

Bio-cultural Approach: The Essence of Anthropological Study in the 21st Century

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INTRODUCTION

It appears as though anthropology in the 20th century confused itself by creating a vast array of sub-disciplines which are difficult to ascribe to the same umbrella. Such a trend has both positive and negative scopes for the strength and development of the discipline. Various practitioners and researchers of various sub-fields represent a variety of perspectives, “particularly those that are comparative, developmental, ecological, and/or evolutionary” (Dufour, 2006). Indeed, one may argue that there is nothing wrong with such perspectives as far as we do not deviate from the core of our discipline. However, it is difficult to comprehend whether anthropology in the 21st century should have a core or not? This question is highly debatable. The answer may be either affirmative or negative depending upon our understanding and vision of anthropology. But we ought to acknowledge that anthropology is a science which is concerned with both biological and socio-cultural aspects of humankind in time and space. It is neither dead nor will it be dead, but suffers a setback at times.

This chapter is concerned with a bio-cultural/bio-social approach to the study of human variation and evolution – the subject matter of anthropology as a scientific discipline. The basic premise is that the bio-cultural approach is essential for anthropological study of the survival and well-being of human populations in the 21st century. The chapter is delimited to two basic questions: What and why is bio-cultural approach? How is to go about it? As for the first question, an attempt will be made to suggest that bio-cultural approaches should be taken as essential not only for bringing the gap between social/cultural and physical/biological anthropology but also for popularizing anthropology with *integrative thinking* especially in India. “Integrative thinking means *rethinking* basic assumptions, asking new questions, challenging existing theories, and forging new methods” (McElroy, 1990). An attempt will also be made to discuss that anthropology in the 21st century

needs to formulate and deal more with research questions relating to problems or issues that are socially relevant. With respect to the second question, an attempt will be made to provide an overview of some models/paradigms which are based on a series of assumptions and relationships. Such models can be modified or formulated with new research questions to understand human biological variability. Finally, the operational aspects and challenging tasks for bio-cultural studies are briefly mentioned keeping in view the scope and prospect of the subject.

WHAT IS BIO-CULTURAL APPROACH?

Bio-cultural approach is one which views humans as biological, social and cultural beings in relation to the environment (McElroy, 1990). It also views human biological variability as a function of responsiveness and adaptation to the environment with a special focus on the role of socio-cultural environments. Its significance consists in conceptual framework and models for understanding the dynamic interactions among human biological/phenotypic, psychological and socio-cultural traits in response to the environment. Bio-cultural approach has been part of the long history of human biology and biological anthropology (McElroy, 1990; Hruschka et al., 2005; Dufour, 2006), but it has gained more momentum since the 1960s with the initiative of the Human Adaptability Project of the International Biological Programme. Initially, it was mainly concerned with the influence of physical environment on human biological variation, but it has given rise to the incorporation of biotic and socio-cultural environments into research designs for understanding human biological variation.

In most cases, central to bio-cultural studies is the use of demographic, genetic and phenotypic traits such as fertility, mortality, anthropometric measurements and indices, blood pressure, hemoglobin, genetics markers, and so forth as indicators of the survival and well being of human populations in different environments. These indi-

cators are used to assess the interrelationship between biology and environment in terms of ecological, historical, social, economic, psychological, behavioural and other cultural factors. The work of Livingstone (1958) on the evolution of sickle-cell trait in West Africa is one of such good examples. It is often cited as one of the best bio-cultural models of disease (malaria) as an agent of natural selection resulting in genetic adaptation of human populations. It gives an explanation of the interaction between sickle-cell anemia and culture, which is linked with population growth, agricultural expansion, prevalence of *Plasmodium falciparum* malaria and the evolution of sickle cell gene in West Africa (it will also be discussed in the Section on integrated bio-cultural model).

WHY BIO-CULTURAL APPROACH?

The need for greater integration of cultural and biological anthropology has recently become the express concern of many anthropologists all over the world. In her comments on a series of views on physical anthropology at the millennium, Szathmáry (2000) writes, “What impressed me the most . . . was the concern expressed by several contributors about the need for greater integration of the cultural and biological side of anthropology itself. The culture-biology interface, the interaction of these poles, and indeed, the need to reintegrate these poles were themes touched on by several contributors.” Bio-cultural approach provides a basic framework to bridge the gap between cultural and biological anthropology, thereby depicting the true nature of anthropology as a scientific discipline. In other words, bio-cultural approach of anthropological studies is one of those attempts to reintegrate sub-disciplines, especially cultural and biological anthropology, in the present century. It strengthens the holistic approach to understanding the biological and cultural aspects of human populations not only from sub-disciplinary but also from multi-disciplinary perspective, thereby making anthropology more trans-disciplinary in nature.

