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in U.S. Military Service Members***

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Population Health

The Association of Predeployment and Deployment-Related Factors on Dimensions of Postdeployment Wellness in U.S. Military Service Members

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Abstract

Purpose. To assess the effects of predeployment and deployment-related factors on dimensions of wellness following deployment.

Design. Prospective longitudinal study. The dependent variable was dimensions of wellness. Independent variables were measured in terms of modifiable, nonmodifiable, and military factors, such as sex, race/ethnicity, service branch, smoking status, and combat experience.

Setting. A large military cohort participating in the Millennium Cohort Study.

Subjects. Included 10,228 participants who deployed in support of the operations in Iraq and Afghanistan.

Measures. Dimensions of wellness were measured by using standardized instruments assessing self-reported physical health, mental health, and stress. Covariates were measured by using self-reported and electronic data.

Analysis. Factors of postdeployment wellness were assessed by using ordinal logistic regression.

Results. Most participants (78.7%) were categorized as “moderately well” post deployment. Significant modifiable predeployment predictors of postdeployment wellness included normal/underweight body mass index (odds ratio [OR] = 1.72, $p < .05$). Military factors significantly associated with wellness included not experiencing combat (OR = .56, $p < .05$), member of Air Force (OR = 2.02, $p < .05$) or Navy/Coast Guard (OR = 1.47, $p < .05$), and combat specialist occupation (OR = 1.22, $p < .05$).

Conclusion. Multiple modifiable factors associated with postdeployment wellness were identified, which may help inform medical and military leadership on potential strategies to ensure a well force. Those trained in combat roles were more likely to be well post deployment though this apparent benefit was not conferred onto those reporting combat experiences. (*Am J Health Promot* 2013;28[2]:e56–e66.)

Key Words: Wellness, Health Promotion, Military Personnel, Physical Fitness, Combat, Prevention Research. Manuscript format: research; Research purpose: descriptive, modeling/relationship testing; Study design: content analysis; Outcome measure: behavioral, cognitive; Setting: workplace, family; Health focus: fitness/physical activity, smoking control, stress management, weight control; Strategy: education; Target population: adults; Target population circumstances: education/income level, race/ethnicity

PURPOSE

In civilian and military populations, being well contributes to positive health and greater life satisfaction; additionally, well individuals are stronger and better able to adapt to difficult situations, perform their jobs, and reach their fullest potential.^{1–4} While U.S. service members tend to be healthier than the general U.S. population, deployment can have substantial mental and physical burdens.^{3,5–7} Recent reports have estimated new-onset posttraumatic stress disorder (PTSD) symptoms at 7.6% to 8.7% among deployed military personnel reporting combat experiences and 1.4% to 2.1% among those not reporting combat experiences.⁸ In addition, increasing duration and numbers of deployments along with a decreasing force size can lead to stress and a negative sense of well-being.⁹

Both civilian and military medicine are shifting from an illness model to a wellness model.^{10,11} Premature deaths due to modifiable lifestyle factors, such as obesity and smoking, and the increasing costs of health care for disease treatment instead of disease prevention, have contributed to the need to focus on wellness.^{2,10} While the terms *health* and *wellness* are sometimes used interchangeably, most agree that wellness encompasses more than just being disease free.^{2,12,13} Wellness has been defined by many dimensions, such as physical, mental, spiritual, and social interactions, and by behaviors such as exercise, tobacco, and alcohol use.^{3,13,14} Wellness has also been defined by stress, which encompasses

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stress management and how well one copes with and experiences emotions in difficult situations.¹⁰ Individuals who have positive feelings, exercise, and feel they cope well with stress have a greater perception of control and are healthier people and soldiers.¹⁰ The concept of wellness is complex and cannot be defined by a single dimension.^{2,12}

The Millennium Cohort Study, a longitudinal study consisting of more than 190,000 participants, began collecting baseline data on military service personnel in July 2001, before the recent conflicts in Iraq and Afghanistan. Every 3 years, participants are requested to complete a follow-up questionnaire.^{15,16} The questionnaire captures various dimensions of wellness, including physical health, mental health, and stress. Because so much of the literature has focused on morbidity associated with war, this study provides a unique opportunity to prospectively identify predeployment and deployment-related factors that may predict postdeployment wellness. Understanding factors associated with postdeployment wellness may help mitigate adverse postdeployment health outcomes and lead to more efficient risk reduction strategies, resulting in a stronger and healthier force.

