Prospective investigation of complementary and alternative medicine use and subsequent hospitalizations

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Abstract

Background: The prevalence of complementary and alternative medicine (CAM) use has been estimated to be as high as 65% in some populations. However, there has been little objective research into the possible risks or benefits of unmanaged CAM therapies.

Methods: In this prospective study of active duty US Navy and Marine Corps personnel, the association between self-reported practitioner-assisted or self-administered CAM use and future hospitalization was investigated. Cox regression models were used to examine risk of hospitalization due to any cause over the follow-up period from date of questionnaire submission, until hospitalization, separation from the military, or end of observation period (June 30, 2004), whichever occurred first.

Results: After adjusting for baseline health, baseline trust and satisfaction with conventional medicine, and demographic characteristics, those who reported self-administering two or more CAM therapies were significantly less likely to be hospitalized for any cause when compared with those who did not self-administer CAM (HR = 0.38; 95% CI = 0.17, 0.86). Use of multiple practitioner-assisted CAM was not associated with a significant decrease or increase of risk for future hospitalization (HR = 1.86; 95 percent confidence interval = 0.96-3.63).

Conclusion: While there were limitations to these analyses, this investigation utilized an objective measure of health to investigate the potential health effects of CAM therapies and found a modest reduction in the overall risk of hospitalization associated with self-administration of two or more CAM therapies. In contrast, use of practitioner-assisted CAM was not associated with a protective effect.
doxy or diversifying the conceptual frameworks of medicine [3]. With annual out-of-pocket expenditures related to CAM use in the United States estimated at more than $27 billion in 1997 [5], the prevalence of CAM use highlights its significance in the current healthcare environment.

Investigations of CAM use in US adult populations have suggested that women, those of white race/ethnicity, and those with higher education levels are more likely to use CAM therapies [5,7,13]. Investigations of US military personnel have also suggested that those who use CAM are more likely to be officers, in technical support occupations, report more sick days, and report more bodily pain [7].

CAM is often used as an alternative or complement to conventional medicine practices for prevention and/or treatment of disease. Among the most commonly reported CAM therapies are herbal medicine, massage, high-dose megavitamins, and relaxation therapies [5,7,13-17]. Uses range from daily vitamin or herbal supplementation to ward off common colds, to therapies for symptom reduction of chronic illnesses such as fibromyalgia [18] or rheumatic diseases [19], for slowing or treating cancers [20-23], and for relief of symptoms from other serious diseases such as AIDS [24,25] or diabetes [26].

There has been little research, however, into the possible risks of unmanaged therapies [27-29] as well as the benefits CAM may offer in protection against disease or illness [30]. The objective of this study was to prospectively investigate the association of CAM use with subsequent hospitalization in a healthy, active-duty US military population with equal access to conventional medical care.

Methods

Study population

In December 2000, a random sample of 5,000 US active duty and Reserve Navy and Marine Corps personnel was drawn from military rosters of approximately 550,000. Prospective participants were sent a questionnaire to assess baseline health and use of CAM therapies. included in this analysis.

This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research (Protocol NHRC.2001.0001).

Questionnaire data

The 10-page survey instrument was developed by the study team to ascertain the use of CAM therapies, feelings of general health, and some demographic characteristics, while taking no more than 30 minutes to complete. Each invited participant was mailed up to 3 surveys with prepaid return envelopes, based on a modified version of the Dilman method [31]. Self-reported data included race/ethnicity (white, Hispanic, black, Asian or Pacific Islander, other), and salary (<$19,999; $20,000–34,999; $35,000–49,999; $50,000–74,999; ≥$75,000). Also included in the questionnaire were questions to assess general health, bodily pain, medical care, and 24 questions regarding health conditions in the previous 12 months (lung problems, pneumonia, respiratory infections; high blood pressure; heart problems; diabetes; tumors or cancers; digestive problems; urinary tract problems; gynecologic or menstrual problems; neurological problems; sprains or muscle strains; skin or dermatological problems; allergies; dizziness; anxiety; depression; insomnia or trouble falling asleep; addictive problems with alcohol or drugs; obesity; chronic dental problems; arthritis or rheumatism; back problems; severe headaches; any other kind of chronic pain; and chronic fatigue syndrome). Health conditions reported in the previous 12 months were categorized into 0–1, 2–3, 4–5, or 6 or more.

