

Data Quality 201: Data Visualization



Using graphs or charts to help visualize data can be an effective way of exploring and communicating important or complicated information. When used incorrectly however, graphs or charts can complicate, distort, or misrepresent data. Misleading graphs or charts might be intentional or might be the result of errors. Whatever the reason, presenting data in a misleading way can lead to incorrect conclusions.

This guide provides examples of misleading data graphs and charts and provides guidance on how to identify and avoid common errors when presenting data.

Misleading Bar Charts



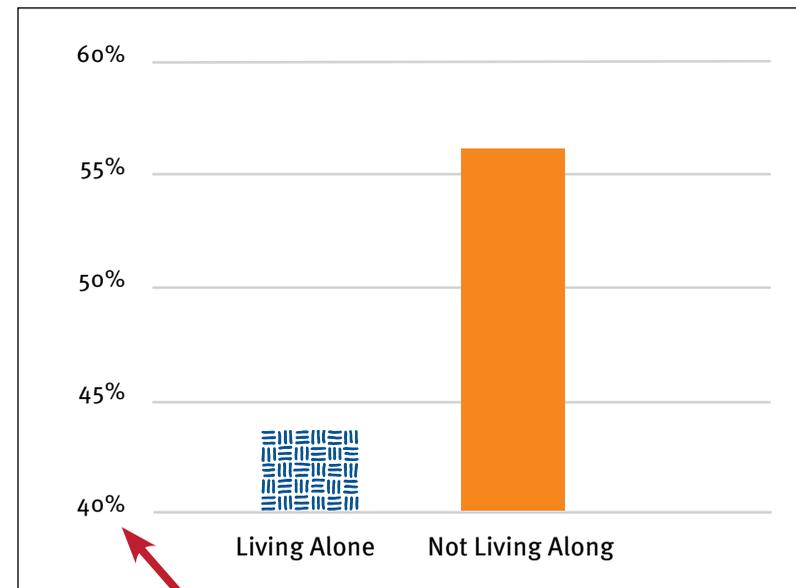
Bar charts

Bar charts are used with discrete data (e.g., number of people) and provide a visual display for comparing quantities in different categories or groups. They help the reader to see relationships quickly.

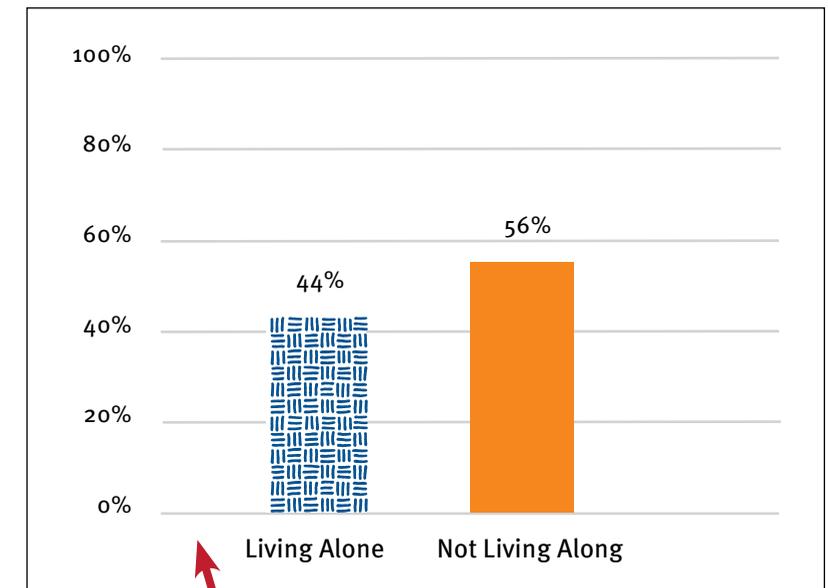
Misleading Axis: In **Figure 1** below, both bar charts show 44% of Older American Act Title III service recipients living alone and 56% not living alone. The bar chart on the left is misleading, however, since the Y axis starts at 40% and ends at 60% and therefore appears to show very large difference between the results, suggesting that most service recipients do not live alone. In reality the difference is much smaller, with only slightly more than half of service recipients not living alone.

