Applied Physiology, Nutrition, and Metabolism

Retrospective Self-reported Dietary Supplement Use by Australian Military Personnel during Deployment to Iraq and Afghanistan: Results from the Middle East Area of Operations Health Study

Journal:	<i>Applied Physiology, Nutrition, and Metabolism</i>
Manuscript ID	apnm-2018-0576.R2
Manuscript Type:	Article
Date Submitted by the Author:	12-Nov-2018
Complete List of Authors:	Lui, Chi-Wai; University of Queensland, School of Public Health Waller, Michael; University of Queensland, School of Public Health Bell, Alison; University of Queensland, RECOVER Injury Research Centre van der Pols, Jolieke C; Queensland University of Technology, School of Exercise and Nutrition Sciences
Keyword:	Dietary supplements, Military personnel, Deployment, Work arrangement, Middle East, Australia
Is the invited manuscript for consideration in a Special Issue? :	Not applicable (regular submission)

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Retrospective Self-reported Dietary Supplement Use by Australian Military Personnel during Deployment to Iraq and Afghanistan: Results from the Middle East Area of Operations Health Study

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Abstract Page

Abstract

The use of dietary supplements is popular among military personnel. There is a lack of understanding about the changes in use during deployment and specific factors associated with such changes. This study retrospectively examined the changes in the pattern of supplement use among Australian veterans during their deployment to Iraq ($n = 8,848$) and Afghanistan ($n = 6,507$) between 2001 and 2009 and identified work-related circumstances that were associated with these changes. The frequency of use of supplements at present and during deployment was assessed. Multiple logistic regression analysis was used to compare the use of supplements between different groups and between those with different deployment experiences. The study found that overall use of supplements was highest on deployment to Afghanistan (27.8%) compared to in Iraq (22.0%, $p < 0.001$) or post deployment (current use 21.2%, $p < 0.001$). Personnel who were younger or at the rank of non-commissioned officer were more likely to use dietary supplements. Men were more likely to use body-building supplements while women more often used weight-loss supplements. Those veterans who did not report using supplements regularly on deployment were far less likely to use them subsequently. Combat exposure, mixed duty cycles and working long hours during deployment were associated with higher supplement use. The findings confirmed that supplement use in the military reflects the unique demands and stressors of defence service.

List of Keywords

Dietary supplements, military personnel, deployment, work arrangement, Middle East, Australia

Body Text

Introduction

The use of dietary supplements (DS) is gaining popularity in many Western societies over the past decades (Binns et al. 2018; Centers for Disease Control and Prevention 2011; Messerer et al. 2001; Rock 2007). DS refer to vitamins, minerals, oils, herbs and other nutritive and non-nutritive products that are consumed as an addition to the normal diet (Australian Bureau of Statistics 2014). The growth and popularity of DS use are associated with population ageing, changes in lifestyle as well as an increase in the prevalence of chronic diseases (Hale et al. 2007; Nichter and Jo Thompson 2006; Willison et al. 2007). The 2011-12 National Nutrition and Physical Activity Survey found that 29% of Australians took at least one DS on the day prior to the interview (Australian Bureau of Statistics 2014). Studies on military personnel (Austin et al. 2016a; Lieberman et al. 2010) and elite athletes (Dascombe et al. 2010; Huang et al. 2006) revealed that the use of DS is even higher in these population groups.

A recent systematic review on DS use by military found that over half of the service members reported consuming such products or substances (Knapik et al. 2014). DS products, such as protein and amino acid supplements that target increasing endurance, muscle strength and energy levels, were particularly favoured by U.S., British and Australian military personnel and many of them used multiple or a combination of products (Austin et al. 2016a; Boos et al. 2011; 2010; Casey et al. 2014; Cassler et al. 2013; Lieberman et al. 2010; van der Pols et al. 2017). The use of weight-loss products was also common among U.S. service members and this may reflect the perceived need of them to control body weight to meet occupational requirements (Austin et al. 2016a; Reyes-Guzman et al. 2015).

