

MILLENNIUM COHORT STUDY
20 YEARS OF RESEARCH
PROTECTING SERVICE MEMBER AND VETERAN HEALTH

A U.S. DEPARTMENT OF DEFENSE AND
DEPARTMENT OF VETERANS AFFAIRS STUDY



MILLENNIUM COHORT STUDY



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20 YEARS OF RESEARCH

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THIS REPORT

The Millennium Cohort Study (MCS) commemorates its 20-year anniversary in 2021. This report highlights findings from the first 20 years of the study with a specific focus on modifiable behaviors as well as selected published findings relevant to participants, stakeholders, partners, and researchers. Descriptions of participants from the baseline survey and our most recent data collection from 2014-16 are also presented, including those specific to service branches, components, and Veterans.

STUDY OVERVIEW

Rationale for Research on Military Health

In the late 1990s, public concern about the potential health effects of deployments following the Vietnam and Gulf War conflicts prompted the Institute of Medicine, Department of Defense (DoD), Veteran's Affairs (VA), and Congress to identify how military occupational exposures affected the long-term health of U.S. service members. The 1999 National Defense Authorization Act (NDAA), Section 743, established "a longitudinal study to evaluate data on the health conditions of members of the armed forces upon their return from deployment." The result was the Millennium Cohort Study (MCS), the largest prospective health study in DoD history.

MCS researchers, in collaboration with all military services and the VA, evaluate detailed data on how military occupational and deployment-related exposures influence a broad spectrum of important health outcomes. Although the original designers of the study could not foresee the military conflicts occurring following the events of September 11, 2001, the study was uniquely positioned to examine near- and long-term effects related to these operations. As force health protection continues to be a priority for the United States military, the study will inform the short- and long-term health for generations of military members.

Goal

The goal of the study is to understand the impact of military service, including deployments and other occupational exposures, on the long-term physical health, mental health, and quality of life of service members. The study contributes to force protection by providing information that is critical for enhancing the long-term health of future generations of military members, Veterans, and their families.

Methods

Launched in the summer of 2001, the MCS began enrolling a representative sample of U.S. military personnel consisting of all branches of the military, Reserve, and National Guard members. Participants were first enrolled in 2001, with additional groups enrolled in 2004, 2007, 2011, and 2020. To date, over 250,000 service members have enrolled in the cohort and more than 50% of participants have deployed in support of military operations. Over time, they have transitioned out of service and currently more than 70% are no longer serving in the military. Participants complete follow-up surveys approximately every 3 to 5 years during and after their time in service. The MCS will continue to enroll and follow participants for the next five decades, through 2068, to fully assess health throughout their lifetime. Research projects analyzing the combined data from our participants have helped to inform policy, focusing on military readiness and protecting the health of military personnel and Veterans.

Partners

Investigators include scientists from the Army, Navy, Air Force, VA, and leading academic institutions. The Millennium Cohort Strategic Board includes many distinguished external scientific researchers and subject matter experts from academia, DoD, VA, and Veteran Service Organizations.



U.S. Army National Guard photo by
Sgt. Jessi Ann McCormick/Released

STUDY OVERVIEW

“The Millennium Cohort Study is one of the largest sources of self-reported health information of current and former service members. Many DoD studies only examine current service members and many VA studies begin examining Veterans after they have separated from the military. The Millennium Cohort Study is one of the few studies that straddle this line.” (CAPT Dennis Faix, physician, former Millennium Cohort Study principal investigator, and current Naval Health Research Center Commanding Officer)¹

About the Study

The MCS is the largest and longest-running health study of United States military personnel. The study began in 2001 to understand the long-term health and well-being of military and Coast Guard personnel.

Data from our participants have helped to inform policy focusing on military readiness and protecting the health of military personnel and Veterans. The MCS is headquartered at the Naval Health Research Center (NHRC) in San Diego, CA.

As mentioned in Science Magazine by McNally (2012), the Millennium Cohort Study is “the most methodologically rigorous epidemiological study on American military personnel deployed to Iraq and Afghanistan.”²

Figure 1. Study Timeline and Description

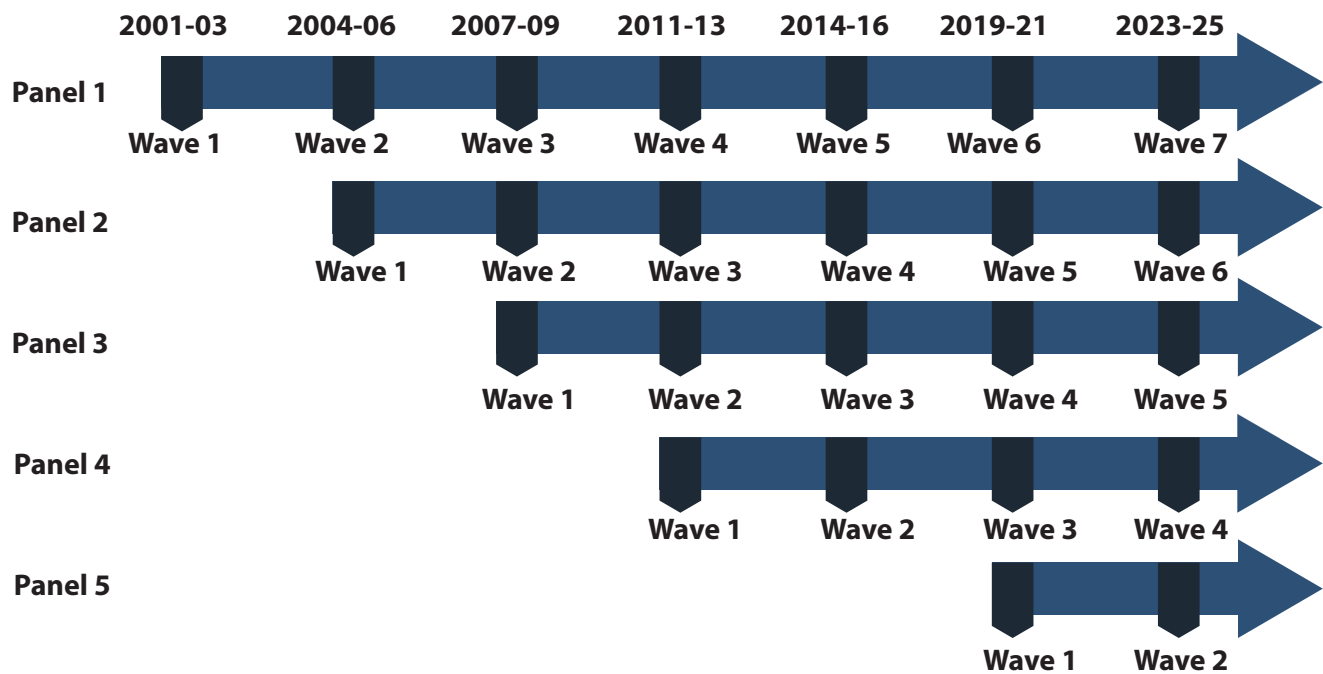


Figure 1 is a timeline of study enrollment and survey data collection over time. Panel is defined as a group of people enrolled into study. Wave is defined as the data collection timepoint. Earlier panels have more waves of data since they have been enrolled in the study longer. As the study continues, additional panels will be enrolled, along with more waves of data collection through 2068.

What happens after participants join the study? They complete surveys approximately every 3 to 5 years, regardless of military service. Participants complete the survey on the website (millenniumcohort.org) or through paper surveys.

RESEARCH AREAS

Over the last 20 years, we have conducted extensive research focused on service members, Veterans, and their families that examine military factors (e.g., combat and deployment experiences) associated with physical and mental health, well-being, and health behaviors. Our research has contributed to knowledge and policies impacting readiness and protection of our service men and women. We have developed over 200 scientific publications, book chapters, briefings, and conference presentations.

Readiness and Deployment: Readiness is the ability of military forces to fight and meet the demands of assigned missions³ and is important because it increases the chances that our Armed Forces will be successful in conflict.⁴ Our research has shown that obesity and health behaviors, such as optimal sleep, affect readiness and resilience of our service men and women. We are continuing to contribute to research on factors that can optimize readiness.

Mental Health: Historically, most of our research has focused on different aspects of mental health among military personnel during and after their service. Post-traumatic stress disorder (PTSD) has been recognized as a major consequence of combat experience and can lead to a range of negative health consequences. While our previous research has focused on specific mental health conditions, such as PTSD and major depression, we are also focusing on emerging areas of research, such as anger, stress, post-traumatic growth, and the adverse health effects of sexual trauma.

Health-Related Behaviors: Over the years, we have focused on major modifiable health behaviors such as tobacco use, tobacco cessation, risky alcohol use, and sleep quality as related to military service, deployments, and transition to Veteran status. We are also researching the effects of smokeless tobacco, vaping, and health care utilization.

Occupational and Environmental Exposures: Our team has conducted research on combat deployments and potential exposures to airborne hazards, including burn pit emissions. We have also investigated mental health in relation to specific occupational categories, such as Special Operators and veterinarians. We are continuing this line of research on occupational and environmental exposures experienced during service.

Physical Health and Injury: Major health concerns that we have examined include chronic diseases, such as diabetes, hypertension, heart disease, autoimmune diseases, and chronic multisymptom illness. In addition, areas we that we are currently researching include respiratory health, musculoskeletal injury, traumatic brain injury and blast injury, hearing loss or tinnitus, neurodegenerative disease, and cancer.

Veteran's Health, Financial Well-being, and Civilian Reintegration: As more of the cohort separates from military service, Veteran's health and the transition to civilian life become growing priorities for our research team. We are also currently examining mental health, financial well-being, social support during civilian transition, employment issues, and homelessness among Veterans.

