

Ecology and Population Biology 314 Data Set 3: Global Distribution of Malaria Mortality and Sickle Cell Allele

Background:

As you learned in lecture, a mutation at a single amino acid in the beta chain of the Hemoglobin gene can lead to changes in the structure of red blood cells. As you saw in the first lab, the frequency of this sickle cell allele (S) varies widely within human populations and appears to be too high to be explained by a simple balance between mutation and selection. As you saw in the second lab, individuals heterozygous for the sickle cell allele (AS) appear to suffer from malaria infection less frequently than individuals homozygous for the normal allele (AA). Together, the research you have done in these labs provides support for the hypothesis that the frequency of the sickle allele (S) is elevated because it affords protection against infection by Malaria.

Although the Malaria hypothesis is logically compelling and consistent with your findings in the previous labs, to date you have analyzed only data from a small number of countries (Module 1) or even only a single hospital (Module 2). Thus, support for the Malaria hypothesis could be strengthened by investigating whether the rate of malaria induced mortality predicts the frequency of the sickle cell allele at the global level. Specifically, finding evidence that countries with high rates of Malaria related mortality also have elevated frequencies of the sickle cell allele (S) would provide valuable support for the Malaria hypothesis.

Your task:

Using the background information above, and the global data on malaria mortality and sickle cell allele frequency compiled in the file DataSet3.xls, evaluate support for the Malaria hypothesis. Be sure to provide appropriate citations within your report for any additional sources you use to justify your conclusions.

The file, DataSet3.xls, contains data collected from a range of sources. Specifically, information on population size was derived from the World Bank's online database (<http://data.worldbank.org/indicator/SP.POP.TOTL>), information on malaria mortality was gathered from the WHO's online mortality database (http://www.who.int/healthinfo/mortality_data/en/), and information on the frequency of the sickle cell allele and latitude was collected from the online database (<http://www.map.ox.ac.uk/explore/inherited-blood-disorders/resources/>) derived from Piel et al. (2012).

References:

Piel F.B., Patil, A.P., Howes, R.E., Nyangiri, O.A., Gething, P.W., Dewi, M., Temperley, W.H., Williams, T.N., Weatherall, D.J. and Hay, S.I. (2012). Global epidemiology

of sickle haemoglobin in newborns: a contemporary geostatistical model-based map. *The Lancet*, doi:10.1016/S0140-6736(12)61229-X