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Institute of Evolutionary Medicine
Institut für Evolutionäre Medizin
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IEMNews

A Tsimane' family living in the Bolivian Amazon. The Tsimane' lifestyle is characterized by natural fertility, daily subsistence activity, small communities, and high pathogen loads. However, many Tsimane' are integrating into the market economy, with associated changes in lifestyle

Image © A. Jaeggi

What indigenous people can teach us about health in the modern world

Many of the diseases and chronic health problems that plague the modern world – heart disease, hypertension, obesity, type 2 diabetes, etc. – arguably arise from mismatches between the environments to which our ancestors adapted, and the environments in which we find ourselves today. We eat processed foods high in fat and sugar and low in fiber, spend most of our days sitting in chairs, and are largely free of parasites. Conversely, people who maintain or have returned to a more traditional lifestyle, characterized by daily subsistence activities and high pathogen burdens have relatively healthy hearts and metabolisms.

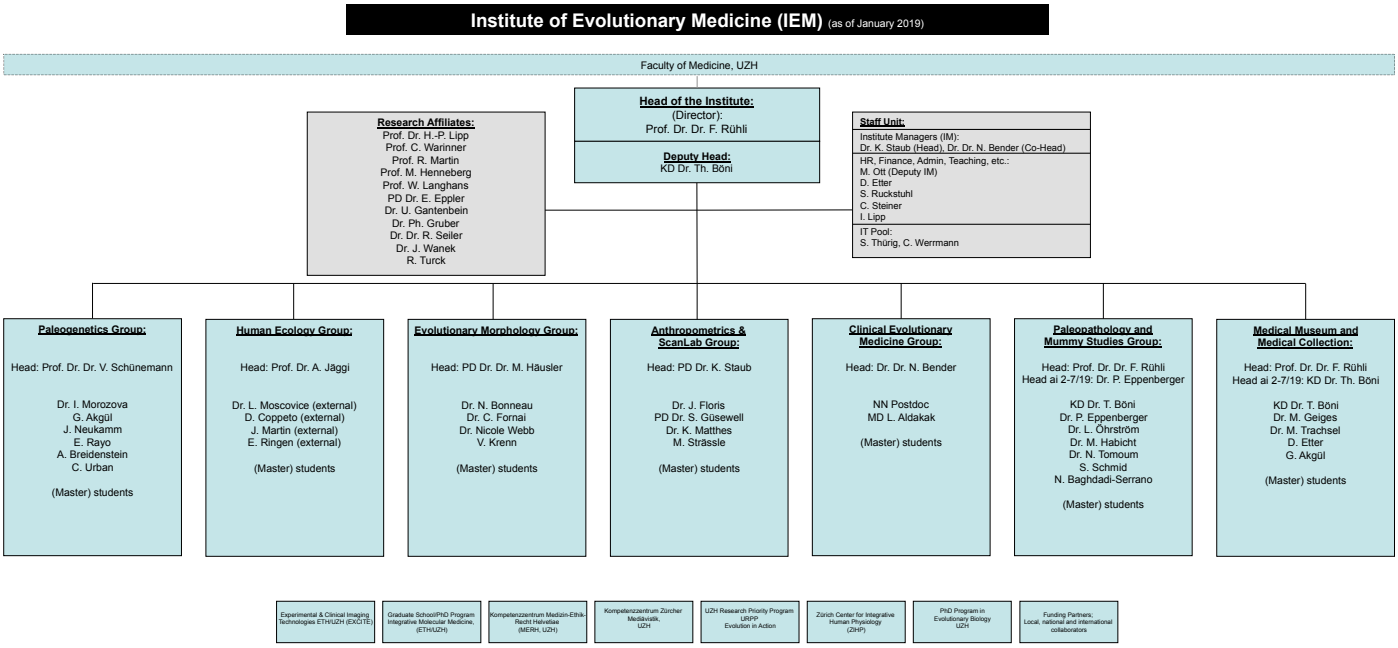
This pattern is exemplified by the Tsimane' of Bolivia, an indigenous group of about 15'000 people who subsist mostly by hunting, fishing, and simple farming. Since 2002, the Tsimane' Health and Life History Project has studied them in great detail, collecting data on their social and economic lives as well as a wealth of biomedical markers, while also providing basic health care. Consequently, the Tsimane' have become a model for metabolic and cardiovascular health, having extremely low levels of hypertension, type 2 diabetes, or coronary artery disease. At the same time, many Tsimane' communities are rapidly integrating into the larger market economy, and consumption of food additives such as sugar or oil are on the rise, along with body weight and BMI. These lifestyle changes, occurring in the context of a population-wide data collection effort, will help us identify specific risk factors for chronic disease.