Women's Health: Our research team understands how vitally important women are to the mission, with women accounting for nearly 17% of the U.S. Armed Forces and now able to serve in all occupations. We have conducted studies on a wide range of topics and experiences, including mental, physical, and reproductive health, tobacco and alcohol use, and the effects of sexual trauma. We continue investigating many aspects of women's health, with emerging topics in sexual health, overall health of women in combat occupations, cancer screenings, and musculoskeletal conditions and injuries.

Disparities: Our research team is currently examining the military experiences and overall health of service members identifying as racial/ethnic or sexual minorities to understand how the military can support readiness and retention among these communities.



IMPACT ON POLICY



U.S. Army photo by Adam Garlington

The main objective of the MCS is to provide evidence-based knowledge to inform and improve interventions, clinical practice guidelines, and policies of key stakeholders, including Department of Defense (DoD) and Veteran's Administration (VA) leadership.

Since the launch of the cohort in 2001, the MCS has investigated the impact of military service, including deployments and other occupational exposures, on long-term mental, physical, and behavioral health of service members and Veterans.

Along with our publications, we also fulfill requests for research that will be used to aid in policy decisions. For example, our team recently provided results and findings describing the impacts of sexual harassment and sexual assault on service members to the Office of Personnel and Readiness, Health Services Policy and Oversight. We have also conducted analyses examining adverse mental health outcomes among Army veterinarians and veterinary technicians, as requested by the Commanding Officer of the Walter Reed Army Institute of Research.

The unique strength of the MCS is our ability to measure long-term health outcomes over a wide range of exposures. We hope study results will help define healthcare policies, guide prevention and treatment programs, and strengthen opportunities for future generations of military personnel. Examples of findings from the MCS that have been used to inform policy include:

Women's Health

The 2020 National Defense Authorization Act (NDAA) directed the MCS to provide annual reports to Congress over 3 years related to gynecological and perinatal health.

Substance Use

The Institute of Medicine (IOM) issued a report in 2013 entitled "Substance Use Disorders in the U.S. Armed Forces" that included direct mention of the MCS and the unique capability to examine substance use in service members and military families.

Respiratory Health

In 2020, the National Academies Press published a consensus report on respiratory health outcomes among service members who were deployed to the Persian Gulf region and Afghanistan. Specific focus of the analysis was on health outcomes of exposure to airborne hazards associated with service in these regions. In particular, the study evaluated and summarized "emerging evidence on respiratory health outcomes in service members from research such as the Millennium Cohort Study."⁵ The report summarized findings across multiple studies and recommendations for future research and policies as related to respiratory health.

Health Promotion/Disease Prevention

The MCS is considered a population health resource for informing performance and readiness optimization of active duty personnel. Data from the study on obesity and deployability have been used to inform current body composition standards. Specific policy changes have been made in DoD recruitment and retention policies. In addition, information has been used to inform Veteran's Health Administration (VHA) weight management programming.

PARTICIPANT PROFILE

Millennium Cohort Study participants are diverse in terms of demographic characteristics and military and deployment experience. Below is a description of the cohort, which is also depicted in **Table 1**.

- Most participants are men (70%), with 30% women.
- Most are non-Hispanic White (73%), followed by non-Hispanic Black/African American (12%), Hispanic/Latino (8%), Asian American/Pacific Islander (4%), American Indian/Alaskan Native (1%), and Other (1%).
- Participants predominantly served in the Army (45%), followed by the Air Force (29%), Navy (16%), Marine Corps (9%), and Coast Guard (2%).
- Over half (54%) have deployed at least once during their military service.
- More than half of participants at the time of enrollment (baseline) were junior enlisted, followed by 26% senior enlisted, and 17% officers.
- Most participants at baseline were Active Duty (66%), followed by 34% Reserve or National Guard.



Table 1. Characteristics of All Study Participants

2001–2016 (n=201,619)		%
Sex		
Male		69.4
Female		30.7
Birth year		
Pre–1960		8.5
1960–1969		16.2
1970–1979		24.3
1980 or later		51.1
Branch of Service, at the time of enrollment		
Army		44.6
Navy		16.0
Marine Corps		9.0
Air Force		28.7
Coast Guard		1.8
Combat deployment, ever		
Not deployed		46.1
Deployed, without combat		12.6
Deployed, with combat		41.3
Race/ethnicity		
Non-Hispanic White		72.8
Non-Hispanic Black		12.2
Hispanic/Latino		7.9
American Indian/Alaskan Native		1.4
Asian American/Pacific Islander		4.4
Other		1.2
Pay Grade, at the time of enrollment		
Junior Enlisted		58.0
Senior Enlisted		26.2
Officer		17.0
Component, at the time of enrollment		
Active Duty		66.2
Reserve/Guard		33.8

Totals may not add to 100% due to rounding

2014–2016 PARTICIPANT PROFILE

Below is a description of the Cohort members that responded to the 2014–2016 survey cycle, which is also depicted in **Table 2**.

- As of 2016, most participants completed some college or more (86%).
- 70% had separated from military service and 1% were deceased.
- More than half were married (70%) and had at least 1 child or more (52%).



U.S. Air Force photo by Airman 1st Class Collette Brooks



U.S. Army photo by Sgt. Jesse Elboaub

Table 2. Characteristics of All Participants That Responded to the 2014–2016 Survey Cycle

2014–2016 (n=112,655)	%
Education	
High school diploma or equivalent	14.1
Some college, no degree	36.2
Associate's degree	13.8
Bachelor's degree	20.5
Master's, doctorate, or professional degree	15.4
Marital status	
Never married	13.7
Currently married	69.5
No longer married	16.8
Number of children	
None	47.7
1	19.9
2	20.5
3 +	12.0
Separation Status	
Separated as of 2016	69.9
Deceased	
Deceased as of 2016	1.2

Totals may not add to 100% due to rounding

HEALTH BEHAVIORS AND HEALTH STATUS OF ALL PARTICIPANTS

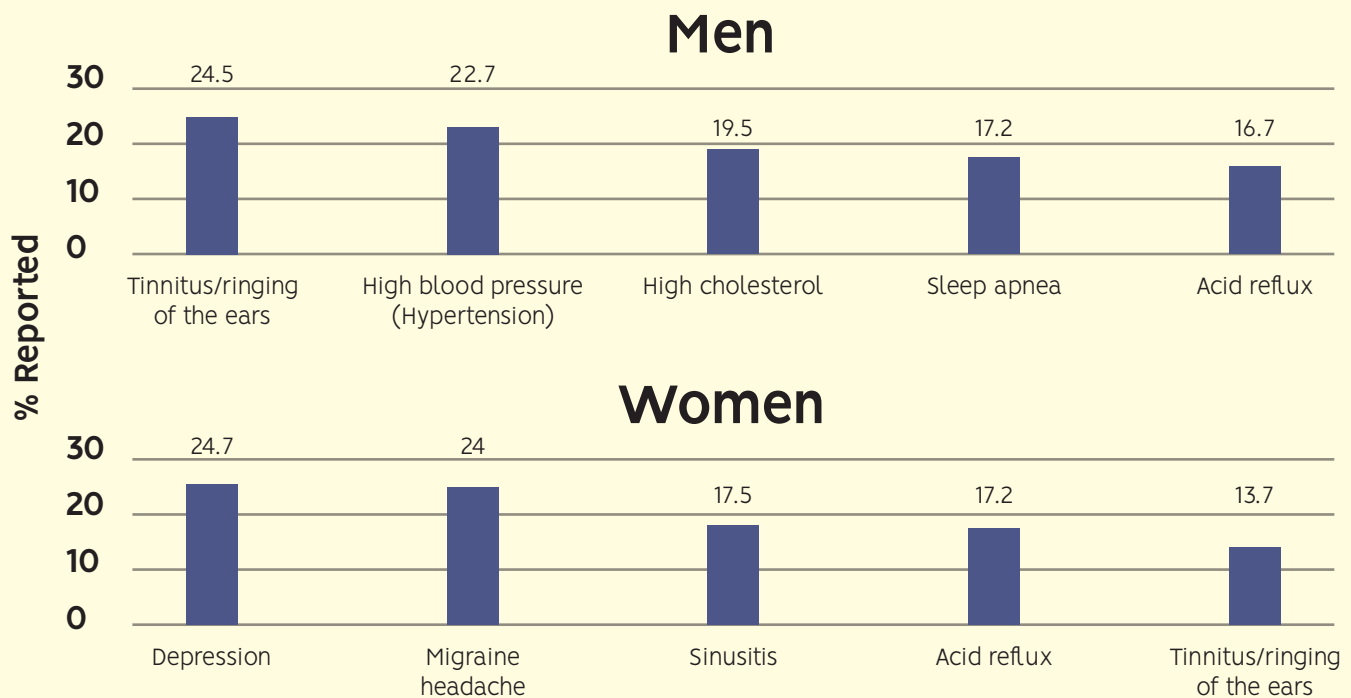
In the 2014–2016 data collection period, the Millennium Cohort Study men and women participants differed slightly in their adoption of health behaviors and reporting of common diagnosed health conditions. Below is a description of the data that describes the health behaviors and health concerns of the cohort, which is also depicted in **Table 3** and **Figure 2**.

- **Sleep:** Sleeping 7–9 hours per night is essential for optimal performance and health. Most recent data from our study showed that 23% of men and women reported sleeping the recommended 7–9 hours per night.
- **Non-smoking:** Men and women had similar frequencies of not currently smoking (90%).
- **Healthy Weight:** Men (20%) were less likely than women (40%) to have a body mass index (BMI) of 18.5–24.9 kg/m², which is in the healthy weight range.

Table 3. Health Behaviors and Health Status (2014–2016)

	Men (n=78,997)	Women (n=33,658)
	%	%
7–9 hours of sleep	23.3	22.9
Non-smoker	89.2	91.1
Healthy Weight (BMI 18.5–24.9 kg/m²)	20.0	39.5

Figure 2. Top Five Most Common Health Diagnoses Reported among Men and Women



Summary: Tinnitus/ringing of the ears and depression, respectively, were the most commonly diagnosed health concerns among men and women.

