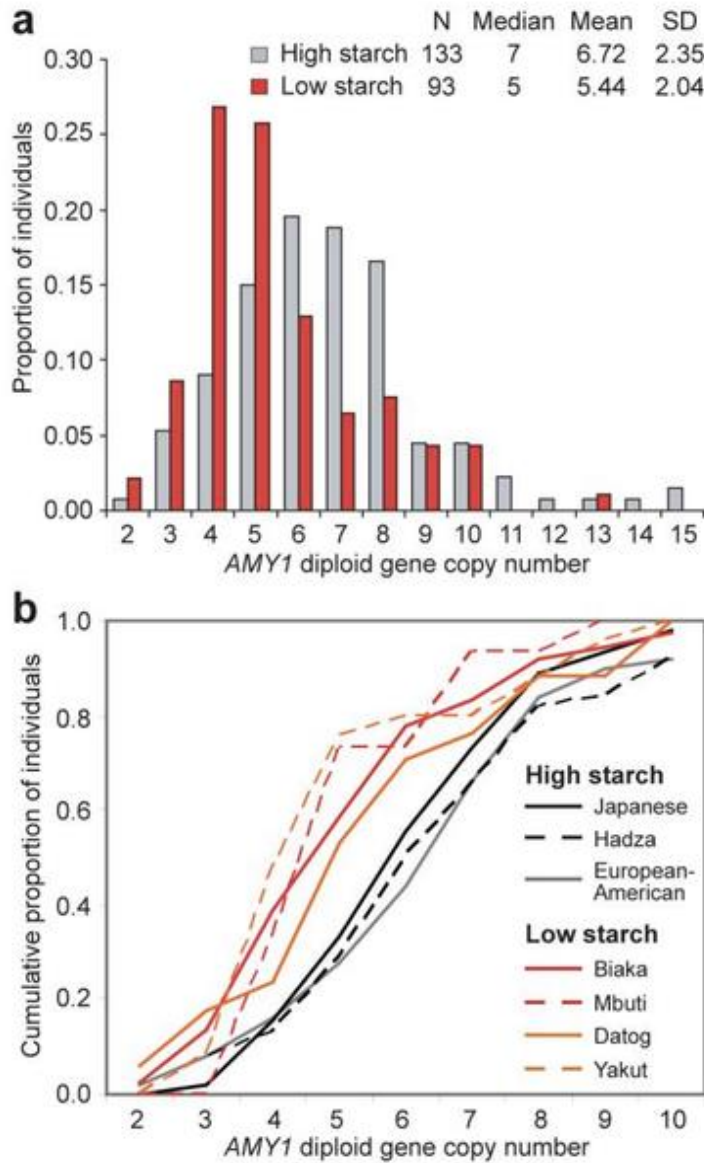




# Amylase Copy Number and Diet

## HOW TO USE THIS RESOURCE

Show the figure below to your students along with the caption and background information. The “Interpreting the Graph” and “Discussion Questions” sections provide additional information and suggested questions that you can use to guide a class discussion about the characteristics of the graph and what it shows.



Caption: Graph a shows the distribution of the number of salivary amylase gene (AMY1) copies in individuals consuming high-starch (gray bars) and low-starch (red bars) diets. Graph b shows the cumulative proportion of individuals in the sampled populations grouped by diet type. Red and orange lines represent populations consuming low-starch diets, while black and gray lines represent populations consuming high-starch diets.

## BACKGROUND INFORMATION

Starch is a high-energy component of foods found in nature. As early humans transitioned from hunting and gathering to more agrarian lifestyles, their diets changed to include more high-starch foods. Some cultures

incorporated more starch into their diets than others, and those cultural differences in human populations are still present in some cultures today. Salivary amylase is the enzyme that breaks down starch in saliva. The gene that encodes salivary amylase (*AMY1*) is somewhat unusual, as most humans have more than one diploid copy of the gene; in fact, the number of copies ranges from 2 to 15. The authors investigated whether the number of *AMY1* gene copies is correlated with the type of diet (high-starch or low-starch) of a population, presented in the two graphs above. A correlation would indicate that having more copies of the *AMY1* gene provides a selective advantage, allowing individuals to break down starch more efficiently.

### INTERPRETING THE GRAPH

Graph **a** shows the distributions of *AMY1* copy number in cultures with a traditionally high-starch diet (gray bars) compared to cultures with a traditionally low-starch diet (red bars). This graph shows that, on average, people from cultures with high-starch diets have a higher number of *AMY1* copies than those from cultures with low-starch diets have.

Graph **b** shows the cumulative proportion of individuals in each culture sampled as *AMY1* copy number increases. Cumulative proportion is the proportion of individuals with a certain number of gene copies plus all of the individuals with fewer gene copies. Cultures that traditionally eat high-starch foods are represented by black or gray lines, whereas cultures that traditionally eat low-starch foods are represented by red or orange lines. This graph shows that people from high-starch cultures generally have a higher *AMY1* diploid copy number than that of people from low-starch populations. This trend is apparent because the red and orange lines fall to the left of the black and gray lines at each cumulative proportion on the y-axis.

**Teacher Tip: Prompt your students to explain the parts of the graph as applicable:**

Graph **a**:

- Graph Type: Histogram
- X-Axis: Salivary *AMY1* diploid gene copy number
- Y-Axis: Proportion of individuals
- Distribution (High Starch): The number of *AMY1* copies ranges from 2 to 15. The mean is 6.72 copies and the median is 7 copies. The standard deviation is 2.35 copies. The data appears to be right-skewed.
- Distribution (Low Starch): The number of *AMY1* copies ranges from 2 to 13. The mean is 5.44 copies and the median is 5 copies. The standard deviation is 2.04 copies. The data appears to be right-skewed.

Graph **b**:

- Graph Type: Line Graph
- X-Axis: Salivary *AMY1* diploid gene copy number
- Y-Axis: Cumulative proportion of individuals

### DISCUSSION QUESTIONS

- How do graphs **a** and **b** differ?
  - o In both graphs, why did the authors plot proportions of individuals rather than number of individuals? Why is this a more accurate representation of *AMY1* gene expression?
  - o What additional information does graph **b** provide?
- Describe the distributions of *AMY1* copies based on diet type in graph **a**.
  - o How do the sizes of the populations differ?
  - o How do the mean and medians differ for each diet type?
  - o How does the *AMY1* copy number range compare between the diet types?

- Describe the trends you see in the data in graph **b**.
  - o Describe the similarities between populations with high-starch diets versus those with low-starch diets.
  - o What is the maximum number of *AMY1* gene copies shown in this graph?
  - o Describe the trend in the lines that you would expect if the graph continued to 15 copies of the *AMY1* gene.
- Why do you think the number of *AMY1* copies is higher in cultures that have high-starch diets?
- If a population has a mutation in their salivary *AMY1* gene causing it not to express any salivary amylase protein, which diet would you predict they are most suited for? Why?
  - o If a person does not practice the diet that they are most suited for because of this lack of gene expression, what might the health consequences be?

**SOURCE**

Figure 2 from:

George H. Perry *et al.* Diet and evolution of human amylase gene copy number variation. *Nature Genetics*. 2007. 39: 1256-1260.

Read Paper: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2377015/>

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