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Original Investigation

Cigarette Smoking, Body Mass Index, and Physical Fitness Changes Among Male Navy Personnel

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Abstract

Introduction: Cigarette smoking has been reported to be higher among deployed military men than among similarly aged civilian or nondeployed men, but the short-term effect of smoking on physical fitness among these young healthy men is unclear. This study examined self-reported smoking status and change in objectively measured fitness over 1–4 years while controlling for body mass index (BMI).

Methods: This study included a large sample of male U.S. navy personnel who deployed to Iraq or Kuwait between 2005 and 2008. A mixed modeling procedure was used to determine factors contributing to longitudinal changes in both BMI and fitness (measured by run/walk times, curl-ups, and push-ups).

Results: Of the total sample (n = 18,537), the 20% current smokers were more likely than nonsmokers to be enlisted, younger, and have lower BMI measurements at baseline. In addition, smokers had slower 1.5-mile run/walk times and could do fewer curl-ups and push-ups compared with nonsmokers. The run/walk time model indicated that over 4 years, smokers (compared with nonsmokers) experienced a significantly greater rate of decrease in cardiorespiratory fitness, even after controlling for changes in BMI.

Conclusions: These results call for continued attention to the problem of nicotine use among young healthy men.

Introduction

It is well known that cigarette smoking is associated with many long-term poor health outcomes including lung cancer and heart disease (Centers for Disease Control and Prevention [CDC], 2010). During 2000–2004, it is estimated that cigarette smoking and exposure to tobacco smoke were responsible for 443,000 premature deaths (CDC, 2008) in the United States. While the physical damage done from many years of smoking has been well documented, the short-term effects of cigarette use, especially among healthy young men, are less recognized. It has been hypothesized that smoking can relieve anxiety and control weight, both reasons for young adults to ignore potential health issues that may occur in the future. Smoking prevention and cessation programs are plentiful among the general population, but for those serving in the military, cigarettes are readily available and cost less than they would in civilian settings. Furthermore, the social environment, especially during times of deployment, may encourage smoking initiation or relapse (Nelson & Pederson, 2008; Poston, Taylor, Hoffman, Peterson, Lando, Shelton, et al., 2008; Smith, Ryan, Wingard, Patterson, Slymen, Macera, 2008). Recent data suggest that about 26% of the male U.S. population aged 18–44 years were current smokers in 2006–2008 (CDC, 2009) compared with about 31% of similarly aged male navy service members in 2008 (Bray, Pemberton, Hourani, Witt, Olmsted, Brown, et al., 2009). Because a higher prevalence of smoking (32%) has been reported among navy service members who have been deployed at least once compared with those who have never been deployed (28%), deployment appears to be associated with an increase in smoking behavior (Bray et al., 2009).

One of the suspected risks resulting from cigarette smoking is a decrease in physical fitness. Changes in fitness are difficult to measure in the short term and may be associated with other factors such as an increase in body weight. Although being overweight or obese has been associated with poor physical fitness scores, it is not clear how cigarette smoking with or without change in body weight could affect physical fitness (Haddock, Pyle, Poston, Bray, & Stein, 2007). However, during stressful times, such as deployment, many potential risk factors may be operating together, and even small declines in physical fitness may be a marker of a larger process affecting overall health (Bridger, Munnoch, Dew, & Brasher, 2009; Haddock, Poston, Pyle, Klesges, Vander Weg, Peterson, et al., 2006; Sloan, Sawada, Martin, Church, & Blair, 2009; Talbot, Weinstein, & Fleg, 2009).

To help understand some of these issues, we conducted this study using a large sample of male U.S. navy personnel who deployed to Iraq or Kuwait between 2005 and 2008 to examine

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the effect of smoking status on changes in fitness over a 4-year period while controlling for body mass index (BMI) and other associated demographic characteristics.

