Ind. J. Phys. Anthrop & Hum. Genet. Vol. 43, No. 2, (2024) : 117-125

BIO-CULTURAL APPROACH TO PALAEOPATHOLOGY

MANJULIKA GAUTAM AND UDAI PRATAP SINGH

ABSTRACT

Palaeopathology is that branch of palaeoanthropology which advocates a scientific study for the understanding of a disease in the past, its manifestation, causes, cure as well as the social impact, through archaeological and historic remains of the disease and establish its antiquity. Its scope encompasses identifying a pathology in a fossil remain, the observation and recording of the condition found in a fossil remain, cultural and biological material surrounding it and analysing the data thus collected to understand the biological and archaeological context of the individual along with the cause (etiology), characteristics (skeletal symptoms), therapeutic treatment, incidence and prevalence, and preventive measures against the condition observed. The multipronged holistic study characteristic to anthropology requires a multidisciplinary intervention to understand the pathological condition and establish its antiquity. The approaches, beginning and reincarnating, since the inception of the field include biocultural approach, bioarcheological approach, molecular biological approach, ecological approach, and epidemiological approach. All the approaches need specialized knowledge of the respective field and a thorough understanding of the applicability and limitations of the discipline. The paper presents the approach underscoring its methodology, related theories, and limitations.

Keywords: *Palaeopathology, Biocultural approach, Antiquity of a disease.*

INTRODUCTION

Etymologically the term 'Palaeopathology' refers to the study of the past of pathology/ disease (*Greek pathos* meaning 'suffering' and *logos* meaning 'study'), based on prehistoric and historic evidences of humans (and animals) and their populations. It was first coined by German physicist R. W. Schufeldt in 1893 (Waldron, 2015) and appeared in the Standard Dictionary of Funk and Wagnall since 1895 (Bagnal et al., 2013).

According to Ruffer (1910) Palaeopathology is the science of diseases whose existence can be demonstrated on the basis of human and animal remains from

Manjulika Gautam, UGC JRF, Department of Anthropology, University of Lucknow-226007, Lucknow; **Udai Pratap Singh**, Professor, Department of Anthropology, University of Lucknow, Lucknow- 226007, Email: drudaipratapsingh64@gmail.com

ancient times (Roberts & Manchester, 2010) and in the broader sense human palaeopathology can be defined as the study of disease in ancient populations by the examination of human remains. (Aufderheide & Martin, 1998). In other words, palaeopathology is that branch of paleoanthropology, which advocates a scientific study for understanding a disease in the past, its manifestation, causes, cure as well as the social impact through archaeological and historic remains of the disease and establishing its antiquity.

Although it began with the ontological pathology of femur of a cave bear in 1774 by Johann Friedrich who was Lutheran pastor (Waldron, 2015), the subject got attention in 1896 when Rudolf Virchow (1821-1902), a renowned German pathologist, archaeologist and an anthropologist, questioned the authenticity of Neander valley specimen and the Neanderthal man population. He suggested that the specimen were the remains of abnormal modern men. (Kerley & Bass, 1967). The science was further popularised by British experimental pathologist, Sir Marc Armand Ruffer (1859-1917), anatomists- Grafton Elliot Smith (1871–1937), Frederik Wood Jones (1879–1954) and Douglas Derry (1974–1961), through their works on pathology of Egyptian mummies, obtained from Nubian cemeteries while constructing the Aswan Dam. (Editorials: Paleopathology, 1922). Roy L. Moodie was first on whom the title 'Paleopathologist' was bestowed, on being appointed at Wellcome Historical Medical Museum (WHMM).

THE APPROACH

The inquiry about the origin and antiquity of a disease instigated the paleopathological studies of the diseases and marked the sublimation of evolutionary thought in palaeopathology. The earliest studies beginning with Wyman's (1868) comparative study on cranial pathologies and Jones's study (1876) on syphilis were based on the instinct of evolution of diseases among populations (Zuckerman et al., 2011).