What about non-physical conditions, such as mental health, or social disorders? Are anxiety, depression, or autism also diseases of civilization, produced by evolutionarily novel social environments? Again, the Tsimane' people can provide some clues. For instance, there is considerable variation in psychological well-being, with people who are less productive (due to senescence, illness, etc.) reporting higher levels of anxiety and depression; conversely, people who are productive members of society are happier. Since productivity has clear fitness benefits in this population (through provisioning of kin, gain in social status, etc.), these findings support the notion that psychological well-being has been designed by selection to motivate the pursuit of adaptive goals. In modern societies filled with celebrities, social media, and large anonymous cities devoid of kin, there may be a mismatch between what people perceive such goals to be and what is actually attainable, possibly increasing the risk for chronic anxiety or severe depression. Future work aims to investigate social disorders such as autism or schizophrenia, to test evolutionary hypotheses such as that these conditions inevitably arise at the extremes of a distribution of social cognition, result from sexual selection for productivity or charisma, or correlate with slower or faster life history strategies, respectively. This will help us better understand the origins of these disorders, and their distribution in modern environments.

Lastly, comprehensive studies such as the Tsimane' project allow us to ask how the social environment contributes to chronic disease risk. In Western societies, relative socio-economic status and arguably also the strength of status hierarchies (as measured by economic inequality) are strong determinants of health and well-being, probably acting through mechanisms related to chronic psychosocial stress and its many deleterious effects on the body. Recent changes in Tsimane' lifestyles and the influx of material goods have seen an increase in economic inequality in some communities, and their traditionally egalitarian social hierarchies have become steeper. Current research investigates the consequences of these changes for psychosocial stress and various health outcomes.

Prof. Dr. Adrian V. Jaeggi

IEM organigram



Vision and mission statement

We are a leading international and globally connected research, teaching and service institute which is part of the medical faculty at the University of Zurich. We analyse ancient biological material and associated data to better understand modern human health issues and diseases. Due to specialist scientific expertise, excellent infrastructure and state-of-the-art methodologies, we are able to work on various interdisciplinary research questions in the context of the field of Evolutionary Medicine. Our core competencies include:

- In the area of morphology: Clinical Anatomy; Variability and adaptation of body morphology as a function of sex, robustness, time (Microevolution), socio-economic factors (etc.); Macroevolution of joint pathologies.

- In the area of imaging: application of modern imaging techniques (MRI, terahertz) on historical tissues; Radiological diagnosis of pathologies.

- In the area of ancient DNA: Co-evolution of diseases and the human genome (evolution of human pathogens, microbiome analyses etc.); Service for Archaeology/Historical Anthropology (paternity testing, sex determination).

- Maintaining the historic Medical Collection for both scientific research and inter-museal exchange.

- Ethical considerations for research on historical human tissues.

We will increase the recognition of the research field of Evolutionary Medicine and expand academic teaching of the subject within and outside the Faculty of Medicine. This will be of a sustainable value for our stakeholders at the University of Zurich, in the research community of evolutionary medicine and adjacent areas, to the economy and ultimately for society in general.

Words from our international collaboration partners

Mislav Čavka, Assist. prof., M.D., Ph.D.
University of Zagreb, School of Medicine and
University Hospital Centre «Zagreb»

The Egyptian collection is one of the most exciting collections of the Archaeological Museum in Zagreb. It has been continuously expanded to include many more ancient Egyptian objects since its foundation in mid 19th Century upon the so-called Zagreb mummy and its linen wrappings, known as the «Liber linteus Zagrabiensis». This manuscript turned out to be the longest preserved text in Etruscan language and is the only preserved Etruscan text with literary features. The origins of the mummy and the «Liber linteus Zagrabiensis» are still unknown. They both most likely originate from ancient Egypt, but it has jet to be understood, why the text was written in Etruscan. A plausible hypothesis is that a community of Etruscan refugees lived in Ptolemaic Egypt and adapted some of the local customs (including mummification).