CAM data

Included in the questionnaire data were 13 practitioner-assisted CAM therapies in the previous 12 months (acupuncture, chiropractic services, homeopathy, spiritual/religious healing, energy healing, folk remedies, massage therapies, self-help group, biofeedback, hypnosis, exercise/movement therapy, psychotherapy, and art/music therapy; categorized into 0, 1, or 2 or more), 8 self-administered CAM uses in the previous 12 months (high-dose mega-vitamin, herbal therapy, homeopathy, prayer/spiritual practice, energy healing, folk remedies, relaxation techniques, and aromatherapy; categorized into 0, 1, or 2 or more).

Demographic data

Demographic data were provided by the Defense Manpower Data Center, Monterey Bay, California. These data included sex, age (categorized by approximate quartile age
groups: 18 to 24 years, 25 to 31 years, 32 to 38 years, and 39 to 57 years), rank (categorized into enlisted and officer), marital status (married or not), service branch (Navy and Marine Corps), DoD primary occupational specialties (10 major categories, defined by the DoD Occupational Conversion Manual) [32], highest level of education (some high school or diploma, some college, and college degree), and date of separation from military service.

Hospitalization data
Hospitalization data for each service member included, if applicable, date of admission and up to 8 discharge diagnoses coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) [33]. Data were captured from all DoD military treatment facilities as well as any private hospitals billing DoD for care during the period of December 1, 2000, through June 30, 2004. Hospitalizations were scanned in chronological order, and diagnostic fields were scanned in numeric order for the diagnostic codes of interest. Probability of hospitalization for "any cause" was examined using time until first hospitalization during the time period of survey submission until June 30, 2004. Hospitalization data indicating a diagnosis in the broad diagnostic category of complications of pregnancy, childbirth, and puerperium were not included.

Statistical analyses
Univariate analyses were performed to assess the significance of associations between hospitalization, demographic, and baseline self-reported variables. An exploratory analysis was developed to further assess variables of interest for significant associations and possible confounding, while simultaneously adjusting for all other variables in the model. Using regression diagnostics, collinearity among variables was assessed.

Cox’s proportional hazards time-to-event modeling was used to independently compare (1) the hospitalization experience of practitioner-assisted CAM users with non practitioner-assisted CAM users and (2) the hospitalization experience of self-administered CAM users with the hospitalization experience of non self-administered CAM users, while accounting for attrition from active-duty service over the follow-up period [34]. Follow-up time was calculated from date of enrollment until hospitalization, separation from active-duty service, or June 30, 2004, whichever occurred first. The saturated Cox regression model was reduced by a manual, backward, stepwise elimination approach to investigate confounding, removing those variables that were not independently associated at an alpha cutoff level of 0.05 and not determined to be confounders. Adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated for the hazard of hospitalization. Additionally, the cumulative probability of hospitalization as a function of time was graphed after stratification by different levels of CAM use. All data management and analyses were completed using SAS, version 9.1.2 (SAS Institute, Inc., Cary, North Carolina).

Results
Data for this analysis were complete and available for 1,319 of the 1,372 active-duty personnel who had elected to participate and submitted their questionnaire (96.1%). There were 434 (32.9%) who reported practitioner-assisted CAM therapies and 427 (32.4%) who reported self-administered CAM therapies in the 12 months prior to taking the survey (Table 1). Although the prevalence of those reporting practitioner-assisted and self-administered CAM use was similar, those using practitioner-assisted CAM included only half of those self-administering CAM (Table 1). As shown in Table 1, 55% of the study population reported fewer than 4 conditions in the previous year, 67% reported very good or excellent health, 56% reported none or very mild bodily pain in the past 4 weeks, 45% reported being very satisfied with their conventional medicine doctor, and 50% reported trusting their conventional medicine doctor completely or a lot. Demographic and military characteristics indicated that 78% of the study population were male, 50% were aged 18–31 years, 60% were married, 66% were white, 50% had some college education, 52% earned $35,000 or more each year, 82% were enlisted personnel, 77% were Navy, and 22% were combat specialists.