It may be acknowledged that Darwin’s theory of natural selection has a considerable influence on the development of anthropology especially biological anthropology. The 20th century is known as a Darwinian century for biology. Natural selection has been recognized as the most important evolutionary force that patterns life and screens biological variation. With the advent of

genetics, “life is genes and genes are life” (Weiss, 2000), giving rise to modern synthesis theory of evolution. Evolution is defined as a change in gene frequencies from generation to generation through the operation of mutation, natural selection, genetic drift and migration – the major evolutionary forces. The “modern synthesis provided legitimacy for the Darwinian approach, which was largely comparative and anatomical” (Weiss, 2000). “The New Physical Anthropology” conceptualized by Washburn in the 1950s, was primarily an “area of interest, the desire to understand the process of primate evolution and human variation”, and population genetics has become the core of the science. However, Washburn also cautioned that evolution should not be conceptualized in terms of non-adaptive traits or genes only because it is impossible if evolution is largely due to natural selection. “If the form of human face can be thoroughly analyzed, this will open the way to the understanding of its development and the interpretation of abnormalities and malocclusion . . . may lead to advances in genetics, anatomy, and medicine” (Washburn, 1951).

Considering the recent findings on population genetics at the molecular level in particular, the role of genes in understanding evolution is once again thought-provoking. Recent DNA studies of contemporary populations, especially mitochondrial DNA (mtDNA), have revealed that humans are relatively homogeneous with little genetic variation (Rosenberg et al., 2002; Jorde and Wooding, 2004), thereby leaving little scope for understanding genetic variation between human populations. What actually is the role of gene in evolution? According to Weiss (2000), “we have tended to forget that natural selection screens phenotypes not genotypes: it is organisms that survive and reproduce. Darwin’s pangenesis was a form of genetic determinism in which circulating heritable units (gemmules) were directly controlled by phenotypes. But genetic variation is not directly controlled by phenotypes (so far as we know), and DNA is not the only thing in an egg, bud, or spore. Though genes remain the only known quasi-permanent heritable material, what determines success is the phenotype of the organism. Selection does not identify the perfect genotype, and preserve it. Selection identifies phenotypes that are too imperfect and removes them. As we identify the genes involved in complex traits (most current

data concern disease), we find that genetic reductionism does not work as well as we expected.”

Evolution as a change in gene frequencies cannot be fully comprehended without considering the role of environment. If genes are not life and life is not genes, what genes are for life? The answer to this question varies from one scholar to another, but it is unquestionably believed that the end product of the interaction between the genetic constitution (genotype) and changing environment is the phenotypes. From the human biological point of view, phenotypes refer to the morphological, physiological and biochemical characteristics of humans as manifested throughout their life. On the other hand, environment refers to all biotic, physical (abiotic) and socio-cultural conditions that influence the growth, development, health and survival of an individual or a group of individuals. How far we have learned the nature and extent of genotype-environment interaction is again debatable, and we need to learn more about it in the present century. The basic observation of Darwin on variability of phenotypes may, therefore, still remain the basic research problem that would generate a lot of research questions to be addressed clearly and practicably in the 21st century. Accordingly, bio-cultural approach to studying human biological and phenotypic variability should gain more momentum in the 21st century.

Anthropologists in the 21st century ought to develop *integrative thinking* with a view to making anthropological research more relevant to the survival and well-being of human populations. In his Presidential Address to the Anthropology and Archeology Section of the Indian Science Congress in 1951, S. S. Sarkar, one of the well-known pioneers of biological anthropology in India, visualized that the discipline should aim and play an important role in making *an individual healthy in mind and body and thus build a healthy nation*. Considering the broad concept of health as a “complete physical, mental, and social well-being” (WHO, 1971), the most effective way to strengthen and popularize anthropology is to have a set of common beliefs and agreements, or conceptual framework, to study socially relevant problems including health problems as visualized by S.S. Sarkar. The interest in nutrition, auxology, demography, human genetics, epidemiology, gerontology, medical anthropology and other health related studies is

a good evidence for the strength and positive development of anthropology in India (Basu, 2003). These areas of interest can be ascribed to the same umbrella of the “survival and well-being” paradigm or “bio-cultural” approach to studying biological and socio-cultural aspects of Indian populations.

FORMULATING RESEARCH QUESTIONS

The need for greater integration of cultural and physical anthropology is indeed very crucial to the strength and identity of the discipline. But the question of “what should we do?” is still debatable, which needs to be addressed meaningfully and practicably. There is no doubt that the “the strength of anthropology as a discipline depends on what it contributes both to thought and to society” (Peacock, 1997). Although contributions of anthropologists to the scientific thought cannot be totally ignored, we may ask ourselves whether or not our thoughts are also formulated systematically and practically in such a way that they are socially relevant. Therefore, formulating meaningful-research questions that are socially relevant should be considered one of the most effective ways to strengthen anthropology as an important discipline in the present century.