Survey findings revealed that promoting general health and performance enhancement are two of the most common reasons for using DS as reported by U.S. military personnel (Austin et al. 2016b; Cassler et al. 2013; Lieberman et al. 2010). The use of DS for performance enhancement is a motive seldom cited in studies on general civilian population (Greenwood and Oria 2008; Knapik et al. 2014). Researchers believe the distinctive purpose and consumption patterns of DS among service members reflect the dangerous job nature and the often hazardous working environments they are exposed to (Austin et al. 2016b; Cassler et al. 2013; Lieberman et al. 2010; Proctor 2016). The use of performance-enhancing or energy supplements is a way for them to cope with physical or cognitive stressors encountered at work and to help recovery from training or injury (Hoedebecke and Brink 2015; Knapik et al. 2014).

Given the increase in popularity of DS use in the military and the potential of overuse or side-effects of these products, it is crucial that we have a better understanding of circumstances and factors that contribute to the change in consumption of DS in this population group (Brooks et al. 2016; Greenwood and Oria 2008; Hoedebecke and Brink 2015). This study aims to fill the gap in the evidence-base by examining the change in patterns of DS use of a large cohort of Australian service members who had recently served in Iraq and Afghanistan. The study retrospectively collected information of DS use both during and after deployment from the same military personnel. The analysis focuses on identifying changes between deployment use and subsequent use, and those risk factors that were associated with DS consumption in deployment and at home.

Materials and Methods

Study Design and Participants

Data analysed in this study are taken from the Middle East Area of Operations (MEAO) Health Study conducted by the Centre for Military & Veterans' Health between 2010 and 2011. The MEAO Health Study was a cross-sectional survey of current and ex-serving Australian Defence Force (ADF) members who were deployed to the MEAO between 1 October 2001 and 31 December 2009. Specifically, the survey covered veterans deployed to Iraq or areas supporting operations in Iraq (including ships in the Persian Gulf), those deployed to Afghanistan or areas supporting operations in Afghanistan, and those attached to foreign militaries or the United Nations in the above areas.

The MEAO Health Study collected data through a survey in either online or offline (hardcopy) format. All participants were asked to complete two questionnaires. The first (health) questionnaire asked about their demographic characteristics, general health status/lifestyle behaviours after deployment (i.e., at the time of data collection). The second (deployment) questionnaire focused retrospectively on their experiences and health in the recent MEAO deployment to Iraq or Afghanistan (Figure 1). Both questionnaires contained questions on the use of DS.

Participation in the MEAO Health Study was voluntary. The research staff made extensive attempts to contact service members on the nominal roll and invited them to participate in the study. Reminder emails were sent and follow-up phone calls were made to non-respondents. Base visits were also undertaken with an arrangement for some ADF members to complete the survey during working hours. Full details on the participant recruitment, response rates, survey design, and methodology had been documented elsewhere (Dobson et al. 2013).

As the present study focuses on establishing the difference between DS use during and after deployment, only those participants who answered the DS questions in both questionnaires

are included in the analysis. Given the Defence Department forbids the use of DS in certain specialist roles (Director-General Defence Health Service 2003), those participants who reported these roles during their most recent deployment are excluded from the analysis.

The study was approved by the ethics committees of the Australian Department of Defence (protocol number LREP 14-010) and The University of Queensland (protocol number 2009001441). Participants of the MEAO Health Study provided consent in writing or electronically, and all aspects of this research complied with the Declaration of Helsinki.

Measures

Use of supplements: Both the health and deployment questionnaire of the MEAO Health Study asked the respondents to specify how often they took the following three categories of DS: ‘body-building supplements (such as amino acids, weight gain products, creatine etc.)’, ‘energy supplements (such as energy drinks, pills, or energy enhancing herbs)’, and ‘weight-loss supplements’. Frequencies of use of these three categories during and after deployment were recorded as never, less than once a month, monthly, weekly, and daily or almost daily. The respondents were also asked to report the name (generic or brand name) of the DS they used under each of the three categories.