When the populational studies were introduced firmly in biological anthropology after Second World War the evolutionary thought spread to other aspects of palaeopathology apart from biological aspects of disease. Washburn (1951-53) introduced 'new physical anthropology' to replace the anthropometric modes of research with hypothesis testing based on the model of evolution and adaptation. The studies on diseases thus started to document the evolution of modern disease burden based on biological, archaeological, ecological as well as social and cultural influences observed in fossil and literary records. Modern Palaeopathology emerged around 1960s and marked a paradigmatic shift from a descriptive mode to considerations based on ecology, epidemiology and ultimately evolution making the discipline more interpretive, interrogative and independent.

The evolutionary thought in palaeopathology strengthened by developments in related fields like processual archeology, ecological and biocultural approaches. Processual archeology introduced shift from description and studies of cultural

diffusion to empirical and ecological approach to highlight the interactions between external systems and their environments.

Livingstone (1958) through his study of advantageous heterozygous selection of sickle cell anemia against malaria in Africa, conceptualized environment as a field of biocultural research, presenting the wide arenas of human adaptability, genetic adaptation, non genetic acclimatization responses and phenotypic plasticity to various environmental and socially influenced challenges in human population. This provided the four-field orientation to Biological Anthropology. (Figure-1).

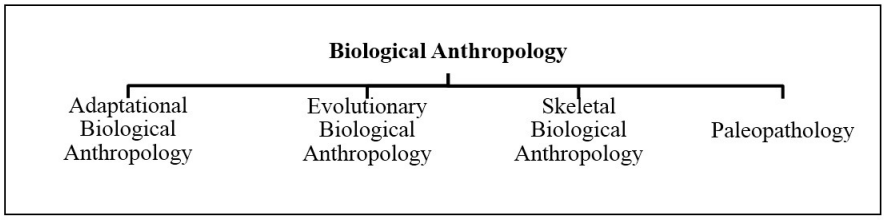

Figure-1: Four fields of Biological Anthropology

The evolutionary and adaptive inductions in anthropological studies provided a cross sectional and cross-cultural approach while skeletal biology and palaeopathology presented the longitudinal explorations in the adaptation process (Zuckerman et al., 2011). Biological anthropology imbibed biocultural approach as a paradigm that viewed human variability as both cause and impact of environmental factors visualizing culture and biology being interconnected.

For disease and health, the biocultural idea propagates that a society's technology, social system and even ideologies can generate biological outcomes like- pattern of a disease. (Zuckerman & Armelagos, 2010) Paleopathologists working on biocultural lines focused on the biomechanics and anatomy to understand the effects of pathologies like malnutrition, arthritis and trauma on human physiology. Behavioral interpretations of pathologies based on culture specific ethnohistoric accounts have also been presented. (For example, mummy studies in Egypt).

During late 1960s biocultural approach in palaeopathology was concerned with the evolutionary processes, patterns of pathologies as effect of social and ecological and political processes on health between and within populations. Later those practicing political economy and processual ecology posited that biocultural and ecological research reflected on 'adaptationist program' a tendency to naturalize the social processes, rather than viewing the social processes as products of larger social and political processes- a weakness common to functionalist and evolutionary perspectives. (Gould & Lewontin, 1979) To counter this criticism the biocultural followers incorporated action-oriented studies that included the issues of power, social relations, and adaptive constraints. (Goodman & Leatherman, 1998)

Recognition of the physiological stress markers/indicators on the skeleton

was the most important impact of renaissance on the rise of evolutionary thought in 1970s (Buikstra, 1991). Providing a pathway of estimating interactions between host resistance, cultural systems and, environmental and sociopolitical stressors, these indicators revolutionized the adaptationist studies by transforming the single individual or disease-based studies to anthropologically oriented longitudinal and evolutionary study of disease based on populations processes (Cook & Powell, 2006).

Integrating archeological, ethnographic, historical and skeletal data for interpreting stress, nutrition, trauma, disease, and activity related pathologies within adaptive framework, the biocultural approach facilitated developments in dating technology, the recovery of large skeletal samples with high quality temporal spatial documentation, and a growing recognition of the fertility of attempting to diagnose specific disease in the skeleton (Cohen & Armelagos, 1984). Palaeopathology used the stress indicators and evidences of trauma, nutrition deficiencies and infectious diseases to examine the effects of agricultural intensification in prehistory on human health. Collaborative works on large comparative data has identified the need of standardization of data and use of large samples in comparing cross cultural diachronic trends in morbidity and mortality (Zuckerman et al., 2011).