Formulating research questions means asking new questions in the light of previous questions/hypotheses/theories/methodology or empirical research findings. Research question is a statement or question that identifies the phenomenon or problem to be investigated or experimented. It is the guiding force for a given study to generate, analyze and present qualitative and/or quantitative data in a systematic manner (Maxwell, 1996). Barring the merits of descriptive or ethnographic study, a research study without research questions is many a time like a boat without oars, especially in biological anthropology. Such type of study is often repetitive or messy because the researcher is bound to get mixed-up with different aspects of a given problem. Research questions allow the researcher to deal with a given problem systematically, to highlight its importance and priority, and to justify why the proposed research on a given problem should be carried out.

As for anthropological research in India, if one takes a glance at research papers published so far, one may admit that there is often an absence

of research question(s) of social significance. In this connection, it may be worthwhile to mention what Basu (2004) has written, "Glancing through the journals which published anthropological articles, in India and abroad, one is still confronted with numerous articles presenting the frequencies of innocuous traits like tongue rolling, arm folding, or describing the birth, marriage or death rates of well-or ill-defined social groups without any conceptual framework. Even if we grant that anthropologists and fellow-travelers are hell-bent on ensuring methodological rigor, including biochemical (of late molecular biological) and statistical finesse, what are their research questions?" The racial paradigm has still dominated the mind and thoughts of many biological anthropologists in India, and their research questions are mostly to address the phylogenetic relationship or differences and similarities between population groups with respect to certain traits.

The major concern is the lack of conceptual framework and meaningful-research questions in many research works relating to the biological and/or socio-cultural aspects of Indian populations. If we are interested in reporting only the frequencies of certain traits as pointed out by Basu (2004), our research question is nothing but mostly related to this question: *Is the study population/group of individuals higher or lower than the other population(s)/group(s) of individuals with respect to certain traits?* Although biological anthropologists may not ask specifically this question, it cannot be totally denied that the main purpose of many research articles published from India and abroad is to address this research question, which is of little social significance. In other words, the results may be interesting to the educated few, but lack practical significance. Consequently, we should not shy away from admitting that our contribution to the society is not as significant as it should be.

Considering the influence of "racial paradigm" consciously or unconsciously on our thoughts, one should have extended or modified the paradigm to the problems of ethnic conflict and its consequences for the survival and well-being of the affected peoples. For example, "Why are there so much of ethnic upsurge and ethnic conflict in recent decades? Why so much of ethnic conflicts even in societies generally known to be homogeneous? . . . Are these all because of a sense of insecurity perceived by small,

indigenous or marginalized groups *vis-à-vis* some numerically, technologically or socio-economically dominant groups? One may add to these issues those concerning indigenous knowledge, biodiversity maintenance, human rights (individual legal rights and traditional community rights), and so forth" (Basu, 2004). Indian anthropologists could have contributed to a great extent in understanding these issues of social relevance.

One of the most effective ways to formulate our thoughts to socially relevant questions is to follow the bio-cultural approach. The different models given below are likely to generate different forms and levels of research questions that are socially relevant. It has been shown that a particular model is responsible for the formulation of another model with different research questions. Under the bio-cultural approach, there are a lot of research questions that are socially relevant, especially in developing countries like India where problems relating to the survival and well-being of human populations are manifold (Huss-Ashmore and Johnston, 1985; Basu, 1987). In addition to diversity in physical environment with different stressors and pathogens or disease vectors; other factors such as depletion of resources, disruption of ecologies, inadequate food supply, socio-economic disparity, poverty, illiteracy, population growth, increasing urbanization and modernization, migration, globalization, ethnic conflicts, and so forth may have a considerable bearing on the survival and well-being of Indian peoples.

BIO-CULTURAL MODELS

According to Thomas et al. (1989) "models are representations of reality that depend largely on a visual or mathematical framework to demonstrate relationships among essential components of a system." A model is also defined as an exemplar or a paradigm formulated and modified to accurately understand the study phenomenon (Basu, 2003). In the present discourse, a model is defined as an exemplar of a system developed or modified to understand a study phenomenon which is interrelated with different aspects of the system. It is, therefore, a heuristic tool to generate research questions or test hypotheses and approaches thereof to understand a complex phenomenon. In bio-cultural study, the system is composed of biology,

culture and both biotic and physical environments in which certain behavioural, psychological and biological characteristics of human populations are the study phenomena. Each of these major parts of the system is again composed of different components. The focus of attention is to understand the interrelationship of the selected components of the system at the population level, especially those that reflect the interaction between biology and culture.