Work arrangement and pattern on deployment: The deployment questionnaire contained questions about work arrangement and pattern of the respondents during their recent deployment to Iraq or Afghanistan. Main duties during deployment were recorded and grouped into four categories (Combat, Combat Support, Service Support and Command Support). Respondents were asked to estimate the average hours they were on duty per day (grouped into categories of 0-12 hrs, 13-14 hrs, 15-18 hrs, 19-24 hrs), and to report the

frequency (often, sometimes, rarely, never) they required working mixed duty cycles or day-night-day shifts.

Combat exposure: Combat exposure during deployment to Iraq or Afghanistan was ascertained based on whether a member was 'present when a loved one/close friend/co-worker was injured or killed', 'saw or handled dead bodies' or was 'witness to human degradation and misery on a large scale'.

Health condition or injury on deployment: Respondents were asked to recall the number of times they attended a sick parade during the deployment to Iraq or Afghanistan. They were asked whether they had a current military injury compensation pension arising from the deployment for various reasons (e.g. musculoskeletal injury, hearing loss, injury sustained in combat, mental health, others). The deployment questionnaire also asked the respondents how well they slept during deployment (e.g. very poorly, poorly, neither good nor poorly, good, very good) and times that the food available had negatively affected their performance (e.g. never once, 2-4 times, 5-9 times, 10+ times).

Statistical and Open Text Analysis

All analyses were carried out using SAS version 9.3 (SAS Institute Inc. 2002-2010). Multiple logistic regression models were constructed to compare the use of body-building, energy and weight-loss supplement between different groups in the MEAO sample and between those with different deployment experiences. Separate analyses were undertaken for those deployed to Iraq and Afghanistan.

The independent exposure variables included in logistic regression models were chosen a priori as possible predictors of supplement use on deployment. The final models include both

statistically significantly and non-statistically significant exposure variables. The models presented are adjusted for all terms as well as education and marital status. Similar logistic regression models were presented for the Afghanistan and Iraq deployments, so comparisons could be made between these two deployment locations.

The brand name and type in each of the three DS categories (body-building, energy and weight-loss) reported by the respondents in the open-text fields were checked online and manually coded into sub-categories based on the most prominent type of ingredients, including protein and amino acids, multivitamins, herbal supplements, carbohydrates and sugars, stimulants (contains mainly caffeine), and creatine monohydrate.

Results

A total of 26,239 ADF members were invited to participate in the MEAO Health Study and 14,032 (53.5%) responded to the survey; 8,848 and 6,507 of these veterans had been deployed to Iraq and Afghanistan respectively between 2001 and 2009. Most of the veterans deployed to the Middle East were male (Iraq: 87.1%/Afghanistan: 90.1%). The mean age at the time of the survey was 37.4 years (range 18.8-69.0 years). The median time since last deployment to the Middle East was 3.0 years (interquartile range 2 to 6) and the time since last deployment was greater for those deployed to Iraq (median 5.0, interquartile range 3 to 6) than those deployed to Afghanistan (median 2.0, interquartile range 1 to 3). In terms of service, most of the participants were employed in the Army (Iraq: 37.3%/Afghanistan: 54.5%) followed by the Air Force (Iraq: 35.3%/Afghanistan: 30.9%) and the Navy (Iraq: 27.4%/Afghanistan: 14.7%). A small proportion of these veterans (Iraq: 6.5%/Afghanistan: 4.1%) had left the ADF since serving in the Middle East. These ex-serving personnel were included in the present study to capture DS use of all ADF members during deployment.

Change in DS Use during and after Deployment

The results suggested that overall use of DS (defined as participants who used any one form of DS once weekly or more) was higher on deployment to Afghanistan (27.8%) compared to Iraq (22.0%, $p<0.001$) or post deployment (current use 21.2%, $p<0.001$). In terms of types of DS used, body-building use was higher in the two deployment (Iraq 13.6%, Afghanistan 18.7%) destinations compared to current use (11.3%, $p<0.001$ for both Chi-squared tests), and energy supplement use was higher during the Afghanistan deployment compared to current use (16.8% v 12.7% $p<0.001$).