Those reporting practitioner-assisted CAM therapy in the previous 12 months were proportionally more likely to be female, enlisted, single or divorced, white, with some college education, report 4 or more health problems, good general health, and moderate to severe bodily pain. With some variations, those reporting self-administering at least 1 CAM therapy in the previous 12 months were proportionally more likely to be female, officers, single or divorced, combat specialists, white, with a college degree, report 6 or more health conditions, and report moderate to severe bodily pain (Table 1).

Regression diagnostics for investigation of the pairwise correlations and the variance inflation factor suggested no discernable collinearity among the variables, although salary and rank were noted as moderately correlated. The proportional hazards assumption was assured by visual inspection of cumulative distribution function plots and tested by the addition to the model of interaction terms between the main variables and time. There were no statistically significant time-by-variable interactions observed using a p-value cutoff of 0.10.
Table 1: Population characteristics by practitioner-assisted or self-administered CAM therapies

| Characteristic                                | Population N = 1,319 | Practitioner-assisted CAM n = 434 (32.9%) | Self-administered CAM n = 427 (32.4%) |
|-----------------------------------------------|-----------------------|--------------------------------------------|---------------------------------------|
|                                               | Number %              | Number %                                   | Number %                              |
| **Practitioner-assisted CAM**                 |                       |                                            |                                       |
| 0 therapies                                   | 885 (67.1)            | --                                         | 192 (45.0)                            |
| 1 therapy                                     | 254 (19.2)            | --                                         | 102 (23.9)                            |
| ≥ 2 therapies                                 | 180 (13.7)            | --                                         | 133 (31.2)                            |
| **Self-administered CAM**                    |                       |                                            |                                       |
| 0 therapies                                   | 892 (67.6)            | 199 (45.8)                                 | --                                    |
| 1 therapy                                     | 237 (18.0)            | 114 (26.3)                                 | --                                    |
| ≥ 2 therapies                                 | 190 (14.4)            | 121 (27.9)                                 | --                                    |
| **Health conditions in past 12 months**      |                       |                                            |                                       |
| 0–1 conditions                                | 216 (16.4)            | 29 (6.7)                                   | 45 (10.5)                             |
| 2–3 conditions                                | 507 (38.4)            | 145 (33.4)                                 | 145 (34.0)                            |
| 4–5 conditions                                | 327 (24.8)            | 127 (29.3)                                 | 112 (26.2)                            |
| ≥ 6 conditions                                | 269 (20.4)            | 133 (30.6)                                 | 125 (29.3)                            |
| **Bodily pain in past 4 weeks**              |                       |                                            |                                       |
| None/very mild                                | 742 (56.2)            | 174 (40.1)                                 | 228 (53.4)                            |
| Mild                                          | 308 (23.4)            | 122 (28.1)                                 | 89 (20.8)                             |
| Moderate/severe                               | 269 (20.4)            | 138 (31.8)                                 | 110 (25.8)                            |
| **Satisfaction with conventional medical doctor** |                     |                                            |                                       |
| Not at all or not very much                   | 196 (14.9)            | 77 (17.7)                                  | 73 (17.1)                             |
| Somewhat                                      | 528 (40.0)            | 187 (43.1)                                 | 185 (43.3)                            |
| Very                                          | 595 (45.1)            | 170 (39.2)                                 | 169 (39.6)                            |
| **Level of trust in conventional medical doctor** |                 |                                            |                                       |
| Little or not at all                          | 238 (18.0)            | 77 (17.7)                                  | 88 (20.6)                             |
| Some                                          | 423 (32.0)            | 140 (32.3)                                 | 130 (30.4)                            |
| Completely or a lot                           | 658 (49.9)            | 217 (50.0)                                 | 209 (49.0)                            |
| **General health**                            |                       |                                            |                                       |
| Poor or fair                                  | 65 (4.9)              | 26 (6.0)                                   | 27 (6.3)                              |
| Good                                          | 367 (27.8)            | 146 (33.6)                                 | 108 (25.3)                            |
| Very good or excellent                       | 887 (67.3)            | 262 (60.4)                                 | 292 (68.4)                            |
| **Sex**                                       |                       |                                            |                                       |
| Male                                          | 1,029 (78.0)          | 323 (74.4)                                 | 301 (70.5)                            |
| Female                                        | 290 (22.0)            | 111 (25.6)                                 | 126 (29.5)                            |
| **Age (years)**                               |                       |                                            |                                       |
| 18–24                                         | 305 (23.1)            | 102 (23.5)                                 | 108 (25.3)                            |
| 25–31                                         | 348 (26.4)            | 114 (26.3)                                 | 102 (23.9)                            |
| 32–38                                         | 342 (25.9)            | 113 (26.0)                                 | 111 (26.0)                            |
| 39–57                                         | 324 (24.6)            | 105 (24.2)                                 | 106 (24.8)                            |
| **Marital status**                            |                       |                                            |                                       |
| Single or divorced                            | 528 (40.0)            | 199 (45.9)                                 | 183 (42.9)                            |
| Married                                       | 791 (60.0)            | 235 (54.1)                                 | 244 (57.1)                            |
| **Race/ethnicity**                            |                       |                                            |                                       |
| White                                         | 866 (65.7)            | 303 (69.8)                                 | 293 (68.6)                            |
| Hispanic                                      | 123 (9.3)             | 28 (6.5)                                   | 37 (8.7)                              |
| Black                                         | 190 (14.4)            | 59 (13.6)                                  | 54 (12.7)                             |
| Asian and Pacific Islander                    | 92 (7.0)              | 31 (7.1)                                   | 27 (6.3)                              |
| Other                                         | 48 (3.6)              | 13 (3.0)                                   | 16 (3.7)                              |
| **Education level**                           |                       |                                            |                                       |
| Some high school or diploma                   | 367 (27.8)            | 115 (26.5)                                 | 102 (23.9)                            |
| Some college                                  | 654 (49.6)            | 226 (52.1)                                 | 221 (51.8)                            |
| College degree                                | 298 (22.6)            | 93 (21.4)                                  | 104 (24.3)                            |
| **Salary**                                    |                       |                                            |                                       |
| ≤ $19,999                                     | 260 (19.7)            | 83 (19.1)                                  | 94 (22.0)                             |
| $20,000-$34,999                               | 377 (28.6)            | 123 (28.3)                                 | 111 (26.0)                            |
| $35,000-$49,999                               | 285 (21.6)            | 100 (23.1)                                 | 92 (21.6)                             |
| $50,000-$74,999                               | 239 (18.1)            | 79 (18.2)                                  | 73 (17.1)                             |
| ≥ $75,000                                     | 158 (12.0)            | 49 (11.3)                                  | 57 (13.3)                             |
After adjustment for potential confounders, reporting 1 or reporting 2 or more practitioner-assisted CAM therapy was not associated with any-cause hospitalization (Table 2). After adjustment for potential confounders in the Cox proportional hazards regression, those self-administering 1 CAM therapy appeared potentially protected (HR = 0.62; 95% CI, 0.33–1.17) and those self-administering 2 or more CAM therapies were significantly protected (HR = 0.38; 95% CI, 0.17–0.86) from any-cause hospitalization, in comparison with those who did not report self-administering CAM therapies (Table 2).

