

**Joint Meeting of the Society for the Study of Human Biology (SSHB)
and
The Japan Society for the Study of Physiological Anthropology (JSPA)**

Human Variation - from the laboratory to the field

Session 1: A Review of Studies of Human Variation

1. From history of anthropometry to anthropometric history

Stanley Ulijaszek (University of Oxford, UK) and John Komlos (University of Munich, Germany)

Biological and cultural variation among human populations was of great interest in the nineteenth century. Although Charles Darwin proposed mechanisms of natural selection to have operated to generate human biological variation, ideas of biological difference between human populations had become formalized into notions of race by the nineteenth century. The creation of racial typologies and the use of morphology and classification continued to be the methods of anthropology into the twentieth century, the physical anthropology of the first half of the twentieth century being concerned almost totally with palaeoanthropology, racial origins, typologies, affinities and classifications. The ideas of typology and classification were challenged and overturned in the second half of the twentieth century with the empirical testing of evolutionary and ecological mechanisms for human biological variation. However, anthropometric descriptions of samples of adults and children have been useful in the determination of health risks of individuals and populations from the early twentieth century onward. The new biological anthropology of the mid-twentieth century embraced the idea of anthropometry as a measure of plasticity and nutritional health and rejected its use in taxonomy. The reframing of the anthropometric method for adaptability research reflected newer understandings of human physical plasticity and health, as determined by physical human growth patterns, and placing this in evolutionary context.

Anthropometry as measure of human well-being (or otherwise) gained great public health valency in the second half of the twentieth century. Most recently, this has been extended to the understanding of human well-being and the biological quality of life in the past. This presentation traces changes in the use of anthropometric methods from the time of Darwin into the twenty-first century.

2. Factors and forces influencing human genetic variation

Alan Bittles (Murdoch University, Perth, Australia)

Information on the structure and composition of the ancestral *H. sapiens* gene pool is inferential, with conflicting opinion as to whether admixture with archaic *Homo* species occurred. Yet resolution of this question is important in assessing the Multi-regional and Out of Africa theories of human evolution. A wide range of techniques have been employed to identify and typify present-day genetic variation on the Y-chromosome, mtDNA and autosomes, including STRs, SNPs, *Alu* repeats and copy number variants, with mtDNA and nuclear whole genome analysis an increasingly accessible and viable option. The extent and nature of genomic

variation between ethnic populations, and the potential application of differences to disease diagnosis, is controversial. In all populations the influence of selection, as opposed to founder effect and drift, in determining the composition of the *H. sapiens* gene pool remains unclear and is probably population-specific. To date, the influence of demography and patterns of social organization on gene pool structure have been under-investigated. Recent studies have indicated the importance of such factors, and suggested the need for modification of widely accepted facets of human population genetic variation, such as patrilocality and matrilocality. The further integration of population demographic history with genome-based studies should help to clarify the regional and ethnic origins claimed by specific communities. Resolution of these various questions is important if the Genographic Project and HapMap are to fully achieve their aims. However, progress may be hampered by the absence of credible supporting anthropological data and appropriately rigorous study design.

3. Growth and maturation: interactions and sources of variation

Robert Malina (Tarleton State University, Stephenville, USA)

The integrated nature of growth and maturation is maintained largely by interactions of genes, hormones, nutrients and energy. Considerable advances have been made over the past few decades in our understanding of genes, hormones and nutrition in the context of the regulation of growth and maturation and as sources of variation in growth and maturity status. Habitual physical activity as a major factor affecting energy requirements of children and adolescents is a topic of considerable current interest in the context of the worldwide epidemic of childhood and adolescent obesity and of the functional consequences of chronic undernutrition. Other factors associated with growth, maturation and physical activity include social circumstances, family composition, ethnicity, climate, among others. Their influences are complex and involve interactions with genes, hormones, nutrients and energy as well as with each other.