Methods

Subjects were identified using deployment information obtained from the Defense Manpower Data Center, Monterey, CA. For the purpose of this study, deployments were recognized if a subject received combat zone tax exclusion or hazardous duty/imminent danger pay while deployed to either Iraq or Kuwait. We selected active-duty navy men with at least one deployment to Iraq or Kuwait between January 1, 2005, and December 31, 2008. Subjects with at least one deployment occurring prior to 2005 were excluded to create a more homogeneous population with respect to deployment experience. Data available from the Navy Personnel Command in the Physical Readiness Information Management System (PRIMS) were used to obtain repeated measurements of BMI, fitness, and smoking status. The PRIMS database houses semiannual Physical Fitness Assessment (PFA) results and Physical Activity Risk Factor Questionnaire (PARFQ) responses. Components of the PFA include an initial weight and height screening and a series of physical tests designed to measure flexibility, muscular strength, and aerobic capacity. The PARFQ includes a question on current smoking. Subjects were first matched to PFA records between 2006 and 2009 to obtain longitudinal height, weight, and fitness measurements. Each PFA record was then matched by subject and date to a PARFQ to obtain smoking status approximately ten weeks prior to the associated PFA. To allow for comparative analyses, only fitness assessments in which the traditional 1.5-mile run/walk was administered were included. All alternative fitness assessments, such as swim and bike tests, were excluded because the times would not have been comparable. Outliers with a run/walk score of less than 400 s or greater than 3,000 s or curl-up and push-up scores less than 1 and more than 200 were also excluded.

Men had an opportunity to report smoking status on each semiannual assessment for a total of eight possible responses during the study time period. To deal with intermittent smoking history, men who responded "yes" to having been a current smoker, on at least one but less than half of their valid risk factor questionnaires from 2006 through 2009, were excluded ($n = 1{,}148$).

Smokers were identified as those who reported positive responses to the smoking status question on at least 50% of the PARFQs administered during the study time period. Nonsmokers were identified as subjects with no positive responses during the study time period. The resulting sample included 18,537 active-duty navy men who were deployed between 2005 and 2008. The Institutional Review Board of the Naval Health Research Center approved the protocol for this study.

Demographic variables used in this study included age and rank. Age was analyzed continuously and categorically (<20, 20–29, 30–39, and ≥40). Baseline age was obtained at the time of the first valid PFA recorded between 2006 and 2009. Rank (officer/enlisted) was determined immediately prior to the first available deployment during our study time period. Warrant officers were combined with commissioned officers due to similarities in responsibilities. Semiannual height and weight measurements were used to calculate longitudinal BMI (kilograms per square meter) values.

Run/walk time, core, and upper body scores were recorded for each individual at each valid PFA. Retained run/walk time scores consisted of 1.5-mile run/walk times that were converted from minutes to seconds. Core scores were expressed as the number of curl-ups that could be completed in 2 min. Upper body scores were expressed as the number of push-ups that could be completed in 2 min. Therefore, lower run/walk time scores and higher core and upper body scores were associated with increased fitness.

Descriptive analyses of demographic and fitness-related characteristics were completed for service members with at least one PFA containing valid fitness, weight, and height measurements. At the univariate level, differences between smokers and nonsmokers for demographic and fitness variables were assessed using chi-square tests for categorical variables and *t* tests for continuous variables.

A longitudinal modeling procedure was used to determine factors contributing to temporal changes in BMI and the three fitness measures (number of curl-ups, push-ups, and 1.5-mile run/walk times). Changes in BMI were modeled using fixed main effects for age at baseline PFA, rank, smoking status, and time in years since baseline PFA. Since changes in BMI are believed to affect changes in fitness, number of curl-ups, push-ups, and 1.5-mile run/walk times were modeled using the same fixed main effects as mentioned previously but with the addition of an effect for longitudinal BMI. In all models, fixed interaction terms between time and each covariate were included to account for differences in the annual rate of change in BMI or fitness measures at different levels of each covariate. To model the covariance of the repeated measurements taken on each subject, a variety of potential structures were evaluated and a random coefficients model was constructed. Models were examined for heterogeneity of the variance structure across smokers and nonsmokers. The preferred longitudinal model for changes in BMI involved a Toeplitz covariance structure without separate parameter estimates for smokers and nonsmokers. The Toeplitz structure required the estimation of a single common variance parameter and $n - 1$ common covariance parameters, where n was equal to the number of repeated measurements. For the purpose of this study, a maximum of $n = 8$ measurements per subject were available, corresponding to two PFAs per year for the 4-year duration of the study. Applying the same model selection techniques to fitness measures (while including longitudinal BMI), the preferred models for run/walk time and push-ups involved a heterogeneous Toeplitz covariance structure with eight separate variance parameters corresponding to the eight repeated measurements. Similar to the BMI model, the preferred model for curl-ups involved a Toeplitz covariance structure. For the curl-ups model, a separate set of estimates were generated for smokers and nonsmokers.

