Summary Comments from Workshop Day 1: Nutritional Armor for the Warfighter—Can Omega-3 Fatty Acids Enhance Stress Resilience, Wellness, and Military Performance?

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ABSTRACT The first day of this conference reviewed the literature on the intake of omega-3 fatty acids, in all forms, around the world. Clinical trials using omega-3 fatty acids for a variety of pathological conditions, and studies examining omega-3 supplementation in nonclinical populations, were examined. Finally, the basic science describing possible mechanisms for observed clinical effects was reviewed. Despite wide recognition that the minute levels needed to prevent clinical deficiency are probably not optimal for health, there is a dearth of information on intake needed to optimize performance among healthy populations. Randomized placebo-controlled trials in humans specially evaluating health outcomes relevant to military populations are needed. Widespread consensus must be built on solid evidence of appropriate intake, both in absolute terms and as a percentage of total fat, before a recommendation to change the intake of omega-3 fatty acids in the Department of Defense is made.

OVERVIEW
The following is a commentary by Dr. Rhonda L. Cornum, presented at the Nutritional Armor for the Warfighter Conference, jointly hosted by the Samueli Institute through the Metabolic Defense Program and National Institute on Alcohol Abuse and Alcoholism. Included is (1) an overview of presentations from the conference, (2) a summary of conclusions from the presented research, and (3) a direction for future studies on omega-3 fatty acids and their incorporation into diets to optimize soldier fitness.

INTRODUCTION
It has been my distinct pleasure to participate in this expert panel and to summarize the first day. My academic interest and current position as Director of “Comprehensive Soldier Fitness” (CSF) made participation in this conference an imperative. CSF is a Department of the Army level Directorate, charged with assessment and training of all Soldiers to achieve and maintain both psychological and physiological fitness. The omega-3s seem likely to significantly impact almost all domains of health, so CSF is very interested in this topic. When invited to this conference, I was given a “mission”; the mission statement was to determine if there was sufficient information to support changing the recommended intakes of omega-3 fatty acids in the military. Currently, no recommendations for military intakes exist. In the next few pages, I will summarize what was accomplished today, and where I believe we stand in accomplishing the mission.

What Was Presented?
The first day’s presentations revolved around presenting the available information linking fatty acid composition of diets with social outcomes around the world, as well as summarizing the clinical and experimental studies of omega-3 fatty acid supplementation. CAPT Joseph Hibbels started off showing the correlations between low fish consumption and greater risk of homicide and major depression around the world. He presented 1 study illustrating the rapid ameliorative effect of supplemental Omega-3 treatment on childhood depression and a meta-analysis of 23 treatment studies indicating that when eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are combined, treatment efficacy is similar to antidepressants. He also cited multiple sources documenting significant relationships between successful suicides and low DHA and EPA; including one study that found Fish Oil supplementation over 12 weeks resulted in reduced depression, suicidal ideation, and improved “happiness.” CAPT Hibbels cited the American Psychiatric Association recommendations that patients with psychiatric illnesses should consume at least 1 g per day of omega-3s, which is consistent with American Heart Association recommendations. More fascinating studies showing correlations between suicides, dementia, homicide, and post-traumatic stress disorder with seafood consumption were presented by Dr. Hamazaki. He addressed the more basic questions linking bleeding, both in vitro and in vivo, with fish oil consumption. He presented data on both sides of the answer, was it helpful or harmful, indicating that bleeding harm is likely only at doses greater than 10 g per day. Dr. Lands reviewed the landmark studies describing why there will likely never be an absolute value of recommended omega-3 intake due to competing background intakes of omega-6 fats. He concluded that tissue targets of omega-3 status should be used and that it is time to take action and make clear dietary recommendations.

On the clinical side, from Ohio State University, we learned the potential implications of omega-3 fatty acids on wound healing. Dr. Janice Kiecolt-Glaser elegantly demonstrated...
the negative effects of chronic stress on wound healing and postulated the possible ameliorative effects of omega-3 fatty acid supplementation. Certainly, a prolonged combat deployment would be considered “chronic stress,” and the likelihood of benefiting from optimal wound healing is high in that environment! Dr. Martindale7 continued in this vein, presenting very interesting theoretical and clinical data, on the efficacy of omega-3 in the intensive care unit setting. He reviewed the original demonstration that polyunsaturated fatty acid administration during hospitalization in patients undergoing coronary bypass grafting reduced the incidence of postoperative atrial fibrillation (54.4%) and was associated with a shorter hospital stay.8 And he posed three very important research questions. First, what are possible nutrient interactions, and the appropriate doses before and after surgery? Second, what role does the ratio of these nutrients play; both for EPA to DHA and total omega-3 to omega-6? Lastly, what is the best ratio of the essential fatty acids to both total fat and total calories? He emphasized that the Society of Critical Care Medicine and American Society of Parenteral and Enteral Nutrition copublished recommendations for the use of metabolic and immune-modulating formulations in trauma and surgery, grading the evidence as an A grade based on two Level One and 15 Level Two studies.9 A similar recommendation was given by the European Society of Parenteral and Enteral Nutrition.10