The bar chart on the right presents the data accurately and in context of the range of possible values, with the Y axis starting at zero and ending at 100. In addition, the bar chart on the right includes value labels, showing the actual percent for both categories. As a rule, bar charts showing percentages should end at 100%. Value labels should be used when they help the reader to know the individual value for each category or group (vs. the relative size or rank).

Figure 1. Percent of Older Americans Act (OAA) Title III service recipients living alone.



Misleading: Y axis does not start at zero and shows a small range.



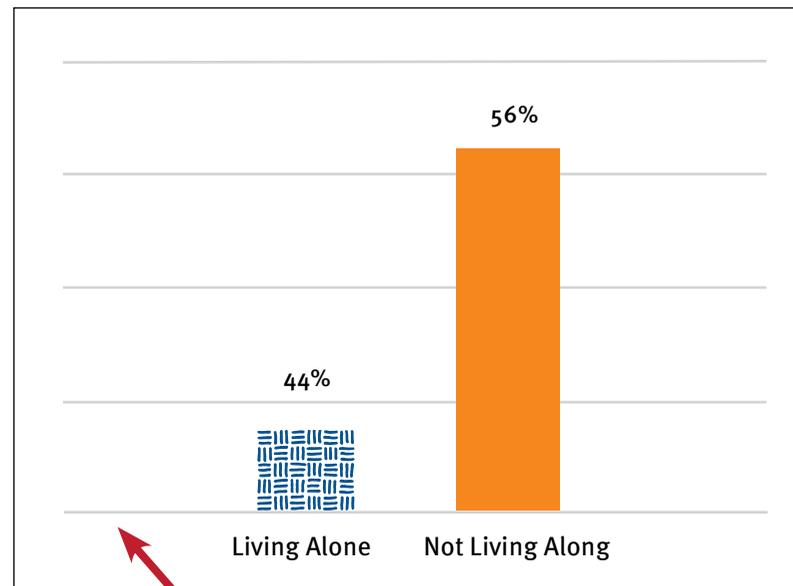
Accurate: Y axis starts at zero and displays the entire range. Bar chart also includes value labels.



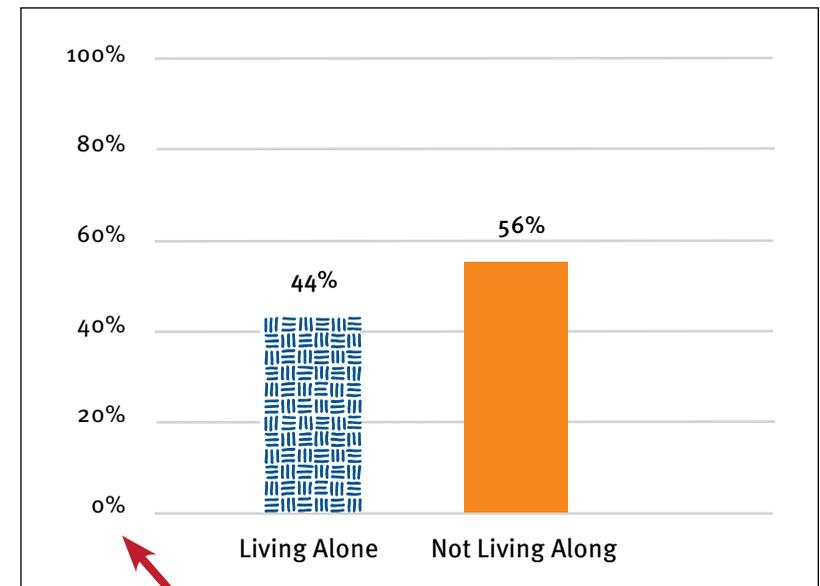
In **Figure 2** below, the first chart is misleading because the scale is not shown. Removing the scale from the Y axis, as shown below in the first chart, makes it impossible to draw conclusions about the actual

difference between the number of service recipients living alone and those not living alone.

