CVH (EMTs: 1.6%; n = 163 and paramedics: 2.1%; n = 226; data not shown).

*Multivariable Analysis*

The final multivariable logistic regression model for the outcome of reported optimal CVH included: (1) the demographic variables: age, sex, marital status, personal income, urbanicity, education level, and number of jobs; and (2) the EMS-related variables: certification level, EMS agency type, primary service provided, primary EMS role, and years of EMS experience (Table 4). Older age, male sex, and working more than one job were demographic variables associated with decreased odds of reporting optimal CVH. Conversely, being single, having a higher income, and being more highly educated were associated with increased odds of optimal overall CVH. For EMS-related characteristics, paramedics had significantly reduced odds of optimal CVH compared to EMTs (adjusted OR = 0.84; 95% CI, 0.78-0.91). Increasing years of EMS experience was associated with decreased odds of optimal CVH. Working in a non-fire-based agency, providing medical transport service, and working in a role other than patient care provider were also associated with decreased odds of optimal CVH.

*Sensitivity Analyses*

The associations remained when examined with a continuous outcome of the five-component score (not shown). There was no change in direction and minimal change in effect sizes comparing the main analysis to the sensitivity analyses (Appendix 2; available online only). When assuming that all missing component observations were classified as ideal, average, or poor, respectively, there was virtually no change in the effect sizes, direction, or confidence intervals. The complete case analysis using the seven-component CVH score (including cholesterol and blood glucose observations) resulted in generally more extreme estimates. Therefore, the main analysis is likely conservative in estimating the associations between demographic and occupation-related characteristics and optimal CVH.

## Discussion

In this cross-sectional, national study of EMTs and paramedics, many reported optimal CVH based on the LS7 metrics. The EMTs met more of the ideal CVH criteria than the paramedics. Several occupation-related characteristics, beyond certification level, were associated with less optimal CVH. Because ideal CVH has been associated with lower rates of chronic disease and mortality,[2,21,22] these findings suggest that many EMS professionals may be at-risk of poor health outcomes.

Despite the sample comprising working prehospital EMS professionals, the frequency of ideal CVH components among EMS professionals was similar to what has been described in other samples. The proportion of the general population meeting the ideal criteria for smoking has been estimated around 70%-90%,[2,21,23] similar to the proportion of EMTs and paramedics (approximately 85%) in this study. Similar to past studies in the general population,[4,21,23–26] ideal BMI was low in EMTs and paramedics, with a large proportion classified as obese. A higher proportion of EMTs reported ideal physical activity than paramedics and the general population.[2,4,21] The physical nature of EMS and potential "healthy worker effect" of currently working EMS professionals may explain the differences as compared to the general population.

Among EMS professionals, more met the ideal diet criteria than has been found in other samples. In general, less than 10% of respondents in past studies report ideal diet behaviors.[2,4,21,24–28] The questionnaire assessed self-reported diet based on a series of questions related to the five diet behaviors included in the score.[3] Comprehensive dietary intake measurement techniques, such as food diaries or food frequency questionnaires, were not used, leading to the potential for recall bias in this sample. In past work when diet was assessed in a similar, self-reported manner, the proportion reporting ideal diet in those estimates was around 10%, comparable to what was seen in this study.[23]

The EMS professionals in this sample reported similar CVD risk factors compared to studies in other emergency responders. The phenomenon of a high prevalence of overweight personnel and obesity among firefighters is well-documented, with estimates



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

| | Univariable | | Multivariable | |
|---|---|---|---|---|
| | Crude OR | 95% CI | Adjusted OR | 95% CI |
| **Age** | | | | |
| < 30 Years | 1.00 | | 1.00 | |
| 30-39 Years | 0.65 | 0.60, 0.70 | 0.68 | 0.61, 0.74 |
| 40-49 Years | 0.48 | 0.44, 0.52 | 0.56 | 0.51, 0.63 |
| 50 Years or Older | 0.53 | 0.49, 0.57 | 0.65 | 0.58, 0.73 |
| **Sex** | | | | |
| Female | 1.00 | | 1.00 | |
| Male | 0.55 | 0.52, 0.59 | 0.54 | 0.50, 0.56 |
| **Marital Status** | | | | |
| Married or Coupled | 1.00 | | 1.00 | |
| Single | 1.59 | 1.48, 1.70 | 1.17 | 1.07, 1.28 |
| Divorced/Widowed | 0.95 | 0.87, 1.03 | 0.94 | 0.85, 1.04 |
| **Personal Income** | | | | |
| < $50,000 | 1.00 | | 1.00 | |
| $50,000 or More | 0.86 | 0.81, 0.91 | 1.26 | 1.17, 1.37 |
| **Urbanicity** | | | | |
| Rural | 1.00 | | 1.00 | |
| Urban | 1.34 | 1.27, 1.42 | 1.31 | 1.23, 1.40 |
| **Education Level** | | | | |
| High School/GED or Less | 1.00 | | 1.00 | |
| Some College | 1.35 | 1.19, 1.52 | 1.32 | 1.15, 1.52 |
| College Graduate or More | 2.20 | 1.96, 2.47 | 2.26 | 1.97, 2.59 |
| **Number of Jobs** | | | | |
| 1 | 1.00 | | 1.00 | |
| 2 or More | 0.93 | 0.88, 0.99 | 0.94 | 0.88, 0.99 |
| **Certification Level** | | | | |
| EMT | 1.00 | | 1.00 | |
| Paramedic | 0.72 | 0.68, 0.76 | 0.84 | 0.78, 0.91 |
| **Years of EMS Experience** | | | | |
| 2 or Less Years | 1.00 | | 1.00 | |
| 3-7 Years | 0.82 | 0.76, 0.89 | 0.84 | 0.76, 0.93 |
| 8-15 Years | 0.67 | 0.62, 0.73 | 0.76 | 0.68, 0.85 |
| 16 or More Years | 0.48 | 0.44, 0.52 | 0.64 | 0.56, 0.72 |
| **Agency Type** | | | | |
| Fire | 1.00 | | 1.00 | |
| Private Service | 0.83 | 0.78, 0.89 | 0.68 | 0.62, 0.74 |
| Other[a] | 0.93 | 0.87, 0.99 | 0.77 | 0.71, 0.84 |
| **Primary Service Provided** | | | | |
| 911 Response | 1.00 | | 1.00 | |
| Medical Transport | 0.93 | 0.82, 1.06 | 0.81 | 0.69, 0.94 |
| Other[b] | 1.33 | 1.23, 1.43 | 1.44 | 1.32, 1.58 |
| **Primary EMS Role** | | | | |
| Patient Care Provider | 1.00 | | 1.00 | |
| Administrator/Supervisor | 0.68 | 0.63, 0.74 | 0.86 | 0.78, 0.95 |
| Other[c] | 0.84 | 0.76, 0.93 | 0.82 | 0.73, 0.92 |