The sophistication and scope of biocultural approach based on evolutionary thought has expanded. New evidences and interpretations have been added to the productive debate over the evolution and antiquity of Cancer. (Zuckerman eet al., 2011). The relationship between frequencies of neoplasms, environmentally related health conditions such as growth arrest and metabolic diseases, and environment quality and rise of modern environments have been investigated by the paleopathologists. Re-examining the mummies for soft tissue pathologies to understand the evolution of skeletally invisible conditions like cardiovascular diseases have also begun (Cockburn, Cockburn, & Reyman, 1980).

Related Theories:

a) **Old Friends hypothesis-** given by Rook (2005) in Palaeopathology is used to highlight the significance of pathogen and zoonoses in shaping the evolution of human immune system and habitats by Armelagos and Harper (2010). They emphasized the role of the heirloom pathogen- lice and malaria and zoonoses like trypanosomiasis in influencing the development in immune system. Plasticity and adaptation debate is a recent development in the evolutionary thought in context of the stress indicators like linear enamel hypoplasia (LEH), porotic hyperostosis (PH) and cribra orbitalia (CO). The debate is around the notion that damage to the immune system early in life results in susceptibility to later life infestations, oppose to the adaptational infestations along the course of time (Armelagos & Harper, 2010).

b) **Barker hypothesis-** also known as the Developmental Origins of Health

and Disease Hypothesis; holds that fetal and neonatal environments have an impact on adult morbidity, and mortality is strengthened by the linkage of increased frailty of a stress indicator to early biological and environmental damage to the immune system resulting in susceptibility to the stress. Deriving from the contemporary human mortality and chronic diseases data the hypothesis is used to study differential survival in a population having a developmental phenotypic plasticity and its contribution to the expression of the phenomenon in later population up to the modern time (Zuckerman et al., 2011).

Limitations of the Approach:

The approach has the following limitations:

1. Changes in human physiology are very important in demonstrating evolutionary change in human populations, but the difficulty in observing processes such as natural selection or genetic drift related to selection of mutations or highly polymorphic systems like HLA limit the advantage. The changes thus observed in a human population do not exhibit highly visible and quantitatively measurable patterns. (Gorbunova et al., 2008; Mace, 2000).
2. Skeletal samples derived from the archeological record include sampling biases or biases generated by differential preservations (taphonomic) of various skeletal elements, biological mortality biases, persistent difficulties in accurately aging skeleton and the variable representativeness of skeletal samples to their original living populations (Wright & Yoder, 2003).
3. Only a few diseases manifest on the skeleton, limiting the number of diseases that can be studied in evolutionary context, (Dustugue, 1980) Most of the studied conditions are chronic as most of the infectious diseases act too acutely on the skeleton. (Zuckerman et al., 2011)
4. A macroscopically visible affects are now being studied through biomolecular techniques but are often confounded by diagnostic uncertainty as the skeleton physiology is affected only by resorption and proliferation of the bone, inhibition in its formation and abnormal in its growth and function hence different diseases can affect the skeleton in similar ways
5. Differential diagnosis is impeded by impacts on the bone from related pathologies, their condition-active or healing at the time of death, individual's response to the causal pathogen, the severity and duration of the condition and the presence of co-existing pathologies (Zuckerman et al., 2011).
6. Lack of standardization in data collection and of criteria used in differential diagnosis and the ability to assess the individual and

population level consequences of diseases. Ortner opined that the lack of methodological and theoretical rigor particularly the absence of standardized diagnostic criteria and data collection had effectively halted any potential theoretical advances, particularly in evolutionary thought (Ortner, 1991; Ubelaker, 2003).

7. For long a lack of methodology to analyze the fundamental questions about human microevolution and adaptation, the biocultural implication of diseases and the evolutionary trajectory and ecology of infectious diseases had been left untouched; the recent decades have worked in this direction and impacts of practices like agriculture along with origin and antiquity of diseases like Syphilis have been understood (Miller et al., 1996).