PROFILE: VETERANS*

Below is a description of the Veteran participants in the Cohort, which is also depicted in **Table 4**.

- Overall, most Veteran participants are men (68%), with 32% women.
- Many Veteran participants were born in 1980 or later (45%).
- Most are non-Hispanic White (74%), followed by non-Hispanic Black/African American (12%), Hispanic/Latino (8%), Asian American/Pacific Islander (4%), American Indian/Alaskan Native (2%), and Other (1%).
- Participants predominantly come from the Army (46%), followed by the Air Force (25%), Navy (17%), Marine Corps (11%), and Coast Guard (1%).
- Less than half (45%) have deployed at least once during their military service.

*A Veteran is defined as someone who separated from the military for any reason.



U.S. Army photo by Sgt. Jeremy Lewis



U.S. Air Force photo by Airman 1st Class Hanah Abercrombie

Table 4. Characteristics of All Veteran Participants

2001–2016 (n=128,471)		%
Sex		
Male		68.2
Female		31.8
Birth year		
Pre–1960		12.5
1960–1969		20
1970–1979		23
1980+		44.5
Branch of service (at baseline)		
Army		46.3
Navy		16.8
Marine Corps		10.7
Air Force		25.0
Coast Guard		1.2
Combat deployment, ever		
Not deployed		54.5
Deployed, without combat		10.1
Deployed, with combat		35.4
Race/ethnicity		
Non-Hispanic, White		73.8
Non-Hispanic, Black		12.3
Hispanic/Latino		7.6
American Indian/Alaskan Native		1.5
Asian American/Pacific Islander		3.7
Other		1.1

Totals may not add to 100% due to rounding



U.S. Navy photo by Mass Communication Specialist 1st Class Patrick Gordon

Table 5. Characteristics of Veteran Participants That Responded to the 2014–2016 Survey Cycle

2014–2016 (n=67,069)	%
Current Employment	
Full-time	66.3
Part-time	7.0
Not employed, homemaker, other	19.4
Not employed, retired	7.4
Current Education	
High school diploma or equivalent	15.9
Some college, no degree	37.1
Associate's degree	13.2
Bachelor's degree	19.4
Master's, doctorate, or professional degree	14.4
Household Income	
Less than \$49,999	29.5
\$50,000 – \$99,999	36.7
\$100,000 – \$149,999	20.4
\$150,000 or more	13.4
Marital status	
Never married	13.6
Currently married	67.5
No longer married	18.9
Number of children	
None	54.1
1	18.6
2	17.5
3 +	9.9
Deceased	
Deceased as of 2016	1.8

Totals may not add to 100% due to rounding

2014–2016 VETERAN PROFILE

Below is a description of the Veteran participants that responded to the 2014–2016 survey cycle, which is also depicted in **Table 5**.

- As of 2016, among Veterans, 73% were employed.
- Most Veteran participants had attended some college or more (84%).
- More than a third (34%) earned over \$100,000 in income per year.
- 2% were deceased.
- Most were currently married (68%).
- More than half of participants had no children (54%).



Photo courtesy of The Millennium Cohort Study

HEALTH BEHAVIORS AND HEALTH STATUS OF VETERAN PARTICIPANTS

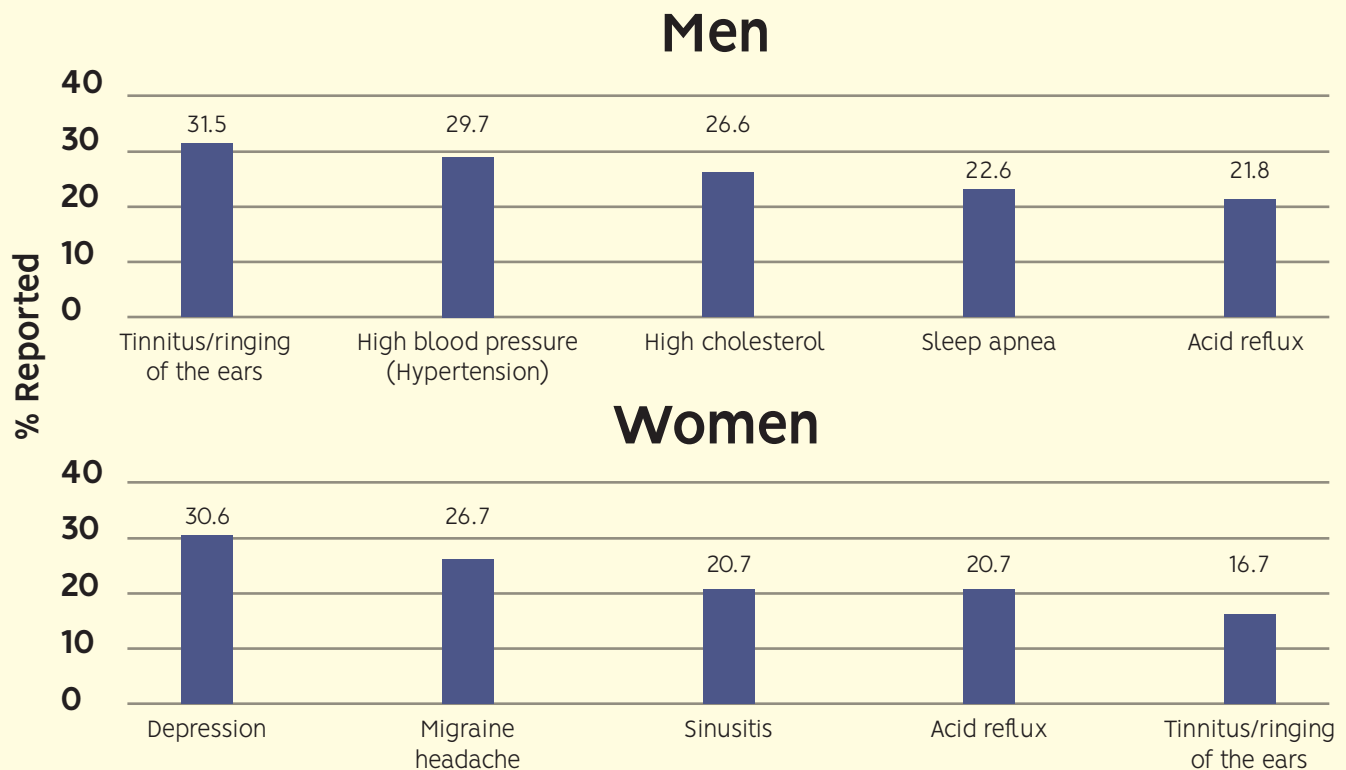
Below is a description of the 2014–2016 data that describes the recent health behaviors and health concerns of current Veterans in the Millennium Cohort Study, which is also depicted in **Table 6** and **Figure 3** below.

- **Sleep:** Sleeping 7–9 hours per night is essential for optimal cognitive function and health. Most recent data from our study showed that 22% of men and women reported sleeping the recommended 7–9 hours per night.
- **Non-smoking:** Men and women had similar rates of not smoking (90%).
- **Healthy Weight:** Men (17%) were less likely than women (35%) to have a healthy weight (BMI 18.5–24.9 kg/m²).

Table 6. Health Behaviors and Health Status (2014–2016)

	Men (n=46,312) %	Women (n=20,757) %
7–9 hours of sleep	21.9	21.6
Non-smoker	87.8	90.1
Healthy Weight (BMI 18.5–24.9 kg/m²)	16.9	35.1

Figure 3. Top Five Most Common Health Diagnoses Reported among Veteran Men and Women



Summary: Tinnitus/ringing of the ears and depression, respectively, were the most commonly diagnosed health concerns among men and women.



U.S. Army National Guard photo by Edwin L. Wriston

Table 7. Characteristics of All Reserve/National Guard Participants

2001–2016 (n=29,537)	%
Sex	
Male	66.9
Female	33.1
Birth year	
Pre–1960	2.7
1960–1969	15.5
1970–1979	27
1980 or later	54.8
Branch of Service (at baseline)	
Army	53.8
Navy	8.8
Marine Corps	3.7
Air Force	32.3
Coast Guard	1.5
Combat deployment, ever	
Not deployed	37.8
Deployed, without combat	15.2
Deployed, with combat	47
Race/ethnicity	
White, non–Hispanic	73.7
Black, non–Hispanic	10.8
Hispanic/Latino	8.3
American Indian/Alaskan Native	1.1
Asian American/Pacific Islander	5.2
Other	1

Totals may not add to 100% due to rounding

PROFILE: RESERVE/NATIONAL GUARD

Below is a description of the Reserve/Guard members of the cohort, which is also depicted in **Table 7**.

- Most Reserve/Guard participants are men (67%), with 33% women.
- The majority of Reserve/Guard participants were born in 1980 or after (55%).
- Most are non–Hispanic White (74%), followed by non–Hispanic Black/African American (11%), Hispanic/Latino (8%), Asian American/Pacific Islander (5%), American Indian/Alaskan Native (1%), and Other (1%).
- Most serve in the Army (54%), followed by the Air Force (32%), Navy (9%), Marine Corps (4%), and Coast Guard (2%).
- More than half (62%) have deployed at least once during their military service.



U.S. Army photo by Sgt. Philip McTaggart/Released

2014–2016 RESERVE/ NATIONAL GUARD PROFILE

Below is a description of the Reserve/Guard participants that responded to the 2014–2016 survey cycle, which is also depicted in **Table 8**.

- As of 2016, most Reserve/National Guard participants had some college or more (90%).
- Around one-third (31%) earned over \$100,000 in income per year.
- Most were currently married (66%).
- More than half of participants had children (58%).