Models are based on a series of assumptions and relationships that can be modified or formulated to study the complex phenomenon or human biological variability in anthropological research. For example, biological anthropology in India started with studies based on taxonomic or racial model. Initially, various studies adopted Risley's classification of Indian population on the basis of morphological and anthropometric techniques, followed by the additional use of serological data, and recently by the use of molecular and sophisticated statistical techniques. The main purpose of such studies is to understand the phylogenetic relationships among Indian populations and sub-populations under the basis of the exemplar of racial or taxonomic model. With the initiative of the Human Adaptability Project of the International Biological Programme during 1962-1974, the taxonomic model is modified into more "explanation-oriented approach." The realization that biological anthropology should be concerned with the "health and well-being" of Indian populations has also started simultaneously in which a new bio-cultural model has emerged. Basu (2003) designated this model as "survival and well-being" paradigm. This "paradigm seems to constitute the basis, consciously or unconsciously, of many biological anthropological studies, even though static, descriptive studies following the earlier "race" paradigm, with or without the sophisticated laboratory and/or statistical methodologies, also continue" (Basu, 2003).

The interest in bio-cultural model among biological and medical anthropologists has its connection with the adaptability model in which the human-environment interaction is the focus of attention to understand human biological variation and/or variability. The adaptability model gets modified and becomes more complex with the formulation of more research questions depending upon the interest of a given study.

General Adaptability Model: Figure 1

depicts the general adaptability model of the human-environment interaction developed to understand human adaptation. This model also provides a starting point to deal with the complex interaction between human biology and environment. It has four major parts: (a) physical or non-living environment – in terms of topography, climate, altitude and energy resources, (b) biotic environment – in terms of nutrition, pathogens, predators, etc., (c) cultural environment - in terms of behavioural, social, economic and technological changes, and (d) human variation in terms of demographic, morphological, genetic, physiological, clinical and functional characteristics. This model serves as a device for understanding "elementary feedback relationships" (Thomas et al., 1989). The model does not, however, provide sufficient guidelines on which types of the environment and biological variation of human populations should be the focus of study. Most studies under this model have considered an environmental stressor as an independent variable, thereby taking many reductionist assumptions in which biotic and physical environmental factors are regarded as the major factors in bringing about human biological variation. It, however, provides a framework to view human biological variation as dependent on the biotic and physical environments and interdependent on the cultural environment, which is in turn interrelated with biotic and physical environments. It also generates many new research questions and hypotheses which are ultimately responsible for the formulation of new models. Following are some of the models

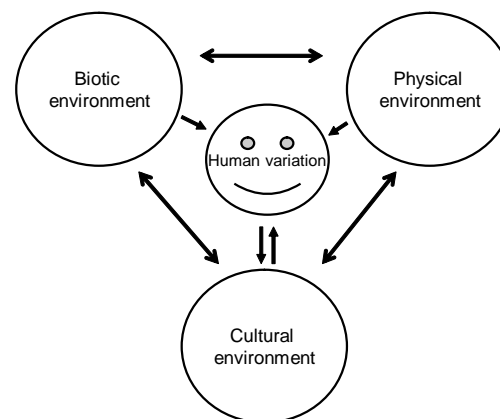


Fig. 1. A simple model of the system showing human relationship with the environment

that can be considered as the by-products of the general adaptability model.

Single-Stress Model: The single-stress model is an offshoot of the general adaptability model. It takes an environmental stressor as independent variable to understand human adaptation. High-altitude hypoxia (low-oxygen pressure) is considered to be the primary stressor that brings about biological and morphological variation. For example, the pattern of growth and development in body size and organs of oxygen-transport systems at high altitude differs from those at the low altitude. Figure 2 shows that hypoxia at high altitude accelerates the growth of thorax dimensions. “On the other hand, joint effects of hypoxia and cold increase energy requirements. This in turn affects the energy balance and results in prenatal and postnatal growth retardation of the musculoskeletal system, which affects both birth weight and stature. Because of the two directional responses, human growth in high altitude populations must be viewed as the result of interaction and adaptation of the organism to competing stresses of hypoxia, cold and energy requirements that characterize the high-altitude environment.” (Frisancho, 1993) It is suggested that the Andean chest morphology is not acquired by either developmental or adult acclimatization, rather it is influenced more by genetic than by developmental and physiological responses/factors (Frisancho, 1993). According to Harrison (1998), the “typical ‘barrel-shaped’ thorax of many mountain peoples is ... partly genetically fixed

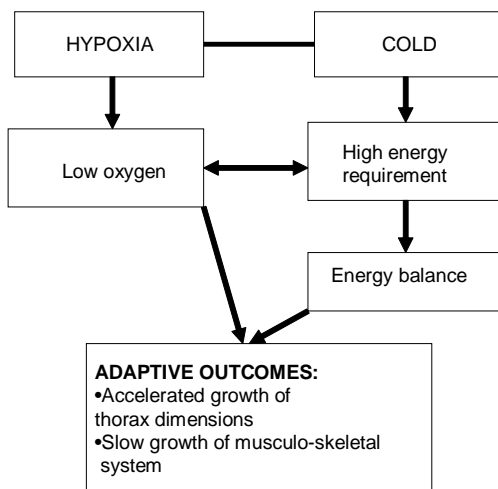


Fig. 2. Single-stress model

since it is also found in the offspring of native highlanders who grow up in lowland conditions.”