8. The approach is difficult to operationalize as the biocultural analyses requires to assess the effects of a culturally defined variable dependent on some aspect of human biology. Since the dimensions required to be assessed need to be ethnologically and historically used and replicable, the analysis is visibly impossible unless the researcher has the location specific ethnographic knowledge, which in most cases is nonexistent or if present is accompanied by degrees of incompleteness and patched with biases of historical, archeological and historical data. Moreover, understanding complex interactions between biology and cultural necessities defining and measuring multiple causal pathogens which can be extremely challenging.

9. The uniformitarian principles of Palaeopathology based on disease organisms and parasite cycles do not consider that the pathogen can evolve too. And that the disease can't be expected to manifest in same way in every environment and human population. (Buikstra & Cook, 1980; Ortner et al., 1992; Heathcote et al., 1998; Zuckerman et al., 2011).

10. Ecological bias arising from processual archeology and human adaptability studies considering societies as a integrated and functional wholes prevent the researcher from accessing the sociopolitical factors such as access to ideology and patterns of disease in past populations (Roberts, 2006).

CONCLUSIONS

Palaeopathology employs anthropological, processual, biocultural and evolutionary approach which is hypothesis driven and theoretical while bioarcheology employs a descriptive approach which is theoretically uncontextualized and data or method driven. It uses biomedical paradigm to determine the implications of diseases. While the proportions vary, human osteology and Palaeopathology reside in a healthy balance between descriptive and analytical and evolutionary approaches

Thus, the biocultural approach provides opportunities to explore hypothesis driven research question which confer direct advantage to the field of Palaeopathology. Clear research objectives provided by evolutionary and biocultural approach can be used to satisfy the considerations for climate surrounding the study of human remains (Park et al., 2010). The biocultural approach in particular can be used to deconstruct and consequently denaturalize human suffering and indicate solutions for coping and combating them in modern era.

Investigations of the linkage between sociopolitical processes and their biological effects on past populations can be used to reveal the causes of health disparities in contemporary societies and vice versa. The use of evolutionary thought may also enable the researchers to predict and interpret the challenges to human health more effectively in the present and in the future (Armelagos et al., 2005).

Finally, Palaeopathology can help us to understand the factors in evolution that have generated contemporary patterns in the global disease burden and as such researchers should be attentive to on the ground applications for their research and the potential of their results to prevent or accommodate disease and lessen human suffering.

References

Armelagos, G., and K. Harper, 2010. The Changing Disease-Scape in the Third Epidemiological Transition. *International Journal of Environmental Research and Public Health,* 7(2): 675–697.

Armelagos, G., Brown, P., and B. Turner, 2005. Evolutionary, Historical and Political Economic Perspectives on Health and Disease. *Social Science and Medicine,* 61: 755–765.

Aufderheide, A. C. and Martin, 1998. Preface. In: A. C. Aufderheide, and C. R. Martin, *The Cambridge Encyclopedia* C. R. *of Human Palaeopathology.* Cambridge: Cambridge University Press.

Bagnal, R. S., Brodersen, K., Champion, C. B., Erskine, A., and S. R. Haebner, 2013. *The Encyclopedia of Ancient History, First Edition.* Blackwell Publishing Ltd.

Buikstra, J. E., 1991. Out of the Appendix and Into the Dirt: Comments on Thirteen Years of Bioarchaeological Research. In M. Powell, P. Bridges, and A. Mires (Eds.), *What Mean These Bones? Studies in Southeastern Bioarchaeology*, pp. 172–189, Tuscaloosa.

Buikstra, J. E. and D.Cook, 1980. Palaeopathology: An American Account. *Annual Review of Anthropology,* 9: 433–470.

Cockburn, A., Cockburn, E. and T. Reyman, (Eds.), 1980. *Mummies, Disease, and Ancient Cultures.* New York: Cambridge University Press.

Cohen, M. and G. Armelagos, (Eds.), 1984. *Palaeopathology at the Origins of Agriculture.* Orlando, FL: Academic Press.

Cook, D. and M. Powell, 2006. The Evolution of American Palaeopathology. In: J. Buikstra, and L. Beck (Eds.), *Bioarchaeology: The Contextual Analysis of Human Remains* (pp. 281–323). Amsterdam: Academic Press.

Dustugue, J., 1980. Possibiities, Limits, and Prospects in Palaeopathology of the Human

Skeleton. *Journal of Human Evolution,* 9: 3–8.