4. Diversity of human adaptability to environments from a physiological anthropology perspective

Akira Yasukouchi (Kyushu University, Japan)

Diversities in morphology and function exist in all species, including *Homo sapiens*. However, the question of whether such diversities reflect original 'diversities of adaptability' in humans, especially those living in modern societies, remains unresolved. Humans have innovated artificial environments totally different from those of hunter-gatherers within a short period of time, and have since continued to seek comfort by adapting to occasional alterations in the persistently changing environment which, if any, aspects of morphology or function are adaptations to technological environments remain to be evaluated. What constitutes truly healthy and comfortable environments is examined here by focusing on the diversity of human adaptability based on physiological anthropology, or physiological polymorphism, functional potentiality and whole body coordination.

Session 2: Methods and Analytical Techniques

1. Physiological methods in body composition and physical function-challenges imposed by variability

Katherine Brooke-Wavell (Loughborough University, UK)

A range of methods may be used to study variability in the composition and physical function of the human body. However, variability may create challenges to their interpretation, some of which can be exemplified by considering age-related differences. Many methods depend to some extent upon assumptions, but the validity of these may be affected by the very variability that is being studied. For instance, many techniques for assessing human body composition, in both laboratory and field, involve assumptions regarding the composition of body components, but this may differ with age. Interpretation of bone mineral density may be affected by age-related changes in bone geometry.

Measures of physical function vary from the controlled, laboratory based techniques, to more applied measures that might relate to ability to perform everyday activities and the field or clinical tests that require more portable or less specialised equipment. Variability in physical ability, as occurs with age, may affect the appropriateness or interpretation of some of these measures of physical function. Whilst some might be robust across a range of abilities, others need to be individualised or may be appropriate only across a narrow range of abilities. Some methods may be invalidated in some disease states, which may become more prevalent with age, whilst others may be less acceptable to older or frailer people, causing potential biases in recruitment. Choosing a physiological method may thus require consideration of validity, suitability for target population, acceptability and feasibility.

2. Tissue and cell adaptability to physical and chemical factors

Susumu Kudo (Shibaura Institute of Technology, Tokyo, Japan)

Endothelial cells (ECs) that line the inner surface of blood vessels are continuously exposed to physical factors such as fluid frictional forces (shear stress) induced by blood flow, and to chemical factors such as oxygen and hormones in the blood. Once thought to be simply a passive barrier, the ECs are now recognized as being a dynamic participant in the biology of blood vessels. ECs are affected by physical and chemical factors, and their function and morphology adapt to physical and chemical factors. The change of EC functions are considered to be largely concerned with the circulatory system in the human body. This chapter describes cell and tissue adaptability to physical and chemical factors in the circulatory system, focusing on adaptability in morphology, mass transport, cell signaling (calcium ion signaling) and energy synthesis (ATP synthesis) to the magnitude of shear stress.

3. Effect of environmental light on human gastrointestinal activity – from laboratory to fieldwork

Yoshiaki Sone (Osaka City University, Japan) and Yosuke Kusano (Nagasaki Wesleyan University, Japan)

In laboratory condition, it can be shown that daytime dim-light exposure has a negative effect on the efficiency of dietary carbohydrate absorption in the evening, while evening time dim-light exposure has a beneficial effect on it. These results suggest that seasonal changes in environmental light may affect gastrointestinal activity, and that there might, therefore, be a seasonal variation in the efficiency of dietary carbohydrate absorption from the intestine. To examine this, the amount of dietary carbohydrate unabsorbed from the intestine after a breakfast in young and elderly Japanese and Polish subjects who were living their everyday life during four seasons of the year in 2004, 2005 and 2006 was measured. The amount of unabsorbed dietary carbohydrate was estimated by the breath hydrogen test. Six grams of lactosucrose, an indigestible trisaccharide, was used for comparison. Results obtained from the fieldwork support the hypothesis that there is seasonality in the efficiency of dietary carbohydrate absorption, which was worse in winter in both groups.

4. Research designs and statistical methods

Nicholas Mascie-Taylor (University of Cambridge, UK)

Research design and statistical methods are key elements in conducting successful research. This chapter examines the various types of study design, broadly divided into descriptive and analytical and describes their advantages and disadvantages and when best to use a specific designs in relation to laboratory and field studies. It goes on to consider the size of the sample required, and the assumptions underlying the methods used in power calculations. The importance of accuracy of measurement and determination of technical errors and reliability are discussed. The final section covers statistical methods with emphasis on small sample sizes.

