

# Epidemiology of CNS Infectious Diseases: A Meta-analysis and Implications for Neurosurgeons Worldwide

Faith C. Robertson BS; Jacob Richard Lepard MD; Rania A Mekary PhD; Matthew Christopher Davis MD; Ismaeel Yunusa Pharm.D.; William B. Gormley MD; Muhammad Raji Mahmud MD, FACS; Basant Kumar Misra MD, MBBS, MS, MCh; Abbas Rattani; Michael C. Dewan MD; Kee B. Park

# Introduction

Central nervous system (CNS) infections cause significant morbidity and mortality, and often require neurosurgical intervention for proper diagnosis and treatment. The objective of this study was to elucidate the global incidence of surgically relevant CNS infection, highlighting geographic areas for targeted improvement in neurosurgical capacity.

### Methods

A systematic literature review and meta-analysis were performed to capture studies relating to CNS infection and epidemiology published between 1990 and 2016 in PubMed, EMBASE, and Cochrane databases The search resulted in 10,906 studies, 154 of which were used in the final qualitative analysis, and 81 in the quantitative meta-analysis. Results were pooled using the random-effects model and stratified by WHO region and national income status for five CNS infection types.

### **Results**

A total of 508,078 cases of CNS infections were included, with a sample size of 130,681,681individuals. Mean age was 35.8 years (range: newborn to 95). The male:female ratio was 1:1.74. Of 81 studies with incidence data, 40 were based in high-income countries, 45 in middle-income countries, and 8 in low-income countries.

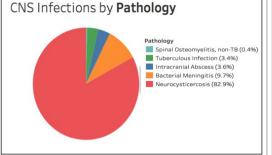
The pooled incidence of studied CNS infections was consistently highest in low-income, followed by middle- and then high-income countries. Regarding WHO regions, Africa had the highest pooled incidence of bacterial meningitis (65/100,000), neurocysticercosis (650/100,000) and tuberculous spondylodiscitis (55/100,000), while Southeast Asia had the highest pooled incidence of intracranial abscess (49/100,000).

# Global incidence of CNS infection by WHO Region Combined Incidence of Central Nervous System Infections by WHO Region Proportional System Infections by WHO Region Conclusion System Infections by WHO Region Proportion System Infections by WHO Region Proportion System Infections by WHO Region Annual Incidence (per 100,000 people) AFR: African Region. AMR-L: Region of the Americas (Latin America). AMR-US/Can: Region of the

# **Results (Continued)**

Europe had the highest pooled incidence of non-tuberculous vertebral spondylodiscitis (5/100,000). Overall, few articles reported mortality data, but limited case fatality information revealed the highest case fatality for tuberculous meningitis/spondylodiscitis (21.5%), and the lowest reported average for neurocysticercosis (5.5%). Funnel plots assessing publication bias suggested our results may underestimate the incidence of disease.

# Overall Proportion of CNS Infection by Pathology Overall Proportion of



# Conclusions

These results underscore the disproportional burden of CNS infections in the developing world, where there is a tremendous demand to provide training and resources for high quality neurosurgical care.

# **Learning Objectives**

By the conclusion of this session, participants should be able to: 1)
Describe the disproportional burden of CNS infections in the developing world,
2) Discuss how case fatality may also be reflective of surgical and technical capacity, and 3) Discuss how we can begin to address the discordance between burden and surgical capacity

### \*\* Author Affiliations

Harvard Medical School, MA; University of Alabama at Birmingham, AL; MCPHS University, MA; Brigham and Women's Hospital, MA; National Hospital Abuja, Nigeria; Hinduja National Hospital, Mumbai; Meharry Medical College, TN; Vanderbilt University Medical Center, TN