Editorials: Palaeopathology, 1922. *The Journal of The American Medical Association* , 282-283.

Building a New Biocultural Synthesis: Political–Economic Perspectives on Human Biology, 1998. (A. Goodman, and T. Leatherman, Trans.) Ann Arbor, MI: University of Michigan Press.

Gorbunova, V., Bozzella, M. J., and A. Seluanov, 2008. Rodents for Comparative Aging Studies: From Mice to Beavers. Age 30(2–3): 111–119.

Gould, S. J. and R.Lewontin, 1979. The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society of London B 205* (pp. 581–598). London: Royal Society of London.

Heathcote, G., Stodder, A., Buckley, H. and D.Hanson, 1998. On Treponemal Disease in the Western Pacific: Corrections and Critique. *Current Anthropology,* 39(3): 359–368.

Jones, J., 1876. Exploration of the Aboriginal Remains of Tennessee. *Smithsonian Contributions to Knowledge,* 259: 1–17.

Kerley, E. R. and W. M.Bass, 1967. Palaeopathology: Meeting Ground for Many Disciplines. *Science,* 157: 638-644.

Livingstone, F., 1958 . Anthropological Implications of Sickle Cell Gene Distribution in West Africa. *American Anthropologist,* 60: 533–562.

Mace, R., 2000. Evolutionary Ecology of Human Life History. *Animal Behaviour,* 59(1): 1–10.

Miller, E., Ragsdale, B. and D.Ortner, 1996. Accuracy in Dry Bone Diagnosis: A Comment on Palaeopathological Methods. *International Journal of Osteoarchaeology,* 6(3): 221–229.

Ortner, D., 1991. Theoretical and Methodological Issues in Palaeopathology. In: D. Ortner, and A. Aufderheide (Eds.), *Human Palaeopathology: Current Syntheses and Future Options* (pp. 5–11). Washington, DC: Smithsonian Institution Press.

Ortner, D., Tuross, N. and A.Stix, 1992. New Approaches to the Study of Disease in Archeological New World Populations. *Human Biology,* 64: 337–360.

Park, V., Robert, ,. C. and T. Jacob, 2010. Palaeopathology in Britain: A Critical Analysis of Publications With the Aim of Exploring Recent Trends (1997–2006). *International Journal of Osteoarchaeology,* 20: 497–507.

Roberts, C. A. , 2006. A View from Afar: Bioarchaeology in Britain. In: J. Buikstra, and L. Beck. (Eds.), *Bioarchaeology: The Contextual Analysis of Human Remains* (pp. 417–439.). Amsterdam: Academic Press.

Roberts, C., and K.Manchester, 2010. *The Archeology of Disease (Third Edition).* Gloucestershire, UK: The History Press.

Rook, G. A. and L. R.Brunet, 2005. Microbes, immunoregulation, and the gut . *Gut vol.,* 54 (3): 317-320.

Ubelaker, D., 2003. Anthropological Perspectives on the Study of Ancient Disease. In: C. Greenblatt, and M. Spigelman (Eds.), *Emerging Pathogens: Archaeology, Ecology and Evolution of Infectious Diseases* (pp. 93-102). Oxford: Oxford University Press.

Waldron, T. , 2015. Roy Lee Moodie (1880-1934) and the beginings of Palaeopathology. *Journal of Medical Biography,* 23 (1): 8-13.

Wright, L. and C. Yoder, 2003. Recent Progress in Bioarchaeology: Approaches to the Osteological Paradox. *Journal of Archaeological Research,* 11(1): 44–70.

Wyman, J. , 1868. *Observations on Crania.* Boston: A.A. Kingman.

Zuckerman, M. K., Turner, B. L. and G. J. Armelagos, 2011. Evolutionary thought in

Palaeopathology and the rise of Biocultural Approach. In A. L. Grauer (Ed.), *A Companion to Palaeopathology* (p. 36). UK: Wiley-Blackwell.

Zuckerman, M. and G.Armelagos, 2010. The Origins of Biosocial Dimensions in Bioarchaeology. In: S. Agarwal, and B. Glencross, (Eds.) *Social Bioarchaeology*. pp. 15–44. New York: Wiley-Blackwell Publishers.