Table 2 also shows other independent risk factors for hospitalization. Those reporting very good or excellent health were at 0.39 times the risk of hospitalization when compared with those reporting poor or fair health (95% CI, 0.17–0.90). Healthcare workers were at 2.63 times the risk of hospitalization in comparison with combat specialists (95% CI, 1.21–5.72).

Figure 1 shows the cumulative probability of hospitalization based on practitioner-assisted and self-administered CAM use, while simultaneously adjusting for all other variables in the model. The statistically significant difference associated with 2 or more self-administered CAM therapies (lowest probability of hospitalization) is apparent when compared with the curve of the highest probability of hospitalization among those not self-administering any CAM therapy. Although the step functions showed some sign of instability over the follow-up period, there was no statistically significant sign (p value < 0.10) of temporal bias within the two groups of CAM users.

Investigation of the 13 specific practitioner-assisted and the 8 self-administered CAM therapies identified only two statistically significant predictors of hospitalization (Table 3). After adjustment for potential confounders in the Cox proportional hazards regression, those who were assisted by a practitioner with acupuncture (HR, 3.92; 95% CI, 1.53–10.06) or chiropractic services (HR = 1.96; 95% CI, 1.01–3.80) were at increased risk for future hospitalization in comparison with those not self-reporting such CAM use. Investigation of self-administered CAM uses found no statistically significant associations, but did find many of the therapies to tend toward a protective effect.