METHODS

Design and Sample

The methodology of the Millennium Cohort Study has been detailed elsewhere.¹⁵⁻¹⁷ Of the 77,047 participants who enrolled in panel 1 between 2001 and 2003, a total of 55,021 (71%) completed the first follow-up questionnaire (2004–2006) and 54,790 (71%) completed the second follow-up questionnaire (2007–2008). Of the 31,110 participants who enrolled in panel 2 between 2004 and 2006, a total of 17,152 (55%) completed the first follow-up questionnaire (2007–2008).

The population for this current study included panel 1 and 2 participants who (1) provided informed and voluntary consent, (2) completed 2004–2006 and 2007–2008 questionnaires (referred to as 2004 and 2007 wellness assessments, respectively), (3) had deployed and subsequently returned from deployment between

Physical Health	Mental Health	Stress
<p>Physical function</p> <ul style="list-style-type: none"> • Vigorous activity • Moderate activity • Lifting or carrying groceries • Climbing several flights of stairs • Bending, kneeling, or stooping • Walking more than a mile • Walking several blocks • Walking one block • Bathing or dressing yourself <p>Role physical</p> <ul style="list-style-type: none"> • Cut down amount of time spent on work or other activities • Accomplished less than you would like • Were limited in the kind of work or other activities • Had difficulty performing the work or activities (for example, it took extra effort) <p>Bodily pain</p> <ul style="list-style-type: none"> • How much bodily pain have you had • How much did pain interfere with your normal work <p>General health</p> <ul style="list-style-type: none"> • I seem to get sicker a little easier than other people • I am as healthy as anybody I know • I expect my health to get worse • My health is excellent 	<p>Role emotional</p> <ul style="list-style-type: none"> • Cut down on amount of time spent on work or other activities • Accomplished less than you would like • Didn't do work as carefully as usual <p>Vitality</p> <ul style="list-style-type: none"> • Did you feel full of pep • Did you have a lot of energy • Did you feel worn out • Did you feel tired <p>Mental health</p> <ul style="list-style-type: none"> • Have you ever been a very nervous person • Have you felt so down in the dumps that nothing could cheer you up • Have you felt calm and peaceful • Have you felt downhearted and blue • Have you been a happy person <p>Social functioning</p> <ul style="list-style-type: none"> • To what extent has your physical health or emotional problems interfered with your social activities with family, friends, neighbors, or groups • How much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friend or relative) 	<p>How much bothered by:</p> <ul style="list-style-type: none"> • Worrying about your health • Your weight or how you look • Little or no sexual desire during sex • Difficulties with husband/wife, partner/lover, or boyfriend/girlfriend • The stress of taking care of children, parents, or other family members • Stress at work outside of the home or at school • Financial problems or worries • Having no one to turn to when you have a problem • Something bad that happened recently • Thinking or dreaming about something terrible that happened to you in the past – like your house being destroyed, a severe accident, being hit or assaulted, or being forced into a sexual act

completing the two questionnaires, and (4) did not have missing data.

Measures

Outcome—Dimensions of Wellness. There is no one definition of wellness. To capture wellness domains similar to previous studies, this study defined wellness on the basis of three domains: physical health, mental health, and stress (Figure).^{10,13,18-20} Wellness was assessed post deployment by using data from the 2007 assessment. Physical and mental health domains were assessed by using the Medical Outcomes Study Short Form 36-Item Health Survey for Veterans (SF-36V).²¹⁻²⁵ Since the standard scoring system relies on the eight scales to create both the physical and

mental component summary scores, we summed the raw points (0 to 100) for each of the scales to create the physical and mental health domains (a scale from 0 to 400). The physical health domain included bodily pain, physical functioning, general health, and role physical, while the mental health domain included vitality, emotional functioning, role emotional, and social functioning (Figure). Stress was assessed by using 10 items from the full Primary Care Evaluation of Medical Disorders Patient Health Questionnaire (PHQ), which was developed and validated to efficiently diagnose several of the most common mental disorders in primary care populations.²⁶⁻²⁸ Par-

ticipants indicated how much they were bothered by a number of problems, such as their health, having no one to turn to, and financial problems or worries (Figure). The stress component was scored on a scale from 0 to 20, based on responses of “not bothered” (2 points) to “bothered a lot” (0 points).

Wellness classifications were determined by quartile scores for each wellness domain, which gave equal weight to each of the three domains. Participants scoring in the highest quartile across all domains were classified as “most well,” those in the lowest quartile across all domains were “least well,” and all others were considered “moderately well.” Using 2004 responses, we used the same scoring to adjust for predeployment wellness.