Based on the preferred models for BMI and fitness, two analogous models were constructed, replacing the continuous time after baseline variable with a categorical variable indicating year after baseline (Year 1–Year 4). For models with significant fixed interaction effects, least squares means for each combination of smoking status and year after baseline were obtained from the categorical time model. For all final models, the significance of each estimated parameter was tested using Wald's test, and type III tests for fixed effects were performed for all categorical variables.

For all analyses, two-sided significance was set at the $p < .05$ level. All statistical calculations were performed using SAS software, version 9.2 (SAS Institute Inc., Cary, NC). For modeling purposes, SAS MIXED procedure was used for its ability to calculate valid *SE*s and to accommodate missing data.

Results

Of the total sample, 20% ($n = 3{,}798$) were identified as current smokers. Compared with nonsmokers, smokers were more likely to be enlisted, younger, and have lower BMI measurements at baseline. In addition, smokers had slower 1.5-mile run/walk times and completed fewer curl-ups and push-ups compared with nonsmokers. All these differences were statistically significant. Smokers were not different from nonsmokers with respect to mean deployment length or number of deployments within the 4-year time period (Table 1).

In modeling BMI, findings were similar when the continuous measure of time after baseline was replaced with a categorical variable indicating year after baseline (Year 1–Year 4). In the final BMI model, older age at baseline, enlisted status, and nonsmoking were all associated with having a higher baseline BMI (Table 2). The model indicated that over time, BMI increased for all service members but at a faster rate for enlisted men as compared with officers. BMI increased at a slower rate for older individuals (as of baseline), meaning that a leveling off in BMI may occur as age continues to increase over time. The estimated rate of increase in BMI was greater in each subsequent year following baseline, and age at baseline had a decreasing effect on the rate of increase in BMI each subsequent year (Years 1–4). From Years 1–2, 2–3, and 3–4, enlisted personnel experienced progressively greater increases in BMI. From Years 1–2, smokers experienced somewhat lower rates of increase in BMI ($p = .08$); however, from Years 3–4, smokers experienced relatively higher rates of increase in BMI ($p = .04$) such that over the course of the study period, smokers were predicted to have increased their BMI at a slower rate followed by a faster rate as compared with nonsmokers (Table 2).

Results obtained from the preferred upper body and core fitness models were similar. Both models found that being older at baseline, having a higher BMI, and smoking were associated with poorer baseline fitness (Table 2). Additionally, enlisted personnel were able to complete less curl-ups compared with officers. Relative to baseline measures, service members were able to complete significantly more push-ups and curl-ups during Years 2–4 of follow-up. However, the significant negative interaction of age at baseline and time suggests that this increase may be mitigated among older service members. While smoking was shown to be associated with worse upper body and core

Table 1. Baseline and Deployment-Related Characteristics of the Sample by Smoking Status, Male U.S. Navy Personnel ($n = 18{,}537$), Iraq and Kuwait, 2006–2009

	Nonsmokers ($n = 14{,}739$)		Smokers ($n = 3{,}798$)		
	N	%	*N*	%	*p* value
Rank					<.001[a]
Enlisted	11,528	75.7	3,697	24.3	
Officer	3,211	97.0	101	3.1	
Age, years					<.001[a]
<20	449	67.0	221	33.0	
20–29	7,493	75.4	2,446	24.6	
30–39	5,142	84.9	918	15.2	
≥40	1,655	88.6	213	11.4	
Number of deployments[b]					.33[a]
1	13,201	79.7	3,371	20.3	
2	1,476	78.3	408	21.7	
3	62	76.5	19	23.5	
	M	*SD*	*M*	*SD*	
Age, years	30.23	7.5	27.37	6.6	<.001[c]
Deployment length[b], days	210.58	70.0	209.17	66.3	.25[c]
BMI at baseline, kg/m^2	26.53	3.1	25.96	3.5	<.001[c]
Upper body score, push-ups	70.61	17.6	65.95	15.7	<.001[c]
Core score, curl-ups	81.35	17.7	75.22	16.3	<.001[c]
1.5-mile run/walk time, s[d]	690.57	87.8	719.95	84.1	<.001[c]

Note. BMI = body mass index.
[a]Chi-square test.
[b]Refers to all deployments occurring during 2005–2008.
[c]*t* test, Satterthwaite *df*.
[d]690.57 = 11 min 31 s; 719.95 = 12 min.