Discussion
The increasing trend of complementary and alternative medicine (CAM) use is likely to continue as physicians and patients search for new therapies to improve quality of life or identify alternative and less-toxic forms of therapy while remaining congruent with personal values and beliefs [5,16,35,36]. As the prevalence of CAM use grows however, so does concern over possible side effects from misuse, abuse, and interactions of unmanaged therapies [27-30]. Since there is little known about the risks and benefits of CAM use, and more than 1 in 3 US Navy and Marine Corps personnel use some form of CAM [7], this investigation sought to prospectively document the association of CAM use and subsequent hospitalization in a healthy active-duty population. These data suggest that practitioner-assisted CAM use was marginally associated with an increased risk of future hospitalization, while use of self-administered CAM therapies was significantly associated with a decrease in risk of future hospitalization.

Although not statistically significant, elevated hospitalization risk associated with practitioner-assisted CAM merits consideration. Although these analyses controlled for differences in self-reported general health, bodily pain, and health conditions, this elevated risk may be reflective of seeking healthcare from a professional for a longstanding condition for which conventional medicine has not pro-
Table 2: Adjusted hazard ratios for any-cause hospitalization in personnel reporting practitioner-assisted or self-administered CAM therapies

| Characteristic                                      | Population | Hospitalized | HR*   | 95% CI |
|-----------------------------------------------------|------------|--------------|-------|--------|
|                                                     | Number     | %            | Number| %      |       |
| **Practitioner-assisted CAM**                        |            |              |       |        |
| 0 therapies†                                        | 885        | 67.1         | 57    | 66.3   | 1.00  | --    |
| 1 therapy                                           | 254        | 19.3         | 14    | 16.3   | 0.99  | 0.53, 1.84 |
| ≥ 2 therapies                                       | 180        | 13.6         | 15    | 17.4   | 1.86  | 0.96, 3.63 |
| **Self-administered CAM**                           |            |              |       |        |
| 0 therapies†                                        | 892        | 67.6         | 65    | 75.6   | 1.00  | --    |
| 1 therapy                                           | 237        | 18.0         | 13    | 15.1   | 0.62  | 0.33, 1.17 |
| ≥ 2 therapies                                       | 190        | 14.4         | 8     | 9.3    | 0.38  | 0.17, 0.86 |
| **Health conditions in past 12 months**             |            |              |       |        |
| 0–1 conditions†                                      | 216        | 16.4         | 11    | 12.8   | 1.00  | --    |
| 2–3 conditions                                      | 507        | 38.4         | 26    | 30.2   | 1.10  | 0.53, 2.28 |
| 4–5 conditions                                      | 327        | 24.8         | 22    | 26.7   | 1.46  | 0.68, 3.18 |
| ≥ 6 conditions                                      | 269        | 20.4         | 27    | 31.4   | 2.22  | 0.99, 4.98 |
| **Bodily pain in past 4 weeks**                     |            |              |       |        |
| None/very mild†                                      | 742        | 56.2         | 45    | 52.3   | 1.00  | --    |
| Mild                                                | 308        | 23.4         | 22    | 25.6   | 1.02  | 0.58, 1.79 |
| Moderate/severe                                     | 269        | 20.4         | 19    | 22.1   | 0.94  | 0.50, 1.77 |
| **Level of satisfaction with conventional medical doctor** |            |              |       |        |
| Not at all or not very†                             | 196        | 14.9         | 10    | 11.6   | 1.00  | --    |
| Somewhat                                            | 528        | 40.0         | 32    | 37.2   | 1.78  | 0.79, 4.02 |
| Very                                                | 595        | 45.1         | 44    | 51.2   | 2.30  | 0.91, 5.82 |
| **Level of trust in conventional medical doctor**    |            |              |       |        |
| Little or not at all†                                | 238        | 18.0         | 15    | 17.4   | 1.00  | --    |
| Some                                                | 423        | 32.0         | 27    | 31.4   | 0.80  | 0.39, 1.66 |
| Completely or a lot                                 | 658        | 49.9         | 44    | 51.2   | 0.69  | 0.31, 1.53 |
| **General health**                                  |            |              |       |        |
| Poor or fair†                                       | 65         | 4.9          | 8     | 9.3    | 1.00  | --    |
| Good                                                | 367        | 27.8         | 27    | 31.4   | 0.45  | 0.20, 1.03 |