Analysis revealed that those service members who did not use DS regularly (defined as less often than once a week) on deployment were far less likely to subsequently use DS than those who did (Table 1, $p<0.001$ for each comparison of current and deployment use). For instance, about half (49.2%) of the respondents who used body-building supplements once a week or more often in Afghanistan continued to use this type of DS when they returned to Australia. In contrast, 95.4% of the respondents deployed to the same destination who used body-building supplements only once a month or less often had stopped using this type of supplements after they went home. Similar patterns were observed in the use of energy and weight-loss supplements among respondents across the two deployment destinations although the use of weight-loss supplements after deployment was relatively lower when comparing to the other two types of supplements. Chi-squared tests produced significant p-values (<0.001) for all of these 2-by-2 comparisons of use on deployment and current use (Table 1).

Types of DS used by Deployment to Iraq and Afghanistan

Table 2 provides a detailed breakdown of supplements type used by service members during their deployment to Iraq and Afghanistan. Body-building supplements used by service members during deployment comprised largely of amino acids and protein products (Iraq: 59.5%/Afghanistan: 62.9%), which were typically taken as bars or powder. Products predominantly containing creatine monohydrate (Iraq: 11.7%/Afghanistan: 10.0%) were also frequently used as a body-building supplement, followed by multivitamins (Iraq: 8.2%/Afghanistan: 8.6%).

Regarding the category of energy supplements, the most common type consumed was products that contained stimulants (Iraq: 44.4%/Afghanistan: 50.1%), followed by products that contained multivitamins (Iraq: 14.3%/Afghanistan: 17.1%), and carbohydrates and sugars (Iraq: 11.7%/Afghanistan: 7.0%).

Users of weight-loss supplements most commonly used products that contained stimulants (Iraq: 39.1%/Afghanistan: 38.7%). They also often reported using amino acids and protein products (Iraq: 12.0%/Afghanistan: 16.0%), as well as products that predominantly contained carbohydrates and sugars (Iraq: 8.7%/Afghanistan: 6.7%), and herbal supplements (Iraq: 2.2%/Afghanistan: 3.1%).

DS Use Associations by Deployment to Iraq and Afghanistan

This section examined the association of DS use to demographic characteristics, deployment experiences and work pattern in Iraq and Afghanistan. Given the size of the table of results and similarity between findings of the two deployment destinations, only the Afghanistan data (Table 3) are provided here.¹ The results reported from here on refer to both deployment locations unless specified otherwise.

¹ The Iraq data are available for download as supplementary material.

Personnel who were younger or at the rank of non-commissioned officer were more likely to use DS on deployment. Men were more likely to use body-building supplements while women more often used weight-loss supplements (OR 1.6, 95% CI: 1.1-2.4, $p=0.02$). Use of body-building supplements and energy supplements was particularly common among Army personnel compared to personnel in other services (OR 1.6, 95% CI: 1.1-2.1, $p=0.005$, compared to Navy). In Iraq, serving in a combat role and having combat exposure were associated with more frequent use of all three DS categories. No relationship was found between having a combat role in Afghanistan and DS use, while combat exposure in this destination was associated with a higher level of use of energy supplements (OR: 1.3, 95% CI: 1.1-1.6, $p=0.003$).

In terms of work arrangement, personnel who reported frequent mixed duty cycles on deployment were most likely to report energy supplement use and this association was clearer in use reported in Afghanistan than in Iraq. The findings also indicated that those who reported more hours on duty on deployment in Iraq were more likely to report energy supplement use (19-24 hrs vs. 0-12 hrs on duty; OR: 1.24, 95% CI: 1.0-1.5, $p=0.03$). This association between working hours and consumption of energy supplements, however, was not present in DS use reported in Afghanistan.

The analyses found no clear relationship between problems with military food rations and DS use on deployment. However, the data suggested that service members who slept poorly on deployment were most likely to use energy supplements. Those who attended sick parade more frequently were more likely to use all three categories of DS (Table 3).

Discussion

This study examined DS use of a large cohort of Australian service members during their deployment to Iraq and Afghanistan, and change in DS use after deployment. As Pietrzak et al.'s recent review (2013) highlighted, deployment experiences are some of the most significant factors shaping health behaviours (e.g. smoking, drinking and eating) of military forces. By comparing the pattern of DS use during and after deployment within the same military personnel, this study provided a rare opportunity for assessing DS use in the ADF during and after deployment, and to identifying the social and circumstantial factors in combat theatre that are associated with changes in DS consumption.