Session 3: Factors Influencing Human Variation

1. The genetics of anthropometric and physiological characters

Tony Comuzzie (Southwest Foundation for Biomedical Research, San Antonio, USA)

The vast majority of phenotypes related to anthropometric and physiological phenotypes represent complex biological phenomena resulting from the involvement of multiple genes and strong interactions both between genes as well as between genes and the environment. However, because of their complex etiology, these traits do not yield to simple Mendelian analysis. Initially for such complex phenotypes we were generally limited to the estimation of heritability (i.e., the estimation of the overall genetic contribution to the variance) and this was latter followed by analyses that allowed for the estimation of major gene effects, but still did not provide the identification of the specific genes involved. Beginning a little over a decade ago advances in both analytical and molecular techniques made it possible to undertake genome-wide analyses in large extended pedigrees allowing for the detection of specific regions of the genome harboring a gene or genes influencing a complex trait. Now in the post-genomic era,

we have the tools which are now allowing us to identify the specific genetic polymorphism underlying the observed variance in complex phenotypes.

Evidence is now rapidly accumulating which demonstrates the feasibility of identifying the underlying genes influencing quantitative variation in complex phenotypes such as those represented by anthropometrics and physiological characters by using a combination of molecular and statistical approaches. A number of specific functional genes that influence complex phenotypes in humans have recently been successfully identified and the list is growing steadily. In this presentation we will discuss the genetic architecture that underpins anthropometric and physiological traits and review the state of the science regarding the identification of the responsible genes.

2. Lifestyle and cold tolerance in modern society

Takafumi Maeda (Hokkaido University, Japan)

Whole body cold tolerance can be evaluated by the suppression ability of heat loss and the ability of heat production. In modern societies especially Japan, temperature is set using air-conditioning systems (both cooling and heating). So indoor temperature is controllable within a comfortable range throughout the year. Moreover, it is considered that the nutritional status and its balance in young people in Japan is not good because of the use of convenience foods. Lifestyle such as using the air-conditioning system and the convenience store also effects basal metabolic rate.

This chapter examines the relationships between basal metabolic rate, body composition, air temperature and questionnaires regarding lifestyle for 37 subjects. It also examines the relationships between basal metabolic rate and cold-induced heat production in 10 male subjects.

The suppression ability of heat loss in the cold means the ability to reduce skin temperature, which is dependent on the capacity to undergo vasoconstriction. In this regard the results concerning the relationships between vasoconstriction ability and physical fitness are also discussed.

3. Variation in circadian photo-sensitivity to light - individual, seasonal and ethnic differences in suppression of melatonin by light

Shigekazu Higuchi (National Center of Neurology and Psychiatry, Tokyo, Japan)

Melatonin secreted from the pineal gland is controlled by a biological clock. It is suppressed by exposure to light, this being thought to reflect human circadian photo-sensitivity to light. There are large individual differences in melatonin suppression by light. In the present study, two experiments were carried out to identify the seasonal and ethnic variations in melatonin suppression by exposure to light in Akita (39° North), in the northern part of Japan. First, ten healthy male young adults were exposed to light (1000 lx) for two hours at night in winter and summer. Salivary samples were collected before exposure to light and during exposure to light. The percentage of melatonin suppression was significantly larger in winter (66.6 % +/- 18.4) than in summer (37.2 % +/- 33.2). Average level of daily ambient light to which each subject was exposed was significantly lower in winter (183.5 lux) than in summer (357.5 lux). This

suggests that increased suppression of melatonin in winter is caused by less exposure to daily ambient light. Increase in circadian photo-sensitivity to light is thought to be an adaptation to lower exposure to light in winter. In the second experiment, ten healthy light-eyed Caucasians and eleven dark-eyed Asians were exposed to light at night. The percentage of melatonin suppression was significantly larger in light-eyed Caucasians (88.9 +/- 4.2%) than in dark-eyed Asians (73.4 +/- 20.0%). The sensitivity of melatonin to light suppression in light-eyed Caucasians was higher than that in dark-eyed Asians, suggesting that circadian photo-sensitivity to light is related to eye pigmentation and/or ethnicity.