| Very good or excellent                              | 887        | 67.3         | 51    | 59.3   | 0.39  | 0.17, 0.90 |
| **Sex**                                             |            |              |       |        |
| Male†                                               | 1,029      | 78.0         | 63    | 73.3   | 1.00  | --    |
| Female                                              | 290        | 22.0         | 23    | 26.7   | 1.25  | 0.72, 2.18 |
| **Age (years)**                                     |            |              |       |        |
| 18–24†                                              | 305        | 23.1         | 18    | 20.9   | 1.00  | --    |
| 25–31                                               | 348        | 26.4         | 17    | 19.8   | 0.64  | 0.30, 1.36 |
| 32–38                                               | 342        | 25.9         | 24    | 27.9   | 1.15  | 0.53, 2.48 |
| 39–57                                               | 324        | 24.6         | 27    | 31.4   | 1.17  | 0.51, 2.70 |
| **Marital status**                                  |            |              |       |        |
| Single or divorced†                                 | 528        | 40.0         | 27    | 31.4   | 1.00  | --    |
| Married                                             | 791        | 60.0         | 59    | 68.6   | 1.68  | 0.99, 2.86 |
| **Race/ethnicity**                                  |            |              |       |        |
| White†                                              | 866        | 65.7         | 54    | 62.8   | 1.00  | --    |
| Hispanic                                            | 123        | 9.3          | 11    | 12.8   | 1.61  | 0.81, 3.20 |
| Black                                               | 190        | 14.4         | 11    | 12.8   | 0.90  | 0.46, 1.79 |
| Asian and Pacific Islander                          | 92         | 7.0          | 6     | 7.0    | 0.77  | 0.32, 1.87 |
| Other                                               | 48         | 3.6          | 4     | 4.7    | 1.20  | 0.42, 3.48 |
| **Education level**                                 |            |              |       |        |
| Some high school or diploma†                         | 367        | 27.8         | 25    | 29.1   | 1.00  | --    |
| Some college                                        | 654        | 49.6         | 37    | 43.0   | 0.85  | 0.49, 1.46 |
| College degree                                      | 298        | 22.6         | 24    | 27.9   | 1.44  | 0.63, 3.32 |
| **Salary**                                          |            |              |       |        |
| ≤ $19,999†                                          | 260        | 19.7         | 11    | 12.8   | 1.00  | --    |
| $20,000-$34,999                                     | 377        | 28.6         | 35    | 40.7   | 1.92  | 0.87, 4.22 |
| $35,000-$49,999                                     | 285        | 21.6         | 15    | 17.4   | 1.01  | 0.38, 2.64 |
| $50,000-$74,999                                     | 239        | 18.1         | 12    | 14.0   | 0.68  | 0.24, 1.95 |
| ≥ $75,000                                           | 158        | 12.0         | 13    | 15.1   | 1.01  | 0.30, 3.47 |
| **Rank**                                            |            |              |       |        |
vided a solution. This explanation is supported by the investigation of specific CAM treatments (Table 3). Only those who received practitioner-assisted acupuncture and chiropractic therapy were at increased risk of hospitalization, suggesting that these CAM users may have had conditions characterized by chronic pain, necessitating increased uses of both CAM and conventional medicine. However, investigation of diagnostic codes did not reveal specific trends of illness. More study into the temporal sequence of CAM and conventional medicine use among those with chronic pain conditions is likely worthwhile.

The finding that those self-administering a single CAM therapy were somewhat protected from future hospitalization, and those self-administering 2 or more CAM therapies were statistically significantly protected, is interesting. This may reflect an elevated individual role and interest in personal health, leading to more involvement in one’s own self-care. This explanation is supported by investigation of the specific CAM uses. Table 3 shows that no single self-administered CAM use was statistically significant, but high-dose mega-vitamins, prayer or spiritual practice, and aromatherapy all had more than a suggested twofold protective effect against hospitalization. Another possible explanation of the observed health of CAM users may be the placebo effect [37-39]. The application of hospitalization, as a relatively objective measure of severe health problems, makes this explanation much less likely. Whether the apparent decrease in risk for adverse health outcomes is due to a healthy mindset and hypervigilance towards one’s own health or a direct effect of a certain therapy should be considered for future study using a more controlled analytic design.

