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HELICOBACTER PYLORI INFECTION, GASTRIC DYSBIOSIS, AND THE RISK OF GASTRIC ADENOCARCINOMA IN MILITARY PERSONNEL: A COMPREHENSIVE REVIEW

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Abstract – *Helicobacter pylori (H. pylori)* infection is the primary risk factor for gastric adenocarcinoma. Military personnel face unique occupational hazards, including high-stress environments, deployments to endemic regions, and specific dietary patterns, which may increase susceptibility to infection and subsequent gastric dysbiosis. This narrative review examines the relationship between *H. pylori* infection, gastric microbiota alterations, and gastric cancer risk in military populations, using real-world epidemiological data. A comprehensive literature review focused on *H. pylori* prevalence in military cohorts and its impact on the gastric microbiome. The search spanned January 1990 to August 2026. Recent epidemiological data indicate that *H. pylori* infection is significantly higher in young military personnel (aged 17-25 years) than in civilian counterparts (35.6% *vs*. 25.9%, $p = 0.001$). Acquisition of *H. pylori* in austere military environments reduces gastric microbiota diversity, initiating a cascade of mucosal atrophy and intestinal metaplasia. Furthermore, combining infection with military-specific stressors and field rations (Meals Ready-to-Eat) exacerbates dysbiosis, thereby accelerating tumorigenesis. Military personnel are a vulnerable population for *H. pylori*-induced gastric dysbiosis. Routine screening and eradication programs tailored for service members, alongside microbiota-targeted therapies, are imperative to mitigate the long-term risk of gastric adenocarcinoma.

Keywords: *Helicobacter pylori*, Gastric microbiota, Dysbiosis, Gastric adenocarcinoma, Military medicine.

INTRODUCTION

Gastric adenocarcinoma remains one of the leading causes of cancer-related mortality globally. Chronic infection with *Helicobacter pylori* (*H. pylori*) is the strongest identified risk factor for gastric cancer, prompting the World Health Organization to classify it as a class I carcinogen[1,2]. In recent years, the gastric microbiota has attracted significant attention. The healthy human stomach harbors a diverse, low-density microbial community; however, *H. pylori* infection drastically alters this ecosystem, leading to a state of dysbiosis that contributes to carcinogenesis[3].

While the overall prevalence of *H. pylori* is declining in developed nations, specific occupational cohorts remain at elevated risk[4]. Military personnel are exposed to unique environmental and psy-

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chological stressors, including deployments to highly endemic regions, crowded living conditions, and prolonged consumption of processed field rations. This comprehensive review assesses the epidemiology of *H. pylori* in military populations and elucidates how military-specific factors exacerbate gastric dysbiosis and increase the risk of gastric adenocarcinoma.

LITERATURE SEARCH STRATEGY

To conduct this narrative review, a comprehensive literature search was conducted in August 2026, covering January 1990 to August 2026. The search focused on studies examining *H. pylori* prevalence in military cohorts and its effects on the gastric microbiome. Relevant literature was identified using search terms aligned with the study's core themes, including *Helicobacter pylori*, gastric microbiota, dysbiosis, gastric adenocarcinoma, and military medicine. Data from recent cross-sectional studies of military personnel were synthesized to inform this review.

EPIDEMIOLOGY OF *H. PYLORI* IN MILITARY POPULATIONS

Military deployments to developing regions, where *H. pylori* is highly endemic, expose service members to an increased risk of acute infection. Historical data from deployments to regions such as the Middle East have shown high rates of gastroenteritis, which can facilitate the transmission of enteric pathogens, including *H. pylori*[5]. Furthermore, close-quarters living conditions during basic training and shipboard deployments facilitate fecal-oral and oral-oral transmission.

A pivotal cross-sectional study assessing the prevalence of *H. pylori* in Northeast China revealed marked differences between military and civilian populations. Although overall prevalence was similar across age groups, a significant disparity emerged among adolescents and young adults. In the cohort aged 17 to 25 years, the prevalence of *H. pylori* infection was significantly higher in the military group than in the civilian group (35.6% *vs.* 25.9%, $p = 0.001$)[6] (Figure 1). This suggests that early-career military personnel are particularly susceptible to infection, likely due to environmental exposures associated with entry-level training and barracks life. Studies of US military personnel have also highlighted the occupational risks of *H. pylori* acquisition during overseas deployment[7].