Indiana National Guard photo by Spc. Jules Iradukunda/Released

Table 8. Characteristics of Reserve/National Guard Participants That Responded to the 2014–2016 survey Cycle

2014–2016 (n=18,034)	%
Education	
High school diploma or equivalent	10.1
Some college, no degree	33.7
Associate's degree	13.7
Bachelor's degree	26.8
Master's, doctorate, or professional degree	15.7
Income	
Less than \$49,999	25.8
\$50,000 – \$99,999	43.5
\$100,000 – \$149,999	20.8
\$150,000 or more	9.9
Marital status	
Never married	18
Currently married	65.8
No longer married	16.3
Number of children	
None	42.8
1	21.4
2	22.5
3 +	13.3

Totals may not add to 100% due to rounding



North Carolina Air National Guard photo by MSgt. Richard Kerner

HEALTH BEHAVIORS AND HEALTH STATUS OF RESERVE/NATIONAL GUARD PARTICIPANTS

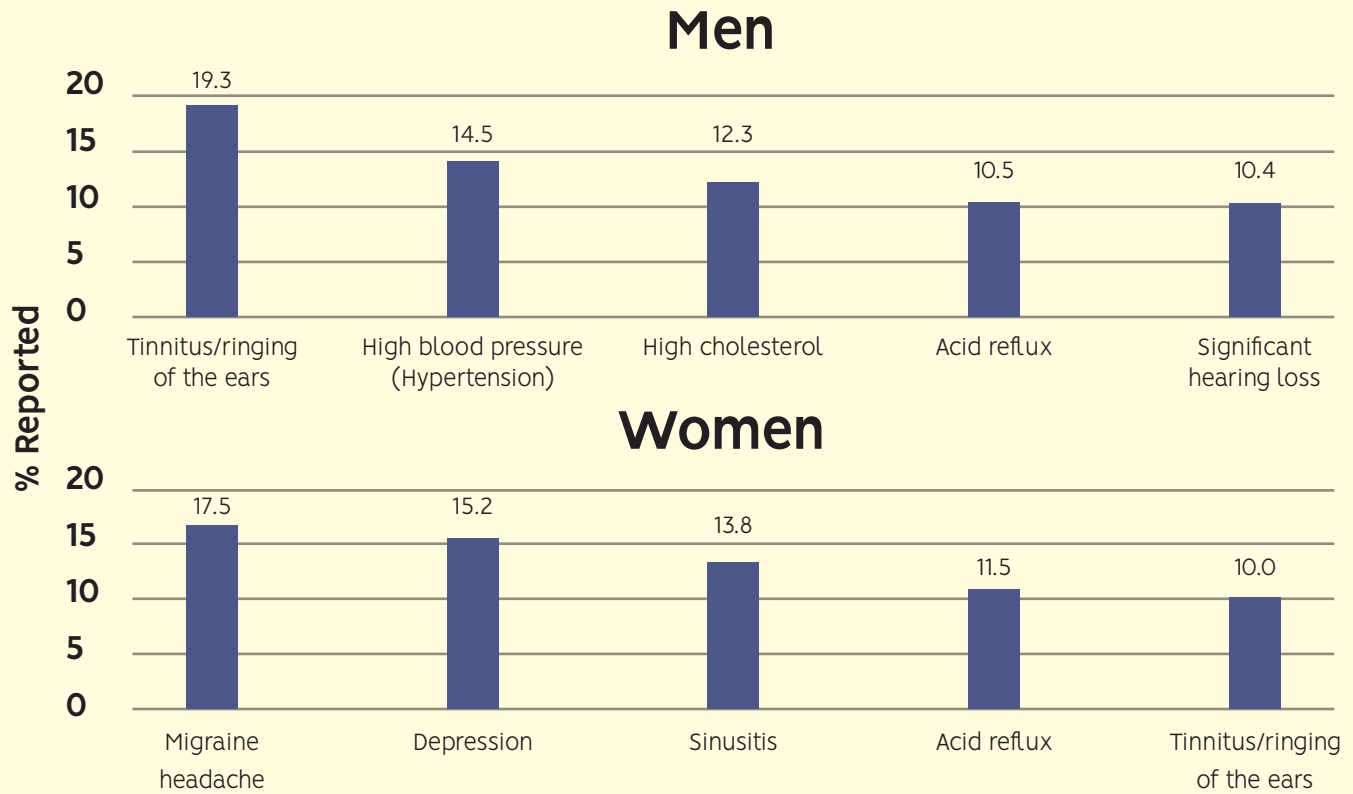
Below is a description of the 2014–2016 data that describes the recent health behaviors and health concerns of current Reserve/Guard (R/G) in the Millennium Cohort Study, which is depicted in **Table 9** and **Figure 4** below.

- **Sleep:** Sleeping 7–9 hours per night is essential for optimal cognitive function and health. Most recent data from our study showed that 27% of R/G men and women reported sleeping the recommended 7–9 hours per night.
- **Non-smoking:** Men and women had similar rates of not smoking (90%).
- **Healthy Weight:** Men (17%) were less likely than women (35%) to have a healthy weight (BMI 18.5–24.9 kg/m²).

Table 9. R/G Health Behavior and Health Status (2014–2016)

	Men (n=12,002) %	Women (n=6,032) %
7–9 hours of sleep	27.0	27.2
Current non-smoker	91.4	92.6
Healthy Weight (BMI 18.5–24.9 kg/m²)	22.6	47.1

Figure 4. Top Five Most Common Health Diagnoses Reported, Reserve/Guard Men and Women



Summary: Tinnitus/ringing of the ears and migraine headache, respectively, were the most commonly diagnosed health concerns among men and women.

PROFILE: ACTIVE DUTY

Below is a description of the data that describes key characteristics of the currently active duty participants, which is also depicted in **Table 10**.

- Most active duty participants are men (74%), with 26% women.
- Most are non-Hispanic White (69%), followed by non-Hispanic Black/African American (13%), Hispanic/Latino (9%), Asian American/Pacific Islander (6%), American Indian/Alaskan Native (2%), and Other (2%).
- Most serve in the Army (33%), followed by the Air Force (37%), Navy (19%), Marine Corps (8%), and Coast Guard (3%).
- Almost three-quarters (73%) of active duty participants have deployed at least once during their military service.



U.S. Navy photo by Chief Mass Communication Specialist Byron C. Linder



U.S. Air Force photo by Senior Airman Cheyenne Lewis

Table 10. Characteristics of All Current Active Duty Participants

Active Duty (n=43,611)	%
Sex	
Male	74.4
Female	25.6
Birth year	
Pre-1960	0.3
1960-1969	5.4
1970-1979	26.3
1980 or later	68
Branch of Service (at baseline)	
Army	33.3
Navy	18.5
Marine Corps	7.6
Air Force	37.1
Coast Guard	3.6
Combat deployment, ever	
Not deployed	27.1
Deployed, without combat	17.9
Deployed, with combat	55
Race/ethnicity	
White, non-Hispanic	69.4
Black, non-Hispanic	12.9
Hispanic/Latino	8.6
American Indian/Alaskan Native	1.6
Asian American/Pacific Islander	6.1
Other	1.5

Totals may not add to 100% due to rounding



U.S. Navy photo by Chief Mass Communication Specialist Ahron Arendes/Released

Table 11. Characteristics of Active Duty Participants That Responded to the 2014–2016 Survey Cycle

2014–2016 (n=18,034)	%
Education	
High school diploma or equivalent	11.5
Some college, no degree	35.2
Associate's degree	15.6
Bachelor's degree	19.7
Master's, doctorate, or professional degree	18
Household Income	
Less than \$49,999	25.9
\$50,000 – \$99,999	49.3
\$100,000 – \$149,999	18.6
\$150,000 or more	6.3
Marital status	
Never married	11.3
Currently married	76.9
No longer married	11.8
Number of children	
None	36.2
1	21.7
2	26.2
3 +	15.8

Totals may not add to 100% due to rounding

2014–2016 ACTIVE DUTY PROFILE

Below is a description of the Active Duty participants that responded to the 2014–2016 survey cycle, which is also depicted in **Table 11**.

- Most active duty participants had some college or more (89%).
- Most (75%) earned under \$100,000 per year.
- Most were married (77%).
- Most had 1 or more children (64%).



U.S. Marine Corps photo by Cpl. Sean Potter

HEALTH BEHAVIOR AND HEALTH STATUS TRENDS AMONG THE SERVICE BRANCHES

Below is a description of trends for health behaviors over time for active duty participants across all service branches (i.e., Air Force, Army, Coast Guard, Marine Corps, and Navy).