Table 2. Linear Mixed Model Estimates, Male U.S. Navy Personnel (*n* = 18,537), Iraq and Kuwait, 2006–2009

	BMI, kg/m²			Upper body, push-ups			Core, curl-ups			Cardio, s[a]		
	b	*SE*	*p* value	b	*SE*	*p* value	b	*SE*	*p* value	b	*SE*	*p* value
Intercept	22.59	0.13	<.01	106.93	0.60	<.01	127.72	0.92	<.01	310.31	4.13	<.01
Time after baseline												
1 year	Referent			Referent			Referent			Referent		
2 years	0.81	0.07	<.01	2.74	0.62	<.01	2.38	0.65	<.01	0.24	2.51	.93
3 years	1.29	0.08	<.01	1.99	0.71	.01	2.25	0.73	<.01	−0.34	2.96	.91
4 years	1.62	0.11	<.01	2.22	0.89	.01	3.06	0.89	<.01	−9.00	3.84	.02
Age at baseline, years	0.10	0.00	<.01	−0.58	0.02	<.01	−0.62	0.02	<.01	3.02	0.08	<.01
Age at baseline × Time												
Age × 1 year	Referent			Referent			Referent			Referent		
Age × 2 years	−0.02	0.00	<.01	−0.07	0.02	<.01	−0.07	0.02	<.01	0.04	0.06	.56
Age × 3 years	−0.03	0.00	<.01	−0.07	0.02	<.01	−0.08	0.02	<.01	0.18	0.08	.02
Age × 4 years	−0.04	0.00	<.01	−0.12	0.02	<.01	−0.13	0.02	<.01	0.54	0.10	<.01
Rank												
Officer	Referent			Referent			Referent			Referent		
Enlisted	1.07	0.07	<.01	0.49	0.32	.13	−4.42	0.34	<.01	23.47	1.51	<.01
Rank × Time												
Officer × Time	Referent			Referent			Referent			Referent		
Enlisted × 1 year	Referent			Referent			Referent			Referent		
Enlisted × 2 years	0.11	0.04	<.01	−0.48	0.30	.11	−0.10	0.32	.76	1.99	1.23	.11
Enlisted × 3 years	0.15	0.04	<.01	−0.02	0.34	.95	0.36	0.35	.30	−0.03	1.42	.99
Enlisted × 4 years	0.22	0.05	<.01	0.64	0.42	.12	0.06	0.41	.89	1.78	1.79	.32
BMI, kg/m²				−0.71	0.03	<.01	−0.90	0.03	<.01	10.20	0.12	<.01
Smoking status												
Nonsmoker	Referent			Referent			Referent			Referent		
Smoker	−0.47	0.06	<.01	−6.74	0.28	<.01	−7.65	0.28	<.01	39.00	1.32	<.01
Smoking status × Time												
Nonsmoker × Time	Referent			Referent			Referent			Referent		
Smoker × 1 year	Referent			Referent			Referent			Referent		
Smoker × 2 years	−0.05	0.03	.08	0.32	0.26	.22	−0.19	0.28	.51	3.57	1.06	<.01
Smoker × 3 years	0.03	0.04	.39	0.04	0.30	.90	−0.40	0.31	.19	4.53	1.27	<.01
Smoker × 4 years	0.09	0.05	.04	−0.04	0.38	.92	−0.21	0.38	.58	5.51	1.65	<.01

Note. BMI = body mass index.

[a]Unlike upper body and core parameter estimates, a positive cardio parameter estimate indicates an inverse relationship with fitness.

fitness at baseline (by an estimated 6.7 fewer push-ups and 7.7 fewer curl-ups), smoking did not appear to affect the rate of change in upper body or core fitness over time.

The final cardiorespiratory fitness model found that older age at baseline, higher BMI, enlisted status, and smoking were all associated with slower 1.5-mile run/walk times at baseline (Table 2). The model indicated that over time, older individuals and smokers experienced a significantly greater rate of decrease in fitness, as measured by the 1.5-mile run/walk time, than younger individuals and nonsmokers. This model suggests that the effect of age at baseline on the rate of decline in cardiorespiratory fitness increases each subsequent year following baseline with significantly faster decreases in fitness during Years 2–3 and 3–4 (Table 2). When adjusting for all other covariates, this model predicted that being enlisted added an average of 23.5 s to baseline times and being a smoker added an average of 39.0 s to baseline times. These findings are summarized using least squares means, which are estimated mean run/walk times for a population at mean age and mean BMI with equal numbers of enlisted personnel and officers. For these calculations, mean age and mean BMI were determined using the entire sample, and predictions were made based on the model parameter estimates. Figure 1 shows the trends in adjusted 1.5-mile run/walk times according to smoking status.