Deployment Metrics

Deployment data were obtained from electronic files from the Defense Manpower Data Center. Data on deployment before the 2004 assessment were categorized as not deployed, deployed without combat, and deployed with combat. Multiple variables were used to assess deployment experience in support of the operations in Iraq and Afghanistan between the two assessments, including combat experience, cumulative deployment time, shortest dwell time, and time out of theater until wellness assessment. Participants were classified as experiencing combat if they reported personal experience to one or more of the following: a person’s death due to war or disaster; physical abuse; dead or decomposing bodies; maimed soldiers or civilians; or prisoners of war or refugees. Cumulative deployment, dwell time, and time from last deployment until wellness were categorized as 1 to 180, 181 to 270, and >270 days. Cumulative deployment was calculated as the total number of days deployed between assessments. For personnel with more than one deployment, shortest dwell time was assessed between 2004 and 2007 assessments as the shortest number of days out of theater until next entrance into theater. Time from last deployment to wellness refers to the time home from last deployment before and until 2007 assessment. In a secondary analysis,

combat was assessed by using 12 questions that collect information about other, specific combat experiences. A score from 0 to 12 was calculated and then divided into quartiles from the number of personal combat experiences, such as being attacked or ambushed, receiving small arms fire, or handling or uncovering human remains.

Nonmodifiable Predeployment Factors

Predeployment factors were assessed by using responses from the 2004 assessment, before deployment. Based on 38 health conditions, such as migraines and cancer, the number of diseases was assessed by using self-report of ever being diagnosed by a health professional. The number of conditions was summed and then categorized (none, 1, 2, or 3+ diseases reported).

Life stressors were based on the scoring system of the Holmes and Rahe Social Readjustment Rating Scale, whereby self-reported stressful life events are assigned point values.^{29–31} From the summation of these scores, life stress was classified into three categories: low/mild, moderate, and major.

Demographic and military-specific data were obtained from electronic personnel files, including sex, birth year, education, marital status, race/ethnicity, pay grade, service component (active duty and Reserve/National Guard), service branch (Army, Air Force, Navy, Coast Guard, and Marine Corps), and military occupation. Data were supplemented with self-reported data, if available, when missing.

Modifiable Predeployment Factors

Mental disorders were assessed by using either standardized instruments or self-reported behaviors. A positive screen for depression, panic and other anxiety syndromes, and binge-eating disorders were evaluated by using the PHQ. The PHQ-9 depression scale was scored by using the complex scoring algorithm, which uses nine questions from the PHQ and corresponds to the depression diagnosis from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*.^{32,33} Using six anxiety items and 15 panic items of the PHQ, we classified participants as screening positive for

panic or other anxiety syndromes if they met the standardized criteria for either disorder.^{26–28} Binge-eating disorder was defined as endorsement of binge-eating behaviors as often as twice a week for the last 3 months with the absence of inappropriate compensatory behaviors.³⁴ The PTSD Checklist–Civilian Version, a validated self-report measure of PTSD symptoms, was used to classify participants as screening positive for PTSD if they reported a moderate or above level of at least one intrusion, three avoidance, and two hyperarousal symptoms (DSM-IV criteria).^{35–38} Participants who screened positive for depression, panic and other anxiety syndromes, binge-eating disorders, or PTSD were considered as having a mental health disorder.

Self-reported weight and height from the 2004 assessments, before deployment, were used to calculate body mass index (BMI) and categorize participants as: (1) underweight or normal body weight (BMI, <25 kg/m²), (2) overweight (BMI, 25 to <30 kg/m²), and (3) obese (BMI, ≥30 kg/m²).³⁹ From self-report of cigarette use and quitting, participants were categorized as (1) never smokers, (2) past smokers, or (3) current smokers.³¹ Heavy weekly drinking was defined as consumption of more than 14 drinks per week for men and more than seven drinks per week for women, from research indicating that drinking beyond this level may increase the risk for alcohol-related problems.^{40,41} Participants who reported drinking five or more drinks for men or four or more drinks for women on at least 1 day per occasion during the past year were considered potential binge drinkers.

Assessment of complementary and alternative medicine (CAM) use was based on self-report of using health treatments other than conventional medicine in the last 12 months. These questions were grouped as either practitioner-assisted (acupuncture, biofeedback, chiropractic care, energy healing, folk medicine, hypnosis, and massage) or self-administered (herbal therapy, high dose/megavitamin therapy, homeopathy, relaxation, and spiritual healing) therapies.⁴²

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**Table 1
Characteristics of Millennium Cohort Participants by Postdeployment Wellness Status (n = 10,228)*†**