In a current collaboration project with the Paleopathology and Mummy Studies Group of the IEM, we shall attempt to better understand the origin and time setting of the Zagreb mummy and the «Liber linteus Zagrabiensis». Besides 14C dating, we plan to analyze ratios of stable isotopes 86,87Sr and 204,206,207,208Pb in enamel and dentin of one of the mummy›s teeth. We plan to analyze stable isotopes of all mummies from the Collection (in total five whole mummies and three mummified heads) and try to correlate the results with the mummies' dental health status. We also plan to conclude the collaboration on the mummy from the Zagreb Cathedral, which is a Christian relic, believed to be a child mummy from Herod's Biblical massacre.

Earlier cooperation with the IEM led to the joint publication of the very first research-article on diagnostic imaging of ancient Egyptian canopic jars, for which we examined a small series of ancient Egyptian canopic jars from the Archaeological Museum in Zagreb, as well as to several scientific abstracts presented at international conferences. I am therefore looking forward to many more equally successful joint research projects.

Words from a new member of the IEM

Christian Urban, MSc
PhD Student Paleogenetics Group
Paleogenetics Group

My first encounter with paleogenetics was during my biochemistry bachelor at the University of Tübingen. I was amazed by the possibilities that DNA extraction from thousands of years old tissue offers. We can open a door to the past and witness evolution across millennia on a sub-cellular level. I started to work as a student assistant in the Paleogenetics Group with Verena Schünemann in Tübingen and also did my Bachelor's Thesis on M. tuberculosis in medieval skeletons there. During my consecutive Master studies at the University of Tübingen, I continued my work in the Paleogenetics Group. In 2018, I concluded my studies with my Master's Thesis on gene expression and viral particle formation of the feline calicivirus at the Friedrich-Loeffler-Institute in Greifswald. My major scientific interest lies with bacterial and viral pathogens. Pathogen origin, spread, and co-evolution with its host are fascinating topics. We can learn so much for the future by looking at the past. This is also reflected in my two major projects for my PhD studies at the Institute of Evolutionary Medicine.

For my first research topic, I take a look in the past. I try to assess the general bacterial pathogen prevalence in ancient Egypt. Therefore, I will work with mummy samples originating from various locations and time points from ancient Egypt. My first goal is to identify human pathogens present in my samples. Further analysis will then be applied to place the new data in context with previous study results, assess pathogen spread, and identify differences to modern pathogens. On the one hand, my results will present new archeological information, thereby filling and coloring the mosaic of the past. On the other hand, the results of past pathogen dispersal, adaption, and evolution contributes to our general understanding of modern pathogens.

My second research project addresses a pressing, modern topic: zoonoses. Most newly emerging human diseases and many re-emerging ones are zoonoses originating from animal wildlife. Recent examples for newly emerging zoonoses causing severe outbreaks are SARS, HIV, avian influenza, and Ebola. Animal populations can function as pathogen reservoirs and play an important role for re-emerging zoonoses and introduction of newly emerging zoonoses to human populations. Therefore, a general screening of pathogen prevalence – bacteria and viruses – in animal populations is essential for a general risk assessment and disease containment. In collaboration with the Vetsuisse Faculty, we will screen potential pathogen reservoir populations of the Swiss animal wildlife. Our long-term goal is to establish a nation-wide database for pathogen prevalence in animal wildlife. This will allow for early detection of emerging and re-emerging diseases and accurate risk assessment.

The Institute of Evolutionary Medicine is the perfect place for the past and future dualism of my PhD research. I am proud to be a part of this highly interdisciplinary institute and I am looking forward to contribute my part to future intra-institute collaborations.

IEM-publications (selected publications since last IEM News Sept/2018)

Askari Z, Mas-Coma S, Bouwman A et al. (2018). Fasciola hepatica eggs in paleofaeces of the Persian onager Equus hemionus onager, a donkey from Chehrabad archaeological site, dating back to the Sassanid Empire (224-651 AD), in ancient Iran. Infection, Genetics and Evolution, 62:233-243.

Brockbals L, Habicht M, Hajdas I et al. (2018). Untargeted metabolomics-like screening approach for chemical characterization and differentiation of canopic jar and mummy samples from Ancient Egypt using GC-high resolution MS. The Analyst, 143(18):4503-4512.

Burlakoti A, Kumaratilake J, Taylor J et al. (2019). Asymmetries of total arterial supply of cerebral hemispheres do not exist. Heliyon, 5(1):e01086.