**Table 4.** Crude and Adjusted Odds Ratios of Optimal Overall CVH from Complete Case Multivariable Logistic Regression Model

Note: Hosmer-Lemeshow goodness of fit: $\chi^2 = 6.70$; $P = .57$.

Abbreviations: EMS, Emergency Medical Services; EMT, emergency medical technician; GED, general equivalency diploma; OR, odds ratio.

[a] Other agency types included hospital-based, municipal/third service, military, and tribal.

[b] Other primary service included hazardous materials response, specialty care transport, rescue, paramedic intercept, air medical, other (free entry).

[c] Other roles included educator, preceptor, other (free entry).



https://doi.org/10.1017/S1049023X19004254 Published online by Cambridge University Press

of approximately 40% reporting a BMI over 25.[29–31] Furthermore, the dietary habits of emergency responders have been documented as sub-optimal.[32,33] The cardiovascular risks associated with intermittent strenuous activity described in firefighters likely translates to other emergency responders with similar duties, which may lead to increased risk of duty-related CVD and major cardiac events.

Differences between EMS professionals by certification level were hypothesized, based on prior studies comparing EMTs and paramedics.[12–14] The practice environments for EMTs and paramedics differ, with paramedics responsible for critical tasks such as advanced airway management of critical patients and termination of resuscitation in the field at many agencies.[34] These differences appear to impact the stress levels, burnout, and other physical and mental health conditions of EMS professionals, with paramedics reporting higher levels of these negative factors.[12–14] These factors may result in poorer health behaviors and thus poor CVH. In the present study, certification at the paramedic level was associated with decreased odds of reporting optimal CVH, even after adjusting for the common risk factors such as age and sex and hypothesized occupation-related factors such as agency type, service provided, and call volume. Certification level as an independent risk factor may highlight its role as a proxy variable for undescribed employment factors, such as a higher level of job stress, that should be further explored in order to understand the increased risk associated with higher-level EMS professionals.

### Limitations

This study was limited by self-reported data, especially for blood glucose and cholesterol. A large proportion of respondents marked unknown for these factors, while blood pressure had much less missing data. In the EMS setting, measuring blood pressure in patients and potentially one's self is a common task, whereas point-of-care testing for cholesterol and fasting blood glucose is more limited.[34] The factors of blood glucose and cholesterol were excluded from the CVH score calculated, and based on the sensitivity analysis using the complete observations with data on all seven components, the risk of misclassification or bias introduced was likely low with no change in direction of association from the main analysis. Non-response bias was also a concern due to the low response rate from the electronic survey. Despite the 10% response rate, responses were received from a geographically representative sample of over 24,000 EMS professionals. Decreasing survey response rates both overall and for the EMS population specifically are documented difficulties,[18,19] therefore an abbreviated non-responder survey was conducted by telephone to assess for non-response bias.

### Conclusion

A large proportion of working EMS professionals in this sample reported optimal CVH, but a number of less than ideal health behaviors and factors may place these critical health care workers at-risk for CVD. It is unclear what is driving the differences between EMTs and paramedics after accounting for common risk factors such as age and sex. Future studies should focus on better understanding the CVH and metabolic risk profiles for EMS professionals and the association with incident CVD, major cardiac events, and occupational injury or mortality.

### Author Contributions

REC: Conception of the work; analysis and interpretation of data; drafting of work; final approval of version to be published; agrees to be accountable for all aspects of the work. RPC: Design of the work; interpretation and acquisition of data; critical revision of work; final approval of version to be published; agrees to be accountable for all aspects of the work. JKB: Interpretation of data; critical revision of work; final approval of version to be published; agrees to be accountable for all aspects of the work. REF: Interpretation of data; critical revision of work; final approval of version to be published; agrees to be accountable for all aspects of the work. ARP: Conception of the work; interpretation of data; critical revision of work; final approval of version to be published; agrees to be accountable for all aspects of the work.

### Acknowledgements

The authors would like to acknowledge Melissa Bentley, PhD for her work on the development of the survey instrument and data collection.

### Supplementary Material

To view supplementary material for this article, please visit https://doi.org/10.1017/S1049023X19004254.

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