Figure 2. Percent of OAA Title III service recipients living alone.



Misleading: Y axis scale is not shown.



Accurate: Y axis scale is shown.

Misleading Line Graphs



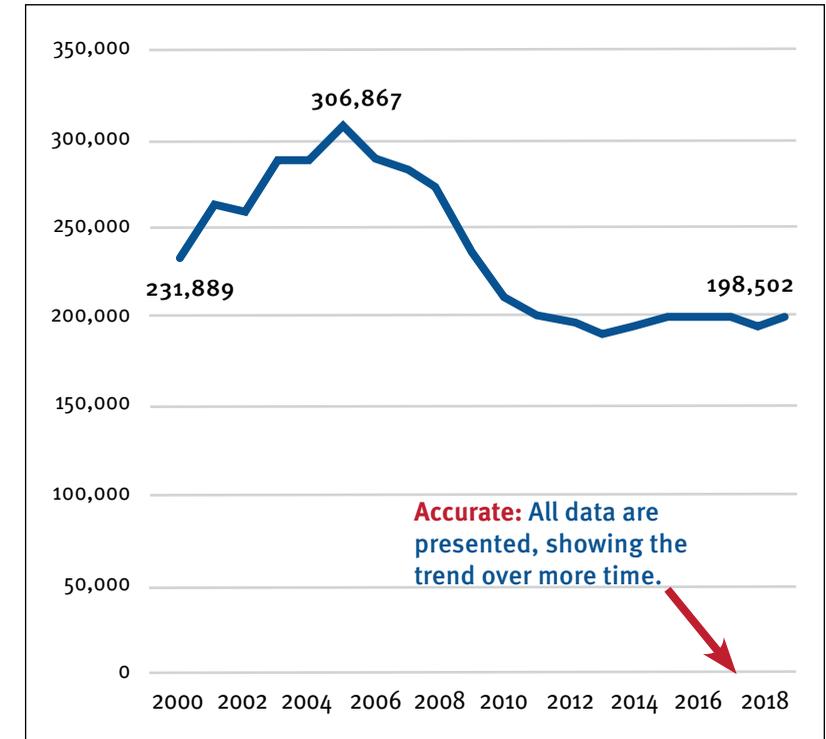
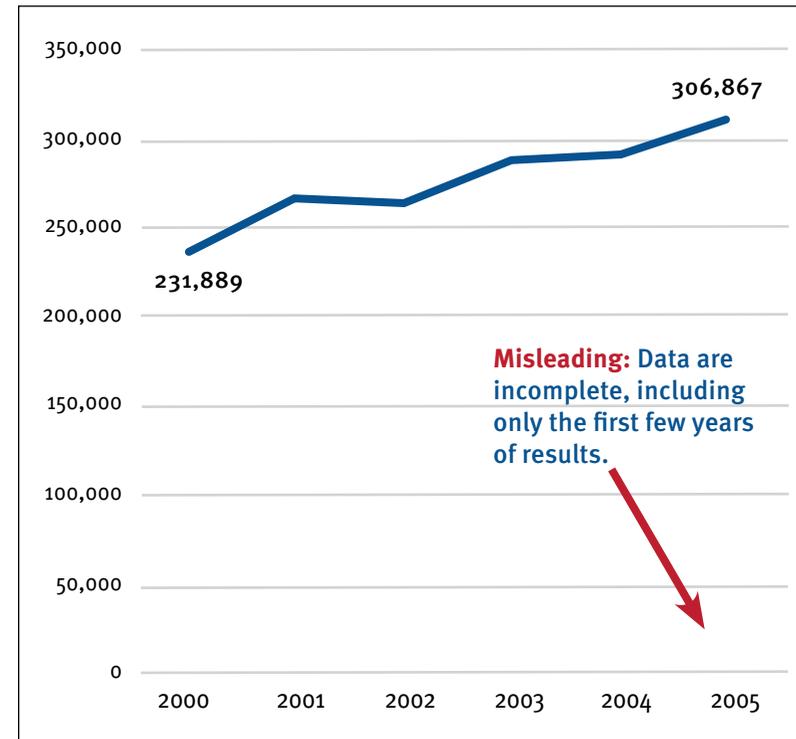
Line graphs

Line graphs (line charts) are used with continuous data, providing a visual display of data or information that changes over time. They help to illustrate overall trends such as an increase or decrease in performance over time.