Discussion

The prevalence of smoking in this study of active service navy men was low (20%) compared with studies of similarly aged men in military populations (31%; Bray et al., 2009). There are several possible reasons for this discrepancy. First of all, the military percentage reported above is based on an anonymous survey, while the self-report smoking data used in the current study were collected during routine PARFQ administrations that occur twice a year. Passing the associated Physical Readiness Test is an important step in remaining in the military and advancing toward promotion. Because these test results (and associated PARFQ responses) become part of the individual's military record, there may be a tendency for sailors not to report negative behaviors, especially since the navy does not validate smoking or nicotine use. For these reasons, smoking prevalence data are expected to be low. Despite using only self-report smoking data, we found consistent differences in BMI and fitness between smokers and nonsmokers. It is expected that these differences would be even more pronounced had all smokers in the population been identified.

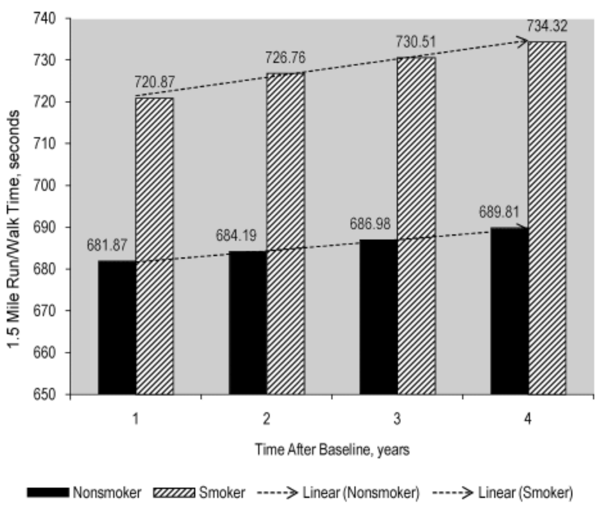

Figure 1. Linear mixed model least squares means for 1.5-mile run/walk time in seconds displaying superimposed linear trend lines according to smoking status, male U.S. navy personnel (N = 18,537), Iraq and Kuwait, 2006–2009.

While the study period was only 4 years, constant changes in cardiorespiratory fitness among smokers, although small, were apparent starting in Year 2 and continuing to Year 4. While there were changes in both groups, smokers started with a significantly poorer fitness level, and their cardiorespiratory fitness level decreased at a faster rate than nonsmokers. Because we did not know how long the smokers had been smoking, their low baseline fitness could be the result of declining fitness for years prior to our study. Even though changes over the course of the 4-year period were small in magnitude, the increasing trend among smokers suggests that the disparity in cardiorespiratory fitness level between smokers and nonsmokers will continue to widen at an increasing rate in the years to follow. A decline in physical fitness levels, while not an immediate health concern, may lead to poor quality of life or coronary heart disease risk factor profiles in the future (Bridger et al., 2009; Haddock et al., 2006; Sloan et al., 2009; Talbot et al., 2009). Furthermore, low fitness scores may be associated with other characteristics, such as the ability to handle stress. Other work has shown that, among a very fit and select group of U.S. navy men undergoing specialized survival training, men with low physical fitness (assessed by 1.5-mile run time) had higher test scores assessing the impact of stressful events (Taylor, Markham, Reis, Padilla, Potterat, Drummond, et al., 2008). Another study among navy personnel (Conway & Cronan, 1992) found that smokers engaged in spontaneous exercise activities less frequently and for a shorter duration than nonsmokers. Our results may be the effect over time of healthy individuals initiating smoking and undergoing a steady decrease in cardiorespiratory fitness levels that is in part attributable to a decrease in the amount of exercise.

We observed other interesting changes in BMI. While it is has been hypothesized that smoking can prevent weight gain, the results of the current study suggest that in the long term, smokers' BMI may increase at a slightly faster rate than that of nonsmokers. Without regard to smoking, previous studies of U.S. Army soldiers found that, over 2 years, weight gradually increased, but fitness remained the same (Williamson, Bathalon, Sigrist, Allen, Friedl, Young, et al., 2009). While the small changes found in the current study may not be of immediate concern, it is expected that many of these men will continue to smoke and that over time, these currently healthy men may experience decreases in cardiorespiratory fitness and increases in BMI greater than what would be expected from aging alone.