The study found an overall higher level of DS use among the Australian service members during their deployment to Afghanistan (27.8%), compared to Iraq (22.0%), or compared with current use (21.2%). Previous U.S. studies have found higher DS use on deployment than in garrison (Austin et al. 2016a; 2016b; Jacobson et al. 2012; Varney et al. 2017). The more prominent use of DS in Afghanistan compared to Iraq observed in our data could be the result of a timing effect as DS use has gained popularity over the past decade and participants deployed to Afghanistan have a more recent deployment history compared to those deployed to Iraq. The only exception to this trend is the lower use of weight-loss supplements in Afghanistan (3.9%) compared to Iraq (4.8%) and at the time of the survey when the service members were based in Australia (4.3%). The former divergence may be partially explained by a lower proportion of women deployed in Afghanistan (9.9%) compared to Iraq (12.9%) and generally higher weight supplement use in women. Regarding the latter divergence, our results provided no explanation for it, but there is evidence that the use of weight-loss supplements was more prominent among US personnel in garrison than on deployment (Austin et al. 2016b). The context associated with the use of this particular form of DS thus requires further examination in the future.

The examination of socio-demographic factors associated with DS use during deployment revealed that personnel who were younger in age, working in the Army and at the rank of the non-commissioned officer were more likely to use DS. In addition, deployed men were more likely to use body-building and energy supplements while weight-loss supplements were more common among their female counterparts. This patterning of socio-demographic factors and DS use on deployment remains very similar to those observed in previous studies on DS use in the military (Austin et al. 2016a; Boos et al. 2011; 2010; Casey et al. 2014; Cassler et al. 2013; Knapik et al. 2014; Lieberman et al. 2010; van der Pols et al. 2017).

Our analyses on the types of DS used by deployed Australian service members found that the consumption of protein and amino acid products (especially as a body-building supplement) and stimulants (especially as an energy supplement) was very common, and this finding was consistent with findings of previous research on the British and U.S. military personnel deployed to combat theatres in the Middle East (Austin et al. 2016b; 2011; Boos et al. 2010; Cassler et al. 2013; Lieberman et al. 2010; Varney et al. 2017). In terms of work pattern and arrangement during deployment, our analysis indicated that service members who reported combat exposure, more hours on duty, frequently mixed duty cycles and attended more sick parade tended to use more DS. Similar to the findings of Varney et al. (2017), we confirmed that reported suboptimal sleep quality was associated with an increase in the use of DS.

Taken together, these findings provide support to the hypothesis that pattern of DS use in the military reflects the unique demands and stressors of defence service (Greenwood and Oria 2008; Hoedebecke and Brink 2015; Knapik et al. 2014; Proctor 2016). The higher level of use of supplements during deployment that targeted endurance, muscle strength and energy levels, and the association of use of these supplements with specific working conditions and duties, suggest that ADF members used these DS to cope with stress and trauma experienced in deployment, and to help recovery from illness or injuries incurred in action.

The findings of our study have implications for policies and interventions to protect the long-term health and performance of service members. The increase in consumption of DS in combat theatre means that the risk of overuse and side-effects of these products is higher on deployment than in garrison. One such concern is the risk of excessive intake of caffeine. In our previous study on DS use of ADF veterans of Middle East operations (van der Pols et al. 2017), we reported that 55% of energy supplements and 13% of weight-loss supplements used by the personnel contained caffeine (broadly classified as ‘stimulants’ as reported in Table 2), although this ingredient was seldom listed in product information. Given the use of energy supplements were common among service members who frequently worked long hours or mixed duty cycles on deployment, the risk of these persons having excessive caffeine intake was increased and this risk can be accentuated further by their consumption of other caffeine sources and staking of multiple DS products (Cohen et al. 2013).