This study had important limitations that should be noted. First, we selected a broad definition of CAM based on our available survey data. CAM may be defined differently in other research, especially since CAM is, by its nature, somewhat dynamic and evolving. The CAM treatments "psychotherapy" and "self-help groups" are among the more contested inclusions in any definition of CAM. Please note, however, that fewer than 2% of our sample reported use of these treatments. Exclusion of psychotherapy and self-help groups from the CAM definition did not change results of this analysis. Still, these analyses should be interpreted with the various CAM definitions in mind. Approximately 40% of the Navy and Marine Corps population contacted elected to participate, diminishing the ability to generalize these findings to all Navy and Marine Corps personnel or the US military in general. These data were self-reported, and recall bias may be problematic when trying to identify and quantify CAM use. Further, uncertainty caused by labels given to CAM therapies that may not explicitly describe the varying forms of the therapy within the label may cause over or under-reporting of a therapy. Additionally, these data may lack the power to identify significant results with modest levels of association. Conversely, because these analyses were not mathematically adjusted for multiple comparisons, some findings may simply be due to chance. Furthermore, it was not possible to determine if differences in CAM use occurred from the time between survey completion and end of follow-up for hospitalization surveillance. The average time from survey submission to hospitalization was over one year and only CAM use at the time of the survey completion was able to be assessed. Lastly, this investigation focused on morbidity severe enough to require hospitalization, not a broader spectrum of health outcomes.

Despite these limitations, these analyses offer the first exploratory, population-based epidemiologic investigation of a diverse set of CAM therapies that may be of benefit or risk of morbidity among CAM users and nonusers.

### Table 2: Adjusted hazard ratios for any-cause hospitalization in personnel reporting practitioner-assisted or self-administered CAM therapies (Continued)

| Service | Enlisted† | Officer | Regular Navy† | Regular Marine Corps | Combat specialists† | Electronic equipment repair | Communications/intelligence | Healthcare | Functional support | Electrical/mechanical repair | Craft workers | Service and supply handlers | Students, trainees, other |
|---------|-----------|---------|---------------|----------------------|--------------------|---------------------------|---------------------------|------------|-------------------|-----------------------------|---------------|--------------------------|--------------------------|
|         | 1,082     | 82.0    | 70            | 81.4                 | 1.00               | --                       | --                        | --         | --                | --                          | --             | --                       | --                       |
|         | 237       | 18.0    | 16            | 18.6                 | 1.02               | 0.40, 2.60               | --                        | --         | --                | --                          | --             | --                       | --                       |
| Service |           |         |               |                      |                    |                           |                           |            |                   |                             |                |                          |                          |
|         | 1,017     | 77.1    | 69            | 80.2                 | 1.00               | --                       | --                        | --         | --                | --                          | --             | --                       | --                       |
|         | 302       | 22.9    | 17            | 19.8                 | 1.17               | 0.64, 2.13               | --                        | --         | --                | --                          | --             | --                       | --                       |
| Occupatio|         |         |               |                      |                    |                           |                           |            |                   |                             |                |                          |                          |
| nal category   | Combat specialists† | 287 | 21.8 | 15 | 17.4 | 1.00 | -- |
|       | Electronic equipment repair | 192 | 14.6 | 7 | 8.1 | 0.73 | 0.29, 1.85 |
|       | Communications/intelligence | 97 | 7.4 | 5 | 5.8 | 1.17 | 0.41, 3.37 |
|       | Healthcare | 115 | 8.7 | 16 | 18.6 | 2.63 | 1.21, 5.72 |
|       | Functional support | 220 | 16.7 | 18 | 20.9 | 1.60 | 0.76, 3.35 |
|       | Electrical/mechanical repair | 236 | 17.9 | 19 | 22.1 | 1.60 | 0.76, 3.36 |
|       | Craft workers | 33 | 2.5 | 1 | 1.2 | 0.44 | 0.06, 3.55 |
|       | Service and supply handlers | 82 | 6.2 | 2 | 2.3 | 0.52 | 0.12, 2.30 |
|       | Students, trainees, other | 57 | 4.3 | 3 | 3.5 | 1.11 | 0.31, 3.99 |

*HR = adjusted hazards ratio; CI = 95% confidence interval.
†Reference category.
Figure 1
Cumulative probability of any-cause hospitalization in Department of Defense hospitals from date of questionnaire submission until June 30, 2004, by practitioner-assisted and self-administered CAM therapy.

