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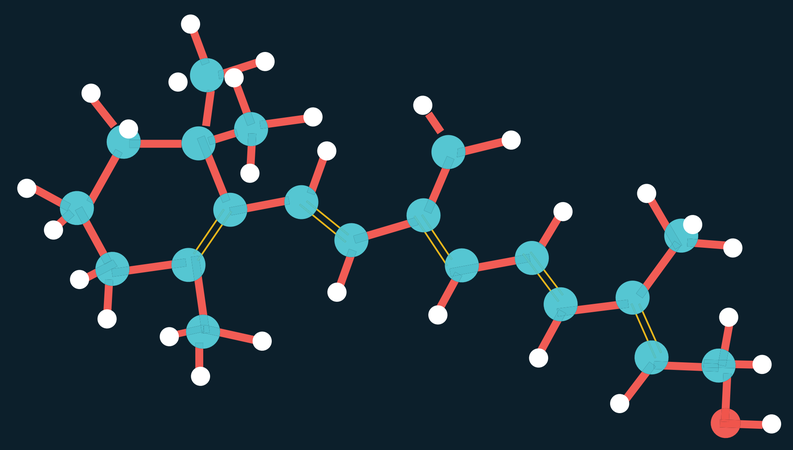

The shape of the vitamin A nutrient intake distribution might vary over time

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Background

National nutrition surveys can only collect a small number of days of consumption data from participants. Nutrient intakes estimated from these data must be corrected in some way so they can be compared to reference values which are based on long-term (usual) intake. One challenge with the calculation of usual intake is the shape of the underlying distribution because the adjustment factor for the standard deviation assumes a normal distribution. If the raw data are not normally distributed, then they must be transformed to perform the adjustment.

In the 1995 National Nutrition Survey (NNS), vitamin A intake distributions were skewed. The adjustment factor released by the Australian Bureau of Statistics (ABS) in the Confidentialised Unit Record File (CURF) assumed that the data would be log transformed and that the method described by the Iowa University[1] would be used. This method is referred to in FSANZ documents as the 'second day adjustment method'.

However log transformation does not necessarily yield a normal distribution. Since 1995, computer power has increased and made it easier to perform more accurate transformations, for example by using the Box-Cox transformation routine to select the most appropriate transformation for the data. This has been incorporated into a SAS program written by the US National Cancer Institute (NCI) for generating usual intakes of nutrients and foods. The NCI method was used by the ABS when reporting the usual intakes of nutrients from the 2011-12 National Nutrition and Physical Activity Survey (NNPAS)[2].

Objectives

We explored the impact of different methods of adjustment on estimated vitamin A intake using the CURF for the 2011-12 NNPAS.

Methods

We used age, sex, survey sampling weight and the two days of reported vitamin A intake for respondents from food and beverages (excluding dietary supplements). Respondents were grouped into the age-sex groups for which separate Nutrient Reference Values (NRVs) are reported[3]. We used the 2006 NRVs and applied them to both the 1995 and 2011-12 surveys.

Within each NRV age-sex group, the mean vitamin A intakes, and its distribution was calculated from the first day (Day 1) only. We also calculated vitamin A intakes using the second day adjustment method using the raw (untransformed) data and also after taking the natural logarithm and then exponenting after performing the adjustment to regenerate the original scale. In addition, we also calculated the average of the two days for the 64% of NNPAS respondents who had this information. We used Harvest, FSANZ's in house modelling and analysis platform to perform the calculations. Results for the NCI method were obtained from the 2011-12 NNPAS usual intakes publication[2]. We graphed the mean, median and 5th and 95th percentiles of each distribution.

We consider the NCI method to be the 'gold standard' as it finds the most appropriate transformation and includes a correction for additional effects, such as variation between weekdays and weekend days.

Results

Figure 1 shows the results for boys and girls aged 14-18 years which were typical of other age-sex groups.

The Day 1 results show that vitamin A intake (as retinol equivalents (RE)) in 2011-12 was higher in boys than girls and skewed to the right, although not as strongly as in 1995.

The NCI and second day adjusted non-logged methods for 2011–12 yield similar means as the Day 1 data, although they draw in the tails of the distribution. The second day adjusted log method performs the adjustment around the median, not the mean, which accounts for the lower mean after exponentiation, although the tails are also drawn in.

The 2-day average leads to a small contraction in the width of the distribution. The variation in location of the mean may be related to the use of a sub-population for this calculation and the effect of averaging, whereas other methods adjust around the raw or transformed mean.

Most of the adjustment methods result in a smaller proportion of the population under the EAR compared to Day 1, the exception being the second day adjusted logged method. The logged and non-logged second day adjusted methods had quite different proportions below the EAR and the proportion from NCI method lying in between these for males and slightly less for females.

Conclusions

Despite having a right-skewed distribution, logarithmic transformation would not seem to be preferable for the 2011–12 NNPAS data.

The shape of the distribution of nutrient intakes might change over time or within subpopulations. Advances in computing opens new opportunities, therefore researchers should examine which transformations are appropriate for their analysis. Improved data collection methods also creates challenges. There are not enough respondents with two days of data in the 1995 survey to use the NCI method, and so tracking changes in intakes over time becomes difficult.

This analysis has used only the intakes reported from foods and beverages. The addition of intakes from dietary supplements could further complicate analysis, especially if it generates a bi-modal distribution.

The method of analysis also determines the prevalence of undernutrition. FSANZ uses a rule of thumb of >3% below the EAR to support fortification. As the exact results depend on the method of analysis, different researchers could achieve different results from their analyses.

References

1. Australian Bureau of Statistics 1998, *National Nutrition Survey. Nutrient Intakes and Physical Measurements. Australia. 1995*. ABS, Canberra.
2. Australian Bureau of Statistics and Food Standards of Australia New Zealand 2015, *Australian Health Survey: Usual Nutrient Intakes, 2011-12*, ABS and FSANZ, Canberra.
3. National Health and Medical Research Council and New Zealand Ministry of Health 2006, *Nutrient Reference Values for Australia and New Zealand*, NHMRC, Canberra.

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Figure 1. Distribution of vitamin A intakes (as RE) for the first day of intake and after estimating longer term intake by four different methods, boys (left) and girls (right) aged 14-18 years, 2011-12 National Nutrition and Physical Activity Survey. The Estimated Average Requirement for each sex is also shown (630 µg/day for boys and 485 µg/day for girls).