Our findings confirmed that service members used more DS in combat theatre than in garrison. It highlighted the need to provide better and more targeted education to ADF personnel in this period on the safety and adverse consequences of DS. Previous studies indicated that service members obtained DS products largely from military commissaries, health food stores on base or online (Gonsalves et al. 2012; Paisley 2015). From personal communications with ADF members we learned that Australian service members had access to an extensive range of DS (which may have included products not permitted in Australia) via online ordering and the U.S. Post Exchange System while deploying in the Middle East. Tighter control and regulation of source and quality of DS products during deployment is thus an important strategy to protect the health and performance of ADF members (Deuster and Lieberman 2016). Our findings on the association between use of DS and work arrangement on deployment may be useful for identifying priority subgroups for adverse event monitoring and/or design of specific interventions.

Limitations

This study has some limitations which should be mentioned. The data on DS use, work experience and arrangement during deployment were reported by the service members several years after the assessed deployment, and is likely subject to some recall bias (Sedgwick 2014). However, this limitation should be balanced against the benefits of the study being based on a large cohort of Australian service members, and benefits of data on DS use within the same individual both during and after deployment. Another limitation is that this research was a cross-sectional study and thus it cannot make any inferences about causality. For instance, it is unclear whether poor sleeping quality was a cause or a consequence of increased DS use during deployment. Further research is required to ascertain the relationship between these two variables. Finally, reporting on DS use may have been incomplete for some persons, and a full match with product names and ingredients could not always be made, however we made all attempts to check carefully the ingredients or brand name online whenever information was available. This limitation and the challenges we encountered in coding the products did reflect the problems of poor labelling and ambiguous description of ingredients in many DS products currently on sale in the market.

Conclusion

By analysing self-reported data on DS use during and after deployment of a large cohort of Australian service members this study showed that ADF members had used more DS during their deployment to combat theatre in Afghanistan than after deployment. The data also showed that people who reported that they used DS on deployment were more likely to be

current DS users. Our study has identified specific work experience and job characteristics that are associated with DS use during deployment. These findings fill an important knowledge gap in the evidence base of DS use in the military. They also provide valuable information for education and regulation of DS use that helps improve the long-term health and performance of Australian military personnel.

Author Contribution

C-WL conceptualised the idea and wrote the first draft. MW oversaw data extraction and conducted statistical analyses. AB extracted and coded supplement product data. JCvdP helped conceptualise the idea and analysis. All authors reviewed and commented on subsequent drafts and approved the final manuscript.

Financial Disclosure

The MEAO Health Study was funded by the Australian Government Department of Defence. The authors used data from the MEAO Health Study during the course of their employment with The University of Queensland, School of Public Health. The authors received no funding from the Australian Government Department of Defence for this specific work.

Conflict of Interest Statement

The authors declare no conflict of interest. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official, or representing the views

of the Australian Defence Force or Department of Defence. The Department of Defence had no role in the design, analysis or writing of this article.

Acknowledgements

The authors want to thank the veterans who participated in the MEAO Health Study. They would also like to express their sincere gratitude to the editor and three anonymous reviewers for their comments and suggestions which have been very helpful in improving the manuscript.

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Tables

Table 1: Differences between DS use during deployment and after deployment to Iraq and Afghanistan

	Use during deployment				Use during deployment			
	(Iraq)				(Afghanistan)			
	Monthly or less	%	Weekly or more	%	Monthly or less	%	Weekly or more	%
<i>Body-building supplements</i>								
<i>Use after deployment</i>								
Yes	338	4.4	494	41.2	241	4.6	595	49.2
No	7263	95.6	706	58.8	5022	95.4	615	50.8
P-values*		<0.001				<0.001		
<i>Energy supplements</i>								
<i>Use after deployment</i>								
Yes	549	7.2	469	40.7	404	7.5	459	42.2
No	7087	92.8	683	59.3	4972	92.5	629	57.8
P-values*		<0.001				<0.001		
<i>Weight-loss supplements</i>								
<i>Use after deployment</i>								
Yes	282	3.4	99	23.3	181	2.9	72	28.0
No	8062	96.6	325	76.7	6003	97.1	185	72.0
P-values*		<0.001				<0.001		

* P-values are from chi-squared tests which assess the association between use during deployment and 'current use'.