Dr. Mathew Muldoon11 presented interesting information linking omega-3 fatty acid levels with optimal brain development, both prenatal and during maturity. He also reviewed the available studies on optimizing cognitive performance in nonpatient populations. Taken in conjunction with the studies by Dr. Mickleborough12 on optimizing physical and sports performance with omega-3s, it seems there is a lot of research needed on optimizing healthy populations. To date, the data is not sufficiently compelling to support or defend changing requirements based on the available performance improvement data among healthy, nonimpaired populations.

The basic science studies were fascinating. Dr. Hee-Yong Kim13 presented data linking docosahexaenoic acid with neural activity and synaptogenesis. Dr. Crawford presented a fascinating review of the evolution of requirement of docosahexaenoic acid from the dinoflagellate, to the nervous system of fish, to the human.14 He documented the importance of, and need for, omega-3 fatty acids for optimal nervous system and cardiovascular health throughout the entire animal kingdom.

What Do We Know?

First, there is no doubt that agricultural methods have changed the fatty acid composition of the meats and eggs that are consumed15,16 in America during the 20th century. That fact, in conjunction with changing how food is prepared,17 has significantly impacted the total amount of fat consumed, as well as the ratio of omega-6 to omega-3 fats in America. Beyond that, what can unambiguously be supported is fairly modest, although what can be suggested regarding the burden of disease due to these dietary changes is enormous. There was consensus that there is an optimal and minimal range of omega-3 essential fatty acid intake. There seems to be no argument that the optimal intake of omega-6 essential fatty acids is in excess of the minute amount required to prevent the recognized signs of clinical deficiency. But that is where the consensus ended and the discussion began.

There is a very large, and rapidly growing, body of information suggesting that we should increase both the absolute amount and the percent of dietary omega-3 fatty acids while decreasing omega-6 fats in the American diet. In my opinion, it is not clear that there is sufficient information to make changes in Department of Defense guidance, policy, or products. There are multiple questions that must be answered before we change policy; this conference may well have increased, not decreased, the number of questions.

What Should We Do?

The current Army Regulation on Nutrition Standards18 states that “… menu planners will establish menus with 30 percent or less of total calories from fat. Saturated fat should be limited to 10 percent of total calories and cholesterol should be limited to no more than 300 milligrams (mg)/day.” The first question to be answered is has this been achieved? In fact, there are menu plans available in the Department of Defense that would achieve this level of both fat and unsaturated fatty acid intake. But menu “planning” availability is not the same as changing food preparation and delivery, and these available plans have not been implemented across the force. With this in mind, the value of making more stringent recommendations is questionable. If we have actually achieved the “not more than 30% fat, not more than 10% saturated fat” at a location, the obvious next step would be to determine the metabolic consequences to Soldiers consuming a diet that meets this standard. The plasma and tissue fatty acid compositions which result from consuming a diet that meets the current total fat standard, but does not specify omega-3 and omega-6 content, should be determined. Perhaps just following the current guidelines, if applied to menu planning and food products, would be sufficient to optimize fatty acid composition. This evaluation has not yet been done. However, here is a plan to incorporate sampling of omega-6 and omega-3 from blood obtained in collaborative studies with UK research teams who will track brigade-size element over course of deployment (COL Carl Castro, Personal communication; Military and Operational Medicine Research Directorate, Medical Research and Material Command; December 12, 2009).

Second, while there was general concordance that we should increase omega-3 intake while decreasing omega-6 fatty acid intake, each presenter had markedly disparate views on how the change should be delivered. The data seems pretty
clear that unless and until the “background” intake of omega-6 fatty acids is reduced, that supplementation of the typical American diet with fish oil or DHA supplements will barely move the levels of omega-3 in tissue or blood.\(^{19}\) Once the baseline intake of omega-6 is brought back to levels predating the explosion of soy and canola oil use, then the best way to increase intake of omega-3 was open for debate. These alternatives ranged from changing the composition of the beef, chicken, and eggs which are purchased (buy “range fed”), to supplementation with fish oil vs. flaxseed and nut oil, to supplement with fish oil concentrate vs. fish oil as part of fish flesh (“eat more fish”), and any number of permutations. Until there is scientific concordance on what methods of dietary delivery are important and practical, it will not be possible to write a meaningful Department of Defense directive.