However, the inability to identify genes responsible for morphological variation in high-altitude populations is the major drawback to the single-stress model. Critics have criticized that scholars working under the single-stress model have just taken for granted that adaptation is an *explanatory paradigm* of human variation without taking into consideration other alternative explanations (Gould and Lewontin, 1978). It is pointed out that, unlike sickle-cell gene for the malaria, there is a lack of evidence for specific genes responsible for enhancing oxygen transmission in high-altitude populations (Baker, 1984). Thus, the view that a genotype of an organism is able to produce a range of phenotypic changes in response to the environment seems to be, at present, more acceptable than that of genetic adaptation which holds that a given modification is due to genes which are transmitted through generations. There is evidence that physical work capacity among Europeans, who have grown up at high altitude, are comparable to the Andean natives (Frisancho et al., 1973). In addition, recent studies among Asian populations indicate the absence of altitude differences in chest dimensions (Weitz et al., 2000; Weitz and Garruto, 2004). It was also observed that Tibetan males at 4,300 m had narrow and deeper chests during and after adolescence than their counterparts at 3,200 m and 3,800 m (Weitz et al., 2000). On the basis of these and other evidences, it is difficult to attribute thorax dimensions in high-altitude populations to genetic adaptation only. It suggests, instead, that a given genotype has a range of phenotypes characterized by developmental plasticity - any observable modification or phenotypic variability in response to a sequence of environments during growth and development - which is highly unpredictable (Khongsdier, 2006).

The relationship between genotype and phenotype is very crucial for understanding developmental plasticity. We know that the phenotype is the developmental outcome of the complex interaction between genotype and environment. The development of any phenotype depends on the genotype that determines a range or set of alternative phenotypes in response to a sequence of environments. This range is known as the range of reaction, or *norm of reaction*, of the genotype (Dobzhansky, 1970). It is also

defined as the mapping function of the environment into phenotype for a given genotype (Lewontin, 2004). The norm of reaction of each genotype is highly unpredictable because it encompasses a set of alternative modifications, or outcomes (phenotypes), depending upon a sequence of environments in relation to that genotype. Experimental works on plants show that a given genotype produces different phenotypes according to different elevations from sea level. It is, therefore, suggested that the relative height of different plants was unpredictable from one environment to another. For example, the genotype of a given plant that grew tallest at low elevation was the shortest at medium elevation and the second tallest at high elevation (Zuzuki et al., 1981; Lewontin, 2004). The findings on chest dimensions of the Tibetan males at high altitudes by Weitz et al. (2000) may have certain implications for human populations.

In view of the above circumstances, it is expected that the human adaptive pattern at high altitudes would demonstrate considerable plasticity (Thomas et al., 1979, 1989). It also appears that organisms “avoid a relatively irreversible commitment to genetic change when solutions to environmental problems can be reached through phenotypic plasticity” (Slobodkin, 1968).

Although hypoxia is a primary stressor at high altitude, its direct links with the genetic make-up of populations at high altitude is still a subject of controversy. The single-stress model paves the way for bio-cultural models, which seek to understand the interaction of specific morphological, physiological, behavioural, and genetic processes (Thomas et al., 1989). Thus, genetic adaptation is simply considered one of the several modes of adaptation. Other modes of adaptation include ontogenetic modifications or developmental plasticity, physiological acclimatization, cultural and behavioural adjustments (Lasker, 1969).

Segmented Bio-cultural Model: This model is commonly followed by biological anthropologists in which biological data, such as physiological, genetic, morphological and demographic variables are collected and correlated with socio-cultural or environmental variables. Figure 3 depicts that biological data are the primary focus of attention in the segmented model. Under this model, the focus of study is to understand whether biological variables are associated or correlated with either socio-cultural or ecological variables (McElroy, 1990). It can be observed from

the Figure that the relationship between culture and environment is not fully addressed under the segmented model. In other words, the segmented model does not account in detail for the interplay between culture and environment in relation to biology. For example, the growth and nutritional status of children is correlated with socio-economic status, or with geographical altitude, to simply understand whether growth or nutritional status is affected by altitude or socio-economic status of the population. Thus, the approach in this model is more deductive or deterministic. In other words, growth or nutritional status is assumed to be dependent on socio-economic status or ecological factors. There is a lack of attempt to understand whether altitude or ecological condition is correlated with socio-economic status which is in turn associated with the growth and nutritional status of children.

Integrated Bio-cultural Model: This model depicts the interaction among biological, cultural and environmental variables with respect to certain biological traits or health variables in question (Fig. 4). When the research question is related to health problems, collected data on health indicators are systematically integrated with socio-cultural and other environmental variables.