4. Geography, migration, climate and environmental plasticity as contributors to human variation

Michael Little (Binghamton University, SUNY, USA)

Humans are highly mobile and have migrated to inhabit nearly all of the existing global land surface. Movement began out of Africa by *Homo habilis* or *Homo erectus* nearly two million years ago into Asia and Europe, then again from Africa about 100,000 years ago by *Homo sapiens* to diffuse throughout the Old World. Later migrations of modern *Homo sapiens* led to the habitation of Australia, the New World, and the Pacific. These geographic areas of the world ranged from warm tropical to cold temperate and even to frigid Arctic zones, each zone presenting different stresses from climate, disease, predation, topography, and food needs. The behavioral plasticity of humans, including technology and material culture, is what enabled them to migrate into inhospitable geographic areas where they became exposed to environmental stresses of all kinds. The worldwide population variation that we see in humans today is a reflection, in part, of this ubiquitous distribution of humans throughout highly varied geographic environments.

In this chapter, I shall discuss past and present migration patterns and the effects of migration on human health and adaptability or plasticity. Based on biogeographic survey and both field and laboratory experimental studies in extreme environments on selected populations, we know that most humans can survive in most environments, but there are costs in health and well being. Research designs comparing humans who remain and those who migrate have been a productive means to explore human plasticity and variation. These designs are also productive as a means of speculative prediction on the influences of global climate and biodiversity changes on human adaptability.

Session 4: Linking Laboratory and Fieldwork

1. Human adaptability to emotional and intellectual mental stress

Koichi Iwanaga (Chiba University, Japan)

Although humans have adapt to many environmental, physical, and mental stresses, many of these stresses have been conquered by recent technological development. However, the promotion of technological application to our daily lifes has brought with it new stresses. Overeating, decreases in physical activity, long-lasting VDT works, office and at home, constant temperature and lighting environments, automation are documented with in the several metabolic diseases and symptoms of neuromuscular disorder. These techno-stresses and the human adaptability to them are considered among of the most important subjects of physiological anthropology. Human adaptability to techno-stress is called “techno-adaptability”.

One of the approaches of techno-adaptability is in regard of mental stress due to information processing in central nervous system. Mental stress has both emotional and intellectual components. Emotional stress is considered to be generated in the limbic system and is common to humans and many animals. Intellectual stress is considered to be generated by sophisticated information processing in the neo-cortex interconnected with the limbic system. This type of mental stress is unique to human beings, especially those engaged in city life. In this paper, emotional and intellectual mental stresses are compiled the biological significance of adaptation to both types of stresses in humans is discussed.

2. Pollution, variation, and adaptation

Larry Schell (SUNY at Albany, USA)

Industrial pollution was not present during hominin evolution until only a few hundred years ago, and modern humans may have limited capacity to adapt to pollution exposure without detrimental effects. There is considerable evidence that many types of pollutants may produce decrements in physiological systems including those involved in growth, maturation, and reproduction. There are however, serious challenges in the study of such effects. Observational studies of human populations have appropriate limitations to limit risk to participants, and the possibility of true replication of exact exposure and co-varying conditions is rare, thereby producing the impression that each finding is unique. Experimental studies of laboratory animals provide information of some generalizability to humans and allow for more control of variables, endless replication, and more certainty regarding cause and effect relationships. Experimental laboratory studies are most useful to interpret associations discovered in observational studies of human populations and to guide the selection of endpoints for study in human populations.