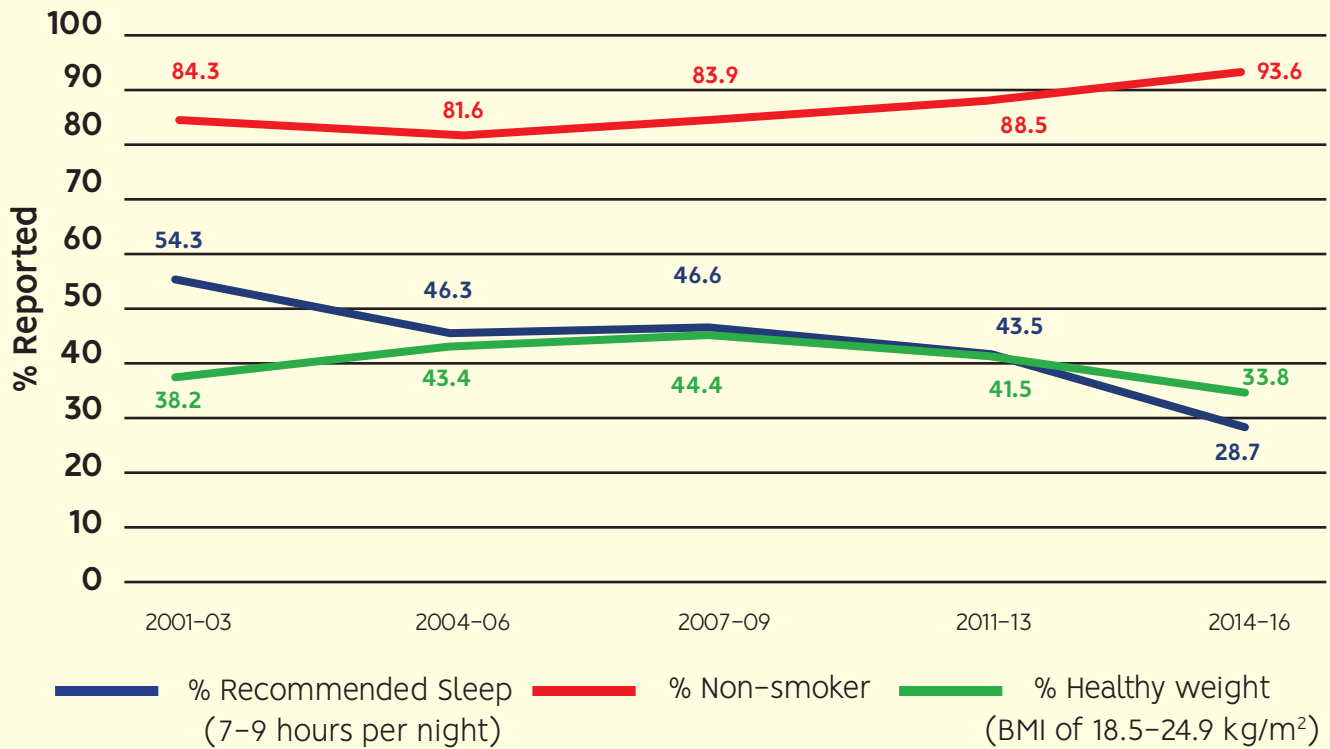
Results over time are presented on the following health protective factors:

- **Recommended sleep** is defined as those who are sleeping an average of 7–9 hours per night.
- **Non-smoking** is defined as those who are not currently smoking.
- **Healthy weight** is defined as those with a BMI of 18.5–24.9 kg/m².



AIR FORCE

Figure 5. Health Behaviors Over Time among Air Force Participants



Summary

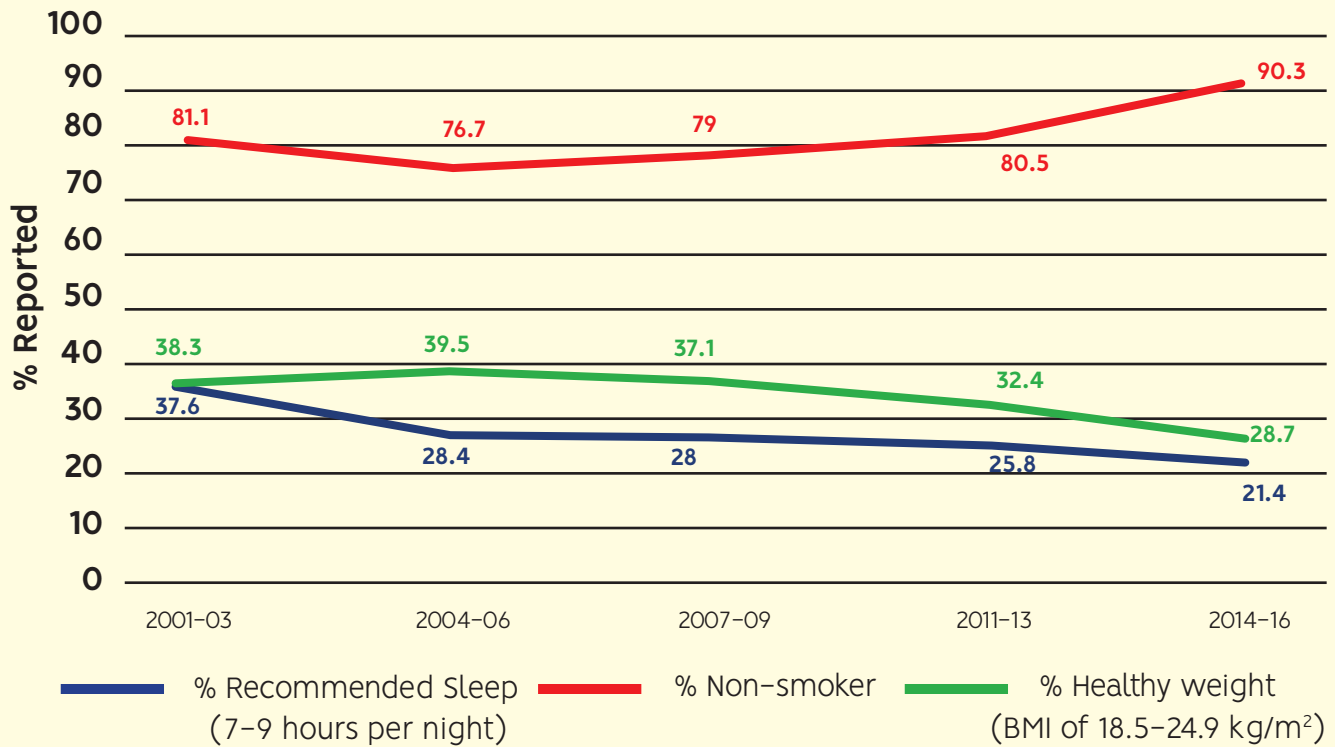
- Participants reported poorer sleep over time.
- The number of non-smokers increased over time.
- Healthy weight varied over time.



U.S. Air Force photo by Yasuo Osakabe/Released

ARMY

Figure 6. Health Behaviors Over Time among Army Participants

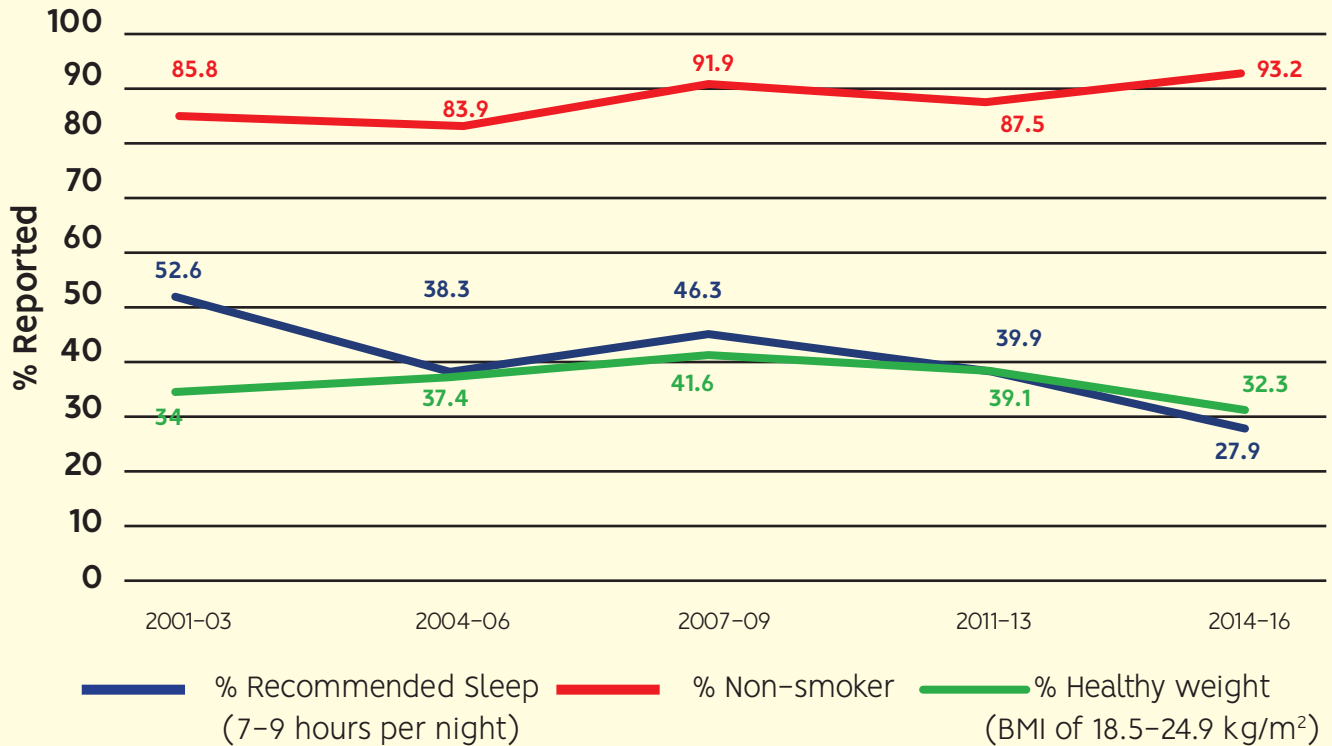


Summary

- Participants reported poorer sleep over time.
- The number of non-smokers increased over time.
- Healthy weight decreased over time.