In **Figure 3** below, each line graph shows the total annual number of complaints brought to, or initiated by, the Long-Term Care Ombudsman Program, which is required to investigate and resolve complaints on behalf of residents of long-term care facilities. The first line graph shows the total number of complaints for 2000–2005 and suggests a steady increase in the number of complaints over time. The presentation is misleading, however, as it covers just a small select period

of time. The second line graph, which shows the total number of complaints for 2000–2018, provides more context and leads to a very different conclusion, with the number of complaints actually declining after 2005 and then remaining quite steady after 2012. If the start and end values of the data are important to know, the values should be added to the line graph. If the goal is to show just the slope of the line (i.e., the change over time), the values do not need to be shown.

Figure 3. Total number of complaints of willful mistreatment of long-term care facility residents.

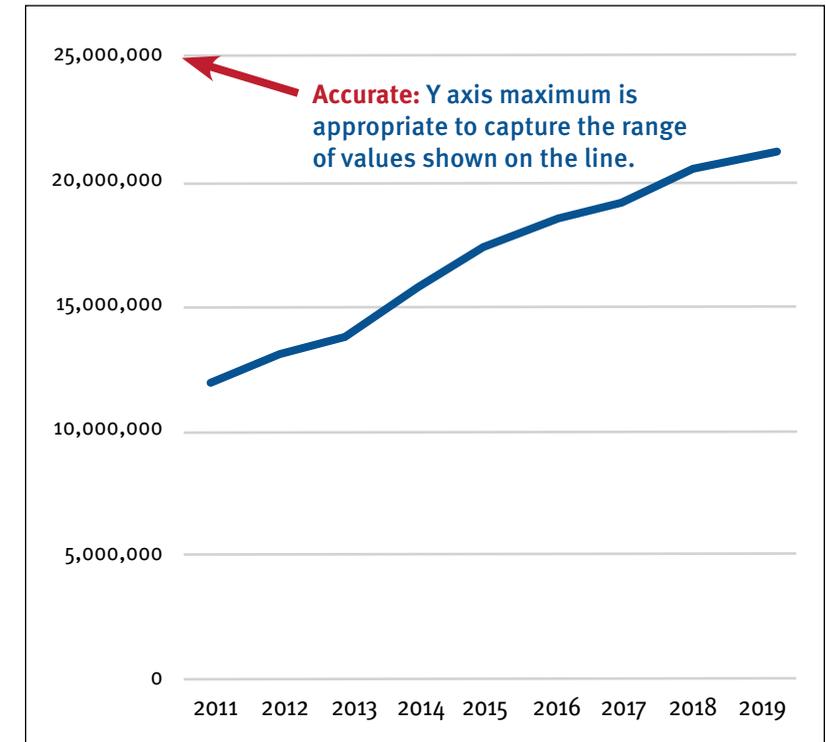
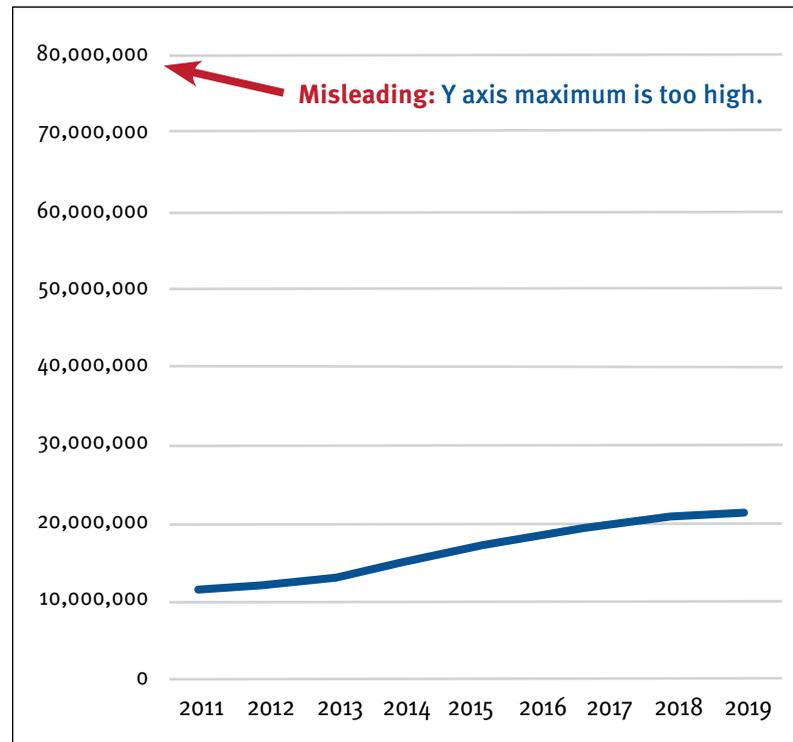