Certain types of associations involving pollutants are of special interest to human biologists. Inhibited cognitive development, slowed or accelerated sexual maturation, interference with fertilization and implantation, more frequent spontaneous abortion and premature delivery, inhibited early growth, and increased mortality, especially of pre-reproductive mortality, are of special interest as they pertain to the possibility of human evolution in response to pollutants. Available evidence suggests that certain pollutants do have some of these effects. Additionally, there is evidence of varying susceptibility to pollutant effects which are related to polymorphisms of xenobiotic metabolizing enzymes (e.g., CYP 450s). With the development of this area of research, it has become clear that the effects of pollutants are highly variable and generalizations about pollutants as one category of influence will give way to more specific statements of relationships. Given their ubiquity and potential for influencing physiological systems, the subject is an unavoidable if challenging subject for human biologists.

3. Bridging the gap between laboratory trials and the reality of the human in context – an environmental ergonomics view

Neil Mansfield (Loughborough University, UK)

Each environment and context is different. Therefore, it can be difficult to transfer findings from one setting into another. When working in the field, techniques are used which define the framework in which data is collected, analysed and reported. Practical frameworks inevitably constrain measurements, as it is not possible to entirely account for the local environmental conditions; therefore it is often desirable to perform work in the laboratory, to normalise, or

control, these conditions. A problem arises when results from the laboratory are to be used in the field. One example of such a problem is that of vibration risk assessments for those operating power tools in construction. Power tool manufacturers are required to 'declare' the vibration emission of the tool, measuring according to specific laboratory test codes which are designed to be repeatable. However, when the tool is measured in the workplace the vibration emission depends on task, operator, operation style, material being worked, etc. Thus, the requirement for a 'fair' and repeatable laboratory test code compromises the validity, as it cannot account for the inherent variation in risk. Similarly, extensive laboratory work has developed techniques of predicting discomfort in vehicles, and these methods work well under well controlled conditions with trained experts. However, data shows that if vehicles are used in their intended environments, the validity of these methods reduces, due to cross-modal interactions and other contextual factors. This contribution discusses these problems of context, and provides suggestions for practical solutions.

4. Impact of natural environmental stressors on physiological processes: methodological approaches in the laboratory and field

Ralph Garruto (Binghamton University, SUNY, USA)

The theme of Session 4 links laboratory and fieldwork in understanding the impact of environmental stressors on physiological processes. Scientists have long recognized that both laboratory and field methodologies each contribute towards an understanding of human biological variation in physiological processes. However, each approach has limitations. For instance, highly accurate physiological data can be obtained under controlled laboratory conditions, but the environment is artificial and the number of individuals studied is often very small, limiting our understanding of human variation in natural populations. Likewise, in human populations living under natural conditions, field methodological approaches, while increasing dramatically the sample size, accuracy of field methods and measurements often come into question. As a result, the methodological approaches of environmental physiologists and biological anthropologists (human population biologists) are sometimes at odds.

This chapter will explore the issues of human biological variation in physiological processes in both field as well and laboratory settings and demonstrate how these two approaches can be synergistic, rather than divisive. Suggested field and laboratory approaches will meld two seemingly different methodologies to identify patterns of "normal" human variation, address questions of adaptation and evolution of human populations using a systems biology approach, consider issues of inter- and intra- population variation, genetic causality and phenotypic distributions, and consider sampling strategies, selection of measurements and equipment, and methodological standardization.

Session 5: Poster Session

Systolic blood pressure is elevated during hot flashes in women at mid-life: the Hilo Women's Health Study

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High visceral fat accumulation combined with low diabetes prevalence: a transient phenomenon of the Kenyan Maasai?

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The Iberian growth: prevalence of overweight and obesity in Portuguese and Spanish children

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Does 12 weeks of physical training modify the range of individual variation in orthostatic haemodynamic responses in sedentary men?

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Effects of illuminance and colour temperature of lightning on taste threshold and saliva secretion in Type A and Type B individuals

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Circulatory responses to mental task at an interval of one year and intervals of several days

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Changes in cerebral hemodynamics and cognitive-task performance after caffeine intake: individual differences and a high inspired oxygen concentration experiment

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Nature and comfort: an approach from the laboratory and the field

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Relationship between initial value and relative change to stimulation in some physiological parameters

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Physiological responses induced by volatile organic compound from Japanese cedar

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Psychosocial stress and intraocular pressure among public school workers

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