Figure 7. Health Behaviors Over Time among Coast Guard Participants



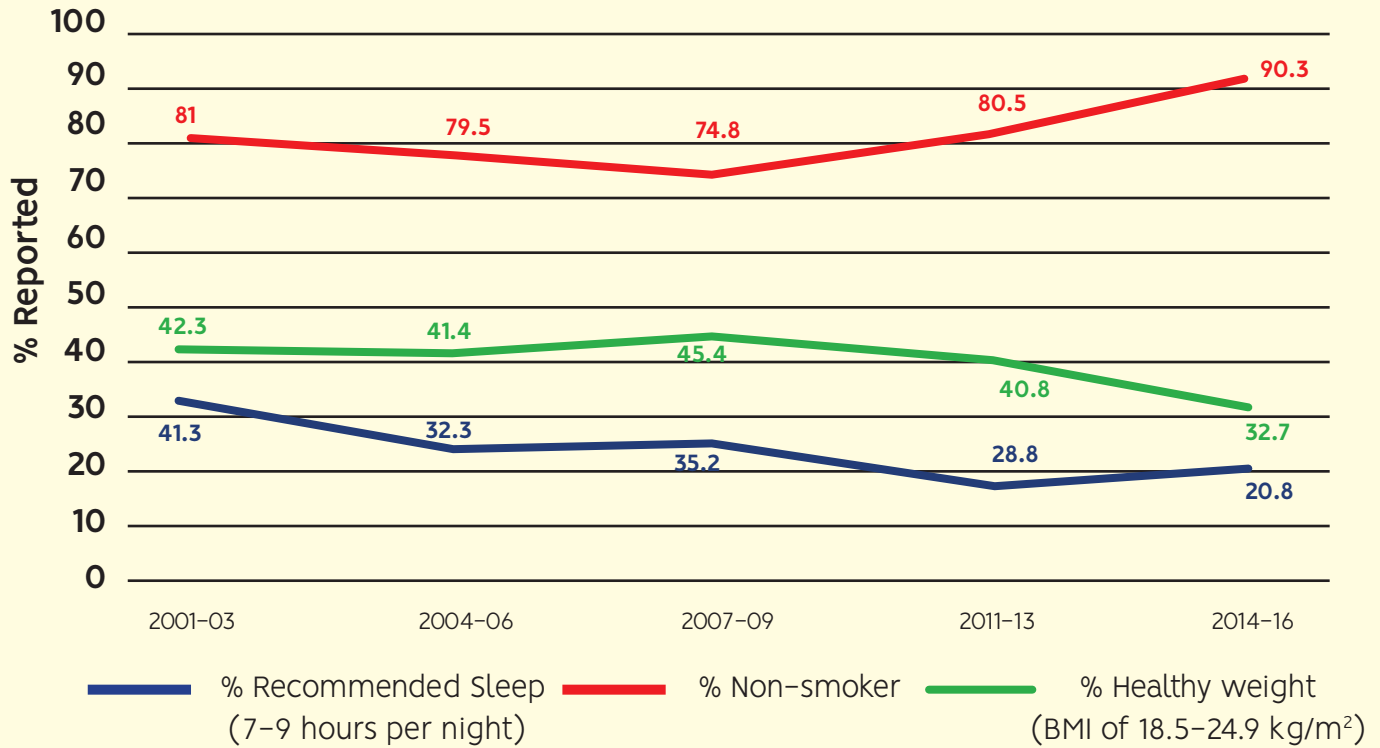
Summary

- Participants reported poorer sleep over time.
- The number of non-smokers increased over time.
- Healthy weight varied over time.



MARINE CORPS

Figure 8. Health Behaviors Over Time among Marine Corps Participants

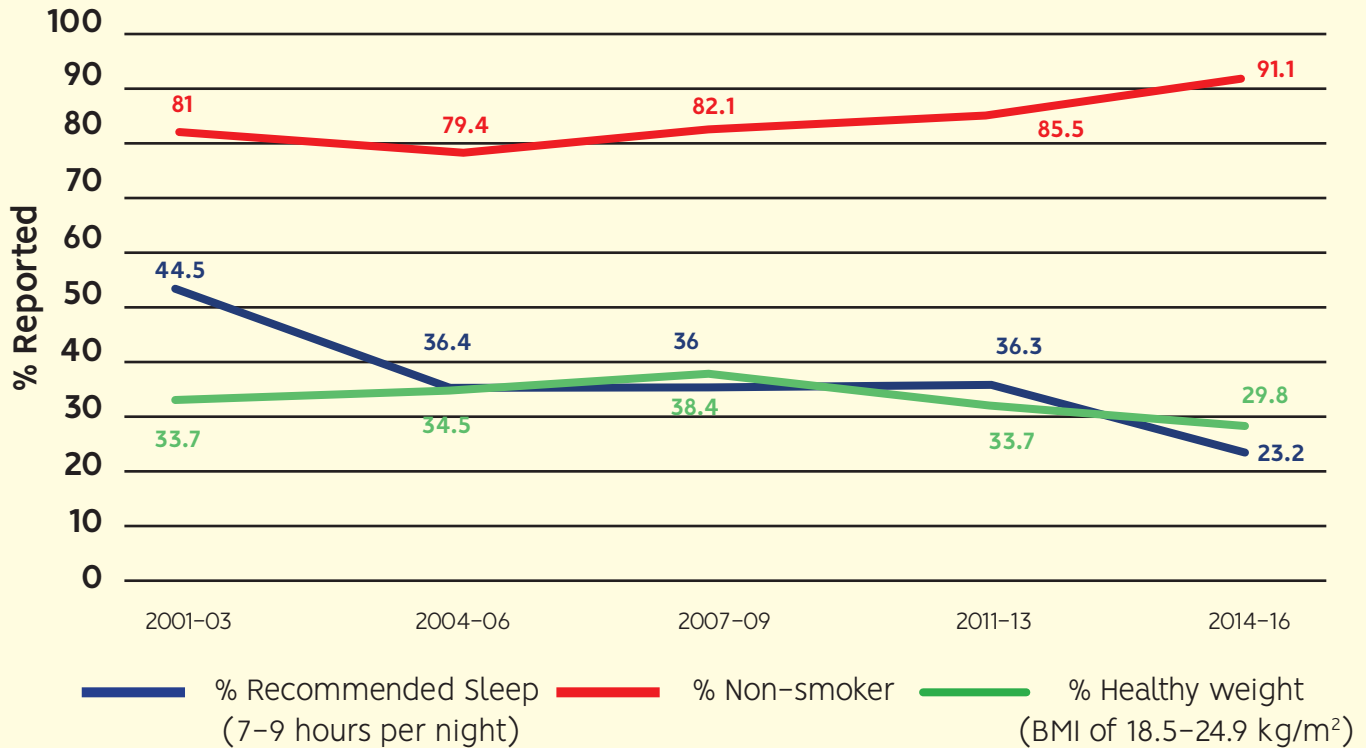


Summary

- Participants reported poorer sleep over time.
- The number of non-smokers increased over time.
- Healthy weight decreased over time.



Figure 9. Health Behaviors Over Time among Navy Participants



Summary

- Participants reported poorer sleep over time.
- The number of non-smokers increased over time.
- Healthy weight varied over time.



FEATURED RESEARCH

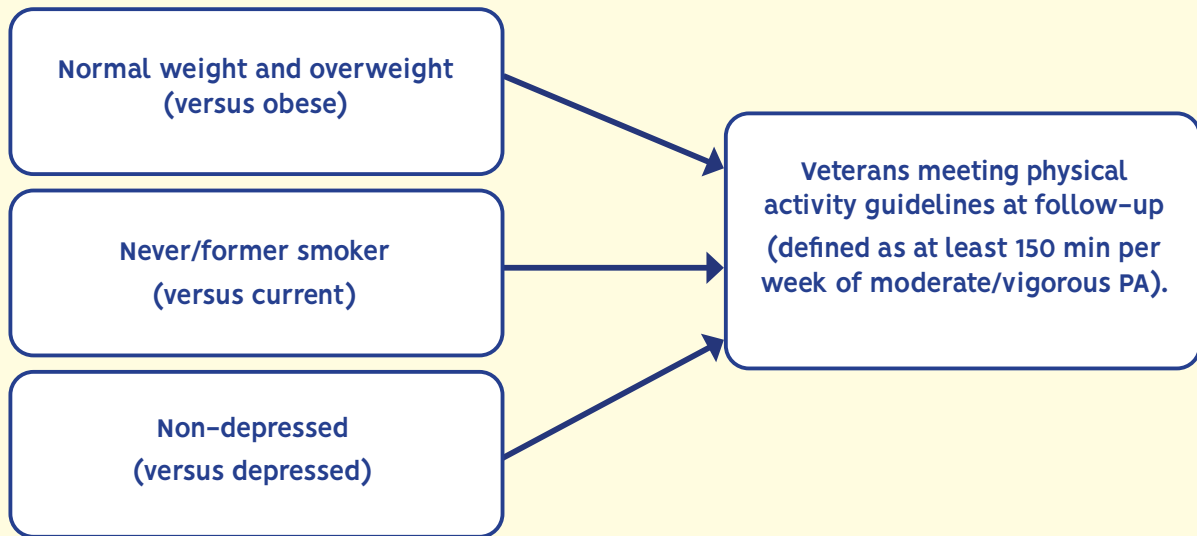
Why is Physical Activity Important?

Research shows that following the U.S. physical activity (PA) guidelines, which include regular physical activity (at least 150 minutes per week of moderate/vigorous intensity), can help prevent type 2 diabetes mellitus (T2DM), heart disease, obesity, depression, and certain cancers (colon and breast).^{6,7} In addition, decreasing sedentary (prolonged sitting) time can also decrease one's risk of heart disease and T2DM.⁸

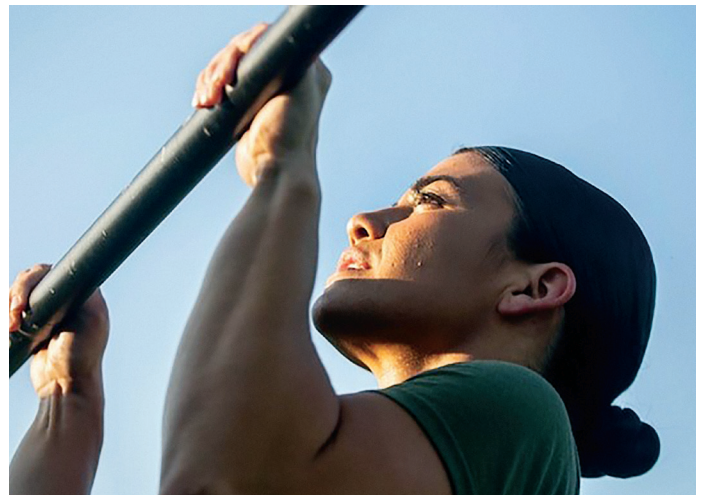
Key Points: What did the Millennium Cohort Study Find?