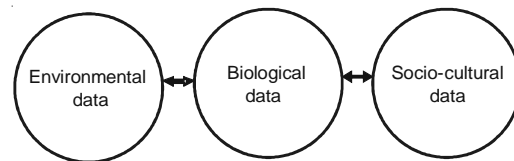


Fig. 3. Segmented bio-cultural model

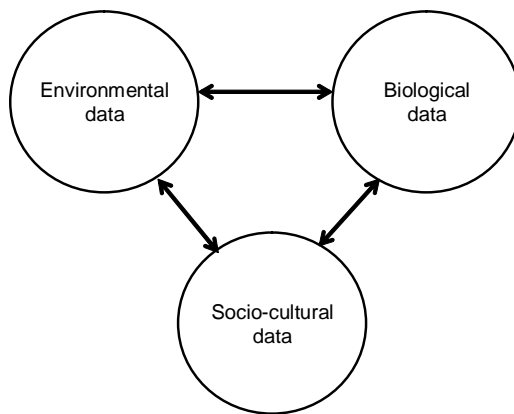


Fig. 4. Integrated bio-cultural model

This model is easy to teach, a bit harder to make a research design, and very difficult to execute in field research (McElroy, 1990). The main assumption in this model is that the interplay between biological and cultural variables is to be looked from historical and/or ecological perspective. For example, the interplay between sickle-cell anemia and culture in West Africa is linked with agriculture and the spread of malaria (Livingstone, 1958). It is observed that the spread of sickling gene is greatly enhanced by the development of agriculture. The clearing of forest for cultivation provides a breeding ground for mosquito (*Anopheles gambiae*) which is the vector of *Plasmodium falciparum* malaria. It is found that the individuals, who are the carriers (heterozygotes) of sickling gene, have a higher immune system against malarial infection when compared with either the normal persons without the gene or with those persons who are homozygous for the gene. There is clear evidence that the frequency of sickling gene is low in hunting and gathering populations as compared to those populations which are more dependent on agriculture. This indicates that the spread of sickling gene is associated with the spread of agriculture because the gene provides a superior fitness to the heterozygous individuals. This is known as selective advantage of the heterozygotes. It provides a good example of the interplay between biological and cultural adaptation of human populations to the environment.

The integrated model also provides a framework to understand not only how biology is interrelated with culture, but also how the latter in terms of behavioural traits is conditioned by biological and environmental conditions. For example, hypervitaminosis A, a condition with an excess of vitamin A due to consumption of the livers and fats of marine and arctic animals, is reported to be responsible for the aberrant behaviour known as *pibloktoq* among Eskimo peoples (Landy, 1985). Such aberrant behaviour could also be linked with socio-economic conditions which may be associated with other biological factors. The integrated model provides a framework for the anthropologists and human biologists to look at the interaction between biology and culture in terms of a sequence of events or variables that are interrelated either directly between culture and biology, or indirectly between them through ecological and historical factors. The model offers a holistic approach to

understanding a given characteristic of human population in a given ecological condition.

Complex Bio-cultural Models: As hinted earlier, a model serves as a device for understanding the interrelationship among various aspects of the system. It can also be modified according to research questions or research design, which may be different according to different circumstances including operational difficulties. This holds true with a bio-cultural model which tends to become more complex with the formulation of new research questions. The study phenomenon in a bio-cultural model is a part of the whole system which is directly or indirectly linked to the survival and well-being of human populations. For example, the vicious-circle model (Fig. 5) indicates that malnutrition leads to a decreased working capacity which again leads to low productivity, poverty, poor living conditions and ill health or diseases (Pacey and Payne, 1985). Thus, the vicious-circle model depicts that malnutrition is influenced by socio-economic condition which is in turn influenced by the former through its effects on body size that is correlated with productivity through physical work capacity. In a developing country, where it is characterized by minimal mechanization, high levels of physical labour are important to obtain the basic needs for the survival and well-being of human populations. Under the vicious-circle model, it is assumed that a deterioration of any character at any point of the circle will affect other aspects of the circle.