Predeployment Characteristics†	Least Well		Moderately Well		Most Well	
	n = 1243		n = 8046		n = 939	
	No.	%‡	No.	%	No.	%
Sex						
Male	863	69.4	6311	78.4	799	85.1
Female	380	30.6	1735	21.6	140	14.9
Birth year						
Before 1960	97	7.8	701	8.7	130	13.8
1960–1969	372	29.9	2481	30.8	312	33.2
1970–1979	455	36.6	2877	35.8	323	34.4
1980 and later	319	25.7	1987	24.7	174	18.5
Race/ethnicity						
Non-Hispanic white	860	69.2	5829	72.5	679	72.3
Non-Hispanic black	151	12.2	759	9.4	92	9.8
Asian/Pacific Islander	82	6.6	772	9.6	104	11.1
Hispanic	120	9.7	529	6.6	52	5.5
Other	30	2.4	157	2.0	12	1.3
Education						
Some college or less	1013	81.5	5548	69.0	543	57.8
Bachelor's degree or higher	230	18.5	2498	31.1	396	42.2
Marital status						
Not married	554	44.6	3346	41.6	345	36.7
Married	689	55.4	4700	58.4	594	63.3
Military pay grade						
Enlisted	1056	85.0	5725	71.2	576	61.3
Officer	187	15.0	2321	28.9	363	38.7
Service component						
Reserve/National Guard	443	35.6	2954	36.7	377	40.2
Active duty	800	64.4	5092	63.3	562	59.9
Service branch						
Air Force	197	15.9	2541	31.6	393	41.9
Army	835	67.2	3953	49.1	361	38.5
Marine Corps	53	4.3	415	5.2	40	4.3
Navy/Coast Guard	158	12.7	1137	14.1	145	15.4
Occupational category						
Combat specialist	231	18.6	1829	22.7	266	28.3
Health care specialist	107	8.6	630	7.8	74	7.9
Service supply and functional support	393	31.6	2088	26.0	224	23.9
Other	512	41.2	3499	43.5	375	39.9
Deployment before 2004 assessment§						
Nondeployed	936	75.3	5758	71.6	654	69.7
Deployed, no combat	96	7.7	1136	14.1	165	17.6
Deployed, 1+ combat	211	17.0	1152	14.3	120	12.8
Disease conditions reported						
0	508	40.9	5405	67.2	771	82.1
1	275	22.1	1530	19.0	128	13.6
2	197	15.9	619	7.7	27	2.9
3+	263	21.2	492	6.1	13	1.4
Predeployment wellness						
Least well	475	38.2	535	6.7	2	0.2
Moderately well	743	59.8	6923	86.0	574	61.1
Most well	25	2.0	588	7.3	363	38.7
Life stressors score						
Low/mild	1101	88.6	7773	96.6	925	98.5
Moderate/major	142	11.4	273	3.4	14	1.5
Practitioner-assisted CAM						
No	997	80.2	7149	88.9	872	92.9
Yes	246	19.8	897	11.2	67	7.1

Table 1, Continued

Predeployment Characteristics†	Least Well n = 1243		Moderately Well n = 8046		Most Well n = 939	
	No.	%‡	No.	%	No.	%
Self-administered CAM						
No	791	63.6	6102	75.8	767	81.7
Yes	452	36.4	1944	24.2	172	18.3
Heavy weekly drinking						
No	1065	85.7	7264	90.3	881	93.8
Yes	178	14.3	782	9.7	58	6.2
Binge drinking						
No	532	42.8	3534	43.9	470	50.1
Yes	711	57.2	4512	56.1	469	50.0
Smoking status						
Nonsmoker	579	46.6	4801	59.7	643	68.5
Past smoker	323	26.0	1887	23.5	188	20.0
Current smoker	341	27.4	1358	16.9	108	11.5
Physical activity						
Inactive	452	36.4	1713	21.3	106	11.3
Active	791	63.6	6333	78.7	833	88.7
Strength training						
Inactive	672	54.1	3209	39.9	270	28.8
Active	571	45.9	4837	60.1	669	71.3
Body mass index (kg/m ²)						
Normal/underweight (<25)	384	30.9	3033	37.7	406	43.2
Overweight (25 to <30)	642	51.7	4152	51.6	474	50.5
Obese (≥30)	217	17.5	861	10.7	59	6.3
Mental disorder						
No	929	74.7	7594	94.4	927	98.7
Yes	314	25.3	452	5.6	12	1.3
Experienced combat between assessments¶						
No	358	28.8	3851	47.9	533	56.8
Yes	885	71.2	4195	52.1	406	43.2
Cumulative days deployed#						
1–180	379	30.5	3169	39.4	468	49.8
181–270	221	17.8	1619	20.1	169	18.0
>270	643	51.7	3258	40.5	302	32.2
Shortest dwell time (in days)**						
Single deployer	1047	84.2	6449	80.2	702	74.8
Multiple deployer dwell time						
1–180	86	6.9	668	8.3	113	12.0
181–270	25	2.0	194	2.4	28	3.0
>270	85	6.8	735	9.1	96	10.2
Days from deployment to wellness††						
1–180	250	20.1	2038	25.3	287	30.6
181–270	146	11.8	1027	12.8	103	11.0
>270	847	68.1	4981	61.9	549	58.5
Completed assessment while deployed‡‡						
No	1110	89.3	7081	88.0	829	88.3
Yes	133	10.7	965	12.0	110	11.7

* CAM indicates complementary and alternative medicine.