Our research⁹ showed that among Veterans who were discharged from the military, being normal weight or overweight (versus obese), being a non-smoker or former smoker (versus current smoker), and not being depressed (versus being depressed) made participants more likely to meet the physical activity guidelines at follow-up (e.g., at least 150 min per week).

Figure 10. Relationship between Physical and Mental Health Factors and Physical Activity among Veteran Participants.



Summary: Participants who were normal weight, never/former smokers, or who did not report depression were more likely to meet physical activity guidelines.



FEATURED RESEARCH

Why is Obesity Research Important?

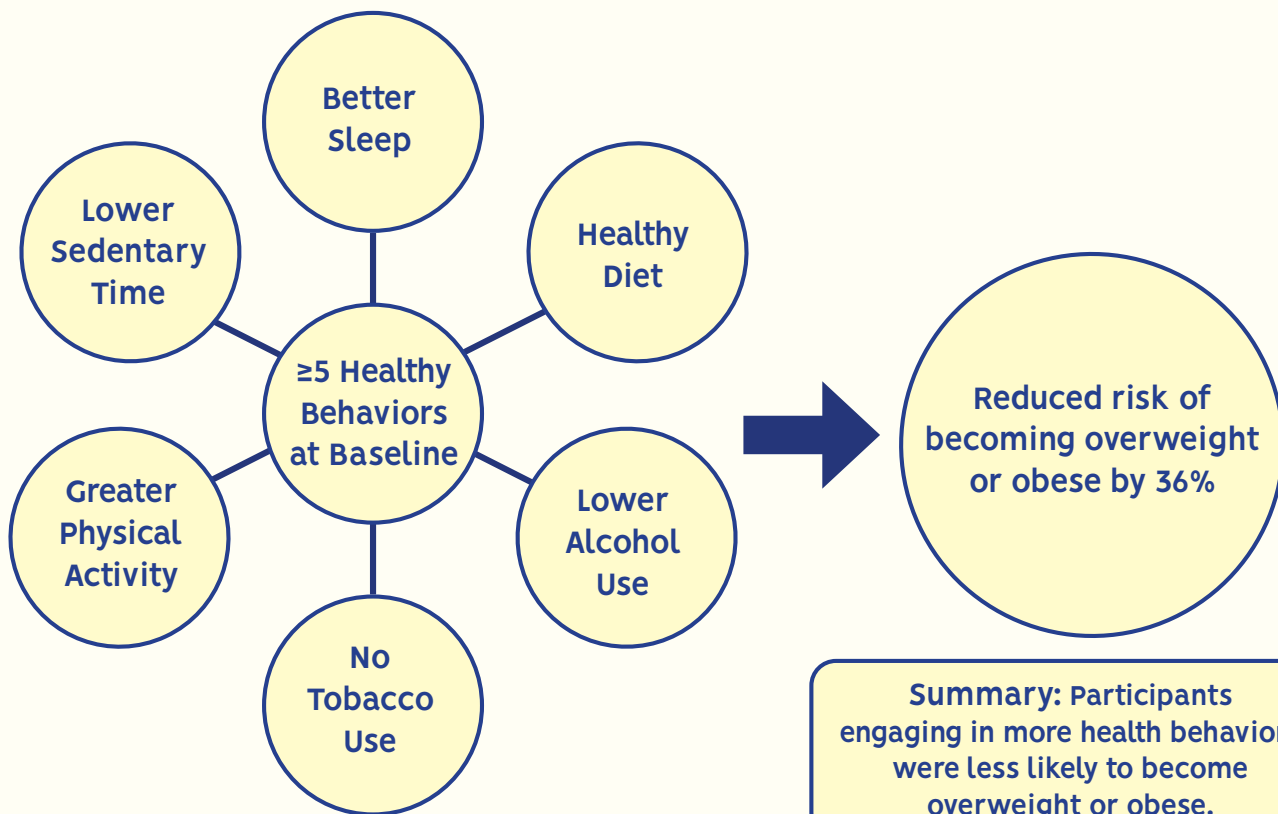
While current service members are less likely to be obese compared to civilians, this rapidly changes around the time of separation from the military. Health behaviors can help reduce one's risk of becoming obese. BMI is a measure of weight status. It is calculated from your height and weight.¹⁰ Research shows that higher BMI is related to increased risk for diabetes, sleep apnea, heart disease, and cancer in the general public and in service members.¹¹ The great news is that obesity is preventable through lifestyle modification. Lifestyle modification refers to adopting "health behaviors" such as increasing physical activity, decreasing prolonged sitting (sedentary time), maintaining a healthy diet, practicing good sleep hygiene (having good sleep quality and the optimal level of sleep), avoiding binge drinking or "at risk" alcohol use, and refraining from tobacco use.

Key Points: What did the Millennium Cohort Study Find?

Mirroring national data, our research has shown that high blood pressure, diabetes, coronary heart disease, and sleep apnea were more common among participants who were obese compared to those who were not.¹¹

In another study that we conducted, Millennium Cohort participants were surveyed¹² and followed for an average of 6 years to see how behaviors influenced weight change over time for 11,025 normal weight Veterans. Healthy behaviors include: physical activity, lower sedentary time, healthy diet and sleep, not smoking, and lower alcohol use. Results show that among Veterans, healthy behaviors matter over time. Among those who had a "healthy weight" in the beginning, those engaging in health behaviors were less likely to become overweight or obese at the 6-year follow-up time point. These results mean that adopting several health behaviors may be more effective in reducing obesity.

Figure 11. Relationship between Health Behaviors and Weight Status at 6-Year Follow-up among Veteran Participants



FEATURED RESEARCH

Why is Research on Alcohol Use Important?

Chronic unhealthy alcohol use has many negative health effects, such as heart and liver diseases and certain types of cancer. Unhealthy alcohol use coupled with its negative consequences leads to diminished force readiness, medical morbidity (increased chronic disease) and mortality (early death), and increased spending for medical and legal costs.

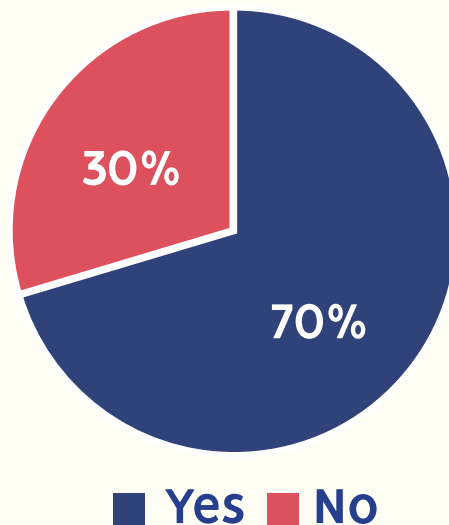
Research has shown that certain military factors, such as combat experience and membership in the Reserve or National Guard, may put service members at higher risk for unhealthy drinking, yet few studies have examined factors associated with chronic unhealthy alcohol use in the military population.

Key Points: What did the Millennium Cohort Study Find?

The Millennium Cohort Study is collaborating with leading alcohol researchers to conduct research to understand how military service, deployment, mental health and physical health are related to alcohol use. An example study is featured below in **Figure 12**.

Figure 12. Millennium Cohort Study Alcohol Use Research Results

Participants with 2 sequential positive screens for unhealthy alcohol use (see below for definition)



Summary: We followed participants from their first survey for another 3–12 years, to look at patterns of continued unhealthy alcohol use (defined as heavy weekly, heavy episodic, and problem drinking [an assessment of consequences related to drinking too much]).¹³

Our findings showed that among those who were unhealthy alcohol users at their first survey, 70% continued unhealthy use at their follow-up surveys, around 3–5 years later, which suggests chronic use.

FEATURED RESEARCH

Why is Sleep Research Important?

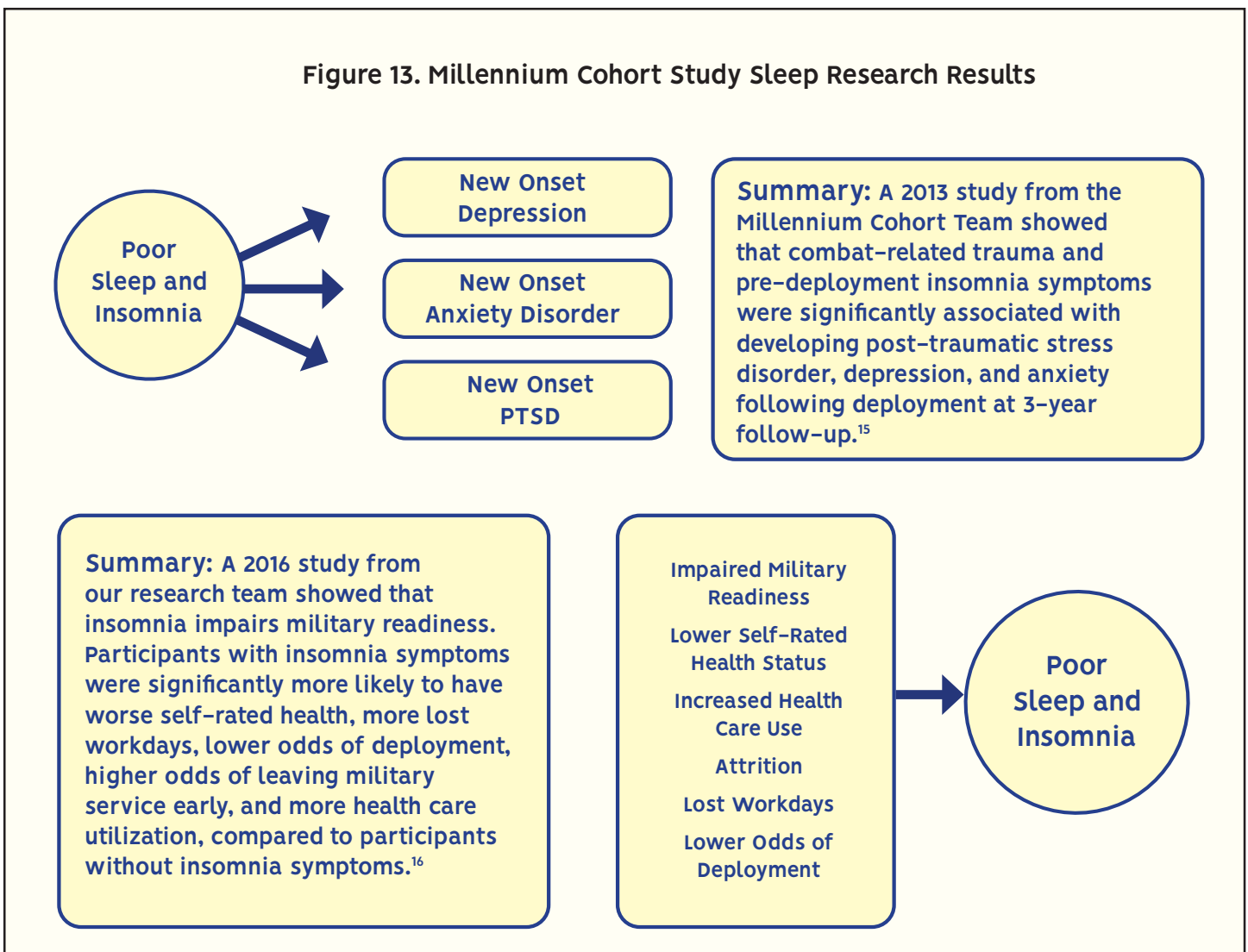
Sleep is essential for good health. Not getting enough uninterrupted sleep negatively affects a person's attention, learning and memory, and physical health.