The third vital question is how will we know when we have achieved success; ie, what are the optimal tissue, and/or circulating levels, of omega-3 fatty acids, and how should they be monitored? There was unanimity that it is “too low” now; there was not any consensus on a goal other than “more.” It is not possible to write a meaningful directive without much greater clarity than “more.” To make a meaningful public health policy directive, there must be accepted measures of low-, medium-, and high-risk levels of omega-3, like we have for cholesterol and triglycerides.\(^{20,21}\) Next, it is essential to have rapid, safe, relatively noninvasive and inexpensive ways for individuals to monitor the adequacy of their lipid composition. People must be educated to become responsible for their own health improvement; but, if individuals cannot monitor their status, it is hardly possible for them to act responsibly.

There is clearly a need for ongoing randomized controlled clinical trials in many areas of specific interest to the U.S. Military. These trials include reduction of suicide risk, treatment of mental health and mental health disorders, increased resilience to prolonged stresses, and the optimization of physical and cognitive performance. Some investigators, such as Dr. Martindale, noted that the body of clinical trials has been sufficient to establish treatment recommendations by the Society of Critical Care Medicine and American Society of Parenteral and Enteral Nutrition for use in trauma and surgery grading the evidence as an A grade. Others including Drs. Innis, Hibbeln, Howe, and Lands referred to the abundant clinical data in cardiovascular disease prevention and treatment of immunological disorders.

Several speakers today suggested that the field had moved beyond the need for clinical trials. That is the only question that I believe can be definitively answered now. It is absolutely critical to continue to do the randomized clinical trials especially for improving mental health outcomes and optimizing performance among healthy populations to get the answers. It has taken the determined efforts of many dedicated researchers to convince the leadership of all the Services that it is imperative to have sufficiently powered clinical trials to answer important questions about health. Speaking for the Army, the combined efforts of the research community has convinced the leadership that we must make policy decisions on the basis of solid science, including pre-clinical data and multiple randomized placebo-controlled trials in humans specially evaluating health outcomes relevant to military populations. For example, there is no evidence of omega-3 fats improving physical performance or cognitive performance among already healthy populations, hence no compelling evidence for optimization of performance among unimpaired military populations.

Lastly, perhaps most importantly, we need to recognize that changing a standard does not change behavior, nor will it necessarily impact health. We must approach changing eating behavior in the military as a war against obesity, and suboptimal health and performance. And this war is not played on a linear battlefield; it must be waged at all levels—economic, educational, and regulatory. If the objective is to limit fat intake on one hand and also to increase the percentage of omega-3 fatty acids, then Soldiers and their families must be taught to understand the differences and incentivized to do so. Soldiers pay for food; they do not pay for health care. It follows that the battle to change individual behavior should then include making the desired behavior less expensive. Currently, the cheapest, most filling meals (“fast foods”) are the ones absolutely highest in saturated fats and lowest in omega-3. A separate front in the war is educating Soldiers on the individual, personal desirability of changing. Stating that changing their fat intake now will decrease the chronic disease burden later on is unlikely to be compelling; it has certainly not decreased the use of tobacco products in this population.\(^{22}\) The education campaign must include how it will enhance their performance in the current fight, how it will increase the likelihood of survival on today’s battlefield. As shown by the explosion in the use of various dietary supplements and the “CrossFit” exercise regimen, a good advertising campaign often obviates the need for regulatory guidance to change behavior.

Despite the length of time that has passed since this conference took place, the data remain inconclusive. While a recent study suggests that increased levels of dietary omega-3 fatty acids may decrease risk of heart failure,\(^{23}\) another points to an increased risk of type 2 diabetes.\(^{24}\) As recently as 2013, the strongest comment that one author could make was “We are getting closer to providing evidence-based recommendations on fish and fish oil intake to facilitate memory function during old age. In the meantime it is advised to follow the general CDC dietary recommendations.”\(^{25}\)

**CONCLUSION**

In conclusion, the presentations at this conference illustrated significant potential to enhance soldier performance as well as potentially decreasing morbidity and mortality from chronic metabolic disease, psychological dysfunction, infection, and trauma. This has been an important conference, demonstrating in practical ways that physiology and psychology are
inextricably linked, not just statistically related. Everyone who attended the conference seemed absolutely convinced that we can indeed improve military performance and overall health and fitness by changing the intake of essential fatty acids; they have already made significant changes in their own diets to reflect these beliefs. Hard questions still remain: What is the optimum intake? What form should it take? How should we monitor it?

REFERENCES