† All variables, except service component and completing assessment while deployed, were significant at the $p < 0.05$ level.

‡ Percentages may not sum to 100, owing to rounding.

§ Deployment in support of operations in Iraq and Afghanistan that occurred before 2004–2006 assessment.

|| Screened positive for depression, binge-eating disorder, posttraumatic stress disorder, or panic or other anxiety syndrome.

¶ Self-reported personally witnessing death, abuse, maimed soldiers or civilians, or prisoners of war or refugees between 2004–2006 and 2007–2008 assessments.

Total number of days deployed between 2004–2006 and 2007–2008 wellness assessments.

** Shortest dwell time refers to the shortest dwell time (measured in days) the participant experienced from multiple deployments between 2004–2006 and 2007–2008 assessments. Single deployers refers to individuals who only deployed once between 2004–2006 and 2007–2008 assessments, so their dwell time could not be assessed.

†† Time from last deployment to wellness refers to the time home from last deployment before and until 2007–2008 assessment (measured in days).

‡‡ Completed assessment while deployed refers to deployment during the 2004–2006 or 2007–2008 assessment.

Other Modifiable Factors

Physical activity and strength training were assessed post deployment because predeployment measures were not available. Participants' physical activity was determined from recommendations made by the American College of Sports Medicine and the American Heart Association.⁴³ Individuals were classified as physically active if they self-reported moderate/light exercise ≥ 150 minutes per week (30 minutes per day, 5 days a week) and/or vigorous exercise ≥ 60 minutes per week (20 minutes per day, 3 days a week). Participants who self-reported strength training or work that strengthened their muscles (based on conducting 8 to 10 strength-training exercises in 30 minutes) for ≥ 60 minutes per week were considered engaged in active strength training.

Analysis

Descriptive and univariate statistics were used to evaluate the unadjusted relationship of predeployment and deployment-related factors with post-deployment wellness. A variance inflation factor of four or greater was used to check multicollinearity. The proportional odds assumption was tested and not violated; therefore, ordinal logistic regression was used to test the adjusted association of predeployment and deployment-related factors with postdeployment wellness. Variables that were not statistically significant ($p \geq .05$) were removed from the final model, starting with demographics and ending with deployment-related factors. Additionally, three secondary ordinal logistic regression analyses were performed (1) on the final model excluding predeployment wellness, (2) on the final model excluding physical activity and strength training, and (3) on the final model where combat deployment was assessed by using the 12 combat items and was categorized into quartiles, with the lowest quartile being deployed without combat and the highest quartile being deployed with the highest amount of combat experience. In addition, tests for multiplicative interactions were performed to investigate whether sex modified the association between several factors and wellness, including BMI, CAM use, smoking status, mental health, physical

Table 2
Adjusted Odds of Postdeployment Wellness Among Millennium Cohort Participants, 2004–2008*

Characteristics	Wellness†	
	Odds Ratio‡	95% Confidence Interval
Sex		
Male	1.43	1.25, 1.64
Female	1.00	
Birth year		
Before 1960	1.44	1.17, 1.78
1960–1969	1.02	0.88, 1.19
1970–1979	0.98	0.85, 1.13
1980 and later	1.00	
Race/ethnicity		
Non-Hispanic white	1.00	
Non-Hispanic black	0.97	0.81, 1.16
Asian/Pacific Islander	1.23	1.02, 1.48
Hispanic	0.78	0.64, 0.95
Other	0.81	0.56, 1.16
Education		
Some college or less	1.00	
Bachelor's degree or higher	1.41	1.24, 1.60
Service branch		
Army	1.00	
Air Force	2.02	1.77, 2.29
Marine Corps	1.28	0.99, 1.63
Navy/Coast Guard	1.47	1.25, 1.72
Occupational category		
Combat specialist	1.22	1.06, 1.39
Health care specialist	1.23	1.00, 1.51
Service supply and functional support	1.00	0.88, 1.14
Other	1.00	
Disease conditions reported		
0	1.00	
1	0.65	0.57, 0.75
2	0.45	0.38, 0.55
3+	0.45	0.37, 0.55
Practitioner-assisted CAM		
No	1.00	
Yes	0.73	0.62, 0.85
Self-administered CAM		
No	1.00	
Yes	0.81	0.72, 0.92
Smoking status		
Nonsmoker	1.00	
Past smoker	0.88	0.78, 1.01
Current smoker	0.71	0.61, 0.81
Physical activity		
Inactive	1.00	
Active	1.73	1.51, 1.97
Strength training		
Inactive	1.00	
Active	1.61	1.44, 1.81
Body mass index (kg/m ²)		
Normal/underweight (<25)	1.72	1.44, 2.06
Overweight (25 to <30)	1.35	1.14, 1.59
Obese (≥ 30)	1.00	
Mental disorder		
No	1.00	
Yes	0.56	0.46, 0.67