While smoking status was not observed to affect changes in core and upper body fitness across the 4-year time interval of our study, smokers were shown to have dramatically lower baseline core and upper body fitness levels. It is possible that the period of observation used (4 years) was not long enough to capture significant changes in these fitness measures attributable to smoking status. This finding may also be the result of the limited nature of the measurements themselves. The number of curl-ups and push-ups completed in 2 min are integer values that are less informative than the more granular and therefore more informative measure of 1.5-mile run/walk time in seconds. Additionally, the 2 min allotted for completion of the core and upper body assessments imposes an upper limit to the score a highly fit individual can achieve. Compared with run/walk times, curl-ups and push-ups are less standardized measures, and the criteria for completion of a single curl-up or sit-up may be arbitrarily enforced by the personnel administering the assessment.

Using the 1.5-mile run time as a measure of fitness is supported in the literature by several studies demonstrating that fitness tests are associated with positive coronary heart disease risk profiles (Talbot et al., 2009). Physical fitness, particularly aerobic conditioning as measured by 1.5-mile run time, has been associated not only with the development of coronary heart disease but also with quality-of-life issues as well (Sloan et al., 2009). A cross-sectional study by Sloan et al. found that men in the U.S. navy with higher levels of cardiorespiratory fitness had better scores on both physical and mental summary scores than the referent group (lowest quartile). Furthermore, compared with the lowest quartile, those with higher levels of cardiorespiratory fitness also had lower BMI, lower blood pressure, and a lower prevalence of smoking. In Finland, physical fitness in male military personnel (measured by a 12-min running test) found absence due to sickness more common among the slowest runners (Kyrolainen, Hakkinen, Kautiainen, Santtila, Pihlainen & Hakkinen, 2008).

This study has several strengths, including the large sample of men (n = 18,537) who were healthy enough for deployment and the longitudinal method of analysis. Other studies using PRIMS found similar associations for higher BMI and lower fitness or performance scores, but these studies analyzed cross-sectional data and did not control for smoking status, thus limiting their interpretation (Bray et al., 2009; Zajdowicz & McKenzie, 2003). We used a population ready for deployment to ensure that the sample was healthy and at risk for smoking initiation or continuation (Poston et al., 2008; Smith et al., 2008). This study also used a longitudinal approach and took advantage of the pre- and post-objective and repeated measurements of BMI and standardized tests for fitness to account for significant correlations between measurements taken on the same subject at different points in time. Consideration of the within-subject covariance allowed for a more accurate identification of the unique effect of smoking on short-term changes in fitness and BMI among an otherwise healthy population.

A major limitation of the study was the lack of validation of smoking status. Because smoking data were obtained every 6 months for approximately four years, eight potential timepoints were available. To be classified as a smoker, the person had to have reported "yes" to current smoking on at least half of the timepoints. However, even without validation data and using conservative estimates, changes in cardiorespiratory fitness and BMI associated with smoking were apparent. It is possible that with more accurate smoking data (including validation, smoking history, and daily number of cigarettes), our findings may have been stronger.

Smoking in the military setting has often been accepted and even encouraged by favorable pricing and the social environment (Nelson et al., 2008). However, as the harmful effects of tobacco smoke among military personnel became recognized, efforts to discourage smoking have included increasing the cost of cigarettes and encouraging the use of cessation programs (Nelson et al., 2008). Although cigarette smoking among U.S. military populations has decreased from around 50% in 1980 to approximately 33% in 2005, recent data indicate that the rate of cigarette smoking is on the rise (Bray et al., 2009; Conway & Cronan, 1992; Nelson et al., 2008). The results of the current study suggest that smoking remains a problem in the military and is associated with measurable declines in cardiorespiratory fitness. These results call for continued attention to the problem of nicotine use among young healthy military or civilian men to reduce long-term health problems.

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Declaration of Interests

None declared.

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14. ABSTRACT

The short-term effect of cigarette smoking on a military population of healthy men is not clear. The study objective was to examine smoking and change in fitness over 1–4 years, while controlling for fluctuations in body mass index (BMI). Of the total sample, 20% (n = 18,537) were identified as current smokers. Compared with nonsmokers, smokers were more likely to be enlisted, younger, and have lower BMI measurements at baseline. Additionally, smokers had slower 1.5-mile run/walk times and completed fewer curl-ups and push-ups than nonsmokers. A linear mixed modeling procedure was used to determine factors contributing to longitudinal changes in both BMI and 1.5-mile run/walk time. The model indicated that over 4 years, smokers, in comparison with nonsmokers, experienced a significantly greater rate of decrease in fitness, even while controlling for changes in BMI. These findings suggest that smoking during military deployment has adverse short-term effects that may persist long after military service has ended.

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