

Response to Letter to the Editor on Sleep, Obesity, and Injury Among US Male Career Firefighters

Reply:

We appreciate the great interest and comments provided on our paper, “Sleep, Obesity, and Injury Among US Male Career Firefighters.” We address Gao’s et al perceptions on the health and safety of US male firefighters, the study limitations they expressed concern about, and provide clarification on other issues raised.

Point No. 1: Use of self-report of physical activity (SRPA) based VO_2 max estimation in a “Highly Fit Population.” Gao’s et al primary criticism about using the non-exercise VO_2 max model, involving the SRPA rating, for male firefighters is based upon their argument that firefighters are a “highly fit population.” Objectively, a highly fit occupational group would have a low prevalence of individuals who are overweight or obese. However, as we clearly reported in our paper, firefighters are not “highly fit.” The prevalence of overweight or obesity was more than 81% among one of the largest samples of US male career firefighters examined to date.¹ Our finding that overweight and obesity is a major problem in the fire service is in line with more than two decades of research documenting poor body composition in the US fire service.^{2–14} Importantly, firefighters get less fit over time with some studies showing they gain between 1.2 and 3.4 pounds per year throughout their career.^{2,15,16}

Gao et al also argues the inadequacy of the SRPA for VO_2 max estimation based on the misconception that firefighters, as a group, are “aerobically well-trained.”

Firefighters as a group are not “aerobically well-trained.” Research into the aerobic capacity of US male firefighters has found their aerobic capacity is similar to sedentary individuals up to modest levels of aerobic capacity.¹⁷ Smith¹⁷ detailed the mismatch between the current fitness profiles of US firefighters and the fitness demands of the occupation in 2011, and evidence detailing the lack of fitness among US male career firefighters has increased. In fact, Storer et al¹⁸ published a “call to action” to improve firefighter fitness in which they review in detail the inadequacy of firefighter aerobic fitness levels with respect to safely and effectively performing their job duties.

Gao’s et al argument about the adequacy and appropriateness of our fitness measures largely relies on their incorrect assumption that firefighters are a highly fit and aerobically well-trained population, which is disproven by decades of research. In addition, the non-exercise VO_2 max model involving the SRPA has been shown to be a valid estimator of measured VO_2 max.^{19–24} We appreciate the authors hypothesis that fitness may modify the association between sleep and injury. However, that was not the research question explored in this paper, but could be explored in further research.

Point #2: Sleep as a moderator versus mediator, and obese physical activity injuries. A simplistic explanation of the association between sleep, obesity, and occupational injury is provided by Gao et al, and they fail to consider the bidirectional association between sleep and obesity. Obesity is a risk factor for sleep-related disturbances,²⁵ specifically obstructive sleep apnea (OSA),²⁶ and excessive daytime sleepiness.²⁷ Sleep-related disturbances are prevalent among firefighters. In a large national survey of US firefighters, 37.2% screened positive for at least one sleep disorder, with OSA being the most common on screening measures (28.9%), and over 80% of those screening positive for OSA did not have a current diagnosis.²⁸ Lastly, obesity has been examined as an effect modifier in the association between sleep and occupational injury in studies using US national cohort data.²⁹ Given the bidirectional association, it is more appropriate to examine obesity as an effect modifier rather than an intermediate factor.

Gao et al note we did not provide an in-depth explanation on the finding that only obese firefighters without enough sleep were more likely to develop an on-duty physical activity injury compared with those with enough sleep. We did not provide an explanation because examining this association was not the aim of this research paper. We also did not provide an

explanation because, as noted in our paper, we could not single out the type of injury (activity being performed), or if the physical activity was performed on-duty, due to differences in the types and amount of information and injury measures collected in the two cohorts. Thus, we only made a suggestion about the association because it is a research question requiring further exploration with different data. In addition, Gao et al use exercise and physical activity interchangeably, which is strongly discouraged because they are very different.³⁰ This confusion can be particularly problematic when discussing an occupational group performing exercise on-duty, and for whom maintaining physical fitness through exercise is crucial for occupational safety and health.

Point #3: Observational study and sleep measurement. Gao et al suggest the classification of this paper is incorrect, explaining “this study may not be a strictly observational study because the intervention, the Fire Service Joint Labor Management Wellness Fitness Initiative as a wellness program, has been included.” They do not expand their argument, and we therefore must assume they misunderstood the use of baseline data, the longitudinal cohort study design used in Fuel 2 Fight, where the data in question came from, and general principles of epidemiologic research. As noted in our paper,¹ both Fuel 2 Fight and FIRE were longitudinal cohort studies. Neither of our studies have any association with the Fire Service Joint Labor Management Wellness Fitness Initiative wellness program. The goal of our study was to explore the cross-sectional relationships between the variables of interest from baseline data from the two studies described. We did not manipulate the exposure nor provide interventions in either study, and used only baseline data.

Gao et al mentioned the sleep measurement used in this paper as a limitation and recommended the Pittsburgh Sleep Quality Index (PSQI). We agree the PSQI is an excellent measure for examining sleep quality. However, the PSQI in its current form is not set up to capture differences between on-duty and off-duty sleep, which may be important in firefighter sleep research. Our qualitative work has identified sleep difficulties as an area of concern among firefighters, particularly while on duty at the fire station.³¹ Therefore, the FIRE study investigators created the two sleep measurements and completed a 2-week test-rest of all measures prior to survey implementation. Therefore we thought stating that reliability tests were conducted on all measures in previously published research³² was sufficient for this paper. We combined the sleep measures in our

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paper¹ as we were more interested in establishing overall sleep for the research aim, prior to examining differences between on-duty and off-duty sleep. We agree with Gao et al these measures would benefit from validation.

All papers have limitations, particularly when combining data from two cohorts with different overall aims not specifically designed to answer the research question in the paper. We acknowledge those limitations and make appropriate conclusions in this paper based on our findings within the context of the fire service health and safety literature as a whole.

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