Table 2, Continued

Characteristics	Wellness†	
	Odds Ratio‡	95% Confidence Interval
Experienced combat between assessments		
No	1.00	
Yes	0.56	0.50, 0.63
Days from deployment to wellness		
1–180	1.21	1.07, 1.37
181–270	1.05	0.90, 1.23
>270	1.00	

* CAM indicates complementary and alternative medicine.

† Ordinal regression used to assess wellness outcome.

‡ Odds ratios and associated 95% confidence intervals are adjusted for all other variables in the table and also adjusted for predeployment wellness, which is not shown. Nonsignificant variables removed include marital status, pay grade, service component, prior deployment, life stressors score, heavy weekly drinking, binge drinking, cumulative deployment, dwell time, and completing questionnaire while deployed.

activity, and combat between assessments. All data analyses were conducted with SAS software, version 9.2 (SAS Institute, Inc, Cary, North Carolina).

RESULTS

Of the 108,157 participants, 63,590 completed the 2004 assessment and a follow-up wellness assessment in 2007. Those who did not deploy between the two assessments ($n = 49,014$) or who had missing data ($n = 4348$) were excluded, leaving 10,228 for this study. Of these participants, 939 (9.2%) were classified as most well, 8046 (78.7%) as moderately well, and 1243 (12.2%) as least well post deployment. Internal consistency was tested by using Cronbach α , and an α of .83 was found, indicating internal consistency.

Predeployment characteristics based on wellness status are described in Table 1. Regarding military factors, participants who were most well were proportionately more likely to be Air Force members, officers, deployed with no combat before 2004 assessment, report no combat experience between assessments, have fewer numbers of cumulative days deployed, and be a multiple deployer with a shorter dwell time.

The results from the final multivariable ordinal logistic regression model are displayed in Table 2. Those who reported combat experience between assessments (odds ratio [OR] = .56;

95% confidence interval [CI] = .50, .63) were significantly more likely to be less well post deployment than those deployed without combat. Air Force (OR = 2.02; 95% CI = 1.77, 2.29) and Navy/Coast Guard personnel (OR = 1.47; 95% CI = 1.25, 1.72) had significantly increased odds of being more well than Army personnel. Likewise, being a combat specialist (OR = 1.22; 95% CI = 1.06, 1.39) and taking the wellness assessment within 180 days of returning from deployment (OR = 1.21; 95% CI = 1.07, 1.37) had significantly increased odds of being more well than being in the other occupational category, and taking the wellness assessment 270 days or more of returning from deployment, respectively. Cumulative deployment, dwell time, and completing assessment while deployed were not significantly associated with wellness, and further assessment of these as continuous variables did not change results.

Nonmodifiable factors predicting postdeployment wellness in the final model were male sex, race/ethnicity (Asian/Pacific Islander), education (bachelor's degree or higher), fewer diseases reported, and birth year (before 1960). Significant modifiable factors of wellness were BMI ($<30 \text{ kg/m}^2$), not using CAM, being a non-smoker, physically active, strength training, and not screening positive for a mental disorder.

**Table 3
Secondary Analysis Adjusted Odds of
Deployment Combat Quartiles With
Postdeployment Wellness Among
Millennium Cohort Participants,
2004–2008**

Deployment Characteristic	Wellness*	
	Odds Ratio†	95% Confidence Interval
Combat quartiles‡		
No combat	1.00	
Combat, quartile 1	0.76	0.65, 0.88
Combat, quartile 2	0.63	0.54, 0.23
Combat, quartile 3	0.44	0.38, 0.52

* Ordinal regression used to assess wellness outcome.

† Odds ratios and associated 95% confidence intervals are adjusted for sex, birth year, race/ethnicity, education, service branch, occupation, number of disease conditions, practitioner-assisted complementary and alternative medicine (CAM), self-administered CAM, smoking status, physical activity, strength training, body mass index, mental disorder, time from last deployment to wellness assessment, and predeployment wellness, which are not shown.