However, the assumptions underlying the

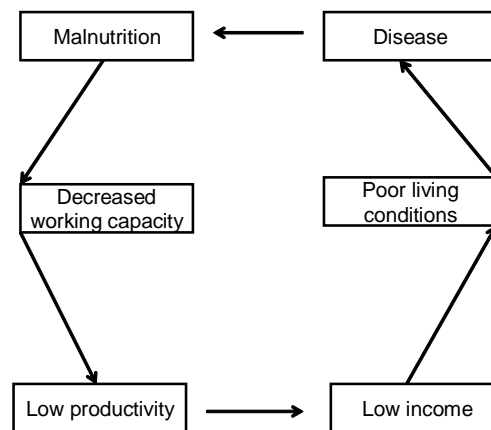


Fig. 5. Vicious-circle model of malnutrition

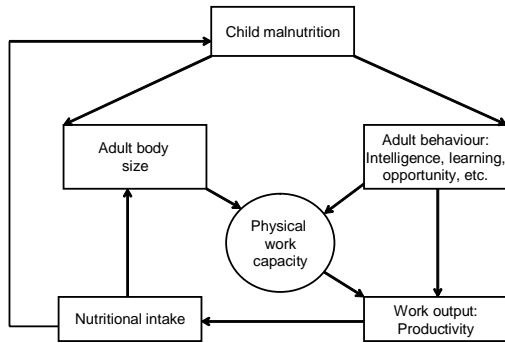


Fig. 6. Simplified vicious-circle model of malnutrition

vicious-circle model can be undermined by other variables depending upon the research design of a given study. Figure 6 shows a simplified vicious-circle model which explains the interrelationship between malnutrition and other morphological, functional and behavioural variables (Martorrel and Arroyave, 1988). The Figure depicts that the effect of malnutrition on working capacity of adults is through childhood malnutrition. Physical work capacity is also influenced by behavioural factors such as intelligence, learning, motivation, opportunity, etc. Therefore, childhood malnutrition leads to small adult body size and poor behavioural condition which jointly affect the individual physical capacity that leads to low

productivity, thereby affecting the current nutritional status of both adults and children. In a more complex model (Fig. 7), environmental quality and market structure can also be considered as important determinants of nutritional status (Ferro-Luzzi, 1985).

OPERATIONAL ASPECTS

It is clear from the presentation given above that bio-cultural approach is very broad just like holistic approach – the conventional ideal of anthropological study of humankind. We may agree with Hruschka et al. (2005) that “In most cases no single researcher can cover the breadth of knowledge, master the variety of research techniques, or collect the diversity of data often necessary for a bio-cultural project.” However, it is also doubtful whether there is such a perfect bio-cultural study from the practical point of view. In addition to the diversity of data required, the interaction between biology and culture is dynamic or an on-going process. As shown in this presentation, a given bio-cultural model gives rise to the formulation of other models, depending upon research questions or research design. It is unlikely for any single researcher to carry out an ideal bio-cultural study. It is the cumulative joint efforts from within and outside the discipline that approximate the ideal bio-cultural study. Indeed, students should be encouraged to begin by

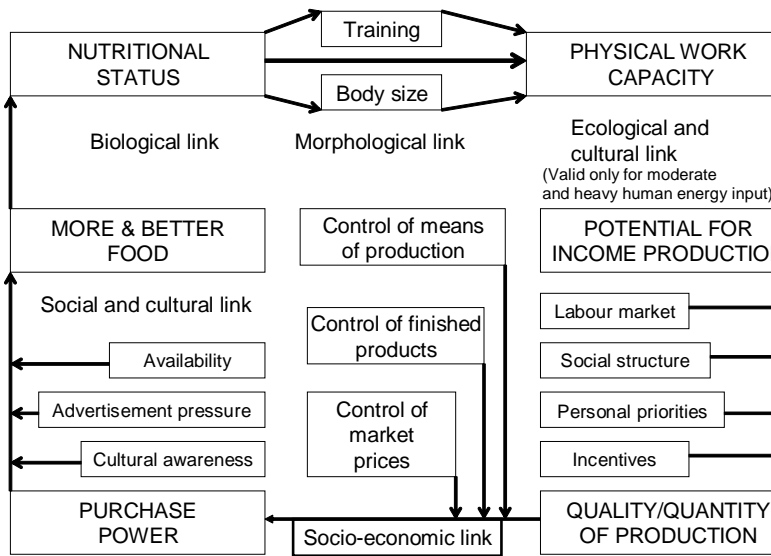


Fig.7. Complex vicious-circle model of nutritional risk

formulating anthropological research questions that are socially relevant and then select methods and techniques from within and outside the discipline appropriate to the task at hand. By formulating research questions that are socially relevant, or related to the survival and well-being of human populations, we are not only delimiting the vast area of bio-cultural study but also popularizing more and more anthropology.