Table 3: Adjusted hazard for any-cause hospitalization in personnel reporting specific practitioner-assisted and self-administered CAM uses in the last 12 months

| CAM characteristic                  | CAM use |   | Hospitalized |   | HR*  | 95% CI |
|-------------------------------------|---------|---|--------------|---|------|--------|
|                                     | Number  | % | Number       | % |     |        |
| Practitioner-assisted CAM           |         |   |              |   |      |        |
| Exercise/movement therapy           | 245     | 18.6 | 17 | 19.8 | 1.13 | 0.64, 1.97 |
| Massage therapies                   | 181     | 13.7 | 12 | 14.0 | 0.98 | 0.51, 1.86 |
| Chiropractic services               | 113     | 8.6  | 11 | 12.8 | 1.96 | 1.01, 3.80 |
| Art or music therapy                | 41      | 3.1  | 0  | 0.0  | --   | --     |
| Acupuncture                         | 32      | 2.4  | 5  | 5.8  | 3.92 | 1.53, 10.06 |
| Spiritual/religious healing          | 30      | 2.3  | 2  | 2.3  | 1.14 | 0.27, 4.81 |
| Folk remedies                        | 30      | 2.3  | 3  | 3.5  | 1.52 | 0.46, 5.09 |
| Energy healing                      | 24      | 1.8  | 3  | 3.5  | 2.12 | 0.63, 7.17 |
| Psychotherapy                        | 18      | 1.4  | 3  | 3.5  | 1.57 | 0.46, 5.41 |
| Homeopathy                          | 17      | 1.3  | 1  | 1.2  | --   | --     |
| Self-help group                      | 17      | 1.3  | 0  | 0.0  | --   | --     |
| Hypnosis                             | 11      | 0.8  | 0  | 0.0  | --   | --     |
| Biofeedback                          | 9       | 0.7  | 0  | 0.0  | --   | --     |
| Self-administered CAM               |         |   |              |   |      |        |
| Herbal therapy                       | 208     | 15.8 | 9  | 10.5 | 0.62 | 0.30, 1.26 |
| High-dose or mega-vitamin therapy    | 148     | 11.2 | 5  | 5.8  | 0.42 | 0.17, 1.06 |
| Relaxation techniques                | 139     | 10.5 | 9  | 10.5 | 1.97 | 0.47, 1.99 |
| Prayer or spiritual practice         | 132     | 10.0 | 4  | 4.7  | 0.39 | 0.14, 1.07 |
| Aromatherapy                        | 68      | 5.2  | 2  | 2.3  | 0.37 | 0.09, 1.53 |
| Energy healing                       | 34      | 2.6  | 3  | 3.5  | 1.28 | 0.39, 4.19 |
| Folk remedies                        | 32      | 2.4  | 0  | 0.0  | --   | --     |
| Homeopathy                          | 18      | 1.4  | 0  | 0.0  | --   | --     |

*HR = adjusted hazards ratio; CI = 95% confidence interval.
Hospitalizations are an objective outcome measure, in contrast to self-reported symptoms or illnesses. These hospitalization data are very complete because active-duty military personnel have ready access to essentially free medical care in DoD facilities and have medical care coverage in private hospitals for emergencies. Since active-duty personnel seldom seek care outside the DoD healthcare system, it is likely that these data captured virtually 100% of the most serious health outcomes. Lastly, the use of sophisticated statistical modeling techniques with many variables to adjust for possible confounding, and the integration of data from diverse sources, allowed for the quantification of hospitalization risk over time associated with CAM use.

Conclusion
This analysis prospectively quantified reported CAM use in relation to adverse health outcomes requiring hospitalization. Using an objective outcome measure in a well-defined population of young adults, these data suggest a statistically significant protective effect associated with self-administered CAM therapies. In contrast, use of practitioner-assisted CAM therapies was not associated with decreased rates of subsequent hospitalization. More rigorous testing of CAM therapies and interactions with conventional therapies is possible and should be conducted.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
TS and BS performed the statistical analysis. All authors helped conceive the study, participated in its design and coordination, and helped to draft the manuscript. All authors read and approved the final manuscript.

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