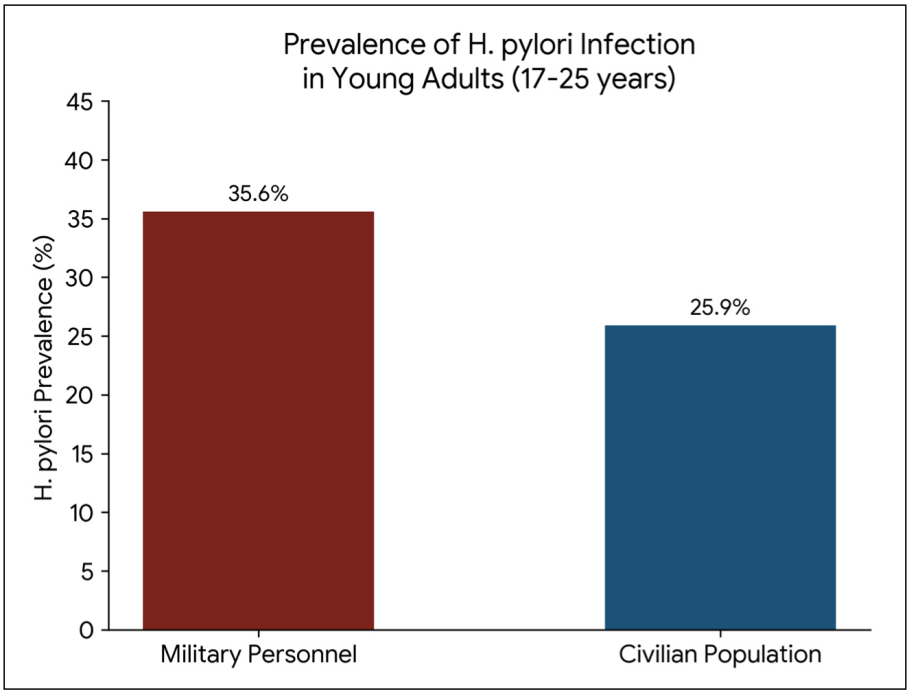

Figure 1. Prevalence of *H. pylori* infection in young adults (17-25 years), comparing military personnel and civilians. Data derived from recent epidemiological cross-sectional studies[4].

GASTRIC DYSBIOSIS AND CARCINOGENESIS

The pathogenesis of gastric adenocarcinoma follows a well-defined sequence known as Correa's cascade, progressing from normal mucosa to chronic non-atrophic gastritis, atrophic gastritis, intestinal metaplasia, dysplasia, and ultimately adenocarcinoma[1]. *H. pylori* plays a foundational role in this cascade by dominating the gastric niche and inducing profound dysbiosis.

Upon colonization, *H. pylori* neutralizes gastric acid *via* urease production and adheres to the gastric epithelium. This active infection drastically reduces the alpha-diversity of the gastric microbiome[8]. As atrophy progresses and acid secretion declines (hypochlorhydria), the stomach becomes colonized by a variety of pathogenic oral and intestinal microbial strains (e.g., *Streptococcus*, *Lactobacillus*, *Veillonella*)[3,9]. The resultant metabolic byproducts of these dysbiotic communities, particularly the reduction of nitrates to carcinogenic N-nitroso compounds, act synergistically with *H. pylori* virulence factors (such as CagA and VacA) to promote genomic instability and malignant transformation in the gastric epithelium[10].

IMPACT OF MILITARY-SPECIFIC FACTORS ON THE MICROBIOME

In addition to the direct pathogenic effects of *H. pylori*, the military lifestyle imposes secondary insults on the gastrointestinal tract that further compromise microbial homeostasis:

- Psychological and Physical Stress: High-tempo operations and chronic psychological stress elevate cortisol and catecholamine levels, which can alter gastric motility and reduce mucosal immunity, thereby facilitating bacterial overgrowth and dysbiosis[11].
- Dietary Factors: Prolonged reliance on Meals Ready-to-Eat (MREs) during deployments significantly impacts the gut microbiome. MREs are typically low in fresh dietary fiber and high in sodium and preservatives. A low-fiber diet diminishes the production of short-chain fatty acids (SCFAs), which are crucial for maintaining epithelial integrity and suppressing inflammation[12].
- Circadian Misalignment: Shift work, night operations, and rapid travel across time zones disrupt circadian rhythms, which are closely linked to the gut microbiome's composition and function, further exacerbating the dysbiotic state[13].

LIMITATIONS OF THE STUDY

While this review highlights critical associations, it is important to acknowledge limitations in the current literature. First, the synthesized epidemiological data rely heavily on specific regional cohorts (e.g., Chinese and US military personnel), which may not generalize well to all global armed forces because deployment locations, baseline endemic risks, and genetic variation differ. Additionally, the nutritional composition of combat rations (MREs) varies significantly across nations, potentially exerting distinct modulatory effects on the gut microbiome that require further standardized investigation.

CONCLUSIONS

Military personnel, particularly young recruits and those deployed to austere environments, constitute a high-risk demographic for *H. pylori* infection and subsequent gastric dysbiosis. The convergence of occupational exposures, stress, and dietary changes accelerates the premalignant inflammatory cascade. To mitigate the risk of gastric adenocarcinoma, military health systems must implement targeted screening protocols (e.g., urea breath testing or fecal antigen tests) for service members before and after deployments. Furthermore, integrating microbiota-directed therapies, such as specific probiotics, alongside standard eradication regimens may help preserve gut eubiosis. As recently demonstrated, modulating the gut microbiome is a critical determinant in optimizing clinical outcomes, enhancing therapeutic efficacy, and mitigating toxicity in cancer management and preventive therapeutics[14]. Such targeted interventions are vital to support military personnel's overall health and operational readiness.

Ethics Approval

Not applicable.

Informed Consent

Not applicable.

Availability of Data and Materials

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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Conflict of Interest

The author declares that he has no competing interests.

Authors' Contributions

D. Basta conceived and designed the study, performed the extensive literature search, structured the manuscript draft, designed the clinical data tables, and approved the final submitted version.

AI Disclosure

AI-assisted technologies (Large Language Models, specifically Gemini by Google) were used during manuscript preparation solely to improve readability and language formatting. The author meticulously reviewed, verified, and edited all content and assumes full responsibility for the clinical accuracy, scientific integrity, and originality of the final published article.

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