‡ Combat assessed by using self-reported 12 questions and categorized into quartiles, whereby lowest quartile corresponds to the least amount of combat experience and the highest quartile corresponds to the highest amount of combat experience.

When predeployment wellness was removed from the model, results remained consistent (results not shown). There was no evidence of sex-specific effect modification in the model when interactions were tested between sex with BMI, combat, CAM, smoking status, mental health, and physical activity. In another analysis, physical activity and strength training were omitted from the final model because these covariates may be closely related to the wellness definition and were measured post deployment, but results remained consistent (results not shown). Additionally, the main results remained stable when the 12-item combat experience scale was used in place of the simpler instrument, and a potential trend was seen, whereby the odds of being well significantly decreased as the amount of combat experience increased (Table 3).

DISCUSSION

In this study, we defined wellness as a multidimensional concept spanning the continuum of physical and mental health as well as stress. Using this definition in a traditionally healthy population allowed for the isolation of predeployment and deployment-related factors independently associated with postdeployment wellness. Among deployers, experiencing combat, service branch, occupation, and time from deployment to wellness assessment were associated with postdeployment wellness. Other findings were consistent with known modifiable factors that benefit health, such as regular physical activity, strength training, maintaining a lower BMI, and abstaining from cigarette smoking.⁴⁴⁻⁴⁹ As expected, predeployment factors, such as screening positive for mental disorders, were associated with being less well.

Combat experience was a significant predictor of being less well post deployment. Additionally, an association between increasing amount of combat experience and a decrease in wellness was observed when using the 12-item combat questions. Combat experiences have been associated with many adverse health outcomes, including maladaptive behaviors and psychiatric disorders; however, to our knowledge, this is the first time that a direct inverse association between combat experiences and wellness has been described.^{6,8,31,50-53}

Perhaps surprisingly, combat specialists, independent of actually reporting combat experience, had increased odds of wellness. Consistent with this finding, previous research has found combat specialists to be at decreased risk for mental health outcomes, though other work has shown no significant association.^{8,53} It has been hypothesized that perhaps combat specialists are more mentally prepared and physically fit, which is a predictor of wellness, and receive more specialized training that better prepares them for deployment and the stressors of war.⁵⁴

In this study, Air Force and Navy/Coast Guard members had an increased odds of wellness, compared with Army service members, which is

consistent with previous findings examining postdeployment PTSD.^{55,56} It is unclear what is driving this association of Army personnel being less well than members of other branches. Army soldiers tend to be the sustaining force of long-term land operations, however, and may have more direct contact with the effects of war and combat in these recent operations, compared with their air- and sea-focused counterparts. Further investigation is needed to understand how the operational tempo or recruitment strategies, which may affect predeployment physical and mental health, differ among service branches and their role on wellness.

Additionally, taking the wellness assessment within 180 days following deployment was predictive of increased wellness, perhaps suggesting a delayed-onset of negative health outcomes.⁵⁶ Cumulative deployment, shortest dwell time, completing assessment while deployed, and prior deployment were not associated with wellness. Finally, while studies^{8,19,34,56} have found inconsistent associations of service component (Reserve/National Guard vs. active duty) with mental and physical health outcomes, service component was not significantly associated with postdeployment wellness in this study.

Many nonmodifiable factors were associated with postdeployment wellness. Men, college-educated individuals, older individuals, and Asian/Pacific Islanders were significantly more likely to be well post deployment, while being Hispanic predicted being less well, after adjustment for other behavioral and deployment-related factors. While some previous studies have found no increased risk for postdeployment mental health outcomes among women, most findings suggest that women have higher rates of adverse mental health outcomes.^{8,53,57,58} Women may be more impacted by the negative effects of combat, possibly because of greater internalizing of symptoms, likelihood of reporting symptoms, and interference faced from the conflicting role of being a parent while deployed.⁵⁹⁻⁶³ Consistent with most previous studies, deployers possessing greater education (bachelor's degree or higher) were more well post deployment, possibly because service members with higher

education may be afforded the opportunity to serve in leadership roles that entail increased autonomy to make decisions on perceived risks.^{64,65} While prior findings indicate that older age trends toward being protective of postdeployment mental health outcomes, after full adjustment, age is usually no longer significant.^{55,56,64} In many previous military reports among deployers, Asian/Pacific Islanders and Hispanics have been classified with other nonwhite and nonblack races and ethnicities, so it has not been established whether they are less likely to develop adverse health outcomes post deployment.^{55,56}