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Table 2: Subgroups of DS used during deployment to Iraq and Afghanistan

	Body-building				Energy				Weight-loss			
	Iraq		Afghanistan		Iraq		Afghanistan		Iraq		Afghanistan	
	N	%	N	%	N	%	N	%	N	%	N	%
Amino acids/protein products	387	59.5	452	62.9	65	9.9	81	13.6	22	12.0	26	16.0
Carbohydrates and sugars	5	0.8	5	0.7	77	11.7	42	7.0	16	8.7	11	6.7
Creatine	76	11.7	72	10.0	9	1.4	4	0.7	2	1.1	3	1.8
Herbal supplements	6	0.9	5	0.7	16	2.4	5	0.8	4	2.2	5	3.1
Multivitamin	53	8.2	62	8.6	94	14.3	102	17.1	5	2.7	8	4.9
Stimulants	21	3.2	19	2.6	292	44.4	299	50.1	72	39.1	63	38.7
Other	5	0.8	5	0.7	8	1.2	4	0.7	6	3.3	6	3.7
Not found/not specified	97	14.9	99	13.8	96	14.6	61	10.2	57	31.0	41	25.2
<i>Total</i>	<i>650</i>	<i>100</i>	<i>719</i>	<i>100</i>	<i>657</i>	<i>100</i>	<i>597</i>	<i>100</i>	<i>184</i>	<i>100</i>	<i>163</i>	<i>100</i>

Table 3: Association of deployment DS use (weekly or more) with selected demographic characteristics, deployment experiences and work pattern, Afghanistan (adjusted odds ratios and 95 % confidence intervals)

	Body-building Supplements			Energy Supplements			Weight-loss Supplements		
	N	% User	OR (95% CI)	N	% User	OR (95% CI)	N	% User	OR (95% CI)
Overall	1213	18.6	-	1091	16.8	-	257	3.9	-
Age ^a									
20-29	597	36.7	Ref	421	26.0	Ref	114	7.0	Ref
30-39	486	18.7	0.41 (0.35, 0.48)**	475	18.3	0.65 (0.55, 0.78)**	109	4.2	0.61 (0.44, 0.84)*
≥40	130	5.7	0.12 (0.10, 0.15)**	195	8.6	0.31 (0.25, 0.39)**	34	1.5	0.27 (0.17, 0.42)**
Gender									
Male	1176	20.1	Ref	995	17.0	Ref	216	3.7	Ref
Female	37	5.8	0.23 (0.16, 0.33)**	96	15.0	0.92 (0.71, 1.20)	41	6.4	1.62 (1.08, 2.42)*
Service									
Navy	109	11.4	Ref	111	11.6	Ref	37	3.9	Ref
Army	796	22.5	1.55 (1.14, 2.11)*	694	19.7	1.25 (0.93, 1.69)	153	4.3	0.92 (0.54, 1.56)
Air Force	308	15.4	1.44 (1.09, 1.92)*	286	14.3	1.32 (0.99, 1.74)	67	3.4	0.80 (0.49, 1.29)

Rank on deployment

Commissioned Officer	238	12.0	Ref	219	11.4	Ref	38	2.0	Ref
Non-commissioned Officer	736	19.4	1.39 (1.07, 1.80)*	608	17.7	1.45 (1.13, 1.88)*	149	4.3	1.71 (1.00, 2.92)
Other ranks	239	33.3	1.46 (1.09, 1.95)*	262	23.9	1.42 (1.06, 1.91)*	69	6.3	1.54 (0.85, 2.79)

Role on deployment

Command Support	106	12.4	Ref	111	13.0	Ref	25	2.9	Ref
Service Support	344	14.4	0.78 (0.59, 1.02)	337	14.6	0.93 (0.72, 1.20)	91	3.9	1.14 (0.70, 1.87)
Combat Support	233	16.7	0.84 (0.63, 1.11)	201	14.4	0.78 (0.59, 1.03)	52	3.7	1.03 (0.61, 1.75)
Combat	521	29.5	1.21 (0.91, 1.60)	424	24.0	1.01 (0.76, 1.33)	83	4.7	1.00 (0.58, 1.73)