In **Figure 4** below, each line graph shows the total units of homemaker services provided for OAA Title III recipients, using different Y axis maxima. The first line graph has a very high maximum (80,000,000), causing the graph to reflect less growth and a less steep line.

The second line graph uses a more appropriate Y axis maximum (25,000,000) given the range of data points, and indicates a rather large growth in units of services over the years.

Figure 4. Total number of units of homemaker services provided to OAA Title III service recipients.



Misleading Pie Charts



Pie charts

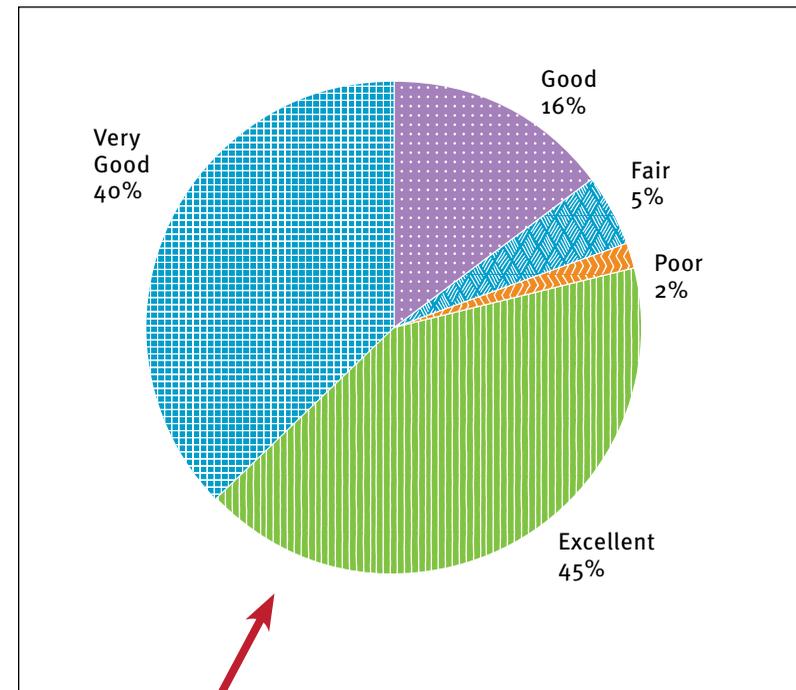
Pie charts are best used for showing part-whole relationships (rather than comparing different parts). Generally, use a pie chart if one or two of the categories have a much higher value than the others. This type of chart allows the reader to see at a glance which categories have the largest shares of the pie. When creating pie charts, do not use more than five or six categories (pie slices), make sure there is a clear message and the slices add up to an even 100%, and label the pie slices rather than using a legend.

A misleading pie chart could result from using incorrect data or from choosing a chart format that may lead to misinterpreting the data.