- Sleep deficiency (too short or too long of sleep) and untreated sleep disorders are associated with a growing number of health problems, including heart disease, high blood pressure, diabetes, obesity, and depression, all of which can be harmful to military readiness.
- In addition to health problems, poor sleep is associated with lost worker productivity, and poor sleep and fatigue can cause accidents, making sleep a serious public health issue.¹⁴
- Sleeping 7–9 hours per night is essential for optimal performance of the service member.

Key Points: What did the Millennium Cohort Study Find?

The Millennium Cohort Study is collaborating with leading sleep researchers to conduct research to understand how sleep affects health over time and influences readiness and warfighter performance. Some example studies are featured below in **Figure 13**.

Figure 13. Millennium Cohort Study Sleep Research Results



FEATURED RESEARCH

Why is Research on Tobacco Use Important?

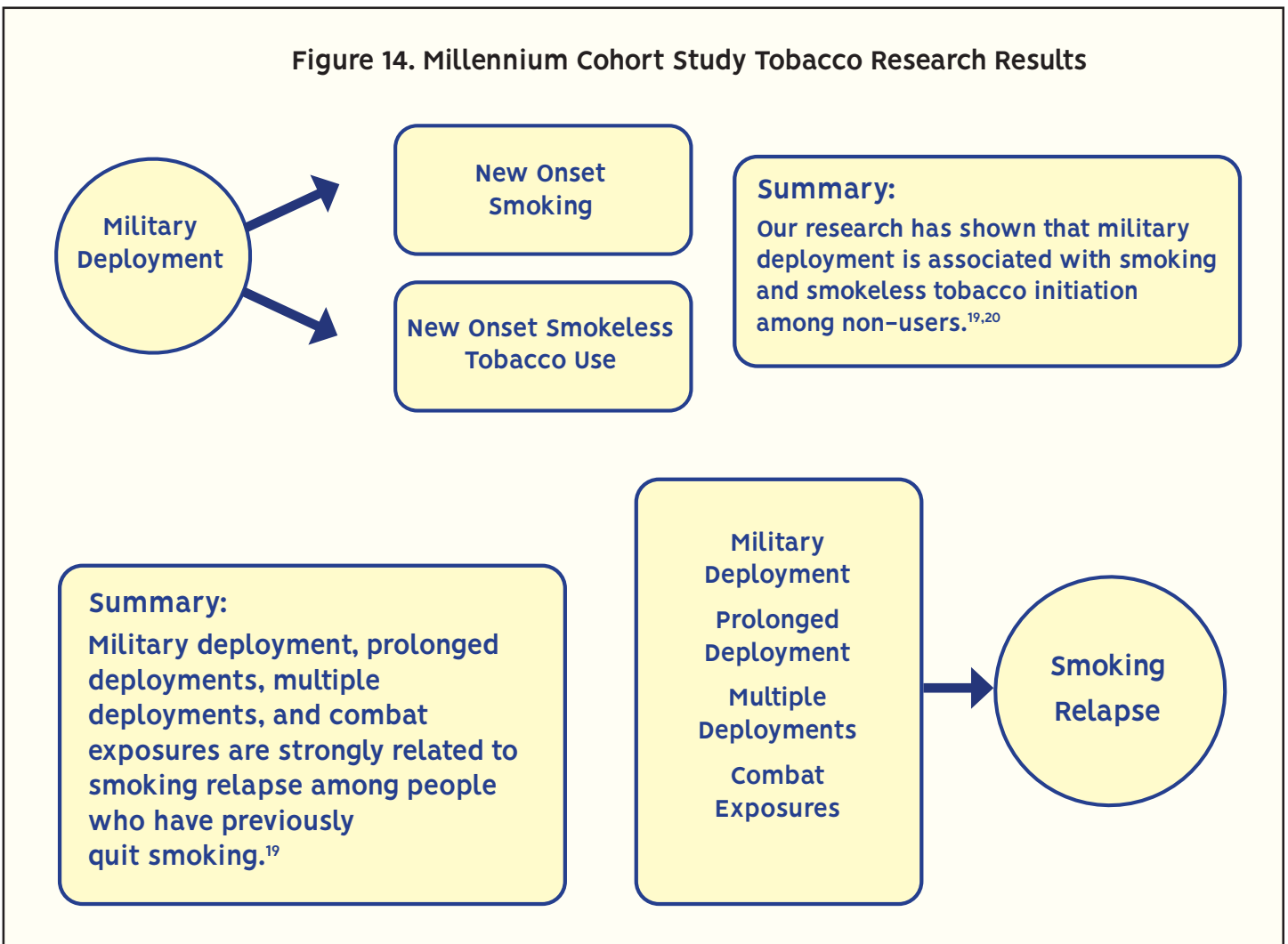
Tobacco use, through its many forms (cigarettes, vaping, cigars, smokeless tobacco), has many negative health effects and is related to diseases such as cancer, heart disease, and chronic obstructive pulmonary disease (COPD). Tobacco use is the leading cause of preventable death in the world.¹⁷

- Cigarettes and smokeless tobacco products are more often used among service members than the U.S. population.
- Regular tobacco use leads to diminished force readiness, medical morbidity (chronic conditions) and mortality (early death), and increased spending for medical costs.
- According to the Military Health System, “using tobacco in any form poses a threat to readiness and the overall health of the force.”¹⁸
- It is thought that smoking is used as a coping strategy for the stress experienced in military deployments.

Key Points: What did the Millennium Cohort Study Find?

The Millennium Cohort Study is collaborating with leading tobacco researchers to conduct research to understand how military service and deployment affect tobacco use trends, mental and physical health in relation to tobacco use, and tobacco cessation. Some example studies are featured below in **Figure 14**. We are currently collecting data related to vape use and will be reporting on this in the future.

Figure 14. Millennium Cohort Study Tobacco Research Results



MILLENNIUM COHORT STUDY 20 YEARS OF RESEARCH

In summary, the Millennium Cohort Study is the largest and longest-running health study of United States military personnel. The study began in 2001 with the initial goal of understanding the long-term health and well-being of military personnel. When first enrolled, all participants were active duty or Reserve/National Guard service members, and over time they transitioned out of service so that currently more than 70% are no longer serving in the military. Data from our participants have helped inform policies focusing on military readiness and protecting the health of military personnel and Veterans. As we look forward to the next five decades of the study, we are optimistic in our ability to inform data-driven policy development that is relevant to service members and can improve well-being and quality of life during and after service.

Future Research Collaborations: How to Get Involved

We welcome new collaborations on research projects focused on active duty, Reserve/National Guard, and Veterans. Briefly, research proposals are reviewed and approved by an oversight committee to ensure alignment with the study's objective. The overall objective of the Millennium Cohort Study is to characterize the military service experiences and health outcomes of a large cohort of military and Veteran personnel and contribute to the understanding of factors that influence military health.

The full process for collaboration is available at <https://millenniumcohort.org/research/collaboration>

Acknowledgments

Participants

The participants in this study have contributed many hours responding to questions about their health status over the years. The success of this study is due to their dedication and contribution of time and effort. We thank the participants for their commitment. With their continued dedication, the study will be able to continue to make contributions to the future health of service members and Veterans. The valuable information participants provide on a regular basis helps us understand the health concerns and needs of service members and Veterans. This information is critical to shape future DoD, VA, and other organizational policies and initiatives. We would like to extend our sincerest gratitude to participants for your service and time spent completing the Millennium Cohort surveys.

Disclaimer

I am a military service member or employee of the U.S. Government. This work was prepared as part of my official duties. Title 17, U.S.C. §105 provides that copyright protection under this title is not available for any work of the U.S. Government. Title 17, U.S.C. §101 defines a U.S. Government work as work prepared by a military service member or employee of the U.S. Government as part of that person's official duties.

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The study protocol was approved by the Naval Health Research Center Institutional Review Board in compliance with all applicable Federal regulations governing the protection of human subjects. Research data were derived from an approved Naval Health Research Center Institutional Review Board protocol, number NHRC.2000.0007.

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MILLENNIUM COHORT STUDY
20 YEARS OF RESEARCH
PROTECTING SERVICE MEMBER AND VETERAN HEALTH

**A U.S. DEPARTMENT OF DEFENSE AND
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