Combat exposure

No	806	16.2	Ref	701	14.1	Ref	193	3.9	Ref
Yes	406	27.0	1.11 (0.92, 1.33)	387	25.8	1.32 (1.10, 1.58)*	63	4.2	0.87 (0.60, 1.26)

Mixed duty cycles

Never	77	11.0	Ref	60	8.6	Ref	22	3.2	Ref
Rarely	104	17.3	1.27 (0.89, 1.83)	84	14.0	1.35 (0.91, 1.99)	24	4.0	1.06 (0.57, 1.98)
Sometimes	225	15.2	1.07 (0.78, 1.47)	218	14.7	1.45 (1.04, 2.03)*	50	3.4	0.79 (0.45, 1.39)

Often	804	21.9	1.34 (1.00, 1.80)	727	19.8	1.75 (1.28, 2.40)**	160	4.4	0.96 (0.57, 1.60)
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Hours per day on duty

0-12	468	19.4	Ref	366	15.1	Ref	110	4.6	1 (Reference)
13-14	113	14.1	0.76 (0.59, 0.98)*	115	14.4	0.97 (0.75, 1.24)	25	3.1	0.67 (0.40, 1.10)
15-18	262	15.8	0.91 (0.74, 1.12)	274	16.6	1.15 (0.94, 1.41)	50	3.0	0.78 (0.53, 1.15)
19-24	355	23.2	0.85 (0.69, 1.04)	321	21.0	1.05 (0.85, 1.29)	66	4.3	0.83 (0.57, 1.22)

Quality of sleep on deployment

Very poorly	49	17.0	Ref	74	25.4	Ref	17	5.9	Ref
Poorly	199	18.3	1.06 (0.72, 1.57)	208	19.1	0.78 (0.55, 1.10)	45	4.1	0.84 (0.44, 1.61)
Neither good nor poorly	391	18.9	1.13 (0.77, 1.64)	375	18.2	0.74 (0.54, 1.03)	91	4.4	0.83 (0.45, 1.53)
Good	447	18.6	1.13 (0.77,1.65)	362	15.1	0.63 (0.46, 0.88)*	81	3.4	0.61 (0.32, 1.15)
Very good	109	19.4	1.33 (0.86, 2.05)	62	11.0	0.49 (0.32, 0.74)**	21	3.8	0.80 (0.38, 1.69)

Available food negatively affect
performance

Never	901	17.2	Ref	803	15.3	Ref	189	3.6	Ref
Once	80	23.1	1.04 (0.77, 1.41)	82	23.8	1.36 (1.03, 1.81)*	14	4.1	1.12 (0.63, 1.98)
2-4 times	112	24.4	1.19 (0.92, 1.54)	101	22.0	1.12 (0.87, 1.45)	26	5.7	1.39 (0.88, 2.19)

5-9 times	44	34.4	1.81 (1.18, 2.79)*	34	26.8	1.22 (0.79, 1.90)	8	6.3	1.21 (0.54, 2.70)
10+ times	71	25.9	1.16 (0.83, 1.62)	61	22.3	0.89 (0.63, 1.26)	16	5.9	1.21 (0.67, 2.18)

Times attended sick parade

0	443	15.3	Ref	398	13.8	Ref	90	3.1	Ref
1	269	21.0	1.33 (1.10, 1.60)*	208	16.3	1.07 (0.88, 1.31)	49	3.8	1.10 (0.75, 1.61)
2	228	22.7	1.52 (1.24, 1.87)**	206	20.6	1.40 (1.14, 1.72)*	55	5.5	1.58 (1.09, 2.30)*
3+	230	21.4	1.46 (1.18, 1.79)**	228	21.2	1.42 (1.16, 1.74)**	54	5.0	1.40 (0.95, 2.04)

Adjusted for all exposures in the Table and marital status and education.

^aAt time of survey

*p<0.05

**p<0.001

These p-values indicate a significant difference from the Reference category.

Figure Caption Page

Figure 1: Timeline of deployment to the Middle East and data collection

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Figure 1: Timeline of deployment to the Middle East and data collection

156x69mm (300 x 300 DPI)