In **Figure 3** below, both pie charts show how recipients of caregiver services rated the services (i.e., excellent, very good, good, fair, or poor). The pie chart on the left is misleading, however, since the percentages do not sum to 100. The chart creator either used

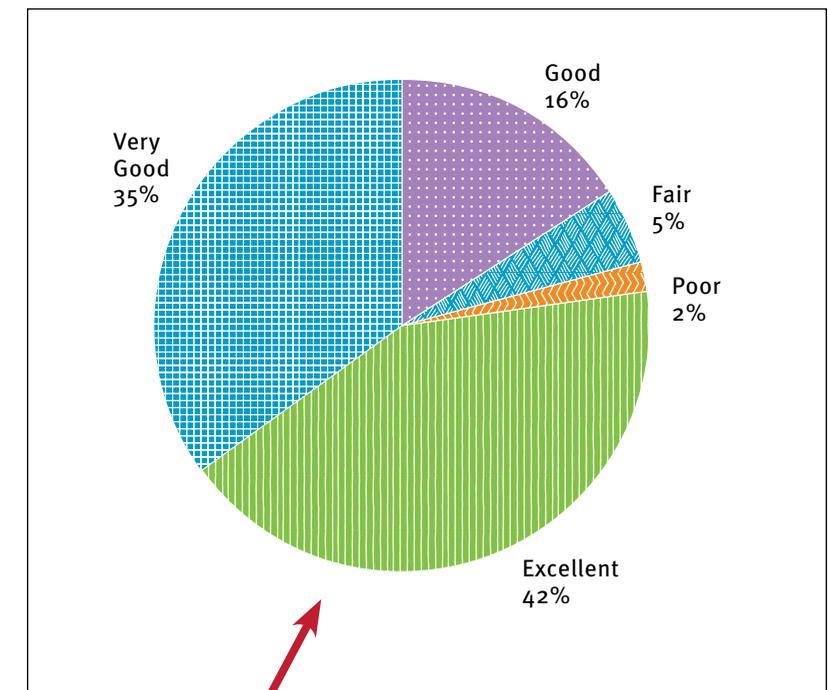
incorrect data or changed it (by accident or intentionally) when constructing the pie chart. Additionally, the label does not indicate who did the rating. The pie chart on the right presents the data accurately, with the percentages summing to 100 and the title expanded to indicate who did the rating.

Figure 3. Rating of OAA Title III caregiver services.



Misleading: Percentages do not sum to 100.

Figure 3. Rating of OAA Title III caregiver services by service recipients.



Accurate: Percentages sum to 100.

Title expanded.