Our capacity for culture, on the one hand, makes us possible to create and manage many aspects of the biotic and physical environments. That very capacity, on the other hand, creates havocs and challenges to the survival and well-being of the different species including our own species. Central to the bio-cultural study is the interaction between biological and cultural characteristics of human populations in relation to the biotic and physical environment. Thus, a bio-cultural approach can be represented differently by means of either a very simple or complex model. In that respect, any study which deals with the relationship/interrelationship between biological and socio-cultural characteristics may be ascribed to the broad perspective of bio-cultural approach. However, a bio-cultural study ought to be designed as a contribution to our understanding of the complex whole of the genotype-environment interaction in which culture plays a very important role. Formulating of meaningful research questions, as discussed earlier, is very crucial in this respect. For example, how long shall we continue to prove that poor socio-economic status in terms of income and/or educational levels is associated with poor nutritional status of populations in developing countries? We tend to forget that income and/or educational levels are the “universal factors” of social and economic change (Khongsdier et al., 2005). What are the role of other socio-cultural factors such as beliefs, ideas and behaviours at a population level that may act as constraints or in congruence with the so-called universal factors in bringing about human biological variation? It is clear that improvement in economic status is crucial for improving the growth and nutritional status of children in developing countries. Whether or not other socio-cultural factors like exogamy or intermixture between populations could also produce significant changes in the growth and nutritional status of children (Khongsdier and Mukherjee, 2003a, 2003b)? The point is that bio-cultural studies may also need

to look more at confounding or mediated socio-cultural factors that shape the apparently statistical relationship between biological traits or health indicators and such commonly reported-independent variables that tend to vary across cultures, or those constructs that are not defined clearly. For example, the relationship between health and racial groups has been largely reported in nutritional, epidemiological and other medical journals, despite evidences that genetic differences between races are negligible (Rosenberg et al., 2002), and the concept of race in public health is of little or no value (AAPA, 1996; AAP, 2000; Cooper, 2003; Karter, 2003). More studies are needed to deal with the genetic and socio-cultural dimensions of health disparities between specific populations or ethnic groups. Similarly, only few studies have dealt with the cultural dimensions of socio-economic differences in health or risks of diseases (Dressler et al., 1998; Dressler, 2004), and so forth.

CHALLENGING TASKS

Bio-cultural approach is not without any problems and challenging tasks. Although it sounds more appealing, the models given above are easy to teach, but subject to operational difficulties in field research. Dufour (2006) has mentioned three types of challenges which include “(1) defining precisely what we mean by constructs like socio-economic status, poverty, rural, and urban; (2) operationalizing key variables so that they can be measured in ways that are ethnographically valid as well as replicable; (3) defining and measuring multiple causal pathways.” For example, poverty is multidimensional; its definition varies according to psychological, social and economic contexts. The question of how to define and measure poverty or socio-economic status in bio-cultural studies still remains to be addressed meaningfully and practicably. Biological anthropologists are more familiar with measuring biological variables than socio-cultural variables. They ought to collaborate more with cultural anthropologists and other social scientists in understanding and measuring the key socio-cultural variables that are likely to influence human biology. More importantly, more integrated courses at the teaching level should be introduced to strengthen the holistic nature of the discipline. In addition, the definitions of physical and biological environmental variables

should also be acceptable to human ecologists, geographers and other environmental scientists. In that regard, the discipline needs to be more trans-disciplinary in nature. Last but not least, the most challenging task is to understand the causal pathways of the complex interaction between culture and biology as roughly depicted by the complex vicious-circle model with multiple variables. Although culture is a means to human adaptation, it has also its limitations – it also creates adaptive challenges to human adaptation especially in this century of faster modernization and globalization. These problems should be taken as challenging tasks of bio-cultural studies in the 21st century. Indeed, these problems should also be considered a guiding force towards greater integration of the sub-disciplines of anthropology as a science of humankind.

CONCLUDING REMARKS

Visualizing and considering any approach as an essence of study for any discipline is often influenced by the author's interest in the subject, irrespective of its limitations and drawbacks. So it is with the case of the present author. However, we ought to acknowledge that science is also to address the physical, mental and social well-being of an individual and group of individuals, thereby making a healthy nation and ultimately a better world. Anthropology as a science of humankind in time and space needs to be more popularized itself through its contribution to the scientific thought in general and to the survival and well-being of human populations in particular. In so doing, it ought to be more integrated, and it also needs to formulate more research questions that are socially relevant. Bio-cultural approaches and models with many challenging tasks of social relevance may be considered the most effective ways to formulate and address research questions that are socially relevant in the 21st century.

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KEYWORDS Bio-cultural Approach. Research Questions. Models

ABSTRACT This paper is concerned with a bio-cultural/bio-social approach to the study of human variability. The basic premise is that the bio-cultural approach is essential for anthropological study of the survival and well-being of human populations in the 21st century. The chapter is delimited to two basic questions: What and why is bio-cultural approach? How is to go about it? Addressing the first question, it is suggested that bio-cultural approaches should be taken as essential not only for bridging the gap between cultural and biological anthropology but also for popularizing anthropology with *integrative thinking* especially in India. It is also suggested that anthropology in the 21st century needs to formulate and deal more with research questions that are socially relevant. With respect to the second question, an attempt has been made to provide an overview of different bio-cultural models/paradigms, based on series of assumptions and relationships, which can be modified with new research questions relating to human biological variability – the subject matter of anthropological research. In addition, the operational aspects and challenging tasks for bio-cultural studies were briefly highlighted.

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