A number of modifiable factors were associated with postdeployment wellness. Being physically active, participating in strength training, not smoking, and not being obese were predictive of being well. Much research has found that making these lifestyle choices promotes positive health, which is consistent with being well.^{44,45,47,49} It may be important to encourage deployers to maintain or develop these positive lifestyle choices to help ensure wellness and increase job performance. Inconsistent with some reports in the literature,⁶⁶ CAM use increased the odds of being less well in this study. Previous studies have demonstrated that CAM use is associated with those who report higher stress and use of conventional medicine that has not alleviated their condition. Therefore, it may be that CAM users may be less well before deployment rather than CAM use actually decreasing wellness.⁶⁷ Additionally, mental disorders were predictive of not being well. Possibly, further promoting the use of predeployment mental health support services can help increase wellness post deployment.^{68,69}

Strengths and Limitations

The greatest limitation to this study is that our wellness definition was not based on a standardized wellness instrument; however, the individual domains of our wellness definition were based on standardized instruments covering the major aspects of wellness, such as mental and physical health.^{13,18} This study excluded participants who did not respond to the invitation to

complete the questionnaires. Missing data due to loss to follow-up may have biased the results, since participants needed to complete both 2004 and 2007 assessments for inclusion in analyses. Recent work examining non-response bias in the Millennium Cohort Study, however, has shown limited bias due to nonresponse at first follow-up,⁷⁰ reducing the concern over the effect on the current research.

Despite these limitations, there are many important strengths of this study. To our knowledge, this is the first investigation of associations between predeployment and deployment-related factors on postdeployment wellness. Since there is no one definition of wellness, using questionnaire data including standardized instruments has allowed for a more complete picture of military wellness. Data from this large cohort study allow prospective assessment of postdeployment wellness in a robust study population, with the ability to analyze predeployment and deployment-related factors that were not part of the wellness definition. Investigations of potential biases in the Millennium Cohort Study have found a well-representative military cohort who report reliable data and who are not influenced to participate by poor health before enrollment.^{5,15,71-75} Furthermore, study of the U.S. Reserves and National Guard is usually difficult and their inclusion in this analysis extends applicability to additional service components. Finally, the large sample size of women, frequently absent from deployment-related health studies, permits the prospective analysis of the association of sex with wellness.

Conclusions

Experiencing combat was associated with being less well; however, combat specialists were more likely to be well, suggesting that predeployment training and fitness in this group may serve as resiliency factors for maintaining wellness.⁷⁶ Multiple modifiable factors, such as physical activity, strength training, abstinence from cigarette smoking, and maintaining a healthy BMI were associated with wellness following military deployment; while screening positive for mental disorders and reporting CAM use were associated with

reduced wellness. Future studies are needed to evaluate if modification of these factors may improve wellness post deployment and identify ways to encourage service members to participate in existing wellness programs and seek prompt care for physical and mental symptoms. This will potentially provide solutions for military leaders to enhance force readiness and wellness post deployment.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Wellness has been previously defined by physical, mental, spiritual, and social interactions and by behaviors such as exercise, tobacco, and alcohol use. It is also known that well individuals are healthier, happier, and more productive. Deployment has been attributed to negative health.

What does this article add?

Little research has focused on modifiable and military factors associated with wellness. This study adds to the current literature by investigating which predeployment and deployment-related factors are associated with postdeployment wellness among a large military cohort.

What are the implications for health promotion practice or research?

Understanding predeployment and deployment-related factors associated with postdeployment wellness may help mitigate adverse postdeployment health outcomes and lead to more efficient risk reduction strategies, resulting in a stronger and healthier force. Additionally, understanding modifiable factors associated with wellness can help inform medical and military leadership to ensure wellness.

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14. ABSTRACT Objectives: We assessed the effects of predeployment and deployment factors (e.g., combat experience) on dimensions of wellness following deployment. Methods: We included 10 228 Millennium Cohort Study participants who deployed in support of the operations in Iraq and Afghanistan. Dimensions of wellness were measured using standardized instruments assessing physical health, mental health, and stress. Predictors of postdeployment wellness were assessed using ordinal logistic regression analysis. Results: Of the 10 228 study participants, 9.2% were categorized as “most well” postdeployment. In multivariable analysis, military factors significantly associated with being well included not experiencing combat, service branch (Air Force or Navy/Coast Guard vs Army), and occupation (combat specialist). Significant modifiable predeployment predictors of postdeployment wellness were detected, such as physical activity and body mass index. Conclusions: Experiencing combat was associated with being less well; however, those trained in combat appeared to be protected. Multiple modifiable factors associated with postdeployment wellness were identified, which can help inform medical and military leadership on potential strategies to ensure a well force.
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