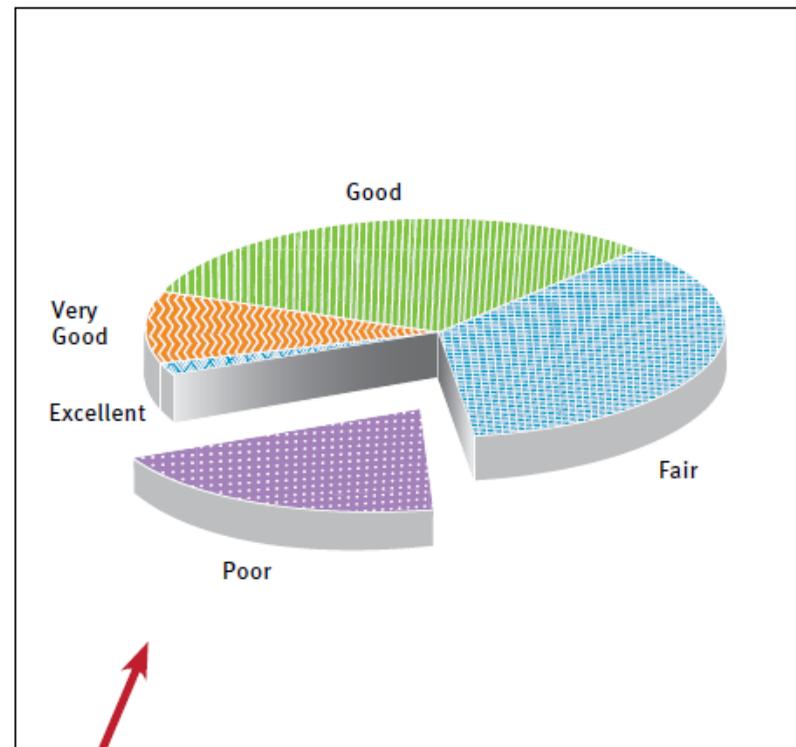




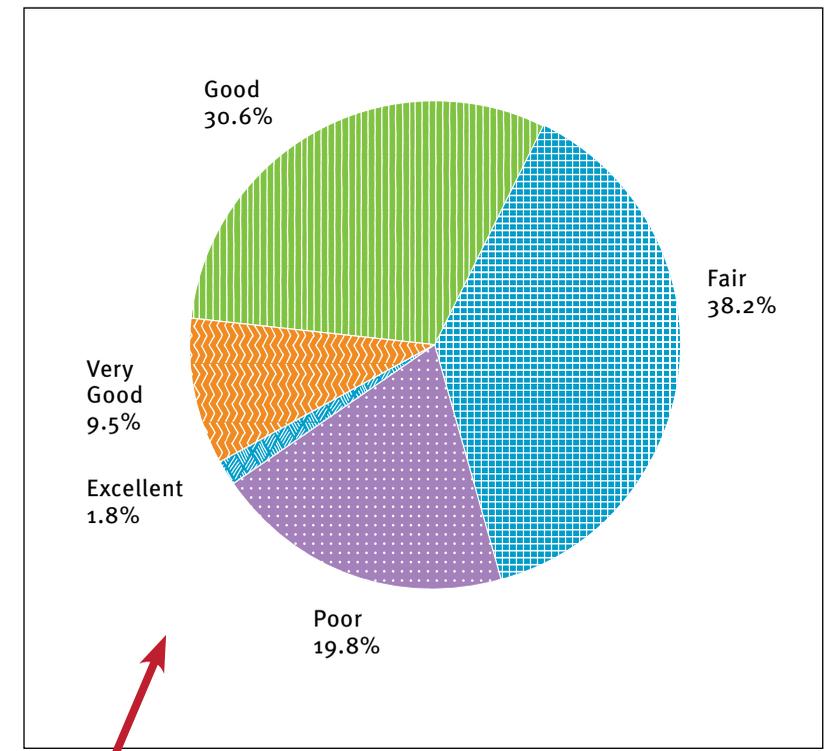
A misleading pie chart could also result from choosing an inappropriate display format. For example, in **Figure 4** below, a 3D “exploded” format is used for the first version, which makes it difficult to interpret and distorts the effect. The slice that is closest to the reader (Poor)

appears almost as large as the one in the back (Good), even though it is only about two-thirds of its size (19.8% vs. 30.6%). The second version is a general pie chart that more accurately shows the sizes of the slices relative to each other.

Figure 4. Self-reported health status rating of OAA Title III case management service recipients.



Misleading: The 3D effect distorts the results, making this slice appear almost as big as the one in the back.



Accurate: Regular pie chart that accurately displays the relative size of each slice.

Conclusion

The examples provided highlight a few ways in which the actual presentation of data may be misleading. The examples do not represent an exhaustive list but are intended to provide general insights on how data may be inadvertently distorted and to identify potential pitfalls to avoid when creating and reviewing graphs and charts.

As a general rule, remember the following when creating and reviewing graphs and charts:

- Ensure that labels are complete and provide enough information for understanding the content of the graph or chart.
- Ensure that, when showing percentage data, all axes have labels and any axis showing percentages starts at zero and ends at 100%.
- Select appropriate scales for axes.
- If appropriate, include the number of people that the data represent.
- Include sufficient data to display an accurate representation of data trends.
- Avoid using a complex design (e.g., “exploded” pie chart) that may distort the data.
- Accurately portray relative percentages/proportions.

For additional information on data quality issues, see the [Data Quality 101 Infographic](#) and [Data Quality 202: Data Quality Standards](#).

For questions, contact ACL’s Office of Performance and Evaluation.