Chekalin E, Rubanovich A, Tatarinova T et al. (2019). Changes in biological pathways during 6,000 years of civilization in Europe. Molecular Biology and Evolution, 36(1):127-140.

Ferrari G, Lischer H, Neukamm J et al. (2018). Assessing Metagenomic Signals Recovered from Lyuba, a 42,000-Year-Old Permafrost-Preserved Woolly Mammoth Calf. Genes, 9(9):436.

Furtwängler A, Reiter E, Neumann G et al. (2018). Ratio of mitochondrial to nuclear DNA affects contamination estimates in ancient DNA analysis. Scientific Reports, 8(1):14075.

Jeong C, Bouwman A, Trachsel C et al. (2018). Bronze Age population dynamics and the rise of dairy pastoralism on the eastern Eurasian steppe. PNAS, 115(48):E11248-E11255.

Knauf S, Gogarten J, Schuenemann V et al. (2018). Nonhuman primates across sub-Saharan Africa are infected with the yaws bacterium Treponema pallidum subsp. pertenue. Emerging Microbes and Infections, 7(1):157.

Liao W, Suendermann C, Steuer A et al. (2018). Aldosterone deficiency in mice burdens respiration and accentuates diet-induced hyperinsulinemia and obesity. Journal of Clinical Investigation Insight, 3(14):e99015.

Minocher R, Duda P, Jaeggi A (2019). Explaining marriage patterns in a globally representative sample through socio-ecology and population history: A Bayesian phylogenetic analysis using a new supertree. Evolution and Human Behavior, 40(2):176-187.

O'Sullivan N, Posth C, Coia V et al. (2018). Ancient genome-wide analyses infer kinship structure in an Early Medieval Alemannic graveyard. Science Advances, 4(9):eaao1262.

Öhrström L, Scheer I, Seiler R et al. (2018). Multifocal bone lesions in an ancient Egyptian child mummy. Journal of Archaeological Science: Reports, 22:93-99.

Schuenemann V, Kumar L, Barquera R et al. (2018). Historic Treponema pallidum genomes from Colonial Mexico retrieved from archaeological remains. PLoS Neglected Tropical Diseases, 12(6):e0006447.

Seiler R, Eppenberger P, Rühli F (2018). Application of portable digital radiography for dental investigations of ancient Egyptian mummies during archaeological excavations: Evaluation and discussion of the advantages and limitations of different approaches and projections. Imaging Science in Dentistry, 48(3):167-176.

Seiler R, Öhrström L, Eppenberger et al. (2019). The earliest known case of frontal sinus osteoma in man. Clinical Anatomy, 32(1):105-109.

Van Schaik K, Eisenberg R, Bekvalac J et al. (2019). Evaluation of lesion burden in a bone-by-bone comparison of osteological and radiological methods of analysis. International Journal of Paleopathology, 24:171-174.

Väre T, Galassi F, Niinimäki J et al. (2018). Potential case of gynecomastia in mummified remains of an early modern period northern finnish vicar. Clinical Anatomy, 31(5):641-644.

Vinci L, Krieger JP, Braun J et al. (2019). Clustering of sociodemographic and lifestyle factors among adults with excess weight in a multilingual country. Nutrition, epub.

Wyss T, Roos L, Studer F et al. (2018). Development of physical fitness performance in young Swiss men from 2006 to 2015. Scandinavian Journal of Medicine & Science in Sports, epub.

You W, Rühli F, Henneberg R et al. (2018). Greater family size is associated with less cancer risk: an ecological analysis of 178 countries. BMC Cancer, 18:924.

New IEM-members

The IEM is happy to welcome the following members to the institute:

- Norina Gassmann, Dr. med. Student Anthropometrics Group
- Prof. Dr. Adrian Jaeggi, Head Human Ecology Group
- Viktoria Krenn, PhD Student Evolutionary Morphology Group
- Prof. em. Dr. Wolgang Langhans, Academic Guest
- Dr. Liza Moscovice, Postdoc Research Assistant Human Ecology Group
- Christian Urban, PhD Student Paleogenetics Group
- Dr. Nicole Webb, Postdoc Research Assistant Evolutionary Morphology Group

Editorial
PD Dr. Kaspar Staub, Corina Steiner
Institute of Evolutionary Medicine,
University of Zürich,
Winterthurerstr. 190, 8057 Zürich, Switzerland

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